The Art and Science of Embalming

Carl Lewis Barnes

PLATE NO. 1.

Typography of the Arterial and Venous System.

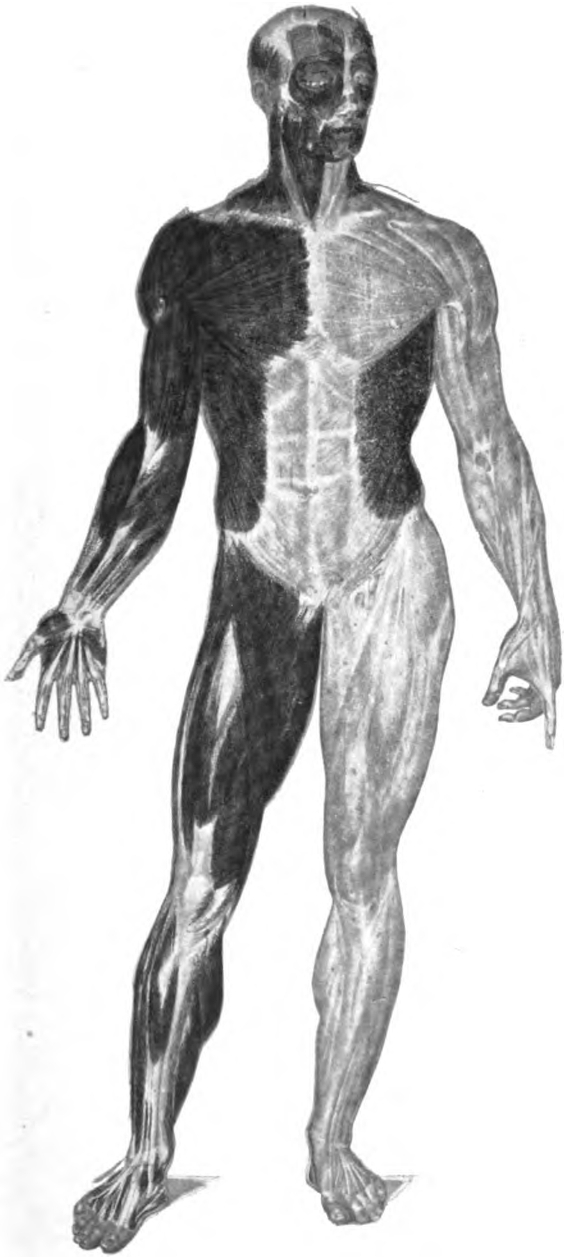

PLATE NO. 2.

Typography of the Muscular System.

THE

ART AND SCIENCE

OF

EMBALMING.

Descriptive and Operative.

BY

CARL LEWIS BARNES,

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OMY AND MINOR SURGERY IN THE INDIANA COL-
LEGE OF PHYSICIANS AND SURGEONS, ETC.

A practical and comprehensive treatise on Modern Embalming,
together with a description of the Anatomy and
Chemistry of the Human Body.

STATEMENT TO THE READER.

Preface to the First Edition.

THE WRITER asks no apology for the introduction of this volume to the Undertaking profession of America. During my services as Demonstrator in the Indiana College of Embalming, and as President of the Chicago College of Embalming, I felt that the student would receive more benefit if he had a complete and modern text book to guide him in his studies.

There being no work in the field which completely covered all the different topics necessary to complete a course in embalming, I have written this work, feeling that it would give the student a more comprehensive view of the work and would enable him to cope with the more difficult parts of the science.

Those in the profession who, on account of business cares, and who have advanced in years, not feeling able to attend a college course, could by consulting a practical work on embalming become acquainted with the modern ideas and the late discoveries which have been put forward in the last five years.

I have endeavored in this work to give only those things which I thought necessary; and while some parts of the book may appear to be superfluous, the expert embalmer would not judge it so.

Some may say the work is too scientific, while others would condemn it because of the lack of those points.

Writing this book as I have written it, not only for the student, but for the beginner, for the practitioner and for the expert, I trust you will see the difficulty of pleasing all.

I have endeavored to give every subject contained in the book a thorough consideration, and where I found language alone could not express the meaning, I have added such engravings as would appeal more direct to the mind. Occular demonstration is proof conclusive.

Having thus explained the cause for introducing this work on embalming, I submit it to the judgment of the embalmers of America, with the assurance that whether favorable or unfavorable, the decision will be just.

In conclusion I wish to thank all those who have so generously aided me in the preparation of this volume, especially Mr. Wm. P. Hohenschuh and Dr. Chas. E. Barmm, my colleagues.

DEDICATION.

To all those who have honored me with their subscriptions before the work was written, the amount of which was sufficient to pay for the entire edition, this work is dedicated by their most humble servant, CARL L. BARNES.

STATEMENT TO THE READER.

Introduction to the Second Edition.

The first edition of my work having met with the approval of the profession, and having been endorsed by the Presidents of State and National Funeral Directors Associations, by Presidents of State and National Embalmers Associations, and by learned authorities on the subject of embalming, as the most complete and modern text book on the subject of embalming, that has yet appeared in the English language, it would be false for me to say that I do not feel complimented. Distinguished Anatomists and Demonstrators, Members of State Boards of Health, and prominent scientists, having encouraged me by the same kind of endorsements, even beyond my most sanguine expectations, I desire at this time to thank each and all for their kind words. Nothing is so gratifying to an author as to see his works imitated. It, above all, is the most striking proof of the success of his efforts. In the five hundred and more pages of the second edition, the text has been augmented so as to include all of the more recent investigations. In order to permit this increased amount of important material a place in this work, it was found necessary to eliminate all that part in the first edition pertaining to ancient embalming. The Self-Pronouncing Dictionary of medical and scientific terms in the back of the book, was carefully compiled by selecting only those technical terms in common use by the profession. The half-tone engravings of actual operations on the cadaver are of a pre-eminent character and, with the full page anatomical engravings in colored plates, "the first of the kind ever produced," the reader will have an anatomical aid superior to any other heretofore introduced.

In conclusion I desire to thank all those who so generously aided me in the preparation of the second edition, especially Mr. James J. Morris, the Assistant Demonstrator in the Chicago College of Embalming.

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CHAPTER I.

Death: Its Phenomena, Modes, Signs and Premonitions.

Premonitions.

The masterful painting of Hogarth, "The End of All Things," was begun by the great artist with the belief that it would be his last. He labored on it with unusual assiduity, fearing he would die before it was finished. When at last the final stroke of the artist's brush had been applied, he gazed intently for a time on his mind's creation, then rising from his seat he seized his palette, broke it in pieces and said, "I have finished."

Soon after he died. Thus his presentiment that the end would soon come was fulfilled. "Requiem," that beautiful strain by Mozart, was composed under the conviction that it would be for himself, and when soon after it had been finished the hour of death drew nigh and life was flitting fast, he asked those around him for the score, and on it being brought to his bedside he smiled; and musing over it said: "Did I not tell you truly that it was for myself I composed this death chant ?"

With many the first symptom of approaching death is the strong presentiment that they are about to die. The great surgeon, Dr. John Hunter, who was also one of the greatest embalmers of his day, intimated on leaving home that if a discussion which awaited him at the hospital took an angry turn it would cause his death. A colleague gave him the lie; the coarse word verified the prophecy and he expired in an adjoining room almost immediately afterward. Often we feel within ourselves we cannot live, the nerves communicate the thoughts to the brain from the weakened vital centers and in many instances it soon becomes a reality. The premonitions of death were fully observed by Shakespeare. Gossiping Dame Quickly informs us Falstaff fumbled with the bed clothes. I have observed this sign among many others in those who are in the throes of death. The patient picking at the bed clothes around her, tossing them from the wearied and weakened frame, as though even these protecting coverings would soon no longer be required, and as life's candle was rapidly burning lower she began to "pick at the flowers," musing and murmuring in indistinct tones; soon the voice began to sound husky, the Pomum Adami moved up and down as though keeping time with the pulse waves which were getting weaker and weaker, slowly carrying the soul to its rest. Many persons, especially those who have been ill with typhoid fever, have no wish to recover: this is often one of the premonitory signs of approaching death. They lose interest in the things which most concerned them during life and health, although with many in the last moments of death their minds revert back to the scenes of their childhood or to some of their greatest achievements. Thus the great Napoleon fought again another battle: was he at Austerlitz? was he in Egypt? or was it his Waterloo? His last words, "*Tete d armee*," were characteristic. While the ship was sinking he was at last again with his army: possibly he could hear the martial sounds of fife and drum, the roar of cannon, the thundering volleys of musketry, the appeals of the dying and the shouts of the brave. All of that once magnificent army was around him again; they swept like a tornado all before them; he was leading them onward and with each advancement they were sweeping down thousands of the enemy; they were repulsed but only for a moment, then onward again with that awful charge, fifty thousand rifles crash, the sound is almost deafening and when the smoke clears away thousands of human dead are strewn upon the ground, never to rise again. The shouts of victory pierce the air and as the echo dies in the distance, all is darkness forever. Amid these imaginations the great leader took his leave.

Ingersol in his tribute to his dead brother, Ebon C., said: "He who sleeps here, when dying, mistaking the approach of death for the return of health, whispered with his latest breath, 'I am better now.'" The grasp of death, as it were, relaxes its tightening grip on us for a moment—one feels "the fever is going now," or "I am better now," or in the last moments when the nerves begin to lose their powers of perception and conduction as the darkness of death comes over one, they are liable to cry out in their last words like Goethe, who experiencing the loss of power in his optic nerves, said, "Let the light enter." Some, after the darkness of death begins to come over them, are suddenly aroused by sudden flashes of light. Or they may inform those around them that they hear "sweet strains of music." These "lightning flashes" are familiar to every experienced physician, they are all premonitory symptoms of approaching death. Or in some patients during these flashes numerous small colored specks will float before the vision (muscæ volitantes). These are often a slight annoyance to the patient, who soon sees nothing but oblivion, and is ushered forever into eternity. The words "death agony" oftentimes convey a meaning of intense repugnancy. It is because in a certain proportion of cases dissolution is accompanied by visible spasms and distortions of the countenance. Yet it is as nearly certain as anything can be that these distortions of the facial muscles are not only painless, but take place unconsciously. This may be said to be true in almost every case excepting those who die from the influence of some irritant poison, and then the death spasm or death agony is certainly experienced by those who are so unfortunate as to die by these methods. This distortion of the face and countenance may be likened to the sudden flickerings in the dying flame of a candle, or the irregular motions in the wheel of an engine whose steam is being gradually withdrawn. Oftentimes a comatose or semi-comatose condition supervenes before death. In such a case it is evident that more or less unconsciousness and no knowledge to the sufferer of his approaching death is known to him. People who have been almost drowned, and who have been resuscitated, tell almost a similar story of the conditions through which they passed previous to the loss of consciousness. After a few moments of painful struggling which was accompanied by the greatest of fear and anxiety, during which it seemed as though their entire life was spread out before them, there was suddenly a few flashes of light before the eyes and then a state of tranquility followed. They see visions of green fields. It is remarkable that nearly every person who has passed through this condition, or death by drowning, refers to seeing green fields. In some cases they hear sweet strains of music, and are so far from being miserable that they experience a degree of ease and comfort of mind and body which is delightful. Attempts to resuscitate those who are apparently drowned, or who are in the third stages of narcotism, will prove difficult at times on account of the resuscitated person protesting energetically against being brought back to life. After they have been fully restored they tell us that the restoration was accompanied by physical pain and acute mental misery. I have resuscitated many persons who were under the toxic influence of morphia, and in nearly every instance after restoring my patient they said that they passed through more misery in the few minutes or hours preceding their restoration than they had experienced in their entire life. Death as a rule is by no means a painless process, although in many cases it is actually devoid of any physical suffering. The famous Dr. Cullen on his death bed faintly intimated to a friend, "I wish I had the power of writing, for then I would describe to you how pleasant a thing it is to die." Sir Walter Scott in his last moment exclaimed, "I feel as if I were to be myself again." Divine nature, I believe, intended that we should go out of the world as unconsciously as we came into it.

Signs of Impending Death.

The signs of impending death are many and various. In no two instances can they be said to be alike; yet several of these signs are common to every case. They, of course, have not the positiveness of the signs of real death, but are sufficient to guide us in forming an opinion as to the approach of death in the afflicted. From a large number of statistics it is well settled that the least mortality is during the hours from eleven o'clock A. M. to two o'clock P. M., and the greatest mortality is in the early morning hours from three to six. These signs of impending death have been recorded by many writers, scientific and otherwise. Shakespeare, in the account of the death of Falstaff, referred to his nose: "His nose was as sharp as a pen." The coldness of the feet gradually extending upward, the picking at the bed clothes (carphologia), and the playing with flowers, this latter sign showing the weak and puerile state into which the once acute mind had fallen. In those about to die speech grows thick and labored; the hands feel cold and clammy, and if they are raised they fall instantly. Listening one hears the difficult respiration caused by insufficient aeration of the blood. The heart loses its power to propel the blood into the extremities, thus the body begins to get cold at these parts first and gradually extends towards the viscera, these structures retaining the heat longest after real death has made its approach. The voice grows weak and speech is difficult, husky or piping. The eyes begin to assume a fixed position and have a staring look as if they were not focused on anything definitely. The lachrymal gland refuses to secrete and the eye begins to lose its luster. Functions are imperfectly and involuntarily performed, memory fails, imaginations cease, the muscles get stiff and rigid (muscle spasm preceding death), small noises irritate, digestion is disturbed and interrupted, capillary circulation is clogged, loss of consciousness supervenes, the brain loses control of the great sympathetic, respiration ceases, and the heart, the central organ of circulation, comes to a full stop, and this stop means the end.

Premature Burial.

Premature burial is such an exaggerated theory that I feel as though it deserves only a passing notice in this book. Possibly in former times, or previous to the year 1616, when William Harvey first discovered the circulation of the blood, premature burial might have actually occurred, and doubtless did occur, but in this enlightened age with all our knowledge of the circulation and respiration, our complete mastery of the phenomena of death makes such a thing as premature burial absolutely impossible, in the hands of even a casual observer. Newspaper writers delight in the marvelous, and without any regard whatever to the scientific phase of the subject, frequent mentioning of cases of premature burial are to be found almost daily in the press of the country. I have carefully investigated some of these newspaper stories only to find that they either originated in the fertile brain of some reporter or were merely published to consume space. Previous to the time of the discovery of the circulation of the blood several authentic cases of premature burial are on record. I will mention only a few of them. Vesalius, the eminent anatomist, was about to give a demonstration before his class. On opening the thorax and reflecting the sternum or breast bone, the exposed heart was seen still beating. Dr. Philip Small, a physician, was summoned to perform a Cesarean section. The woman was nine months pregnant and was about to be confined. During the stages of labor the woman suddenly lost consciousness, the heart ceased to beat, and a glass held over her face showed no signs of respiration. After making a few preliminary tests he plunged his knife into the body and was cutting down on the uterus when the woman awoke from her swoon. In the little village of lower Charente, France, a rural guard having no family died. Hardly had his body grown cold when it was taken out of bed and laid on a straw ticking covered with a coarse cloth. An old woman was charged with the watch over the death bed. At the feet of the body was placed a branch of boxwood put into a receptacle filled with holy water. A lighted taper was near at hand. Toward midnight the weary old watcher fell asleep. A few hours later she awoke surrounded by flames from the fire that had caught her clothes. She hurried out crying for help and the neighbors running together at her screams saw issuing from the hut a naked spectre limping and hobbling on legs covered with burns. While the old woman slept the lighted taper had fallen over and ignited the bedclothes. The fire thus kindled had aroused the supposed dead and the old watcher from their sleep. It is interesting to learn that they both under proper care grew sound and well. The Abbe Prevost being struck down by apoplexy was regarded as dead. A physician was about to hold an autopsy, but when he cut through the scalp with a knife the Prevost awoke and regained consciousness, only to die immediately afterwards. I never believe in touching the body with the knife until one has brought into play all of the various tests or has observed all of the phenomena attending real death.

Modes of Death.

The expert when summoned to inspect a body supposed to be dead, or found under suspicious circumstances, has no easy task before him. He should *first* determine the fact of death; *second*, the known or unknown cause of the death; *third*, the time which has elapsed since the death, and, *fourth*, the actual mode of the death. Life according to some writers is situated in one of three great centers,—the heart, the brain or the lungs. I cannot agree with the weight of authority on this point. I rather incline to the belief that life is situated in each individual cell. Every molecule of protoplasm has its being, its life. This conglomeration of cells is connected together into one mass by the great sympathetic, the motor and sensory nerves. The higher nature touches them all and life is the result. The actual departure of life from the body may be said to occur under one of three forms: Death by failure of the *heart's* action (syncope); by failure of the *respiratory* organs, the lungs (apnoea), or failure of the functions of the *brain* (coma). It is only reasonable to state that the failure of any one of these great life centers will immediately cause a cessation of vital functions in the other.

Death by Syncope.—The heart's action may be arrested either by a deficient nerve supply, a deficient supply of blood, (anemia), or by a defective quality of the blood, or through the loss of heart power, such as would be caused by sudden shocks and blows upon the epigastrium, or through a flabby or degenerated condition of the muscular structure of the organ itself. Life may be terminated by sudden hemorrhage or, as is the case in chloroform narcotism, the left side of the heart will empty itself, as will also the arteries, and the blood will congest in the veins of the body. Thus the patient actually dies by aenemia or bleeds to death as it were in his own vessels.

Death by Como.—The brain centers are usually those first incapacitated. The power of the brain may become suspended either through the result of injury or disease, producing unconsciousness. Following the suspended functions of the brain the respiratory apparatus is weakened as is evidenced by the slow stertorous and irregular breathing, which finally just preceding the death becomes rapid, feeble and irregular. As soon as the Medulla loses power the respiratory centers fail and breathing ceases altogether. The heart thus deprived of its normal stimulant, arterial blood, soon ceases its beating and death is the result. In apoplexy we have an example of a natural death by como. The blood escaping from the ruptured vessels compresses the brain and unconsciousness supervenes. Injury to the skull such as fractures involving the inner table would be an example of an unnatural death by como, while in a case of narcotic poisoning such as caused by morphia we have the brain centers destroyed by the action of the drug on the nervous system without any compression from a mechanical standpoint.

Death by Apnoea—Asphyxia.—Asphyxia is that condition found in all those cases strangled, smothered or drowned, or who die from the influence of poisonous gases such as methane gas in coal mines, charcoal gas, carbonmonoxide, etc. Breathing is either arrested by paralysis of the respiratory muscles or by mechanical pressure on the throat and thorax. In all these modes of death the respiratory apparatus fails first. The heart continues to beat, thus congesting the large veins of the head, neck and lungs. Thus in many of these cases if we get to them soon enough life may be restored by artificial respiration and relieving the congestion. In asphyxia from hanging the warmth of the body is usually preserved longer than under common circumstances, *i. e.*, from twelve to fifteen hours, before which period rigidity is seldom complete. The blood of the asphyxiated subject resists slow combustion and putrefaction, and many of these cases of asphyxia will preserve several days without showing the least sign of decomposition. In the case of the Smith family at North Indianapolis, three were asphyxiated in a room by means of natural gas. Suspicions pointed to murder and an investigation was held. The bodies were opened and the stomach and contents subjected to a chemical examination for poisons. This examination, however, proved negative, but an examination of the bodies made two weeks afterwards showed them to be in an excellent state of preservation. No means whatever were applied to prevent these bodies from undergoing a rapid dissolution.

The blood in the asphyxiated subject remains a bright scarlet.

Signs of Actual Death.

The cessation of life is always followed by certain changes in the body denoting the return of its elements to those of the outer world. The changes which tend to occur in all individuals after death, for the most part are regular in appearance, one following upon another until the body has been entirely reduced to the dust from which it came. These changes which occur in the dead body have been termed "signs of death."

The conditions most readily mistaken for actual death are syncope, apoplexy, catalepsy and asphyxia. Many learned articles have been written on the subject of a positive sign of death, but they have all been proven negative when it came to giving a positive sign which would be sufficient to distinguish between cases of suspended animation and actual death. In the past year (1897) the scientist has undertaken a new method of ascertaining the existence of real or apparent death by the use of the Roentgen (X) rays. The temperature sign and the decrease of occular tension have also received support and consideration from the very highest of medical investigators. The injection of a solution of ammonia beneath the subcutaneous layer of the skin as a means of certifying real or apparent death has also received favorable comment by many of the medical profession. With all these methods in addition to those formerly employed by the profession, it will be seen that we are rapidly approaching the time when we will be able to prove the existence of real or apparent death in a few moments. Information of a great deal of value may be obtained by the merely superficial examination of the body. The facial expression (facia hypocrates) and the complete cessation of all censorial and intellectual faculties, together with the complete absence of muscular motion, will at times cause a hasty decision, as will also the presence of wounds which have severed large vessels, or injuries to the skull which have resulted in fractures of a compound variety. The general paleness or pallor of the whole body, except in those of florid complexions, will also present itself for immediate consideration.

The undertaker when he is called upon to care for a body, should he find the relatives in doubt as to whether the person was really dead, should proceed to help them reach a correct opinion by applying one or all of the various tests which have thus far been advanced as favorable signs of death. He need not follow any particular order, but in most cases the investigator begins his examination by applying the test which in his mind is the best, and after reading authorities on this subject the reader should use his own judgment and proceed with the investigation.

After making the usual objective examination of the body, he should begin the search for more positive information.

Absence of Circulation.—This is one of the most positive signs of death, and, when actually demonstrated, further investigation is unnecessary. The mere fact that the pulse is absent is no criterion that the heart is inactive. Careful examination over the pericardial region will give us information as to whether there are any heart sounds; if these be absent and there is no perceptible pulse, it is a very good sign that the death is real; yet we cannot accept this as a positive sign, for the reports of Col. Townsend, Col. Medley, and others, who claim to have witnessed the burial of certain Hindoo fakirs that were afterwards taken up and resuscitated (although complete and accurate information on this subject is wanting), we cannot say that cessation of the circulation is a positive sign of death. The fakirs that the above named gentlemen had the pleasure of seeing, entered into a state resembling hibernation, during which condition it is reported that neither respiration, pulse beat or heart sounds could be detected. It has been suggested by good authority that a needle passed into the third or fourth costal space, near the sternum (breast bone), will cause heart movements if life be present, which can be seen by the movement of the needle. The introduction of a fine needle, which is thoroughly aseptic, into the fibers of the heart would not cause much trouble, but should never be attempted only as a last resort and then in the hands of an expert. If a needle is introduced into the tissues of a dead body and after a few minutes withdrawn, it will show no marks of corrosion or rust, but should the body be alive the needle, a short time after removal, will show signs of rust; as it comes in contact with the blood caused by the rupture of the capillary circulation, while in the dead body no circulation exists. This, however, is not positive as the needle might penetrate a vein which contains blood in the dead body and then after a short time the needle will rust just the same as if it had been introduced into a live person.

One of the best tests to be applied in order to discover the existence or absence of circulation is to cause pressure to be made over the superficial veins of the fore-arm or the ankle. If circulation exists the veins on the distal side of the ligature, or other means of making the pressure, will fill up gradually and will become quite prominent, but if no circulation exists, no perceptible change will occur. In applying this test, the ligature should only be applied tight enough to shut off the venous circulation and should not be of sufficient strength to cut off the circulation through the radial or ulnar arteries if the arm be used, or the tibials if the ankle is the location of the investigation. This test should be applied with care and cannot be used with any degree of certainty only after the lapse of several hours. The blood after death tends to leave the arteries and escape into the veins; this usually begins at the time dissolution occurs and the arterial system may empty itself in less than thirty minutes after death,even before death in chloroform narcosis, and it may be hours or even days before the process is complete. In the majority of cases the blood has passed from the arteries into the veins in about five and a half hours after death. Thus if a ligature was applied two hours after supposed death the veins might fill up on the distal side of the ligature and might lead one to suppose that circulation still existed, while it would only be the escape of the blood fiom the arteries into the veins. I rather believe, although it has never to my knowledge been suggested or applied, that this test should be made by tying the ligature tight enough to prevent circulation either through the arteries or veins, and instead of observing the distal portion of the hand or arm the part just above the ligature and towards the heart should be the field of investigation. If circulation exists at all it will manifest itself by causing a distension of the blood vessels, redness and swelling on the side of the ligature next the heart, and if it does not exist and the subject is really dead, then no perceptible change will occur, only another good sign of death, corroborative of the first, which will be seen in the loss of elasticity in the skin and the marks made by the ligature will remain many hours after it has been removed. This can never occur in any live person, even in cases of General Anarsaca (Dropsy), the capillary circulation will be sufficient to cause a change denoting the existence of circulation.

Cessation of the Respiration.—This has been urged by some as a positive sign of death. The respiratory function may be reduced to so low an ebb by the action of narcotic poisons, that it is next to impossible to detect its presence. Some of the tests applied are the following: Holding a feather to the nostrils and observing whether it moves or is disturbed by the current of air that might be escaping from the lungs; placing a mirror over the mouth and nose and noticing whether there appears any moisture from the action of expired air, is also employed to detect the presence or absence of breathing. The direct examination by aid of the stethoscope should complete the examination. All other methods which have been advanced are less important than the above and are useless if we use the tests just given.

Physical and Chemical Changes.—After death the blood begins to leave the arteries and enter the veins, these becoming filled to distention, and the consequent early appearance of decomposition in the blood causes the blood to gravitate through the walls of the blood vessels and penetrate to the dependent parts of the body; this gives rise to a peculiar dark venous discoloration, which is known as "post mortem discoloration" and is a very good sign of death. But since these dark venous congested spots have appeared on the dependent parts of those who have suffered from some long continued illness, and are practically identical with the hypostasis caused by venous congestion and post mortem staining, it cannot be accepted as a positive sign of death. While post mortem discoloration is making its appearance in the body, certain other and no less important signs of death are making their appearance on the ventral and uppermost surfaces of the body. This is particularly noticeable along the course of the large veins, such as the femoral, basilic, or jugulars, and in some cases the frontal over the forehead. The blood, which has become fluid through the process of decomposition, percolates through the vessel walls, while the gaseous elements of that medium escape towards the surface. As the hæmaglobin, the coloring matter of the blood, and the oxygen, its gaseous element, are closely assimilated with each other, when decomposition begins in the blood this gas escapes along the course of the veins and, carrying the coloring matter with it, gives rise to a peculiar reddish or purplish staining known as "post mortem staining." This sign, then, like that of post mortem discoloration, may be accepted as one of the numerous signs certifying death. These latter stainings may also appear in certain diseased conditions during life, and, like the other signs above given, cannot be accepted as positive.

Changes in the Skin.—As soon as the vital function of life has ceased, the surface of the entire body becomes pale and of an ashen hue. This is due partly to the settling of the blood in the deeper parts, and also by the putrefactive changes occurring in the cellular part of the skin. When the skin of a dead person is caught up between the fingers and pinched, it does not readily regain its original position, while in the living state it easily approximates itself to the surrounding muscles. The features of a dead person generally have a shrunken appearance; the nose seems to be pinched, and the lips are inelastic and cold to the touch. If froth or mucous bubbles gather about the nasal openings or at the mouth, caused by the purging of the body, it is a sign that the respirations are absent, but since this froth makes its appearance in cases of epilepsy, it could not alone form a very favorable sign of death. When heat is applied to the body by laying a hot iron or other hot material on the skin, it is not followed by those changes of repair which take place immediately after a burn of the living skin. The skin of a dead body loses its transparency, and if the fingers of the hands are approximated or brought together they will not transmit the rays of light.

If a solution of ammonia be injected beneath the skin hypodermically it will cause a rose or violet red spot to appear if the body be living, and if dead the spot will be a dirty yellow, and in some cases will not appear at all. If life exists, such injection always causes a violet spot to appear at the place of injection.

Suggillation, or livid violet colored spots, will appear in the skin sometimes within fifteen minutes after real death, while it may be several days before they occur. These spots are the same as those described as post mortem staining and discoloration, and are termed by some as "death spots." These spots often bear a close resemblance to bruises or ecchymoses, which latter are the results of violence inflicted before death. They are important in a medico-legal sense, and it is oftentimes necessary to prove the real nature of the discoloration before a jury. If the body has only been dead a few hours when found, then an incision into the discolored spot will cause blood to flow if it has been caused by a blow or

[illegible]

Changes in the Muscles.—[illegible]

muscles of the lower jaw and the flexor muscles of the extremities. Cases are recorded by Barlow and Pepper where in the case of a body dead of Asiatic Cholera it was seen to draw up or contract the muscles of one side and in one instance a case is reported to have completely turned on its side, although it was proven to be a case of real death, and the muscles were contracting only through the changes, chemical and otherwise, occuring in the muscles.

The Gibbons Method of Resuscitation in cases of Suspended Animation, resulting from Electric Shock, Blows upon the Epigastrium, Drowning, etc.

EXPLANATION OF CUT.—By means of a small bellows especially constructed, air is forced into the lungs by a tube introduced into the mouth or nostrils; the second movement of the bellows exhausts the air from the lungs, while a third movement forces it in again, etc., thus the natural or normal respiratory function is produced.

The above method has been adopted by The Royal Life Saving Association of Canada.

Rigor Mortis, Post Mortem Rigidity, Cadaveric Rigidity.— By the above terms is meant that phenomena which takes place after death, commonly known as stiffening of the body.

Cause.—As soon as a body dies certain changes begin to manifest themselves in the tissue entering into its composition. The blood leaves the arteries and escapes into the capillaries and veins, thus congesting those vessels. The blood then, is the first of the fluids to undergo a change caused by death; the hæmoglobin escapes from the red blood corpuscles, becomes dissolved in the liquor sanguinis and escapes into the surrounding tissue. The cause of this escape of hæmoglobin is due partly to oxidation, and, second, to the putrefactive changes in the blood itself, the hæmoglobin escaping from the corpuscles during this change. The copuscles first lose their circular disc shape arrangement and become stellular in appearance, soon after becoming granular, and finally being dissolved entirely. Before this change in the blood is completed, a chemical change is taking place in the myosin of muscle and the protoplasm of the tissues. The cause of this change in the muscle plasma is not very well understood, on account of the chemical changes which take place so early after death. Just as soon as the myosin of the muscles and the protoplasm of the cells become granular or coagulated, the muscular tissues wherein it first begins, takes on a peculiar rigidity or stiffening, which soon spreads to the muscles of the whole body, causing the condition known as "rigor mortis." As soon as this coagulation takes place chemical changes make their appearance, a free acid is developed, which upon analysis proves to be sarcolactic acid, at the same time a large amount of carbonic acid gas is liberated from the tissues.

During the existence of rigor mortis in the dead body — the chemical re-action of the muscle juice is acid, *i. e.*, reddens litmus paper — but as soon as it passes off it is alkaline —turns litmus paper blue. Thus if a body was found and it was a matter of doubt as to whether the rigor mortis had appeared or passed off, the chemical analysis would settle the question.

Variations in Time of Appearance, Duration, Etc.— It is impossible to state the time of appearance of rigor mortis in any given case. It may come on a few moments after death or be delayed for twenty hours, or even longer. This variation is largely due to the condition of the muscular system at the time, and also the physical condition of the subject. To illustrate this point, I will refer to the experiments of Brown Sequard, whose observations developed the following facts: First, that people who die in perfect health, such as die suddenly from accident or in decapitated criminals, the rigor mortis does not make its appearance for several hours — ten to twelve—and the rigidity does not pass off for several days; in some cases a week, even in warm weather. To further illustrate the effect of the muscular system on the rigor mortis, Sequard poisoned three dogs with strychnia. To the first dog he gave three grains; this dog died almost immediately. To the second dog he gave one-half grain; this dog died in twelve minutes. To the third dog he gave one-fourth of a grain; this dog died in twenty-one minutes, the muscular system suffering intensely during that time. Rigor mortis did not make its appearance in the first dog until eight hours after its death, and it did not pass off until the twentieth day afterwards. In the second dog the rigidity came on earlier, commencing two and one-half hours afterward, and disappeared on the sixth day; while in the case of the third dog, whose muscular system had been extremely exhausted, the rigidity came on in thirty minutes and passed off in less than twenty-four hours.

In a case of strychnia poisoning that came under my own observation, that of a young lady who died two hours after taking the drug, the muscular system having been completely exhausted, the rigor mortis appeared in less than an hour and passed off in twelve hours, but on account of the introduction of preservative fluids putrefaction was suspended for several weeks.

In people who are in perfect health at the time of death, the rigor mortis does not make its appearance for several hours and does not pass off for several days. Thus it will be seen that the more the individual approaches health at the time of death, the more firm will be the rigidity of the body. Its duration is also proportionately increased. In those who die from some slow, wasting disease, such as consumption, typhoid or any of the adynamic fevers, which exhaust the whole system, the rigor mortis comes on as early as ten minutes after death and may pass off in a few hours. Some pathologists have claimed that in cases of death from lightning, carbolic acid poisoning, sulphuretted hydrogen, etc., that no rigor mortis appears. This has been disproved, however, by several able authorities, who claim that the rigor mortis came on very early after death and disappeared in an equally short space of time. There seems to be some difference, however, in death from lightning and death from the electric shock from a dynamo, for in two or three deaths of this latter kind the rigor mortis appeared and was quite firm, lasting several hours.

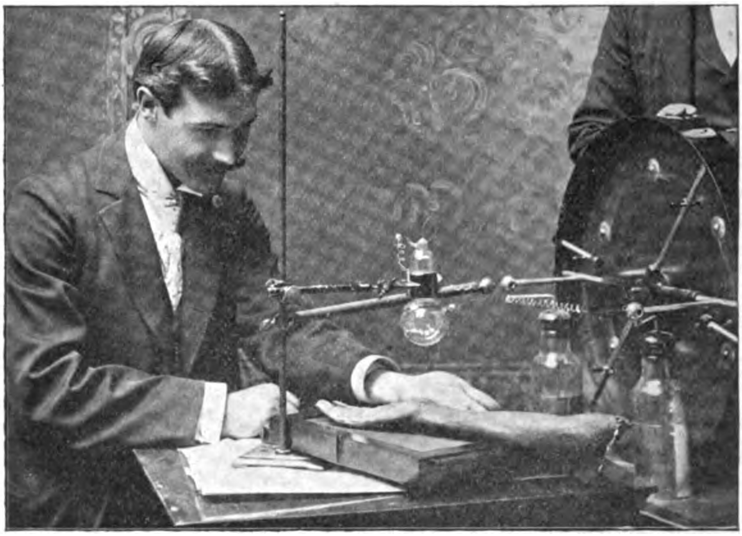
I believe that the chemical change of the myosin in the muscles of the human body after death is stronger in a case of Asiatic cholera than in any other form of death. So violent does this stiffening become in some cases, as has been observed by Wharton, Pepper and others, that the body may be altered in its position, the flexor muscles contracting so violently as to cause the body to turn on its side. The muscular contractions may act alternately—first the muscles of one side and then the other. In this class of cases the lower jaw has been seen to move up and down several hours after the person was dead. This can only be accounted for by the theory of molecular life and chemical activity existing after the occurrence of somatic death.

The rigor mortis begins first in the muscles of the eyes, which in some cases, it is claimed, become fixed even before death; it then spreads to the muscles of the jaw and neck, thence to the pectoral muscles, and then to the muscles of the upper extremities, the muscles of the abdomen and lower limbs being the last to take on the cadaveric rigidity. Its disappearance is in the same order. The muscles of the eye lose their contraction, then the muscles of the jaw, neck and upper limbs, etc. In some cases the lower limbs may be quite rigid while the upper parts of the body will be supple. As soon as the rigor mortis has left the body, putrefaction begins.

Another good sign of death relative to the rigidity of the body is the turning in of the thumb upon the palm of the hand, caused by the contraction of the flexor profundis policis muscle, while in all those cases where the person is simulating death the thumb will be found free and extended from the palm of the hand. The peculiar stiffening of the muscles of a cataleptic subject is easily distinguished from cadaveric or post mortem rigidity. In catalepsy the rigidity when once broken up returns and assumes its original position, while in a person really dead, after the rigor mortis is once thoroughly broken up, the muscles assume a more flexible condition and remain so. Persons who are half frozen present a rigidity of the muscles which should not be mistaken for rigor mortis, and in those cases of drowned bodies where the limbs are stiff, it should not prevent us from making attempts at resuscitation.

The Later and More Positive Signs of Death.—The difference in appearence of the dead and living hands when photographed together by means of the Roentgen (X) rays, the gradual cooling of the body, the changes in the humors of the eye causing a decreased tension in that organ, and the appearance of putrefaction, are four of the most positive signs of death. None of these can occur unless circulation and respiration have ceased absolutely, and if positively demonstrated, further investigation is unnecessary.

Roentgen (X Ray) Test.—To my knowledge the first experiments on dead and living tissue by photographing a dead hand with the living with the same current on a single plate were performed by the writer in April, 1896. Skiagraphs which are obtained by photographing different objects all show a certain degree of density and penetration according to the solidity and opacity of the object to be photographed. Thus when one thinks of the many changes, chemical and otherwise, that occur in the tissues of a dead body, the difference in penetration of ordinary light in the dead and living hands, we at once wonder whether the X rays will act differently on the dead and living subject. If a live hand be held before a lighted lamp the rays will pass through it and the hand become a scarlet red, due to the circulation of blood in the part. If a dead hand be held before the lamp it will not permit the rays to enter and the hand remains opaque and dark. The red corpuscles of the blood in their natural condition are bi-concave circular disks and have a very high refractory power. After death they lose their circular shape and thus their power of refraction; coagulation and suggilation are taking place. If a skiagraph is taken of a dead and living hand on the same plate it will show a very slight difference in penetration. The bones of the dead and living hands will show with about the same distinctness, but the soft tissues of the dead hand appear the least bit darker than the living. At the present rapid rate of advancement in this particular field of science, we may expect in the near future by means of this apparatus to actually photograph life and death on the same plate.



Dr. Carl Lewis Barnes taking a skiagraph of his own hand, with that of a cadaver (April, 1896). First experiment of the kind ever made.

Temperature—Animal Heat, Post Mortem Caloricity, Etc.—The normal heat in the human body during health and life varies but little; the mean temperature in the living subject, taken in the axilla and the mouth, will average about 37 deg. C. or 98.05 deg. F. The temperature varies if taken in the different cavities of the body, and when taken by a thermometer placed in the rectum or vaginæ, will be found to be a little higher; in the former reaching, possibly, 100 deg. F., while if taken in the vaginæ it will be less, and will be found to register approximately at 97.06 to 98 deg. F. Thus temperature varies but little in the living subject, there being few diseases of the human system that will cause a variation of nine degrees either way, without causing death. This temperature in the living subject is kept up by the metabolism of cellular life in the body.

Just as soon as death takes place, the temperature generally begins to fall. It is sometimes increased, and in some cases reaches the unusually high temperature of 111 deg. F. In a case of aggravated dysentery, in a child two years of age, the temperature taken in the rectum registered even higher than this, the mercury reaching 112 deg. F. But, while these are exceptional cases, they should be recorded. The temperature, which rises after death, seldom reaches the 103 deg. F. mark, and then it slowly recedes until it falls far below the temperature during life. The generation of heat rapidly decreases, until the bodily temperature approximates that of the surrounding atmosphere. Physical conditions and the presence of warm clothing, etc., serve to cause slight variations in the gradual cooling of the body, while cold or the opposite extreme hastens it. The physical conditions which bear upon the cooling of the body are several:—gunshot and stab wounds, and death from Asiatic cholera, yellow fever, tetanus, electric shocks, and lightning stroke, retard the cooling of the body considerable, and for many hours after death has really taken place the temperature of the body will have fallen very little. The same is also the case with those persons dead from senility or old age. The heat of the body recedes very slowly, while those who die in middle life are the opposite, and cool rapidly. Of course, there are certain conditions during life in which the bodily temperature falls considerably below 98.06 deg. F., but they should not be mistaken for the gradual cooling of the body after death, the coldness during collapse, and that which comes up in persons apparently drowned, should never be confounded with post-mortem cooling.

Post-mortem caloricity includes all those bodies where there is a rise of temperature above the normal, after death; it is rather a phenomena than a regular condition to be expected in the cases above quoted: Tetanus, yellow fever, Asiatic cholera, electric shocks, etc.

The body becomes cold to the touch in about eight to twelve hours after death, but the heat in the thoracic and abdominal viscera may remain much longer. In order to apply the temperature test, the investigator should place the thermometer in the rectum, for by taking the temperature at this place you will not only prevent mistaking it for that caused by collapse, and which only affects the superficial structures, but will be able to differentiate between the superficial coldness which appears in bodies apparently drowned. If the temperature is taken in this part of the anatomy, instead of the mouth, axilla or superficial parts of the body, it will prevent any possibility of an error. If the temperature of the body falls to 70 deg. F., death is real.

Changes in the Eye.—This test can only be properly applied by the expert: it relates to changes both in the external and internal structures of the organ, and even to the degree of tension in the muscles of the eye. As soon as death takes place, and in some cases a few minutes before, the eye assumes a hazy appearance, which gradually attains to a dull greyish color. The pupil fails to contract on the approach of light, or to dilate on its removal; these tests will be about all we can use without calling to our aid medicaments and instruments of precision. The medicines which are applied to the eye for certifying death are such as cause it to dilate, and properly belong to the field of mydriatics. Chief among these drugs is belladonna, or its alkaloid atropine, which, when introduced in or on the surface of the eye, cause it to dilate if there is any life, while if life is extinct the pupil of the eye will not be affected in the least. A better drug to use, and one which acts quicker and gives the same results, is cocaine (muriate), which will cause the eye to dilate if there is any life, and will not affect it if death is present. However, this test must not be applied until after muscular contractions have ceased to respond to the influence of the galvanic or faradic current. This will be in about eight to twelve hours after death. If muscular contractions still exist it shows that the nerves are still living. Thus if the drug was introduced before these contractions had ceased, the eye would dilate and this might lead one to express a wrong opinion as to the death. If, however, these contractions have ceased, and belladonna, atropine or cocaine does not cause a dilitation of the pupil after a reasonable length of time (one to three hours), death is real.

The next step will be to ascertain the appearance of the retina, and the condition of the inner structures of the eye. This can only be accomplished by the nse of the ophthalmoscope in the hands of a person who is accustomed to its use. If, on looking into the eye, the arteria centralis retinæ is empty, or presents the appearance of no existing circulation, and the whole posterior part of the eye shows a dark venous appearance—the result of the settling of the blood in that part of the organ—it is a very favorable sign of death in the body.

The most recent observations concerning the eye as a medium of certifying death are such as relate to the tension. This has been advanced by some as a positive sign of death, but the author failed to state what degrees of tension are present in cases of glaucoma, or bulging of the eyes. The observations of this writer go to prove that the tension of the eye (which can never be accurately determined during life) was always less after death. For the most part this is correct, but in the case above quoted, that of glaucoma, the tension during life is very high, and consequently after death, when the tension would fall, a glaucomatous eye would probably fall to the tension of the majority of normal eyes. This test, then, should not be considered a positive sign. The cause of the fall of tension in the eye is the result of the gravitation of the fluid constituents, through the coats of the eye, into the surrounding fatty cusion at the back part of the eye; the aqueous and vitreous parts of the eye, which thus escape into the cellular structures after death, retain the tension and globular condition of the ball of the eye during life.

Changes Caused by Bacteria of Putrefaction.—The greenish tinge of putrefaction, when general, is one of the most unequivocal signs of death. This greenish discoloration—which makes its first appearance over the abdominal cavity, corresponding to the right illiac region, over the illeo caecal valve and vermiform appendix—can readily be distinguished from the other forms of discoloration so frequently met with in the first few hours after death. Accompanying these putrefactive changes in the body is a peculiar odor (putrid and offensive to the smell) caused by the gases and chemical products of the cadaveric bacilli, which only develop in putrefying substances.

Remember, putrefaction may appear in a living body, and will resemble post mortem putrefaction very much; especially is this the case in septic poisoning, where the odor resembles very strongly that of putrefaction in the dead body; but the location of the putrefactive changes, together with the appearance of localized swellings or wounds and the discoloration, would prevent error in the minds of the observing.

To recapitulate: The signs which have been given, if taken as a whole and each of them tried, and all give negative results, then we may safely say that the death of the subject is real. Putrefaction will appear earlier in those bodies which have been exposed to a warm, moist atmosphere. Either of the extremes of temperature, cold or hot, or immersion of the body in fluids, will prevent the rapid decomposition of the body. Pyæmia, dropsy (anarsaca), variola, typhus, and poisoning from the narcotic drugs, will hasten decomposition, while death from digitalis, arsenic, alcohol or acids will retard it. It should also be remembered that putrefaction is retarded in those who die from electric shock; the chemical changes which appear in most subjects soon after death are often delayed several hours in the electrocuted subject. The temperature remains near normal and the blood retains its red or scarlet appearance for many hours after the shock. My friend, Mr. P. J. Gibbons, M. A. M. D., of Syracuse, N. Y., who is one of the highest authorities on this subject, has invented an instrument for restoring the respirations and circulation in those bodies apparently drowned or who have been subjected to a severe electric shock. Cut No. 1 will give the reader a good idea of the methods of resuscitating, first applied by Dr. Gibbons and favorably commented upon by the medical fraternity of the world.

The signs quoted in this article are those which are most frequently sought for, and, if when found are negative, are the ones in which most reliance can be placed; and if the presence of life is actually overlooked, it will be attributable to neglect, rather than the impossibility of proving it.

It will be well to make a table of those signs and tests which are to be applied by the public and those which can only be successfully applied by the expert.

Those tests which may be applied by the public are as follows:

Feather to the nostrils to ascertain if respiration exists.

String tied around the finger or wrist to see if circulation is absent.

Mirror held over the mouth and nostrils to see if moisture forms on the surface, if so breathing has not ceased.

Applying a match or hot iron to the skin to ascertain whether circulation and repair is still going on; if a blister forms and water or plasma forms beneath it, life still exists. If it forms but has no water or plasma (yellow colored fluid) in it, death may be real.

Listening over the chest for heart sounds, and respiratory murmurs.

Examination of the skin, if generally pale, cold and clammy to the touch, loss of elasticity when stretched, slowly regaining its usual position, it may be presumed that death is real.

If red or violet colored spots appear over the surface of the arms and chest, and deep uniform blue discolorations are present all over the muscles and tissues of the back, except parts pressed upon, presumption is that real death exists.

If the parts pressed upon such as the back of the shoulders, buttocks, thighs and calves of the leg are flattened and remain so after the body has been turned over, it is a good sign that the body is dead.

If the hands held before the light are dark colored and refuse to transmit the rays of light death may be real.

If the pupil fails to contract on the approach of light to the eye, or to dilate as it is removed, nervous reflexes are at an end and it is a favorable sign that death is real.

The signs or tests which are to be applied by the expert will include the above and the following:

To ascertain the existence or absence of circulation and respiration by auscultation.

To take the temperature both internally and externally.

To examine the eye with the opthalmascope, and to ascertain the degree of tension present.

To take a radiagraph of the dead hand with a living.

To observe whether putrefaction is present by the presence of the characteristic greenish yellow tinge over the abdominal cavity.

To note whether rigor mortis has appeared or has passed off.

To ascertain if post-mortem discoloration or post-mortem staining is present.

To ascertain whether muscular contraction has ceased by applying the faradic current.

To introduce mydriatics in the eye to ascertain the existence of nervous reflexes, and observe whether the pupil dilates.

CHAPTER II.

Putrefaction.

The death of a tissue, animal or vegetable, is always followed by certain chemical and molecular changes, which, in the case of solid tissues, amounts to a mechanical softening, while if the tissue be semi-solid it is reduced to a fluid consistence, and the fluids of the substance are reduced from a complex chemical nature to those of a simpler chemical consistence. These changes which take place are known under various headings, as putrefaction, decomposition, decay, rotting, etc. Since it is not the intention in a work of this kind to enter into the decomposition of the vegetable substances, the following words will apply directly to the decomposition of the human body.

Putrefaction, as first supposed, is not a chemical change alone, but is caused by the action of micro-organisms, principally bacteria (bacterium termo, bacillus cadaver), etc., which develop in the dead body under varying conditions and circumstances. Thus, when the temperature of the season is between 70 deg. F. and 100 deg. F., as in summer time, the bacteria develop much more rapidly, and the decomposition of the body is considerably hastened. These germs may be restrained in their action by lowering the temperature to 32 deg. F., although that temperature does not always kill them. If the temperature could be raised to 212 deg. F. it would be sufficient to kill all the putrefactive bacteria that are present in the body. In warm countries, such as in the arid deserts of Arabia and Africa, in certain parts of Australia, and in those parts where the temperature reaches 130 to 180 deg. F., the body, instead of undergoing a rapid putrefaction, will slowly dessicate and resemble a Gaunche or Peruvian mummy. The intense heat causes the evaporation of the fluids of the body, and bodies that have been found in these parts are extremely dessicated in appearance, caused by this loss of watery constituents. If a body be frozen and the temperature retained at or below 32 deg. F. it may be preserved for an indefinite period. It is reported that the body of a Russian nobleman that had been buried in the frozen soil of Siberia, on being exhumed nearly a hundred years afterwards, was found in a perfect state of preservation. Frequent reference is also made to the finding of bodies well preserved in the arctic regions, also of animals that do not belong to the present century, but which have been dug out of the ice, having been well preserved in this medium for centuries.

Putrefaction is also retarded by deep sea water. Capt. Maurer maintains that all corpses which have been committed to the deep in blue waters, with weights attached, are now standing on the bottom with their lineaments and features as well preserved as the day whereon their comrades cast them over the ship's side. Dr. Konig also reports on cases of the arrest of decomposition in deep waters. This eminent authority, who observed several bodies taken from the waters of the Echoschacht after they had been in it over forty years, states that they were in a perfect state of preservation. There was no formation of adipocere, or the formation of any gases in the intestines or cavities of the body. The internal organs had the appearance of the viscera of one dead only a few hours, retaining their natural color, but the brain had hardened considerably. These bodies were thoroughly saturated with salt, the sodium chloride being present very abundantly in the form of crystals in the interior of the body. Decomposition takes place more rapidly in the open air than when the body is hermetically sealed or shut off from the air, as immersion in water or buried in the earth. It is said that the ratio is as one, two and eight. Thus the body will decay as much in one week in the open air as it will in two weeks in the water, and in eight weeks if it be buried in the earth. Putrefaction will also advance more rapidly in those bodies that are confined in shallow water or are floating near the surface. These bodies, as soon as they are removed from the water and brought into the air, begin to decompose much more rapidly than they would had the body been left in the water.

Effects of Putrefaction on the External Appearance of the Body.

The changes which make their appearance in those bodies which have been exposed to the action of the air, and which have not received any treatment whatever in a preservative way, are, for the most part, quite regular in appearance, duration, etc. Usually about three days in summer or five in winter are sufficient for the body to begin the phenomena of decomposition. The lower part of the abdominal cavity, generally that part known as the right iliac region, begins to change in color from that of the normal to a greenish, yellowish green or greenish purple hue. This discoloration gradually extends to the genitals and finally to all parts of the body. The next sign of putrefaction, after the discoloration has made its appearance, will be those that are caused by the effects of gases, causing pressure on the abdomen, greatly distending it, and giving the body a bloated appearance. The neck and face become distended and discolored from the effects of this gaseous pressure on the diaphragm and great vessels of the thorax; this discoloration is known as "venous congestion." *The gases which have been described by chemists and pathologists as products of the bacteria of decomposition, are: carbonic acid gas, carbonic oxide, ammonia, hydrogen sulphide, carburetted hydrogen, phosphoretted hydrogen, nitrogen and carbonate of ammonia.* Some of these gases are inflammable. and if a match be applied to the escaping gas entering the air from the trocar it will burn with a pale blue flame or with a slightly yellow tint, as is seen in a light from coal gas.

Besides these changes already described, other phenomena soon begin to manifest themselves. The eyes become very prominent, giving them a bulged appearance; this continues for a few days when they collapse, caused by rupture of the coats of the eye and the escape of the fluids from the globe. Mucous and serous accumulations tinged with blood soon begin to escape from the mouth and nostrils. This purged material generally comes from the stomach and lungs, but in rare cases even the contents of the intestines have been detected in discharges from the mouth and nostrils. The cellular tissue of the body, and those parts which are very vascular, such as the labia in the female and the scrotum in the male, become distended. The eyelids become congested and soon little vesicles or blisters form in the epidermis of the skin, which soon becomes moist and in many instances discolored, although the skin may slip without the presence of any discoloration. At about this time the hair, nails and scarf skin become loosened and are very easily detached.

It is often asked: "How soon after death does putrefaction begin?" It is impossible to give a specific answer to this question, as putrefaction has many variations as to time of appearance, duration, etc. Some authorities have stated that putrefaction will not advance as long as the rigor mortis is present in the body, but this has been disproven many times. I have seen the trachea almost consumed by putrefaction, yet the neck and the remaining parts of the body were in a complete state of cadaveric rigidity. Then again putrefaction will advance more rapidly in one body than in another, although they die or are killed under the same circumstances. Casper quotes a case where four men of about the same physical build and age were killed in a riot; these bodies were prepared for burial alike, placed in coffins alike and buried in the same kind of soil and within a few feet of each other, but when they were taken up and examined, a few months later, the extent of decomposition was very different in each body. As a general rule, in about eight hours after death (in summer time) the surface of the chest and posterior part of the neck assume a marbled appearance, caused by the escape of the coloring matter of the blood in the superficial veins, giving to the surface of the body a marbled appearance, which either changes to a reddish purple or shades into a grayish tint, and finally, thirty hours after death, assumes a yellowish green or greenish discoloration. About sixteen hours after death the skin covering the abdomen changes to a yellowish, and then after passing through a yellowish purple, greenish yellow, etc., assumes the true greenish discoloration of putrefaction. At about the same time the posterior parts of the body become discolored by the gravitation of fluid blood into the tissues, giving them the appearance of a bruised part. This discoloration is generally of a bluish black color or a dark purple which shades to a black tint. In six or seven days after death the whole body assumes a greenish discoloration; the skin, if it has not already shown vesications, soon begins to form blisters, and it becomes easily detached; the fluids of the body acquire great liquidity [illegible] towards the point of least resistance, will be [illegible] the posterior parts of the body. The fluids then escape [illegible] openings in the skin, and if the subject is that [illegible] case, this escape of the fluids from the body will take place much earlier than six or seven days; in extreme cases I have seen it escaping only a few hours after death.

Having dwelt for some time on the external appearance of putrefaction, I will now proceed with the effects of putrefaction on internal organs of the body.

The Viscera and Internal Tissues — How Affected by Putrefaction.

The trachea or wind-pipe and the brain of infants are the first organs in the body to take on decomposition; the heart, lungs and the uterus are the organs which resist it the longest. The following table will aid in keeping the order in which the internal organs are attacked by putrefaction—

Organs which putrify rapidly: larynx and trachea, brain of infants, stomach, intestines, spleen, omentum and mesentery, liver and adult brain.

Organs that putrefy slowly: heart, lungs, kidneys, bladder, œsophagus, pancreas, diaphragm, blood vessels and uterus.

TABLE.

1. Trachea and larynx.
2. Brain of infants.
3. Stomach.
4. Intestines.
5. Spleen.
6. Liver.
7. Brain of adults and gall bladder.
8. Heart and lungs.
9. Kidneys and supra renal capsules.
10. Urinary bladder.
11. Oesophagus.
12. Pancreas.
13. Diaphragm.
14. Large blood vessels.
15. The uterus or womb.

Trachea and Larynx.—About the same time the greenish discoloration of putrefaction appears over the lower part of the abdomen, the mucous membrane lining the trachea (wind-pipe) and the larynx begins to take on certain changes of a putrefactive nature; these may appear even before the discoloration appears on the abdomen, and in some cases it will be delayed, but for a short time only. The membrane at first assumes a dark red color (the membrane in life always being pale or very slightly red). Immediately after death it takes on a pallor, which changes at the beginning of putrefaction to a dirty red color, this finally shading to an olive green; then the tissues become so lax that the rings (cartilaginous) separate from the membrane and fall to pieces.

Brain of Infants.—This organ in the infant, on account of its very delicate structure, also on account of its large blood supply, is possibly the second organ in the body to undergo decomposition. It at first changes to a dark red, caused by the early decomposition of the coats of the large sinuses, which allows the blood to intermingle with the structure of the brain. It soon liquifies and escapes through the various openings in the skull.

Stomach.—This organ is, on account of its structure, one of the earliest to take on decomposition. The first effects of putrefaction are found on the fundus and posterior parts of the stomach, or those parts where, on account of the hypostatic congestion, putrefaction advances most rapidly. Post mortem digestion should not be mistaken for putrefaction. The next change that occurs in the stomach is a mottling of the inner membranes, which is soon followed by streaks of a reddish, purplish tint over the blood vessels; then the organ becomes a dirty yellow, which shades into a green discoloration; finally the organ is reduced to a pulpaceous mass, it being impossible to recognize the existence of anything resembling the original organ.

The Intestines are fourth in the order of putrefaction. They take on discoloration, and the post mortem changes are the same as those that take place in the stomach; gases form in them, which increase as the decomposition advances, until the intestines burst from distension. That part of the intestines near the ileo cæcal valve is the first to be entirely consumed.

The Spleen, Omentum and Mesentery.—These organs undergo putrefactive changes at about the same time, being fifth in order. The spleen at first begins to show a slight mottling of its surface, and then changes to a dark red color, this giving place to a greenish blue; it finally becomes soft and pulpy and disappears altogether. The omentum and mesentery begin to putrefy at about the same time as the spleen. They are retarded somewhat, however, by the absence of fat, but should there be much fatty tissue connected with them, they undergo putrefaction much earlier.

The Liver.—This viscus resists putrefactive changes for a considerable time, and in death from some of the poisons, such as arsenic, it has been claimed to be preserved for many months. When putrefaction begins in the liver, the organ assumes a green color, which turns to black; it then softens, liquifies and is finally dissolved.

Brain of Adults.—This organ in the adult subject is much more compact than in the infant, hence it resists putrefaction much longer (fifth or sixth week). The putrefactive changes are seen at the base of the brain first; these spread upward and inward until the whole substance of the organ is under its influence, changing it from a reddish gray to a bluish green. It finally softens and completely disappears. It will be found that those cases of cerebral softening, apoplexy, gun-shot wounds, etc., will cause the brain to decompose much more rapidly than when these are absent. In gun-shot wounds, where the air can get free access to the contents of the cranium, the brain takes on putrefactive changes very rapidly.

The Gall Bladder begins to decompose about the same time as the adult brain.

Heart and Lungs.—The heart and lungs resist putrefaction for a considerable period after death. When putrefaction does commence in the heart, it is first noticed in the columnar carnæ and inner lining membrane of the ventricles. It spreads from the inner wall towards the muscular part of the organ, which is soon brought under its influence; finally the heart becomes so soft and pulpy in consistence that it is impossible to distinguish the auricles from the ventricles, finally disappearing altogether.

The lungs present certain phenomena in relation to putrefaction that are not well understood. They are in direct communication with the air, which always contains millions of germs which could find a suitable nidus in nearly every other tissue of the body. The lungs are also composed of a very soft structure, and offer apparently very little impediment towards decomposition. But these organs resist putrefaction for a long time. If the lungs were in a healthy state at the time of death, they will be found in a good state of preservation for many weeks afterwards. The presence of tuberculosis, abcesses, calcareous deposits, pneumonia, etc., will cause putrefaction to commence much earlier. When decomposition does begin in the substance of the lungs, it is first detected by the formation of gas between the lobes and in the sulci, being found along the under surface. The composition of this gas is not as yet known. The lungs begin to turn green, then black, after which they soften and break up into an unrecognizable mass.

Kidneys and Supra Renal Capsules.—The kidneys and capsules resist putrefaction nearly as long as the pancreas. The first sign of decomposition is generally exhibited on the under and posterior surface of the organ, which soon becomes of a dark blue color; finally the putrefactive process advances towards the pelvis and then attacks the muscular structure. At about this time the capsules covering the kidneys begin to liquify, and in a short time it is impossible to distinguish either of the organs.

Urinary Bladder.—The urinary bladder follows immediately after the kidneys, being entirely consumed in a few days after the kidneys and capsules disappear.

The Oesophagus.—The œsophagus or gullet is next in order after the urinary bladder. Both are consumed at nearly the same time, but the œsopeagus, on account of its structure, resists the putrefactive process somewhat longer than the bladder.

The Pancreas.—This glandular organ, soft in consistence, and placed so near the stomach, intestines, liver and other organs which undergo decomposition very early after death, resists the approach of putrifaction for a longer time than any other organ in the abdominal cavity, unless it be the uterus or womb, which, according to Casper, is the last of all to undergo decomposition.

The Diaphragm.—This musculo-fibrous membrane which forms the partition or dividing membrane between the abdominal and thoracic cavities, is, next to the uterus, the last structure to undergo putrefaction. This first begins at the lower and posterior part of the membrane near its attachment to the vertebra; the membrane becomes spotted and then assumes a blueish discoloration, which soon takes on the characteristic greenish tinge of putrefaction.

The Large Blood Vessels are, next to the hair, nails, bones and teeth, the last to decay. In one case I examined, the body had been buried two months, the arteries were so well preserved that I injected them with a preservative solution, which had the effect of changing the condition of the body considerably. It is impossible to tell just when such structures as the hair, nails, teeth, bones, etc., will take on putrefactive changes. Certain it is that these parts of the body are found in a good state of preservation in the mummies that have been exhumed after they had been buried thousands of years.

The Uterus is the last muscular structure in the body to undergo decomposition; it is often found in a fair state of preservation after the lapse of nine months.

Certain other conditions not previously considered have a tendency to affect the time putrefaction may begin in a subject. These are: corpulency,age and sex,the manner of death, etc. A corpulent or plethoric individual, on account of the greater amount of fluids in the body, will take on putrefaction much more rapidly than a lean subject, or one who has very little fatty tissue. This also applies to women who have died in child-birth. On account of the large amount of blood in the body, it will cause the subject to putrefy very early. New born children and infants will also show signs of decomposition much earlier than adult subjects.

Inference of the Time of Death Before Putrefaction Has Begun.

The phenomena which take place in a dead body before the commencement of putrefaction if observed, may sometimes enable a person to form an opinion of the time at which the deceased died. The body may be still warm and the extremities perfectly pliant, or the body may be cold and rigid. In the case of a murder and suicide that came under my observation, the shot was indistinctly heard about two or three o'clock in the morning. The bodies were not found until eight o'clock in the morning. The wounds on the woman were such as to indicate immediate death as her throat was cut with a butcher's knife and the carotid artery and internal jugular vein were severed. The man had shot himself after committing the deed and had also died almost immediately. When found the body of the woman was quite cold and rigor mortis was quite prominent in the muscles of the head and neck. The body of the man was still warm and pliant. Here is an instance of death at the same time and up to the time of discovery no putrefaction had manifested itself. Yet one body was still warm and the other was quite cold. In the minds of the unobservant they might be lead to give a different opinion as to the time of death in each, but it must be remembered that some bodies cool more rapidly than others. Especially is this so where there has been extensive hemorrhage as in the case of the woman. Very little hemorrhage occurred from the gun shot injury to the man, thus when found five hours later the body of the male was still warm. Another almost identical case came under my observation and I had the opportunity of watching these bodies for a week after the deed had been committed. Putrefaction occurred in the man about the third day and advanced so rapidly that by the end of a week you could scarcely recognize him. This was in the month of September, but the temperature was unusually warm. The body of the woman at the end of a week was in a good state of preservation. All of the blood in the woman had escaped from the divided ends of the large vessels in the neck, while in the man the hemorrhage being internal, decomposition advanced more rapidly. Rigidity of the body is seldom complete in less than from twelve to fifteen hours in those persons who come to their death while they are in a state of comparative health, but this, of course, is different and modified considerably in all those cases of lingering disease — fever, etc. If, for instance, a body was found in a room quite cold, with the rigidity or rigor mortis *not fully developed*, there being no signs of putrefaction present, it may be safely inferred that the body has been dead from four to ten hours. It should also be remembered that rigor mortis begins in the tissues of the muscles of the eye first, then in the muscles of the jaw, and finally passes to the lower extremities. Thus if examining a body found dead before putrefaction has really begun, it would be well to examine, first; the condition of the eyes and then the jaw, the muscles of the chest,the arm and fore-arm, to see whether the rigor mortis has commenced. I know of no better illustration to quote, to enable one to form an opinion of the time which has elapsed before putrefaction commences, than the case of Gardner versus the Crown, tried at the Central Criminal Court in October, 1882. The prisoner lived with his wife and another woman named Humbler. The wife was found dead in her bedroom with her throat cut, at eight o'clock A. M. The position of the body, the nature and direction of the weapon, and the surroundings, as well as other circumstances, proved conclusively that this was an act of murder. As there were no persons in the house at the time of the occurrence excepting the woman Humbler and the prisoner and his wife it followed that either Gardner or the servant Humbler, or both, must have been concerned in committing the deed. When confronted with the crime Gardner accused the servant Humbler of having perpetrated the murder during his absence from home, but as no evidence could be obtained against the woman, Gardner was called upon to answer the charge of murdering his wife. Medical experts examined the body of the woman. Her age was thirty-seven, previous to her death healthy. General inspection showed her to be a well-developed woman. The examination was made at eight o'clock in the morning. Her body was found on a wooden floor, covered with a flannel petticoat and a chemise. The upper extremities were cold and rigid. The face, shoulders and chest were cold and the neck was so rigid with the trunk that the entire body was lifted up with it when the head and neck were raised. The thighs and legs were quite cold; but there was no rigidity below the pelvis. The body had cooled considerably and the only temperature to be observed was in the abdominal cavity; the woman being in the seventh month of pregnancy, such a condition would be a natural inference. The opinion given by the medical expert who made the first examination regarding the time of death was that the body must have been dead over four hours, certainly more than three, and she could not have been dead so short a time as two hours when he first saw the body, and possibly seven hours might have elapsed since the death. Comeley, another medical expert, affirmed this and, considering the general coldness of the body when seen at eight o'clock, said that the deceased must have been dead above four hours rather than under that time. It was observed that about two pints of blood escaped from the wounds in the throat and as the windpipe had been cut the blood flowed directly into the bronchial tubes, thus obstructing respiration, and death was caused by asphyxia. It was proved on the trial that from four to eight o'clock in the morning, for about four hours, the prisoner was absent from home following his usual occupation as a chimney sweep. It was contended by his counsel that the murder was committed during his absence from home or between the hours of four and eight A. M. On this theory alone the woman Humbler could be found guilty. The facts presented at the trial, however, proved the utter inconsistency of the death having occurred between these hours. The result of the trial was that the defendant Gardner was convicted and sentenced to the penitentiary for life. The weight of authority in this case proved, or rather tended to prove, that it was an utter impossibility for a body dying in apparent health to cool in less than four hours, or to show any marked signs of rigidity in less than that length of time. Thus from this inference the jury decided that the woman must have been murdered sometime between the hours of eleven P. M. and three A. M. In one hundred cases of death suddenly where the temperature was taken into consideration and observed by Stevenson and Wilks there was not a single instance in which a body cooled and rigor mortis occurred in four hours or under. Thus if we discover the body in a state of warmth with a very poorly developed rigor mortis it is a safe opinion to say that the body has not been dead more than five hours, and possibly seven hours.

Putrefaction seldom commences before the temperature of the body has fallen several degrees below the normal. Thus if the gradual cooling of the body be taken into consideration in estimating the time which has elapsed since the death, it will serve to reach a diagnosis. It should be remembered, however, in some diseases the body will cool more rapidly than in others, and it is also claimed by some authorities that in all individuals after death there is a slight rise in temperature in the three great cavities of the body (the cranial, the thoracic and the abdominal); but while this may occur in the viscera, caused probably by the rapid chemical changes within their structure, it is just as certain that the external parts of the body will in a few hours after death become more or less cold to the touch, according to the external temperature, the amount of clothing and other surrounding conditions. I may also state that where the clothing protects a body the decomposition of blood in the veins is arrested, while those parts unprotected by clothing will show post mortem staining much earlier. Probably the best method of reaching a scientific conclusion as to the length of time which has elapsed since death occurred, and before putrefaction has nced, is to observe the fall of temperature, and in tak- mperature the investigator must keep in mind the he cause of death, the previous condition of the e time of death, and whether there has been a large amount of blood lost, or whether the death has been due to hemorrhage, etc. As a rule it may be said that the fall of temperature in a body under ordinary circumstances will be about as follows:

	HOURS AFTER DEATH.			
	2 to 3½	3½ to 6	6 to 8	8 to 15 or more.
Maximum temperature	95° F.	86° F.	80° F.	79° F. (26.1° C.)
Minimum temperature	60° F.	62° F.	60° F.	56° F. (13.3° C.)
Average temperature	76° F.	74° F.	70° F.	69° F. (20.5° C.)

In taking this temperature the bulb of the thermometer was placed on the skin over the abdomen and the thermometer was deeply impressed in the folds of the skin, so that the external air might not influence it. From eighteen to twenty-four hours is the average time in which cooling of the body may occur. In winter this is hastened, while in summer it is delayed. From six to eight hours the temperature taken in the deeper tissues of the body will be about 28 degrees C. (82.4 F.). The temperature taken in the rectum in six cases, six hours after death, showed a temperature of 90.6 degrees F. Niderkorn differs considerably from the table given above in his observations of temperature after death. Niderkorn's table is as follows:

	HOURS AFTER DEATH.			
	2 to 4	4 to 6	6 to 8	8 to 12
Maximum temperature	100.4°	98.2°	95.3°	100.4° F.
Minimum temperature	89.6°	80.6°	70.5°	62.6° F.
Average temperature	96.9°	90.2°	81.7°	77.9° F.

It is reported by Nysten that in cases of asphyxia three days are required for the body to cool down to the temperature of the surrounding atmosphere. Of course, this means internal temperature. In the new-born child cooling occurs more rapidly than in those a month old. Thus bodies of old people will cool less rapidly than young subjects; an emaciated body, sooner than fat subjects. Where hemorrhage has caused the death, cooling will also be very rapid, but it is not always the case.

Dervergie gives a very good table for the purpose of ascertaining the length of time which has passed since death. He has divided this into four periods.

First Period: If the warmth of the body is more or less preserved, and there is only a general or partial relaxation of the voluntary muscles, giving special attention to the special circumstances leading to and causing the death, and the condition of the body previous to the death, it may be inferred that the body has been dead from a few minutes to ten hours. In this short period from a few minutes to ten hours the muscles of the body are susceptible of contraction and expansion under the influence of mechanical and electrical stimuli.

Second Period: If the body is perfectly cool throughout and the rigor mortis is well marked, the muscles no longer susceptible to nervous influences, the body must have been dead not less than seven hours and, according to surrounding circumstances, the manner and the causes leading to the death, might have been dead three days. This opinion may be a little indefinite, but my observations lead me to express it in this way. It must be remembered in all of these cases that particular attention must be given to the manner and cause of death, the condition of the deceased at the time of the examination, and his probable condition, healthy or diseased, before the death, the surrounding things attendant thereto, and especially to the time of year and the conditions of temperature at the time.

Third Period: The body is perfectly cool, internally and externally. The arms, the legs and neck, as well as the trunk, are pliant and no remains of cadaveric rigidity are present. This usually marks the beginning of putrefaction, but it may not be noticed at this time. If it has not made its appearance in the form of green discolorations in the right iliac space or on the abdominal structures, the body must have been dead not less than two days nor more than five. If, however, putrefaction is present, then the time may be extended to eight days or longer.

Length of Time Which Has Passed After Commencement of Putrefaction.

According to Taylor, putrefaction is first manifested by a slight greenish discoloration of the skin of the abdomen, while according to Woodman and Tidy putrefaction begins in the mucous membrane of the trachea and larynx first, but it is not shown by any external signs such as are present on the skin of the abdomen. Nearly all medico-legal investigators are alike in this respect. Putrefaction is certainly one of the most unequivocal signs of death. The greenish tinge of decomposition usually manifests itself in from twenty-four hours to three days in summer, and from three to twelve days in winter, depending on the degree of cold. In some cases it may be present within twelve hours after the death, and in extreme cases I have not observed it even after the lapse of fifteen days. This, however, was in the body of an asphyxiated person, which, if it be remembered, takes on decomposition slowly, if it has been caused by the ordinary illuminating gas or natural gas, but in those who have been suffocated with coal gas (methane gas) and sulphuretted hydrogen gases, the body will take on putrefactive changes very rapidly. The bodies of new-born children and those of women dying in child-birth undergo putrefaction very rapidly. The child's body contains more fluids and thus more moisture, which always has a tendency to hasten putrefaction, as is evidenced by the rapidity with which decomposition manifests itself in the bodies of those who die of dropsy (general anasarca). The external conditions affecting decomposition are the air, moisture and temperature. The influence of the atmosphere upon the decomposition of animal tissue is well understood, and from the quotations made on another page it will be seen that a body will decompose in air nearly three times as fast as it will when the air is excluded. Oxygen has a great deal to do with the decomposition of animal tissues. Reese says that nitrogen will preserve animal tissues. However, I do not believe this gas alone would have much influence in preserving a human body. It is a mistaken idea prevalent among the laity that if a body is placed in an air-tight casket no decomposition can occur. An experiment was performed on a body in order to disprove this statement. The body was placed in an air-tight casket without being embalmed or having anything applied to it to preserve it. By means of a small opening in the casket, a rubber tube and a vacuum pump, all of the air that was around the body was exhausted, thus neither nitrogen nor oxygen were present in the external air. Then the case was hermetically sealed. Putrefaction was delayed a little, not manifesting itself until the third or fourth day, but when once begun it progressed as rapidly, and seemed to be in excess of what might have been expected if the body had been left in the open air. Bacteria develop best in the bodies where there is a great deal of moisture. As previously stated, the bodies of the infant and women in child-birth will decompose more rapidly than ordinary persons. The woman during pregnancy has an increase in the amount of blood, thus an increase in the amount of fluids of the body. During this critical period she must not only take care of her own body and supply it with nutritious blood, but must have enough blood to supply that of the child in utero. Fat persons and those of a lymphatic tendency generally decompose very rapidly; lean ones rather slowly, unless they have been entirely exhausted by some lingering disease. The effect of moisture is well understood by all bacteriologists. Saprophitic bacteria develop very rapidly in the bodies of persons who have an excessive amount of serous fluids in them, but if moisture be excluded from the tissues by drying, by removing the moisture, or the introduction of some chemical into the body that will unite with the water and serous matters and form a solid or semi-solid substance of a different chemical composition, then putrefaction may even be arrested in those bodies that die of dropsy or child-birth or a disease where a large amount of serous matter is distributed throughout the body. If one was called to examine a body, and after taking in all of the circumstances which tend to influence, accelerate or modify decomposition, it is found that the abdomen is green, the rigor mortis has disappeared, the temperature of the body lowered, it feels cold, and the extremities are pliant, as well as the muscles of the trunk and abdomen, there being a decrease of tension in the eye, and the cornea when pressed upon with a pencil point, or other instrument, receives an indentation which does not disappear, such a body has been dead from one to three days in summer, and from three to fifteen days in winter, according to the degree of temperature at the time. I desire to quote a case, that of an individual whose vocation was that of a quarryman. He left his home in early December and was last seen going over the mountains to visit a friend. He never reached his friend's house. Search was made for him, but after several days' diligent effort the body could not be located. The search was discontinued. The following spring, about the middle of March, the body was accidentally discovered by some hunters. It was taken to an undertaking establishment, where I made an examination. There was no sign of decomposition over the abdominal cavity except a slight greenish yellow just over the stomach. The body was intensely rigid, and before it could be straightened it was necessary to cut the tendons of the soleus and plantarus muscles, the tendons of the biceps and the flexor tendons of the arm. There was not a sign of decomposition about the face or neck save the inelasticity of the cornea and a decreased tension in the eye, giving it a sunken appearance. It happened that during this winter it was very cold from December to March, the temperature being at a freezing point nearly all that time. Thus it can be seen that decomposition could not advance very much in such a climate. If a body is found in summer time with blebs (blisters) over the skin and maggots in the muscles, the body greatly distended with gases, green all over, the epidermis slipping, the nails loose and easily detached, the eye in such a condition that it is impossible to note its color, and distended as though they would leap from their sockets, the body has been dead from two to three weeks in summer and from three to five weeks in winter, according to the temperature existing at the time. If you are called to examine a body which has been dead evidently a considerable time, and you find that the chest and abdomen have burst open and discharged their contents, the ribs and some of the bones of the extremities denuded of their fleshy coverings, it is safe to presume that the body has been dead from one to two months in the summer and from two to five months in the winter. It is impossible to state exactly how long a body has been dead. The greatest authority on this subject, Orifila, states that we cannot do any more than conjecture. Casper's case, where the men were buried at the same time, in the same kind of soil, in the same clothing, and each found in a different state of decomposition a few days later when they were exhumed, will be sufficient to put us on our guard in giving a concise and definite opinion as to the length of time that has elapsed since the death of the individual. But, taking everything into consideration, the surroundings, the temperature, the condition of the body, the previous history of the individual, if it can be obtained, the manner and cause of death, we will be able by considering all of these to form an opinion which will have some weight before a tribunal or a scientific body.

The Formation of Adipocere is another peculiar phenomena which appears in certain cases during the progress of decomposition. The first accounts of any importance on this subject are those published by Fourcroy in 1789. This gentleman observed a change from the ordinary order of putrefaction. In removing the remains from a cemetery in Paris he came upon a large number of bodies that had been buried one upon the other. These bodies were buried in very moist soil, and when exhumed presented the appearance of a soft cheesy mass of a dirty white color. This condition was present in all of the bodies, and in nearly every instance the whole body was affected alike. Fourcroy gave the name of "adipocere" to this condition. It is also known as saponification. Saponification or the formation of adipocere cannot take place only in the presence of moisture; the body must be buried in very moist soil, or else immersed in water for a considerable time. Drowned subjects frequently present this phenomena. About five or six weeks is all that is required for the body of an infant to be converted into adipocere, if the body has been immersed in water for that length of time. It requires a much longer period for an adult subject—usually one year will elapse before the process is completed. If the body has been buried instead of being immersed in the water, and the soil be of a moist condition, it may be three years before saponification is complete. It has been found upon examination of these bodies that adipocere is a chemical substance, composed principally of ammonium oleate and stearate. There is also frequent deposits of lime found in bodies of this class. The ammonium is obtained from the nitrogen of the body.

In India the body of a young Chinese woman alleged to have died in child-birth was exhumed seventy-six hours afterwards. It was found to be considerably saponified. Such a rapid conversion into adipocere can only occur in hot countries. A male Hindoo was killed by the kick of a horse, and was buried the following day. Four days after burial the body was exhumed and found to be in an advanced state of saponification externally. The heart and liver also were in the same condition. All of these bodies were buried in a soft, porous soil saturated with moisture, the temperature being high. Another case was that of an European sailor who fell into the river Hoogly. The body was recovered in nine days. Saponification was complete in both the external and internal parts. A young European was drowned in the same river. The body was discovered seven days afterwards. Saponification had advanced in both internal and external tissues. The stomach of this individual contained undigested food, flesh and potatoes. The flesh in the stomach was saponified and the potatoes not altered in the least. One case is reported in India where a body was completely saponified both externally and internally in the short period of forty-eight hours. This, however, is an unusually rare occurrence, and could not possibly happen in any other climate remote from India.

Mummification.— This constitutes another condition by which the ordinary progress of decomposition is arrested. Mummification is a condition in which the body dries up or dessicates. This is very frequent in hot countries, such as Arabia, Australia, Egypt, etc. Natural mummies may also be found in many other countries remote from those just named. In the Monastery of St. Petersburg, those bodies which are found dead in the snow are deposited in a chapel in a sitting position. This chapel has open grated windows, giving free access to the air, the cold of which seems to have preserved them and given time for drying. I have seen several mummies which were made in the United States; two of these were produced in the state of Alabama, which has a climate favorable to mummification. One of them, the body of a criminal, was in a very perfect condition of mummification; the other one, that of a negress, was also a fine specimen, but had begun to show signs of decomposition. During my services as Demonstrator at the Indiana College of Embalming, I made several experiments on this line, some of the mummified specimens being in existence at the present time.

The bodies of those such as die from some of the wasting diseases are most liable to this change, lean persons more so than plethoric individuals. Certain embalming preparations containing a large amount of arsenate of soda and alcohol also have a tendency to cause mummification.

CHAPTER III.

Anatomy of the Human Body.

Anatomical Elements.

Without a complete knowledge of the component parts of the body, the embalmer cannot perform his work in a scientific manner, neither will he be able to appreciate the pathological and morbid conditions that present themselves in the various cases he is called upon to handle, unless he is well acquainted with the details of the normal structure of the human body. While it is not necessary that the embalmer should be familiar with the histological conditions or the study of the genesis of cells, and the minute anatomy, he should be well acquainted with the structure of the vascular system, the arrangement of the different viscera, and their function during life.

It is a well known fact that the ancient embalmers were well acquainted with the anatomy of the body, although their facilities for study were not as good as ours, as dissection of the human body was entirely prohibited in the days of Herodotis and Diodorus Sicilus, who were the historians that lived and wrote during the Egyptian period.

The anatomy that is necessary for the professional embalmer pertains more to the study of the vascular system, and to the positions of the viscera, and these will be taken up in their entirety and will be described in full; the anatomical elements, independent of the arteries, veins and the viscera, will be described sufficiently to give the reader an intelligent idea of their structure, without entering into an exhaustive treatise on these minor subjects.

Divisions of the Body.—The body to be dissected is usually divided into sections, or divisions, namely: *The head and neck; the thorax and upper extremities; the abdomen and lower extremities.* The dissector who has the arm and thorax, dissects the viscera contained in that cavity, which are the heart and lungs; also their coverings, the pericardium and the pleura, respectively. The dissector who has charge of the lower extremities, dissects the contents of the abdominal and pelvic cavities, which contain the liver, gall bladder, stomach, spleen, pancreas, large and small intestines, kidneys and their appendages, the supra renal capsules, the bladder and the ureter; and in the female subject we have, in addition to these organs, the uterus or womb, and the falopian tubes and ovaries; the peritoneum is the covering which protects the intestines and the contents of the abdominal cavity.

The dissector who has charge of the head and neck, also dissects the contents of the cranial cavity and the upper part of the spinal cavity; these cavities enclose the brain and spinal cord and its envelopes, the arachnoid membranes, pia mater and dura mater.

Division of the Tissues.—The human body may be further subdivided into its anatomical elements, which are: skin, subcutaneous tissues, the superficial fascia, muscles, bursæ, lymphatics, synovial membranes, deep fascia, arteries, veins, nerves, viscera, ducts, mucous and serous membranes, ligaments, cartilages, bones, teeth, hair and nails.

The Skin.—The skin is composed of two separate and distinct layers, the outside layer being known as the epidermis, the inner layer being known as the true skin or cutis vera. The epidermis, or outside layer, is made up almost entirely of stratified epithelium, the cells of which are large and contain more protoplasm as they encroach upon the cells or outside layer of the true skin. In the colored races of mankind, the pigment or coloring matter, which serves to distinguish one race from another, is found in the deep layer of cells in the epidermis. There are no blood vessels in the epidermis, but the lymph circulates very freely through channels between the cells. The nerves are distributed quite freely throughout the entire layer of the epidermis.

Microscopical appearance of human skin—taken from a section through the tip of the finger.

The cutis vera or inner layer of the skin is composed of connective tissue of a very dense nature, but as the corium deepens, the connective tissue becomes soft and cellular as it begins to encroach upon the subcutaneous tissues, the upper part of which is very intimately connected with the under surface of the true skin.

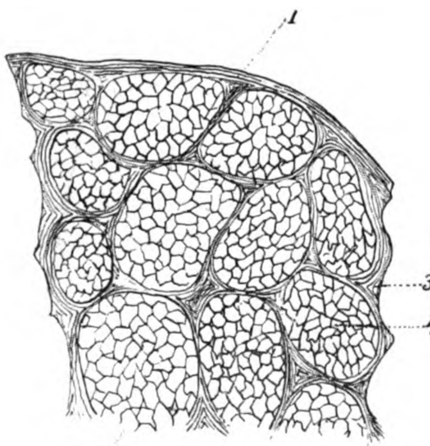
The corium is very freely supplied with blood vessels and nerves; the blood vessels end at the upper surface of the true skin in a capillary net work.

Subcutaneous Tissue. — The subcutaneous tissue is found just beneath the skin. It is made up principally of adipose or fatty tissue. In a great many places in the body this subcutaneous tissue may be divided into two layers, which are then known as the superficial and deep layers of the subcutaneous tissue.

Superficial Fascia.— The superficial fascia of the body is a dense fibrous layer which covers the whole of its surfaces beneath the skin. In many places the superficial fascia is formed into ligaments, which serve to bind down the tendons, as in the wrist and ankle, and in these situations is much thicker and stronger than in other parts of the body.

Muscles.— Since muscular tissue forms the greater part of the fleshy constituents of the body, we should endeavor to investigate it as fully as possible. All muscular tissue possesses the power of contractility, either through the form of nervous stimuli or from mechanical irritation by means of electric currents. The degree of contraction varies however with different muscles and in different regions of the body. Histologists have divided muscular tissue into two kinds — voluntary and involuntary; and a still further division in that of the heart, which is known as cardiac muscular tissue, and will be described more fully with the anatomy and description of the heart. Voluntary muscles are those which are under direct control of the will, while involuntary muscles are entirely independent of the will. The voluntary muscles of the human body are attached to the bony frame-work of the body either at their origin or their insertion, there being but rare exceptions to this rule. Their principal use is that of motion and locomotion. The involuntary muscles of the body are found chiefly in the viscera and between the internal and external coats of the arteries, veins and lymphatics. The involuntary muscles are supplied by the sympathetic nerves.

Minute Anatomy.—If a section of muscle be examined under a low power of the microscope, it will present several important and separate structures; the outside shield of the muscle is a fibrous structure and exists between all the large muscles, under the name of intermuscular septa, but as soon as we take a section through a part of the muscles, we find that the muscle is further divided into bundles of muscular fibres. These fibres are either circular or pyramidal in shape and are separated from one another by a thin fibrous membrane known as the internal perimysium, while the membrane which invests the whole of the muscular fibres is known as the external perimysium. The little delicate membrane which separates each fibre is known as the sarcolema, and is a very elastic membrane, being transparent and possessing considerable toughness. The fibres in the muscles are very short, varying in length from 30 to 40 millimeters, and are arranged parallel to the course of the muscle. These fibres, when examined with still higher powers, present, in the case of the voluntary muscle, a striped appearance, while the involuntary fibres are destitute of these striations; thus voluntary muscles are known as striped, while involuntary muscles are known as unstriped muscles.



2

Microscopical appearance of muscle (low power) from cross section biceps muscle.
1, external perimysium; 2, fasiculus; 3, internal perimysium; 4, muscle fibre.

The Vascular Supply.—The blood supply to the muscles of the body is very great and is characteristic in the distribution of the capillary branches. The vessels, after entering the muscle, are supported into the fibres by means of the perimysium; at this point they break up and spread out into capillaries, which are more or less circular, and within this capillary arrangement the muscular fibre is contained. The muscular fibres are freely supplied with lymphatics and nerves, the nerves always entering the muscle at the center, then spreading towards each extremity.

Chemical Composition.—The chemistry of the muscles is very little understood, on account of the coagulation that takes place in its substance immediately after death, but numerous experiments along this line of investigation prove that after the muscular fibre has been separated from the fats and connective tissue, then frozen and placed in a mortar and the fluids expressed through linen, which acts as a sort of filtering agent, a slight yellow syrupy fluid is obtained, known as the muscle plasma. This muscle plasma, or muscular juice, is mostly neutral, but in some cases is alkaline. As soon as this fluid is obtained from the muscular fibres it undergoes a spontaneous coagulation at ordinary temperature, and resembles very much the plasma taken from human blood. This plasma subsequently contracts and presses out a thin serous fluid, which is known as the myosin of the muscle. This myosin is acid in reaction, and, in the dead body, as soon as it coagulates it causes a peculiar condition, known as rigor mortis, or post mortem rigidity, which appears in all bodies after death, and which is discussed in full in the chapter on that subject.

Bursæ.—The bursæ in the human body are of two kinds—bursa mucosa and bursa synovia. The bursæ mucosæ are found in the subcutaneous areolar tissue beneath the skin and some bony prominence, as at the elbow joint and over the patella at the knee joint. The bursæ synoviæ are found in the deeper tissues, usually between muscles or tendons These bursæ are closed sacs, except where they are situated near a joint, where they usually communicate with the synovial surfaces in the joint. They are composed of fibrous tissue and contain a viscid fluid.

Lymphatics.—In addition to the general or systemic circulation of blood, we have a separate system of vessels for the circulation of lymph. These vessels are known as lymphatic vessels. The lymphatic vessels generally begin at the periphery, in what are known as lymph spaces. These spaces are found in nearly all of the organs and tissues of the body. The lymph which is taken up from these lymph spaces and from the lymph channels in the intestines is collected into a larger system of vessels at the receptaculum chyli, which is situated in the abdominal cavity at a point opposite the third lumbar vertebra. The lymph, which is now collected into the larger lymph vessels, ascends towards the root of the neck, where it is emptied into the thoracic duct, which in turn empties it into the subclavian vein. The lymph fluid which circulates in these vessels is of a clear, viscid consistence, and is supposed to come largely from the lymph which has escaped through the tissues from the blood current and in the interstices of the villi of the intestines.

At the beginning of the lymph capillaries, which are always larger than the blood capillaries, the vessels have but one coat, which gradually merges into sinuses or open vessels, but as the capillaries encroach upon the larger lymph vessels they begin to take on the more substantial form of vessels, having distinct coats and valves along their course, so as to prevent the regurgitation of the lymph. These valves are nearly analagous to the valves in the veins. All along the course of these lymphatics, but more especially in the neck and along the flexure of the thigh, corresponding to the location of Poupart's ligament, will be found a series of glands. These glands vary in size—from that of a millet seed to that of a hazel nut—in the normal or physiological condition; but in certain diseases infecting these glands, they increase in size very considerably. The glands are for the most part arranged in a system of chains, being situated all along the course of a lymph vessel. The lymph fluid which circulates through them is thrown through a system of meshes before it proceeds along the course of the vessel towards the thoracic ducts, which empty the lymph fluid into the circulation by a small duct which enters the subclavian vein at the junction of the subclavian with the internal jugular vein.

Synovial Membranes.—Lining the surfaces of the joints, and interposed between certain muscles and tendons, is a membraneous sac, or tube, which secretes a clear viscid fluid, not unlike the white of an egg. This fluid is known as synovia, and serves to lubricate the joints and articular parts of the body. These membranes are composed of connective tissue, and are tough and fibrous. The synovial membrane, situated in the knee joint,is the largest in the body.

Deep Fascia.—Closely investing the muscles and forming the sheaths for the arteries and veins is a membrane, fibrous in texture, very inelastic and unyielding. This membrane, which invests the deeper tissues of the body, is known as the deep fascia. It serves to protect the different structures and to give attachment to muscles, as is the cases of that of the tensor vaginæ femoris muscle in the thigh; serving also to protect the body. The membrane is thicker on the outside of the extremities than on the inner side. It closely invests every muscle, and in many cases is attached to the periostium of bone. Where it invests the muscles separately, the fascia between the muscles is known as intermuscular septa.

The Arteries.—The arterial system is one complete net work of vascular tubes which serve to convey the blood from the heart to the capillaries, which exist in every part of the body. The arteries are made up of three distinct coats, an inner endothelial coat, so arranged that the epithelium, lining the inner part of the tube, points toward the long axis of the vessel. This coat becomes detached very early after death, and is easily separated from the remaining coats. The middle coat is composed principally of muscular and elastic tissue, and gives strength and elasticity to the vessel. This middle coat is different in many of the arteries. In the carotid and some of its immediate branches, also in the aorta and the larger blood vessels generally, the middle coat has nearly the same amount of elastic tissue as it has muscular tissue. In the smaller arteries the muscular tissue predominates.

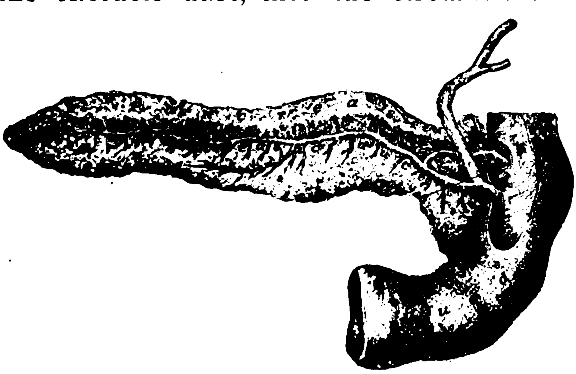
The external or outside coat of the arteries is composed of connective tissue with a small amount of elastic tissue interposed as the external coat approaches on the middle tunic. The outside coat of the artery gives a great deal of strength to the vessel, and is not so easily torn or separated from the other coats when a ligature is placed around it.

The Veins.— The veins, like the arteries, have three coats. The inner coat is made up of much the same material as the inner coat of the arteries, but the inner coat of the veins has less elastic fibres in it and it seldom becomes a complete membrane. The inner coat of the veins is not so easily detached as is the case with the arteries. The middle coat contains both muscular tissue and elastic tissue, but they are in less quantity than the middle coat of the arteries. The external or outside coat is composed principally of white fibrous connective tissue, intermingled with elastic fibres; this coat is stronger than the external coat of the arteries, thus while the veins have thinner walls, they are in many instances stronger than the arteries. Valves are present in a great many of the veins, especially in the large veins of the extremities; these valves are semilunar in shape and are composed of fibrous tissue and a folding in of the inner coat of the vessel; they are very strong and prevent the regurgitation of the blood in the veins. The coats of the veins, like the arteries, differ in different parts of the body. Some of the veins have one or another coat developed more than the average, while others will be found deficient in the inner or external wall.

The Nerves.— All nerve trunks, whether derived from the cerebro spinal or the sympathetic system, may be classed under two headings — medullary and non-medullary. The nerves springing from the brain and cord are made up of the medullary variety, while those springing from the sympathetic system are mostly non-medullated.

The nerves for the most part tend to follow the course of the blood vessels, and in many instances will be found in the same sheaths. They can be distinguished from the vessels or surrounding tissue by their white color, inelasticity and fibrous texture, being hard to the touch and, unlike the arteries or veins, they have no central opening.

Ducts.—Ducts are tubes or canals which serve to convey the products of secretion into the intestines, or in the case of the thoracic duct, into the circulation. There are many smaller ducts and canals in different parts of the human anatomy which serve merely as efferent tubes. These ducts are generally composed of three coats, the middle coat being made up principally of muscular tissue.



PANCREAS AND DUODENUM.
Pancreatic and Bile Ducts opening into the Intestines.

The largest ducts in the body are the ducts leading from the liver (the ductus communis choledicus, the hepatic duct and the cystic duct). The duct leading from the pancreas and the bile ducts empties into the duodenum (see cut of pancreas), the upper part of the small intestines. In the fœtal state we have two ducts which serve to convey the blood from one vascular channel to another; these ducts close at birth. They are the ductus arteriosis and the ductus venosis.

Mucous and Serous Membranes.—The inner coats or lining of the canals of the body, such as the intestinal canal, the vaginæ, the mouth, etc., are lined with mucous membrane, which is a smooth membrane. As this mucous membrane approaches the orifices of the body, it becomes intimately connected to the skin, the point of union being marked by a distinct line, as at the lips. The serous membranes in the body serve to protect the viscera and tissues from friction, and in some instances they serve to protect the viscus which they surround. The serous membranes invest all opposed surfaces and form the lining for the abdominal and thoracic cavities. All of the viscera are surrounded, more or less, with serous membranes.

Ligaments.—Ligaments are found around all joint surfaces of the body. They are composed principally of elastic tissue. These ligaments are exceedingly tough in texture, and are the means of binding the joints together, thus holding the joint surfaces in apposition and preventing displacement. The ligaments are pliable but inextensible, permitting of easy movement in a limited direction.

Cartilage.—There are several varieties of cartilage in the body, according to the location and the function it has to serve. It is found on the articular extremities of the bones, and between the vertebræ. The costal cartilages of the ribs, which connect the ribs to the sternum or breast-bone, are made up of strong white fibro cartilage, while the cartilages of the ear and eustachian tube are composed of the yellow elastic fibro cartilage. The cartilage permits of freedom of movement in the case of the costal cartilages, and at the same time serves to protect the viscera of the thorax. The cartilages of the spinal column and joint surfaces serve as a cushion to prevent concussion.

Bone.— For convenience of description, the bones of the skeleton may be divided into long, short, flat, and irregular. The skeleton gives attachment to the muscles and soft tissues of the body, maintains the shape and position, and protects the viscera from injury. There are *two hundred distinct bones in an adult human body*, but in the child this number is increased, on account of certain bones, such as the pelvis, being divided. These subsequently become united in the adult state.

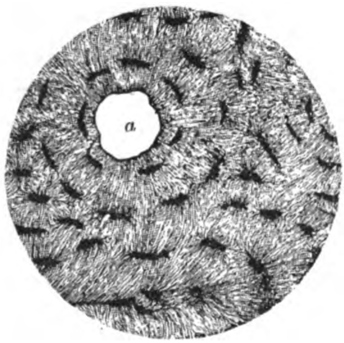
The Skull consists of twenty-two bones, fourteen of which form the face and eight unite to form the cranium. The spinal column is made up, in the adult, of twenty-six bones, while in the child, on account of the yet incomplete union between the sacrum and coccyx, there are thirty-three bones. In the chest we have the thorax, which is composed of the sternum and twelve pairs of ribs, which make in all for the chest, twenty-five bones. In the arm and hand we have thirty bones, which, if we include the clavicle or collar-bone and the scapula or shoulder-blade, makes thirty-two bones, and counting those in the opposite arm and hand would make in all sixty-four bones for the upper extremities. The bones of the leg and foot are thirty in number; thus, if we consider the pelvis, which is composed of the innominate bones, and the bones in the opposite leg and foot, we have in all sixty-two bones in the lower extremities.

The Thorax, which is composed of the sternum in front, the ribs laterally, and the thoracic vertebra posteriorly, is a conical-shaped structure with the base formed by the diaphragm and the apex by the root of the neck.

The Clavicle, or collar bone, and the scapula or shoulder blade, serve to unite the thorax to the arms, the clavicle being connected to the first piece of the sternum and articulating with the acromian process of the scapula. The clavicle is a long bone, cylindrical in shape, and serves as a prominent bony landmark for the location of certain arteries and veins. The humerus is the largest bone in the arm, and is a long bone, cylindrical in shape and articulating at its upper end with the scapula, and below forming the elbow joint by articulating with the ulna. The radius and ulna are long bones of the fore-arm. The brachial artery and basilic vein run in a parallel course over the inner and anterior surface of the humerus. The bones in the thigh and leg are the femur, the tibia and the fibula. The femoral vessels and nerve run over the course of the femur, while the anterior and posterior tibial arteries and veins run in front and behind the tibia respectively.

Microscopical Appearance of Bone.

All bones are composed of two substances—animal and mineral. The mineral matter is made up principally of lime salts, the phosphate and the carbonate being the most abundant. These can be dissolved out of the bone by the addition of hydrochloric acid, which will leave nothing but the animal matter remaining. The animal matter, when boiled, yields gelatin. The long bones are composed of compact layers, while the irregular and some of the smaller long bones, also the flat variety, are composed of an outside or compact layer, while the inner or middle parts of the bone are cancellous. If a section be made through the humerus it will be found hollow in the center, the hollow being filled with a substance known as marrow. If a section of one of these bones be placed under a low power of the microscope, there will be seen numerous little openings or canals through which the blood vessels ramify in distributing the nourishment to the bone. These canals are known as haversian canals. Around these haversian canals are seen several smaller spaces arranged in a

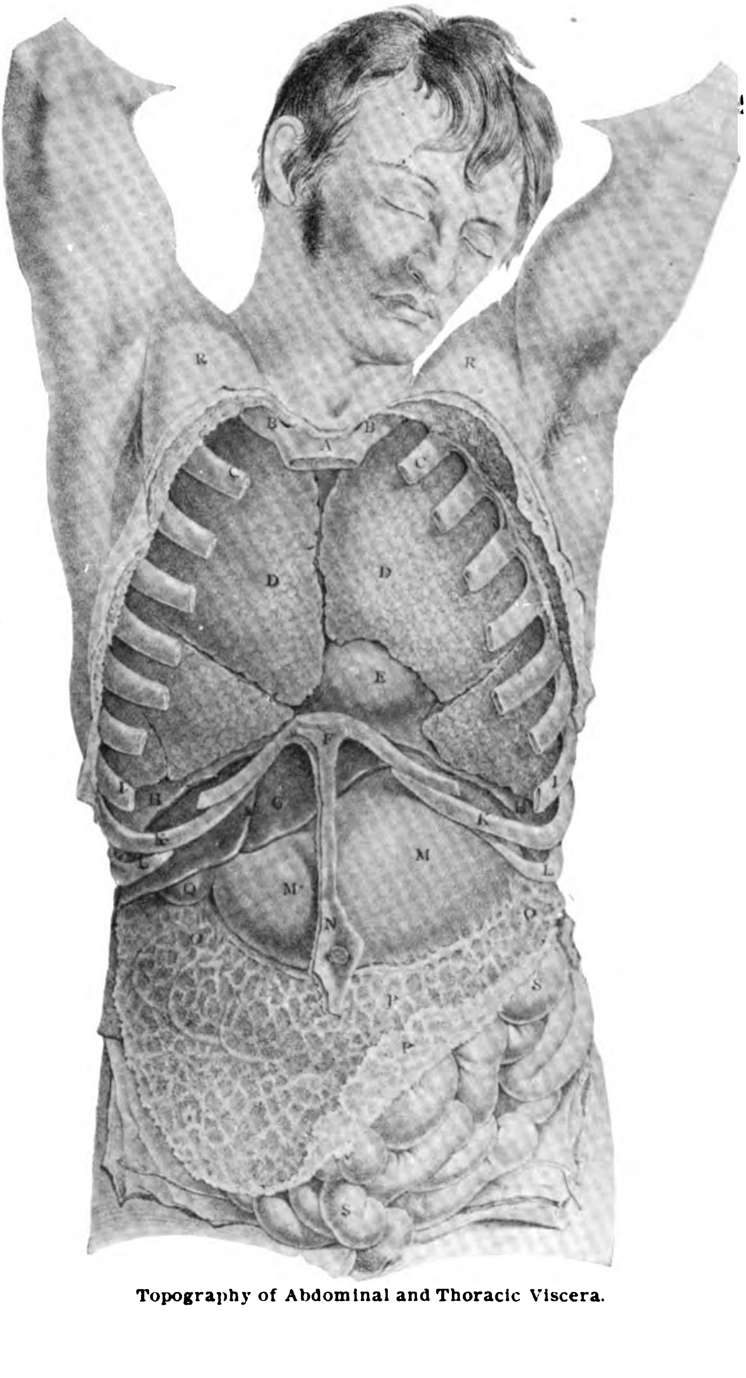


MICROSCOPICAL APPEARANCE CROSS SECTION OF BONE.
X 300 diametus. a, Haversian canals; black dots, Lacunea.

circle; these are known as the lacunæ. Nearly all of the long bones and many of the irregular bones are supplied by a nutrient artery which enters the bone near the center, and then gives off branches which distribute the blood to its extremities. All of the bones have an outside and an inside membranous covering. The outside membranous covering of the bones is known as the periosteum and is composed of two layers, the inner one of which supports the blood vessels and contains the bone cells known as osteoblasts. This inner layer, on account of its bone forming principles, is known as the osteogenetic layer, and lies next to the true bone.

Teeth.—Human beings have two sets of teeth. The first appear in childhood and are known as milk teeth, and are twenty in number. Milk teeth are also known as temporary teeth, while the permanent teeth last until old age. There are thirty-two permanent teeth, being divisible into several classes, known as incisors, canine, bicuspid and molars. The teeth are made up of three different substances which are known as the enamel, the dentine and the cement or crusta petrosa. The dentine forms the principal part of the teeth the cement or crusta petrosa is a bony layer which covers the roots; the enamel is the hardest part of the teeth, and covers the crown.

Hair.—The hair and nails, also the sweat glands and the sebaceous glands, are all outgrowths from the malpighian layer of the epidermis or outer layer of the skin. The hair is generally composed of a shaft and a central canal, through which the nourishment is derived from the root. This part of the hair may penetrate farther than the external layer of the skin and reach to the subcutaneous layer beneath the corium. A great deal has been written concerning the post mortem growth of the hair, but on the authority of C. Henri Leonard, M. A., M. D., this is disputed. This eminent scientist says its growth after death is more a horrid fiction than anything else. It is entirely at variance with scientific and physiological facts and principles I am well aware that many instances are quoted, by those that delight in the marvellous, of such growths. But hair growth is just as much a living physiological process as the beating of the heart; both depend upon circulating blood for their food, and when this is denied them, both cease to live. I admit an apparent growth of hair after death, but there is a vast difference between this growth and a genuine one. The apparent one is made from just the opposite conditions that would favor the true one; for the apparent is seen only in the shrinking of the skin tissues, squeezing the blood and nourishment out of them, thus allowing, through the contraction of the skin, a more projected appearance of the hair cylinder, which to an unpracticed eye would simulate real elongation. This apparent growth may be observed by shaving a body clean, and then placing it in a vault for a week or more, or long enough to allow the shrinking of the skin to take place, then if we look at the body it will appear as if the hair had grown about a quarter to a half inch.



Topography of Abdominal and Thoracic Viscera.

PLATE 3.

A. Upper bone of sternum (breast bone).

BB. First ribs.

CC. Second pair of ribs.

DD. Right and left lungs.

E. Pericardium enveloping the heart, showing prominence of right ventricle.

F. Lower end of breast-bone (sternum).

GG. Right and left lobes of 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 great or cardiac end of the stomach from the left lung.

II. Eighth pair of ribs.

KK. Ninth pair of ribs.

LL. Tenth pair of ribs.

MM. The stomach.

N. The umbilicus (navel).

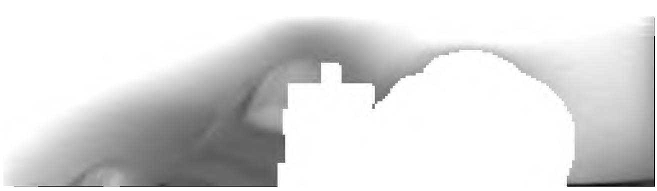
OO. The transverse colon covered by peritoneum.

PP. The peritoneum covering transverse colon and small intestines.

Q. The gall bladder.

RR. Right and left pectoral prominences.

SS. Small intestines.



CHAPTER IV.

The Viscera of the Human Body.

By the term viscera is meant certain organs which are found in the head, the thoracic and abdominal cavities. In the head we find the brain and the beginning of the spinal cord, together with their envelopes, the dura mater, the pia mater and the arachnoid membranes. In the **thoracic cavity** we find the central organ of circulation, *the heart;* the organs of respiration, *the lungs;* also the coverings of these organs, *the pericardium and the plura.* In the **abdominal cavity** we have *the stomach, large and small intestines, the liver, gall bladder, pancreas, spleen, kidneys and their coverings—the supra renal capsules—the bladder*, and in the female subject we have, in addition to these, *the uterus or womb and the ovaries.* The *peritoneum* is the covering which is found protecting the organs in the abdominal cavity.

The Brain.—The average weight of the normal adult brain is approximately estimated at forty-eight to fifty ounces. In the female subject the weight is somewhat less than that of the male brain, and weighs from forty-six to forty-seven ounces. The brain is divided into four separate parts, known as the cerebrum, the cerebellum, the medulla oblongata and the pons varolii, all of which are contained within the cavity of the skull. On removing the skull cap from the calvarium we at once notice a white membrane, tough and elastic, which is very firmly attached to the inner membranes of the skull, and more so to the sutures which unite the different bones of the skull; this membrane is known as the dura mater. Numerous processes of the dura mater serve to bind the different parts of the brain more closely together and to fix it more firmly with the different bony processes of the skull. On removing this membrane we come down upon the brain proper. This organ will be seen to have numerous grooves and fissures running through it in every direction. These grooves and fissures are known as the convolutions of the brain. When the membrane covering these grooves and fissures is spread out they cover, according to Baillarger, 670 square inches of surface. The pia mater is the internal covering of the brain, but is not so tough and fibrous as the dura, the outside covering.

Cerebrum.—The cerebrum comprises the principal weight of the brain. It is divided by the longitudinal fissure into two lateral halves, the under surface of each half being still further divided into three lobes, known as the anterior, middle and posterior lobes. The corpus callosum is composed of a thick layer of medullary fibres and divides or forms the separating membrane between the two lateral halves of the cerebrum. If an incision is made in the right or left hemisphere of the cerebrum, beginning at one extremity and ending at the other, the knife will enter a cavity which exists clear through the structure, from end to end. This is known as the lateral ventricle.

Cerebellum.—The cerebellum is placed posteriorly to the cerebrum and is nearly seven times smaller. It occupies the posterior fosæ of the skull, and is made up of the same cells as the cerebrum, being composed of white and gray cells. The white matter is found more on the surface of the cerebellum, while the gray matter is found in the deeper structures. The superior vermiform process divides the cerebellum into

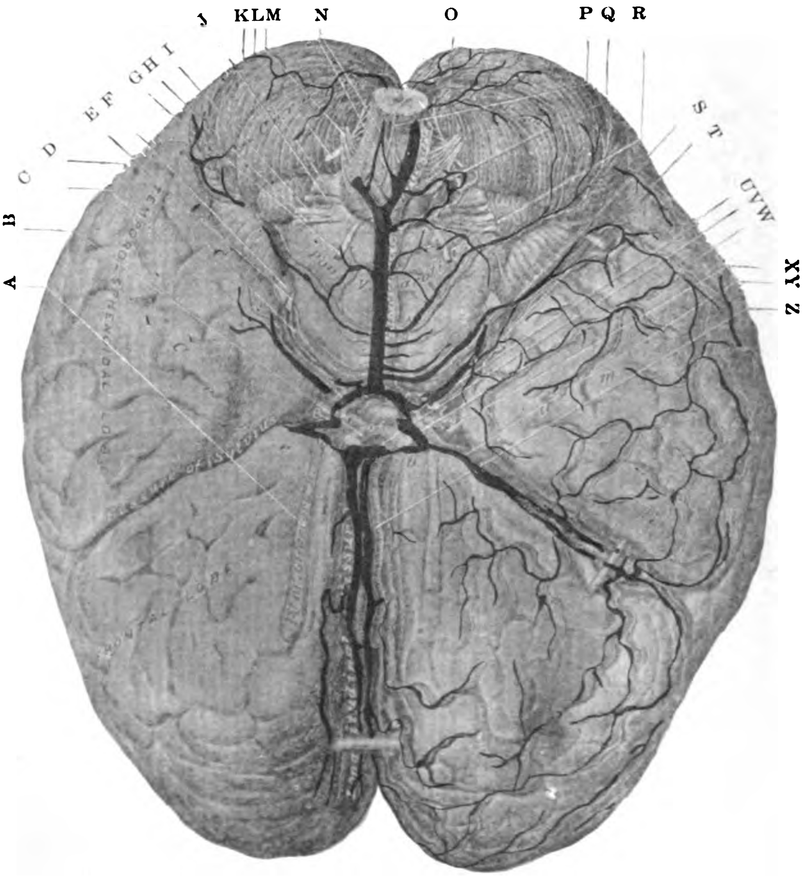

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PLATE 4.

A.	Olfactory nerve	First pair.
B.	Optic nerve	Second pair.
C.	Motor oculi	Third pair.
D.	Trochlear (pathetici)	Fourth pair.
EF.	Trifacial, motor and sensory root,	Fifth pair.
G.	Abducens	Sixth pair.
H.	Facial	Seventh pair.
I.	Auditory nerve	Eighth pair.
J.	Glosso pharyngeal	Ninth pair.
K.	Pneumogastric	Tenth pair.
L.	Spinal accessory	Eleventh pair.
M.	Hypoglossal	Twelfth pair.

N. Anterior spinal arteries.
O. Medulla oblongata.
P. Anterior spinal artery.
Q. Inferior cerebellar artery.
R. Auditory artery.
S. Superior cerebellar artery.
T. Posterior cerebral artery.
U. Posterior communicating artery.
V. Anterior communicating artery.
W. Internal carotid artery.
X. Anterior choriod artery.
Y. Middle cerebral artery.
Z. Anterior cerebral artery.

two hemispheres, which are further divided into lobes and processes. The cerebellum is the center for the co-ordination of muscular movement. The cerebrum, which lies anterior and above the cerebellum, is the center for intelligence, reason and will.

Medulla Oblongata.—The medulla oblongata is the upper expanded portion of the spinal cord. It is connected to the brain by several membranes and processes of the pons varolii, and extends from the pons varolii to the upper part of the atlas, the first bone of the spinal column. The medulla oblongata is the most vital part of man and, it is said, is the only place in the body an injury of which will cause instant death. It controls the functions of circulation, respiration and deglutition.

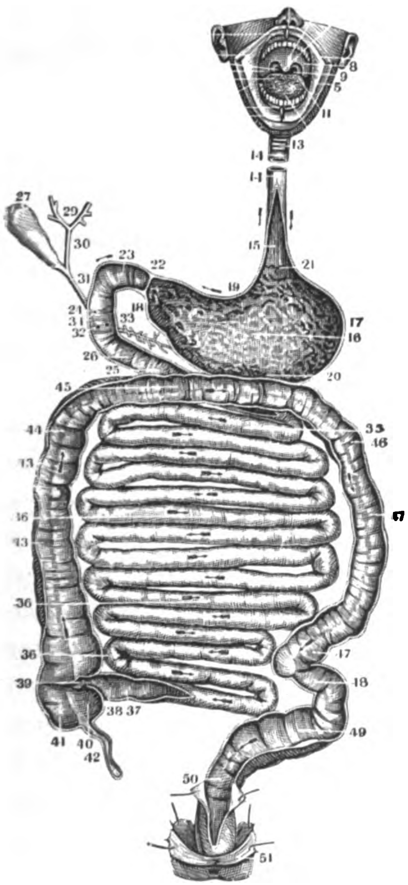
Pons Varolii.—The pons varolii is the commissure which connects the cerebellum to the medulla oblongata. It is composed of a broad band of white fibres, which arch on either side and enter the cerebellum in the form of a thick, rounded cord. The basilar artery, which is formed by the vertebrals and assists in the formation of the circle of willis, runs through the fissure made by this division, into the two cords of fibres, which enter the cerebellum on each side.

Spinal Cord.—The spinal cord is the continuation from the medulla oblongata, and extends from the base of the brain to the second lumbar vertebra, where it ends in a wide expansion, known as the filum terminale. There are many nerves which branch from the spinal cord. These nerves are known as spinal nerves, and are divided into thirty-one separate pairs; of these nerves some are sensory and some are motor. The arachnoid membrane, which is a closed sac, is the membrane which covers and protects, to a certain extent, the spinal cord. It secretes a thin serous fluid, which is known as arachnoid fluid. The spinal cord enters the back bone or vertebra through an opening formed by the posterior part of the body and the processes of the vertebra. These openings in the vertebra do not end at the same place as the spinal cord, but the opening is continuous from the coccyx to the skull. The cavity of the skull and the cavity in the back-bone or vertebra comprise what is known as the *cerebro-spinal cavity.*

The Alimentary Canal.

The inner surface of the mouth is lined with mucous membrane, which is continuous with the mucous membrane lining the pharynx (the throat). The throat, or pharynx, is the expanded portion of the upper part of the œsophagus and is composed of strong muscles and fibrous tissue, which connect the upper part, with muscular attachments, to the basilar portion of the occipital bone and to the inferior surface of the petrous portion of the temporal bones. It is also held in position by muscular attachments to the styloid process of the temporal bone, to the inferior maxillary bone (lower jaw) and to the hyoid bone and the cartilages of the larynx, the upper expanded portion of the trachea or wind-pipe. The throat has seven openings entering it—*the eustachian tubes, the posterior nares or nasal openings, the mouth, the œsophagus,* and the *larynx.* The pharynx extends from the base of the skull to a point opposite the larynx in front, and the fifth cervical vertebra behind. It is this portion of the pharynx that the embalmer uses when he fills up the throat with absorbent cotton to prevent purging.

The Œsophagus.



ALIMENTARY CANAL, HUMAN ADULT.

8, Soft palate; 9, pharynx; 11, tongue; 5, mucous membrane; 13-14, trachea or windpipe; 15-21, oesophagus; 16, stomach; 17, cardiac end; 20, greater curva ure; 19, lesser curvature; 22, pyloric valve; 18, pyloric end of stomach; 33, pancreatic duct; 32, opening of pancreatic duct; 27, gall bladder; 29, hepatic duct; 30, cystic duct; 31, ductus communis choledochus; 24, opening of ductus communis choledochus; 25-26, duodenum; 35, jejunum; 16-36-36, ileum; 37-38, ending of ileum in the caecum; 40-41, caecum; 39, ileo caecal valve. 42, appendix. vermiformix; 13-13-14, ascending colon. 45, transverse colon; 36-47-17, descending colon; 48-49, sigmoid flexure; 50, rectum; 51, sphyncter muscle.

The œsophagus, or gullett, is that part of the alimentary canal which carries the food from the mouth to the stomach. It begins at the lower border of the pharynx and extends to the cardiac orifice of the stomach. It is composed of three coats, which are made up of mucous tissue on the inner surface, the middle coat being composed of areolar tissue; the outside coat is composed of muscular tissue. This tube receives its blood supply from branches of the subclavian and from the aorta. The vessels which branch from the aorta and subclavian arteries enter the coats of the œsophagus and are continued along in the direction of the tube or long axis of the œsophagus. The relations of this structure to the anatomy of the neck should be carefully considered, as the embalmer is required to cut down upon and ligate it, in cases of purging which resist milder treatment, such as plugging the throat with cotton, removing gases with flexible tubes, injecting fluid into the stomach and trachea, etc.

Relations.—In the neck the œsophagus lies in close relation to the trachea or wind-pipe in front. The thyroid gland and the thoracic duct lie in front of it as it descends from the root of the neck to enter the thorax. On either side it is in very close relation to the carotid arteries, especially the left carotid, as the œsophagus inclines more to the left side. The recurrent laryngeal nerves are situated just between the œsophagus and the trachea (wind-pipe). Behind, the œsophagus rests upon the cervical portion of the spinal column.

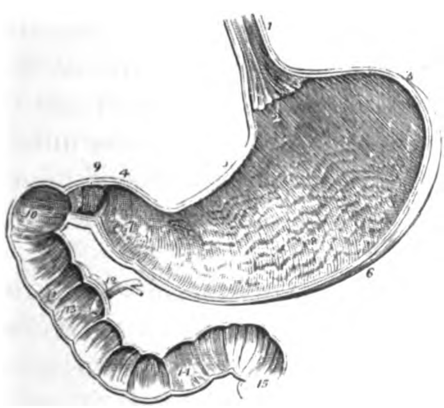
Operation for Ligating the Œsophagus.—In order to tie the œsophagus, in extreme cases of purging from the stomach, the incision should begin about one and one-half inches above the sternum or breast-bone and a little to the left of the trachea. The incision should be continued down to the top of the breast-bone. This incision should divide the structures between the trachea and the anterior border of the sterno mastoid muscle, being careful not to injure the vessels which lie at the immediate left of the gullet. After the first incision the tissues should be carefully dissected away with the handle of the scapel. Pushing the trachea and the vessels aside, you will expose the œsophagus, which may be secured by passing a blunt hook around it and drawing it up into the wound, when it may be tied. It is hardly necessary to state that, with all of the other means now in use to prevent purging, the operation for ligating the œsophagus or trachea is seldom, if ever, resorted to. If it must be ligated, tape will answer the purpose best.

The Abdominal Viscera.

The different organs contained in the abdominal cavity have received careful enumeration on a previous page. One of the most important organs contained in the abdominal cavity is

The Stomach.—This organ is situated in the epigastric region, just beneath the diaphragm. Its cardiac end encroaches slightly to the left hypochondriac region, while the pyloric end is found in the right hypochondriac region. It is about thirteen inches long and five inches in width in the average adult subject, and will hold anywhere from three to seven pints. The stomach is the direct continuation of the œsophagus, and is the largest expanded portion of the alimentary canal. It is composed of three coats, and has two curvatures—a greater and a lesser, and two openings—the œsophagal and the pyloric opening, which permits the food to pass into the duodenum, the upper portion of the small intestines.

The inner coat of the stomach is a mucous coat, and has imbedded in its structure the different glands which secrete the gastric juice; these glands lie wholly in the mucous coat. In the pyloric region of the stomach we find the mucous glands, and in the cardiac end of the stomach, the true peptic glands. The middle coat of the stomach is composed principally of muscular tissue, which is arranged so that the fibres run in different directions, there being three sets of muscular fibres, the longitudinal, the



STOMACH AND DUODENUM.

1, œsophagus or gullet): 2, ending of œsophagus in cardiac end of stomach: 3, cardiac end of stomach; 6, greater curvature: 8, interior of stomach: 7, pyloric end of stomach; 9, pyloric valve: 4, beginning of duodenum: 10, 11, 14 and 15, duodenum; 12, 13, pancreatic duct.

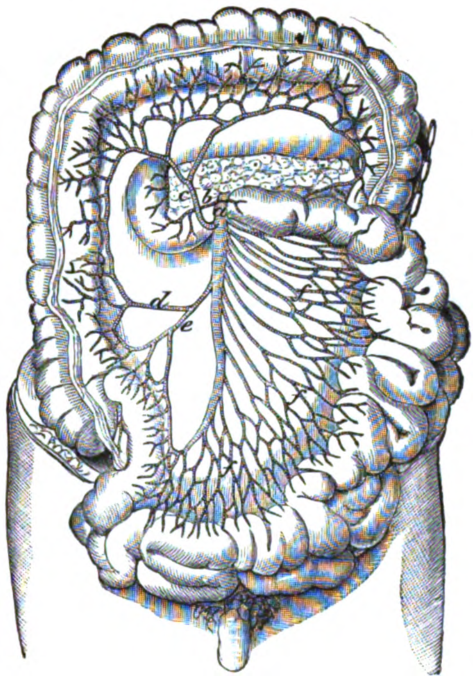
circular and the transverse. The outside coat of the stomach is formed by a reflection of the peritoneum, and is a serous coat.

The Small Intestines.—The small intestines are about twenty feet in length, have four coats, and are divided into three parts. The upper part of the small intestines is known as the *duodenum;* the second part is known as the *jejunum;* the third portion of the small intestines is known as the *ilium.*

The Duodenum is the direct continuation of the stomach, and is the shortest, the most expanded, and the most fixed part of the small intestines. The upper part of the duodenum is supplied with a valve, which is situated just at the pyloric entrance of the stomach. This valve is called the pyloric valve, though its action is not as complete as valves situated in other parts of the body. The duodenum takes a course upwards to the under surface of the right lobe of the liver, and then curves upon itself and gradually approaches the center, where it empties into the jejunum. The duodenum is about eight inches in length. The coats of the duodenum and small intestine are the inner or mucous coat, in which are situated the intestinal glands, lacteals, villi, etc.

The submucous coat, composed principally of areolar tissue, lies between and connects the middle or muscular coat to the mucous. The middle coat is composed of muscular fibres, which are arranged in a longitudinal and transverse direction. The outside coat is formed by a reflection of the peritoneum, and is called the serous coat.

There are several openings into the duodenum. The pancreatic duct, which collects the secretions from the pancreas, enters the upper part of the duodenum, and pours the pancreatic juice into the small intestines at this place. The three ducts which lead from the gall bladder, and which serve to collect the bile, empty the bile into the upper part of the duodenum by a single opening. The *blood supply* to the duodenum is obtained from branches of the hepatic and superior mesenteric arteries.

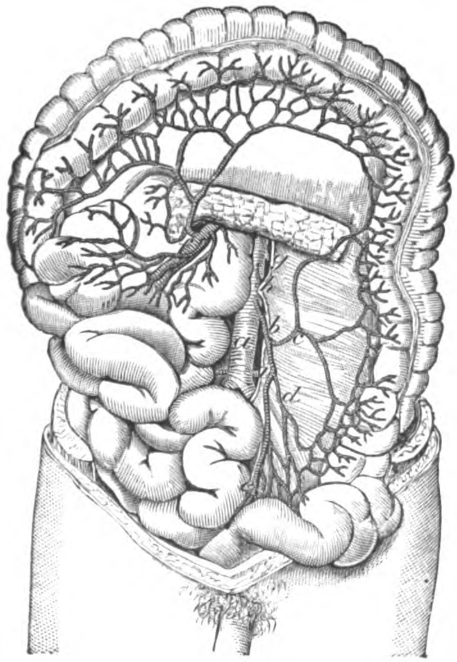


ARTERIAL SUPPLY OF INTESTINES.
a, superior mesenteric artery: b, pancreas: c, colica media branch: d, e, ileo-colic artery and branches; f, f, f, intestinal branches.

The Jejunum.—The jejunum is the second part of the small intestines, and is so named from being found empty after death. Its coats are much thicker than the rest of the small intestines and are supplied more freely with blood vessels. This part of the intestinal canal begins a little to the left of the second lumbar vertebra at the ending of the duodenum. It comprises about two-fifths of the entire length of the small intestine, and is confined more to the central and iliac regions of the abdominal cavity. A trocar puncture in the region of the umbilicus, or umbilical region, would enter some of the folds of the jejunum.

The Ileum.—The ilem is the lower part of the small intestines and, in the continuation of the jejunum, it forms about three fifths of the small intestine. There is no line of demarcation between the beginning or ending of either the jejunum or the ilium. This part of the small intestines is paler than the remaining parts, and is not as freely supplied with blood vessels. Its caliber is much smaller than that of the jejunum or duodenum. It terminates by entering the colon at an obtuse angle in the right iliac fossæ.

The Large Intestines.—The large intestines are about five feet in length, saculated in appearance, and divided into the cæcum, the ascending, tranverse and descending colon, and the rectum. The small intestines, with the exception of a portion of the duodenum, are surrounded above and at the sides by the ascending, transverse and descending colon. The small intestines and the colon are both held in their position by the mesentery and processes of the peritoneum, but the small intestines are not so firmly attached as the ascending, transverse and descending colon. The large intestines begin at the ending of the ileum and at the location of the ileo-cæcal valve, ascend upward from the right iliac fossæ, through the lumbar region, to the under surface of the liver in the right hypochondriac space, where it is curved upon itself and takes a course directly across the cavity, at its superior extremity, and along the anterior wall of the stomach, through the epigastric region, and terminating by a fold in the left hypochondriac space. The descending colon is continued downward from this space to the upper part of the left iliac fossæ, where it forms an "S"-shaped curve, which is known as the sigmoid flexure of the large intestine. The sigmoid flexure is



ARTERIAL SUPPLY OF INTESTINES.

a. Aorta. b. inferior mesenteric artery; c. colica sinistra branch; d. sigmoid branch; e. superior hemorrhoidal; f. superior mesenteric and branches.

continuous with the rectum, the lower part of the large intestines and the end of the intestinal canal.

The Cæcum, the beginning of the large intestines, is the most expanded portion of that tube, but the colon can be differentiated from the small intestines, generally, on account of its larger size. The cæcum is about two and one-half inches, both in its long axis and in its transverse diameter; thus, on account of this wide, but short expansion, it forms a pouch or saculated appearance of the large intestine. Its position is very changeable, being found generally in the right iliac fossæ, at other times it will be found occupying the the left iliac fossæ. The reason for this freedom of movement is very easily explained, when we consider the relations of the peritoneum. At this point the mesentery does not bind down this part of the intestinal canal, like it does the remainder of the colon, which is always, more or less, fixed in its position. The under surface of the cæcum has attached to it a worm-like process, measuring from two to six inches in length and varying in size from two to three lines, or about the thickness of a goose quill. This process is guarded at its beginning, at the cæcum, by an incomplete valve, formed by a process of the mucous coat. This worm-like tube, leading off from the cæcum, is known as the

Appendix Vermiformis.—Its course is usually upward and backward, being curved slightly, the ending being in a rounded form. This tube is pervious for the full length of its course, and sometimes gives rise to a great deal of trouble when it becomes inflamed from injuries or the accidental lodgment of a foreign body within its structure. The disease resulting from inflammation of this tube is known as appendicitis, the mortality in this class of cases is very high.

The Ascending Colon.—The ascending colon is the largest dilated portion of the large intestine, excepting the cæcum. It begins in the right iliac fossæ, and ascends to the under surface of the liver. In its course upwards to the liver, it lies directly over the right kidney and the quadratus lumborum muscle. It is held in position by a process of the peritoneum, or by a narrow meso colon. The small intestines lie to the inner side of the ascending colon, while the peritoneum and abdominal parites lie in front and externally to it. The curve near the under surface of the liver, where the ascending colon merges into the transverse colon, is known as the hepatic flexure.

The Transverse Colon.—This portion of the colon is the longest, and extends from the hepatic flexure to the left hypochondriac region, where it joins the descending colon. In its course across the body, it makes a curve, the convexity of which is sometimes backward and at other times upward, the concavity looking towards the lower part of the abdominal cavity. It is in relation, by its upper and posterior surfaces, with the right lobe of the liver, the gall bladder, the stomach and the lower part of the spleen. The small intestines are found just below it, while the peritoneum and abdominal parites lie in front and anterior to it. Behind, it is in relation to the transverse meso colon.

The Descending Colon.—The descending colon is smaller in caliber than the ascending colon, and is placed more deeply in the abdominal cavity, lying almost directly upon the left kidney and the quadratus lumborum muscle. Its relations, with the exception of its upper curve, is precisely the same as the ascending colon on the right side of the cavity. At this portion (upper) the descending colon is connected by loose areolar tissue to the left crus of the diaphragm, and covers over the anterior surface of the spleen. It is more frequently covered with peritoneum than the ascending colon.

Sigmoid Flexure.—The sigmoid flexure begins at the termination of the descending colon and ends at the rectum.

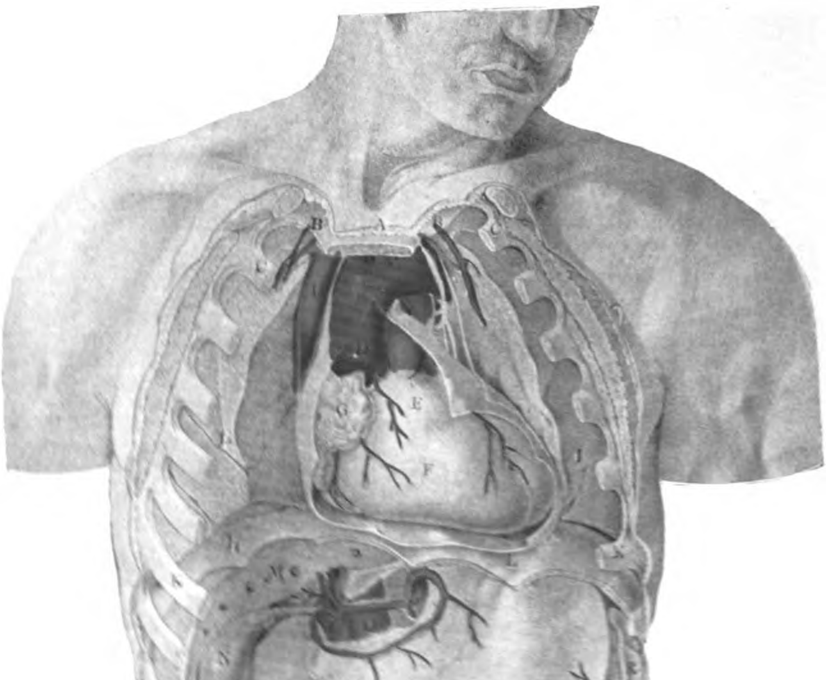


PLATE 5.

A. Upper end of sternum (breast-bone).

B. First ribs.

C. Second pair of ribs.

D. Aorta. Left vagus and phrenic nerves crossing the transverse arch.

E. Origin of pulmonary artery in right ventricle.

F. Right ventricle.

G. Right auricle.

H. Superior vena cava. Right phrenic nerve on its outer border.

I. I. Right and left lungs collapsed and turned outward in order to show relation of heart to thoracic walls.

KK. Seventh pair of ribs.

LL. The diaphragm in section.

M. The liver in section.

N. The gall bladder with its duct joining the hepatic duct to form the common bile duct.

O. The stomach and arteries supplying it.

P. The cœliac axis, giving off the gastric, hepatic and splenic branches.

Q. Inferior vena cava.

R. The spleen.

SSSS. The ascending, transverse and descending colon of the large intestines.

T.T. Convolutions of the small intestines.

In its course from the left iliac fossæ towards the deep part of the pelvis, it forms an "S"-shaped curve. This part of the colon is much smaller than the descending colon, and presents very favorable conditions for opening, for the removal of gases in the large intestine, in those cases where it is impossible to puncture with the trocar. The incision for the removal of gases in this region should begin one and one-half inches inward from the crest of the ileum and a little downward in the left iliac fossæ. By incising the large intestine at this point you will successfully remove all the gases in the large intestines, and, since the opening in the intestinal canal is made at a point below the ileo-cæcal valve, the gas from the small intestines is permitted to escape also.

The Rectum.—The rectum is the ending of the alimentary canal, and is the continuation of the sigmoid flexure. It is narrow at its beginning, at the end of the flexure, but about two inches above the anus it forms a pouch of considerable, but variable, magnitude. It begins just opposite the left sacro iliac symphysis, and makes a gentle curve to the right, then approaches the median line and lies just upon the coccyx.

The Ileo Cæcal Valve.—This valve is situated at the termination of the small intestines (at the cæcum) and the beginning of the large intestine; it is a valve semi-lunar in shape and composed of two flaps of mucous membrane, which are strengthened by strong fibres. It prevents the escape of gas upward in the intestinal canal, and acts similar to the valves in the veins, which prevent the regurgitation of blood. The experiments of Senn, however, prove that hydrogen gas can be forced through this valve, while other investigators claim that fluids can be made to pass through it also. This is a disputed question, however, and should not be accepted as final until other investigations, now being conducted, are completed.

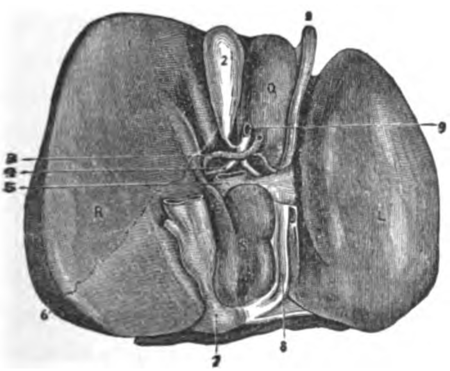
The Blood Supply of the Alimentary Canal.

The vessels supplying the mouth are derived principally from the carotids, the pharynx also receiving its principal blood supply from these arteries. The œsophagus is supplied by three large branches, one derived from the subclavian artery; the other branch is given off by the aorta, while the lower part of the œsophagus is supplied by the gastric branch of the abdominal aorta. The stomach is supplied by the gastric and its branches, the gastro-epiploic and vasa breva from the splenic also supply it with blood.

The duodenum, the first part of the small intestines, is supplied by the pyloric and the pancreatico-duodenal branches of the hepatic and by the inferior pancreatico-duodenal branch from the superior mesenteric. The remainder of the small intestine—the jejunum and the ileum—is supplied by the superior mesenteric artery, the branches of which penetrate the coats of the bowel and anastomose very freely in it. Some of the branches of the superior mesenteric artery pass around the surface of the intestine to join other branches on the opposite side. The large intestine is supplied, also, by the branches of the superior and inferior mesenteric arteries, but in this situation the arteries enter the coats of the bowel and penetrate between the muscular coats, then finally into the submucous, and after reaching the rectum they penetrate the mucous coat. The vessels in the large intestine run in a longitudinal course, following the long axis of the bowel.

The Liver.

The liver, the largest secreting gland in the body, weighs from four to five pounds. It is situated in the right hypochondriac region, just beneath the diaphragm. The left lobe of the liver enters the epigastric space, and partly covers the pyloric end of the stomach. This conglomerate gland is held in position by five ligaments, four of which are derived from the peritoneum; the remaining ligament (the ligamentum teres) is derived from the umbilical vein. These ligaments serve to hold the different lobes of the liver in position, and retain it in the right hypochondriac space. In the child the liver extends across the epigastrium, and the left lobe enters the left hypochondriac space. The five lobes of the liver are: the right and left lobes, the lobulus caudatus, the lobulus quadratus, and the lobulus spigelii. The five fissures, which exist in the liver and separate these different lobes, are: the longitudinal and transverse fissures, the fissure for the gall bladder, the fissure for the inferior vena cava, and the fissure of the ductus venosis.



UNDER SURFACE ADULT HUMAN LIVER.
R, right lobe: L, left lobe: Q, lobulus quadratus: S, lobulus spigelii: C, lobulus caudatus: 9, ducts leading from gall bladder: 2-6, gall bladder: 3, hepatic artery: 4, hepatic duct: 7, inferior venæ cava: 5, venæ porta.

The right and left lobes of the liver are the largest, the right lobe being much larger than the left — the left lobe being six times smaller than the right. The lobulus quadratus is next in size to the left lobe, and is placed between the right and left lobes, just above the lobulus spigelii, which is still smaller than the lobulus quadratus. The lobulus caudatus is the smallest lobe of all and is situated just between the right lobe and the lobulus spigelii.

The covering of the liver is composed of a dense fibrous material, which is closely adherent to the surface of the organ. It finally penetrates the substance of the liver at the transverse fissure, forming a kind of covering for the vessels which ramify through the structure of the liver, constituting what is known as Glisson's capsule.

Microscopical Appearance.— On taking a section of the liver and placing it under the microscope, it will be found to be composed of a large number of rounded or ovoid bodies, known as lobules. Between these different lobules there is a space, through which pass the blood vessels, nerves, hepatic ducts, and lymphatics. A further examination shows these lobules to be made up of cells, rounded in shape, and which are about one one-thousandth of an inch in diameter. These cells are the true hepatic cells of the liver, and secrete the bile.

The Blood Vessels.—The blood vessels entering and emerging from the liver are: the portal vein and the hepatic artery. The hepatic veins collect the blood which is taken to the liver by the portal vein and the hepatic artery, and empty it into the inferior vena cava. The portal vein and hepatic artery, as soon as they enter the structure of the liver, begin to break up into smaller vessels, which ramify between the lobules, at which situation they are known as the interlobular vessels. The hepatic artery gives off branches, which supply the coats of the portal vein and the tissue forming Glisson's capsule. The hepatic artery finally ends by emptying into branches of the portal vein. The interlobular vessels finally give off branches, which enter the structure of the lobules and the cells, where they break up into capillaries. The blood is finally collected by the interlobular and sublobular veins and emptied into the hepatic vein, which carries it from the liver to the inferior vena cava.

Function of the Liver.—The function of the liver may be classed under four different heads. First, it changes the composition of the blood, as it passes through it, by secreting from and adding to it, certain chemicals or products necessary for its nutrition. Second, it secretes the bile, which is collected and stored in the gall bladder. Third, it forms glycogen. Fourth, it assists in the formation of urea.

The ducts, which lead from the liver, begin in the interstices of the lobules in the form of a very fine plexus; these

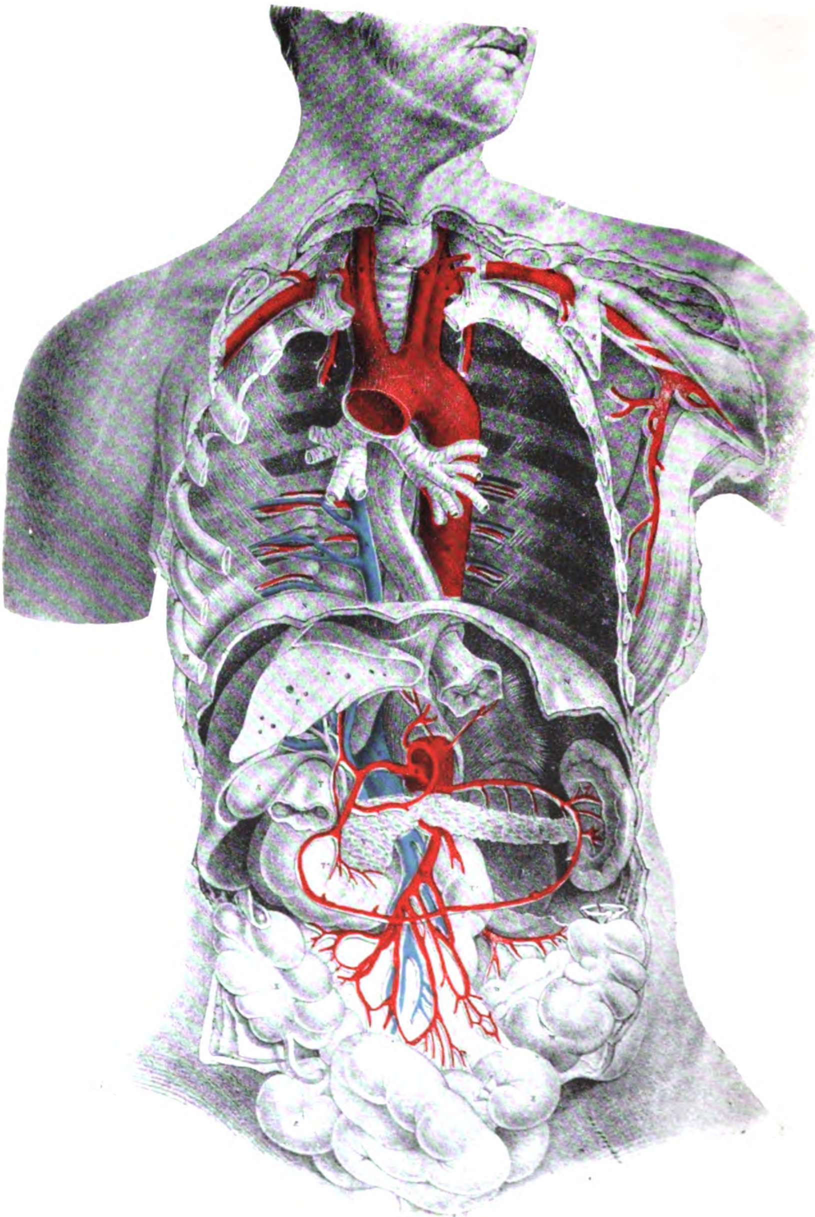


PLATE 6.

A. Thyroid body.

B. The trachea (wind-pipe).

C. First ribs.

D. Clavicle (collar-bone), cut at the center.

E. Pectoralis major muscle, divided near its humeral insertion.

F. Coracoid process of the scapula.

G. Arch of the aorta. G. Descending aorta.

HH. Right and left bronchus.

I. Œsophagus (gullet).

KK. Vena azygos receiving intercostal veins.

L. Thoracic duct.

MM. Seventh ribs.

NN. Diaphragm.

O. Œsophagus cut at cardiac orifice of the stomach.

P. Liver; dots indicate openings of hepatic veins.

Q. Cœliac axis sending off branches to the liver, stomach and spleen. The stomach removed, showing anastomosis of these vessels.

R. Inferior vena cava entering opening in the liver to receive hepatic veins.

S. Gall bladder and ducts.

T. Pyloric end of the stomach; beginning of duodenum.

U. Spleen.

V Pancreas.

W. Sigmoid flexure descending colon.

X. Cæcum, showing attachment of appendix vermiformis.

Y. Mesentery of peritoneum supporting branches of superior mesenteric artery and veins.

Z. Coils of small intestine.

2. Arteria innominati.

3. Subclavian artery; right side.

4. Right common carotid artery.

5. Subclavian artery, left side.

6. Left common carotid artery.

7. Axillary artery; left side.

8. Pectoralis minor muscle, divided near insertion.

9. Subscapular muscle.

10. Coracoid attachment of biceps muscle.

11. Tendon of latissimus dorsi muscle.

12. Superior mesenteric artery and vein.

13. Left kidney.

finally empty into a larger system of ducts, or channels, which are known as the interlobular ducts. These interlobular ducts are about one two-thousandths of an inch in diameter. The interlobular ducts finally unite to form the cystic duct. This duct then empties into the hepatic duct, and the duct formed by their union is known as the ductus communis choledochus, which empties the bile into the duodenum, the upper part of the small intestine.

The Gall Bladder.

The gall bladder is situated on the under surface of the liver, is a pyriform sac, and is the reservoir for the bile. The gall bladder is made up of three coats—a mucous, a muscular and fibrous, and a serous coat, which is only over the anterior surface and the fundus of the organ. This serous coat is derived from the peritoneum. The gall bladder may be divided into three parts—a neck, body and fundus. The neck and body of the organ are directed upward and to the left, while the fundus, or largest part of the gall bladder, is pointing downward and to the right. The capacity of this pear-shaped organ is about one ounce, although in exceptional cases it will hold from nine to fourteen drams. The duct leading from the neck of the gall bladder is known as the cystic duct. This duct, together with the hepatic duct, form the ductus communis choledochus, which empties the bile into the duodenum, the upper part of the small intestine.

The Spleen.

Lying obliquely in the left hypcohondriac region, and in intimate relation with the diaphragm, which separates it from the ninth, tenth and eleventh ribs, is the spleen. This viscus is in direct relation with the cardiac end of the stomach and with the supra-renal capsules lying above the kidneys. It is of a bluish red color, soft in texture, very vascular and of an oblong or flattened shape. The spleen, unlike other glands in the body, has no excretory duct.

In the child the spleen is also in relation with the left lobe of the liver, but in the adult state the left lobe of the liver occupies the epigastric region and does not come in contact with it. The organ is covered with a fibrous coat which, with the serous investment of the peritoneum, renders the surface of the spleen smooth to the touch. Its inner surface is slightly concave, and, besides being in relation with the great end of the stomach and the tail of the pancreas, it presents a fissure, or hilis lienis, for the entrance and exit of the vessels and nerves of the spleen. The upper border of the spleen is larger than the lower, and is rounded, while the inferior border is smaller and somewhat flattened, as it lies in relation with the kidneys and supra-renal capsules. The external surface is convex and, with the external border, lies in relation with the peritoneum, the abdominal parites and the descending colon.

Vessels.—The artery supplying the spleen is the splenic and is derived from the cœlic axis, a branch of the abdominal aorta. This artery is of very large size, considering the weight of the spleen, which varies somewhat in different individuals, its weight being from six to eight ounces. It measures five inches in length, is about one and one-half inches in thickness and three inches in breadth. The branches of the splenic artery are distributed to distinct sections of the organ and anastomose with each other very sparingly. The blood is returned from the spleen by the splenic vein, which begins in the meshes of the spleen and returns the blood from the organ toward the hilis, where it is emptied into the splenic vein. This vein returns the blood into the portal vein, thus, with the mesenterics, serving to form the portal system.

The Pancreas.

Lying along the posterior border of the stomach can be seen a long, flattened organ, glandular in structure and about seven inches in length. This organ is known as the pancreas and secretes the pancreatic juice, which is emptied into the small intestines by the pancreatic duct, which opens into the upper part of the duodenum. The pancreas is classed as a tubulo-racemose gland, and resembles the salivary glands, except in one condition: the connective tissue is not so closely arranged, and the alveoli, instead of being sacular, is more tubular in shape. This organ weighs from three to four ounces and is supplied by the branches of the superior mesenteric and by the pancreatic duodenal branches of the hepatic artery. This gland consists of a body and a greater and lesser extremity. The head of the pancreas is in direct relation with the hepatic flexure of the duodenum, the tail or lesser extremity being in relation with the spleen. It lies just over the first lumbar vertebra and above the aorta, inferior vena cava, and the origin of the superior mesenteric artery; this artery, together with the superior mesenteric vein, lying in a groove between the head of the organ and the duodenum, separates it from that part of the intestines.

The pancreatic duct begins in the lobules of the gland, and finally forms the beginning of the main dnct, about the middle of the organ; the duct is then continued along the course of the pancreas, lying more to the anterior than the posterior part of the organ, until it enters the duodenum, close to the ductus communis choledochus, from the liver. The pancreas is of a slightly reddish-yellow color and is rough on its surface. (See cut of Pancreas, page 65).

Supra-Renal Capsules.

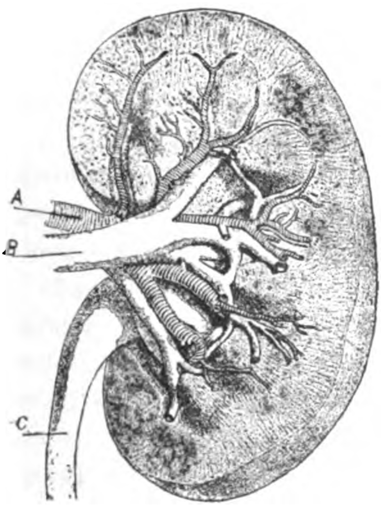
These organs are situated just above, and lie in immediate relation with the kidneys, forming a kind of cap. The right supra-renal capsule is triangular, while the left is semi-lunar in shape. The apex of both of the capsules points inwards toward the vertebral column (back-bone). They are classed as ductless glands, but their structure differs from that of the spleen and thyroid body. These capsules are much larger in the fœtal state, and gradually diminish in adult life. They are supposed to have some function relative to the formation of embryonic tissues. The right supra-renal capsule is closely attached to the under surface of the liver, while the left is in relation with the tail of the pancreas. The upper border of both the capsules touches the under surface of the diaphragm.

Blood Vessels.—The blood vessels which supply these capsules are derived from the abdominal aorta, and are the right and left supra-renal arteries. These arteries branch out quite extensively just before entering the substance of the gland. The blood is returned from the organs by means of the supra-renal veins, which, on the right side, empty the blood direct into the inferior vena cava, but on the left the blood is returned into the renal vein. The color of the organs is slightly yellow.

The Kidneys.

The kidney is a compound tubular gland, situated in the posterior part of the abdominal cavity in the lumbar region, lying one on each side of the vertebral column, just above the ileum. They are very nearly surrounded with fat, which, together with the blood vessels entering them, and the peritoneum—which covers them anteriorly—hold them in position. The upper part of the kidney corresponds to the lower border of the eleventh rib, and extends nearly to the iliac crest. The right kidney, on account of the right lobe of the liver, is much lower than the left, both kidneys being covered in front by the colon, peritoneum and the abdominal parites, while posteriorly they are in relation with the diaphragm and the quadratus lumborum muscle. Each kidney is supplied with a capsule, or fatty cushion (above described), which is in contact with the lower border of the diaphragm. To the naked eye the kidney presents two portions for examination, a medullary and a cortical. The medullary portion of the kidneys contains the pyramids, which are surrounded at the base by the cortical substance; the apex of these pyramids points to the pelvis of the kidney, which is the beginning of the ureter.

Anteriorly the upper surface of the right kidney is in relation to the duodenum and the ascending colon, while the left, anteriorly, is in relation with the descending colon, tail of the pancreas, the lower border of the spleen and the cardiac end of the stomach. The kidneys vary somewhat in the male and female subject; in the adult male they are four inches in length, two and one-half inches in breadth and a little over an inch in thickness, and weigh from four to six ounces, while in the female the kidneys seldom weigh over five and one-half ounces—their weight usually being from three and one-half to five ounces. Each kidney presents for examination several surfaces and borders, there being an anterior surface and a posterior surface, an internal and an external border, a superior and an inferior extremity. The upper extremity of the kidneys is the largest.



SECTION OF HUMAN KIDNEY
A, renal artery; B, renal vein; C, ureter.

The internal border presents a deep concavity, which allows for the entrance of the renal artery and nerves, and also for the beginning of the ureter and the commencement of the renal vein.

Blood Vessels.—The arteries which supply the kidneys are the two renal. The blood is returned from the organ by means of the renal veins. The nerves which supply the kidney are very numerous and form in that organ the renal plexus of nerves.

Function.—The function of the kidneys is to separate certain particles from the blood and secrete the urine. It accomplishes this by means of the uriniferous tubules, which begin in the pyramids of the kidney and gradually convey the urine to the larger ducts, and finally into the pelvis of the kidney and into the upper extremity of the ureter.

Ureter.

This tube, which allows the passage of the urine from the kidneys to the bladder, is from sixteen to eighteen inches long, is composed of three coats and is about the size of a goose quill. It begins in the pelvis of the kidney and extends to the base of the bladder, into which it opens by a constricted orifice. It enters the external coat of the bladder and is continued along between the muscular and mucous coats for nearly an inch before it finally empties, or opens, into the cavity of the viscus. The coats of the ureter are, the fibrous (which is continuous with the fibrous covering of the kidney), a middle or muscular coat and an internal or mucous coat.

Relations.—The left ureter passes obliquely downwards and inwards across the posterior part of the abdominal wall, beneath the sigmoid flexure and over the iliac arteries, enters the posterior false ligament in the male close to vas deferens, and enters the bladder about one-half inch back of the prostate gland and immediately opposite its fellow on the right.

The right ureter takes the same course, only it lies behind the ilium. In the female the ureter on the right side lies alongside of the inferior vena cava. Both ureters run alongside of the neck of the uterus and the upper part of the vaginæ.

The Bladder.

The bladder is the receptacle for the urine. It varies considerably in the male and female subject, and in both at different ages. In the child it is almost an abdominal organ, being located above the pelvic brim, in the hypogastric space, while in the adult subject it is found below the pelvic brim in the cavity of the pelvis, but when distended it may rise a little above the pubic arch.

In the female the bladder is broader and larger than in the male, and its capacity is proportionately increased. It lies between the ossa pubes and the symphysis pubis anterior and the uterus posterior. In man it lies between the pubis anterior and the rectum posterior. The bladder consists of four coats—mucous, submucous, muscular and serous—and has three openings into it, namely: the right and left ureters and the uretha beginning at the neck of the organ.

Ligaments.—The ligaments which hold the bladder in position are, the true and false ligaments, the false ligaments being derived from the peritoneum. The true ligaments are seven in number, namely: the two lateral, two umbilical, two posterior and the urachus.

Blood Vessels.—The arteries supplying the bladder are derived from the superior and the inferior vesical; also the middle vesical. These arteries supply this viscus with blood, the superior sending numerous branches over the fundus and body of the organ, while the middle and inferior supply the base and the neck. The veins return the blood from the bladder to the iliac veins, where it is finally emptied into the inferior vena cava.

The Uterus, Ovaries, and Fallopian Tubes.

Besides the viscera already described as contained in the abdominal cavity, we have, in the female, the uterus or womb, together with its appendages—the fallopian tubes and ovaries. The womb is situated in the cavity of the pelvis, just between the bladder and the rectum, and is held in position by several ligaments, six of which are derived from folds of the peritoneum. These are: the anterior, two cresentric folds which lie between the back of the bladder and the neck of the uterus. The posterior ligament, or recto uterine, is placed between the sides of the uterus and the rectum, dipping down between these two structures, forming what is known as Douglas cul-de-saç. The broad ligaments, or lateral ligaments, are stretched from the sides of the uterus to the lateral edges of the pelvis. Between the folds of the lateral ligaments run the round ligaments and fallopian tubes.

The Round Ligament.—The round ligament, which begins at the sides of the uterus, takes a course a little upwards and through the internal abdominal ring, and is finally distributed to the tissue of the mons venerus.

Fallopian Tubes.—The fallopian tubes, or oviducts, are about four inches in length and spring from the sides of the uterus, with which they communicate by a small opening—"ostium internum"; their course is between the folds of the broad ligament to the sides of the pelvis, where the ligament becomes fimbriated, one of these processes being connected to the ovary. The fallopian tube has three coats—a mucous, a muscular and a serous coat. The ovum, which fecundates the spermatazoa, passes through this tube into the cavity of the womb.

Structure of the Womb.—The uterus is about two and one-half inches long, one and one-half inches wide and one inch thick. Its weight varies, in the non-pregnant state, from eight to ten drams to an ounce and a half, while after gestation, or immediately after delivery, it weighs nearly twenty-four ounces. Of all the viscera in the body which are described as pear-shaped, the uterus is the best likeness, consisting of a body, a neck and a fundus. The upper part, or fundus, of the uterus is its largest part, while the neck, which points into the vaginæ, is the smallest. The body of the organ surrounds with the fundus the largest part of the cavity of the organ.

The Ovaries.—The ovaries are ovoid bodies, two in number, placed one on each side of the uterus, being suspended from the broad ligaments by an attachment to its anterior surface. They are placed below the round ligaments, but are connected to the uterus by the ovarian ligaments. One of the fimbriated portions of the fallopian tubes is connected to the ovaries. These organs are about one and one-half inches in length, one-third of an inch in thickness, and three-quarters of an inch wide. The ovaries are composed of a fibrous stroma and connective tissue.

The Peritoneum.

On account of the high mortality in cases of peritonitis, and the rapid putrefaction which sets in after death, the embalmer should have a clear conception of this serous membrane, which is in contact with most of the viscera in the abdominal cavity. It is a serous membrane which forms a closed sac, except in the female subject, where the sac has an opening for the passage of the round ligament. The peritoneum may be divided into a greater and a lesser sac.

The Greater Sac begins at the anterior surface of the liver, covering that viscus in front, then being reflected onto the stomach and covering that organ above and on its posterior aspect; from thence it is reflected downward to the ileum, forming the anterior layer of the great omentum, the mesentery and the posterior surface of the meso colon. It sends off different layers between the rectum and the uterus, in the female; also between the uterus and the bladder. It is then reflected towards the antero-lateral abdominal wall to the diaphragm, its starting point.

The Lesser Sac begins at the diaphragm, posterior to the greater sac, and covers the posterior surface of the liver. The back part of the stomach also sends a reflection to the under surface of the organ, thus forming the great omentum. It is then reflected over the transverse colon, completing the mesa colon with the coverings of the ascending and descending colons. It then takes a course upward along the posterior abdominal wall, sending reflections to the duodenum and pancreas, and finally becoming attached to the diaphragm, the point from whence it started. The two sacs communicate by an opening where they curve around the hepatic vessels; this opening, or foramina, is known as the Foramen Winslow.

The omenta formed by the peritoneum are three in number, namely: the gastro-hepatic or lesser omentum, the gastro-splenic omentum, and the great omentum or gastro-colic omentum. A mesentery is a double layer of the peritoneum, such as is seen investing certain portions of the large and small intestines, except the duodenum. The blood vessels which supply the intestines pass between the folds of the mesentery. The peritoneum gives off many ligaments, for description of which see Liver, Uterus, Bladder, etc.

With this description of the peritoneum we have described the organs of the abdominal cavity. We will now proceed to investigate the contents of the thoracic cavity, which is situated just above the abdominal, the diaphragm forming the muscular wall or partition between the two cavities.

The Diaphragm.

The diaphragm is the musculo-fibrous membrane which separates the thoracic cavity from that of the abdominal. Its center is tendonous, being surrounded by a muscular expansion which is attached to the under surface of the ensiform cartilage, or end of breast bone, and to the cartilages of the six inferior ribs on each side. It is attached posteriorly to the twelfth dorsal vertebra, and by a fibrous expansion to the adjacent surfaces of the first, second and third lumbar vertebra. It is a very tough fibrous structure, considerable force being required to pass a trocar or embalming needle through it. An examination reveals three openings of large size, while there are several smaller ones; these openings are, beginning posteriorly at the back: the aortic, through which passes the aorta, the largest artery in the body. A little to the left and anterior to the aortic, we have the œsophageal, which allows the œsophagus or gullet to enter the abdominal cavity in conjunction with the right and left pneumogastric nerves.

The aortic opening not only transmits the aorta, but allows the left lymphatic or thoracic duct to ascend through it to the root of the neck, where it empties into the subclavian vein at the junction of the internal jugular. The azygos vein also passes through the aortic opening. The remaining large opening in the diaphragm is the opening for the inferior vena cava, which is situated more to the right and in front of the vertebral column. There are several small openings in the crus for the passage of the splanchnic nerves and the sympathetic nerve trunks; also for the azygos minor vein. These openings, while they allow the passage of the vessels and nerves enumerated above, are not directly continuous with both the cavities. The fibres of the diaphragm are so intimately connected around these structures as to prevent the passage of serous material and fluids from one cavity to the other. This is a very important thing, since it prevents the contaminated fluids in hydrothorax (dropsy of the thorax), or in pleuritic effusions or the escape of serous material from the pericardium, from entering the abdominal cavity and setting up fatal perotonitis in the living state. Thus, while it performs such an important function during life, it serves the same purpose after death, there being many disadvantages in rupturing the diaphragm in cavity embalming. In all the works on embalming that I have consulted, I have found that all of them advise rupturing the diaphragm from below in order to embalm the cavities of the thorax. I have never been in favor of this procedure, as a great deal of the fluid intended for the upper cavities escapes back into the abdominal, thus preventing the desired result in surrounding the lungs, heart, etc., with the preservative solution. It might be of little importance if the operator only intends to make

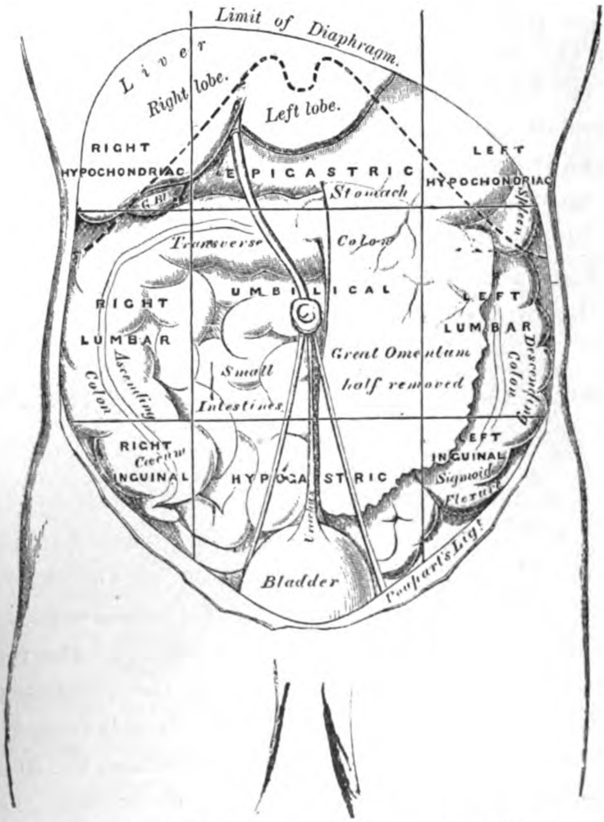
The diaphragm as seen from the under surface (abdominal portion).

a single cavity injection, but in all those cases where we desire complete embalmment we should not rupture the diaphragm. I have previously stated that the pleura were closed sacs surrounding the lungs, and that the pericardium was a membraneous sac intimately attached to the great vessels leading from the heart.

Now, since it is the desire of the embalmer to preserve he will see that if he penetrates the diaphragm , which will necessitate making an opening through the bottom of the pleura and pericardium, the fluid injected into these parts will escape from the openings made by the trocar, just the same as water would escape from a bottle if a hole was made in the bottom. Then again, we must consider the fact that after the embalmer has completed his work the body is placed on an incline of nearly 45 degrees, thus favoring the escape of the fluid injected upward into the thoracic cavity. If arterial embalming is performed, and you are assured of a thorough circulation through the arteries and veins, then it does not make much material difference, since the fluid will enter the pulmonary artery and the bronchial, and will thoroughly embalm the lungs and pleura, as it will the heart and its covering, the pericardium, by the blood vessels which supply them.

Boundaries, Divisions and Contents of the Abdominal Cavity.

The abdominal cavity is bounded above by the diaphragm, the dividing membrane between the abdominal and thoracic cavities. It is bounded below by the floor of the pelvis. It is bounded in front by the aponeuroses of the transversalis muscle and the under surface of the rectus abdominalis, which muscles are, next to the peritoneum, the nearest covering to the cavity in front. It is bounded behind, or posteriorly, by the vertebra (back bone) and the deep layer of muscles known as the fifth layer. If we connect the pelvic cavity to that of the abdominal, the floor of the cavity would be formed by the tissue planes of the perineum, while the lower part and sides would be protected by the innominate bones of the pelvis and the sacro-sciatica ligaments. It is best for us, as embalmers, to consider the abdominal cavity as only one cavity; thus the pelvic and abdominal are divided into the following divisions, which are formed by drawing a line from the lower border of the ninth rib around the body in a circular manner, drawing another parallel to this, beginning at the highest border of the pelvic bones (ossa innominata). These lines will divide the cavity into three parts—a superior, a middle and an inferior. Now draw a line from



the center of Poupart's ligament, on each side, to the cartilages of the eighth rib. You will now have the cavity divided into nine different regions, as follows:

Right Hypochondriac Region, containing the right lobe of the liver, the gall bladder, the pancreas and the upper part of the small intestine known as the duodenum, a portion of the large intestine (the hepatic flexure of the ascending colon), the right supra-renal capsule and the upper border of the right kidney.

The Epigastric Region, or the middle space of the superior division, contains a part of the pancreas, a portion of the liver, and the middle and pyloric ends of the stomach; also a portion of the transverse colon of the large intestines.

The Left Hypochondriac Region contains the lower part of the cardiac end of the stomach, the left supra-renal capsule and the upper border of the left kidney, the spleen and the splenic flexure of the colon.

The Left Lumbar Region contains the lower part of the left kidney, a portion of the small intestine, the descending colon, and part of the omentum.

The Umbilical Region contains a part of the duodenum, part of the transverse colon, the great omentum and mesentery, and some convolutions of the ileum and jejunum.

The Right Lumbar Region contains the lower part of the right kidney, some convolutions of the small intestines, and the ascending colon.

The Right Iliac Inguinal Region contains the cæcum, the appendix vermiformis, and a part of the ureter, the iliac arteries and veins rising in this space and proceeding towards the thigh, where the external iliac artery forms the femoral.

The Hypogastric Region contains the rectum, a part of the small intestines, the bladder in children. In the adult subject the bladder is situated more deeply in the cavity of the pelvis and does not occupy this region unless distended. The uterus, in the female during gestation, will also be found in this space.

The Left Iliac Inguinal Region contains a part of the ureter and the sigmoid flexure of the colon or large intestine, and the vessels described in the right iliac space.

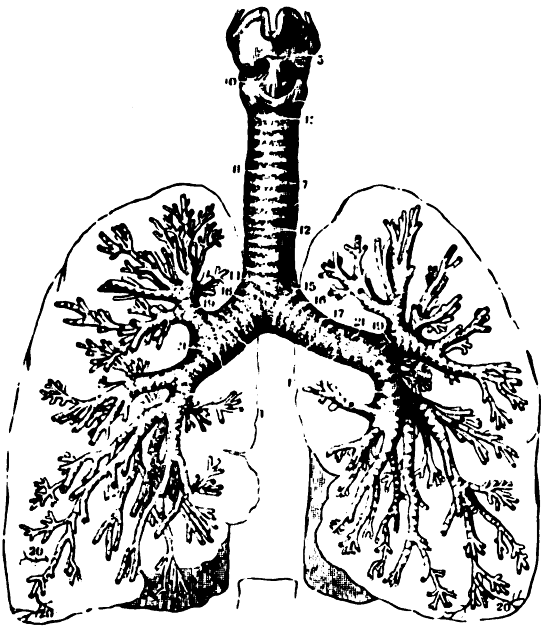
The Thoracic Cavity.

This cavity occupies all that space between the diaphram below, and the root of the neck above. It contains *the lungs, with their coverings, the pleura, the heart and its covering, the pericardium.* Besides these important organs, there is also contained in the mediastinal spaces (spaces between the lungs and extending from the sternum in front to the back-bone posteriorly): the phrenic nerves and accompanying vessels, the arch of the vena azygos major and some lymphatic glands; the arch of the aorta and thoracic aorta; the œsophagus or gullet and the pneumogastric nerves, and the azygos veins; the thoracic duct and the mediastinal glands will be found in these mediastinal spaces. To the beginner it would appear that, since the thoracic cavity contains all of these different structures, there would be very little room left in the cavity for the injection of the embalming fluid, but, since the heart and lungs are the largest organs in the thorax, the fact that the lungs collapse somewhat after death, will allow plenty of space between the pleura for the injection.

The Lungs.

The lungs are placed one on each side of the thoracic cavity, the heart and the mediastinial spaces dividing them into a right and left. Their color varies during life; in the child they are of a pinkish color, but as age advances they gradually assume a slate color, which, as senility approaches, turns to a dark or black color. In all these different stages [illegible]quent mottling of the surface of the lungs takes place. [illegible]mottling is caused by deposits of carbonaceous material, [illegible]lt of the action of the air and carbonic acid in the [illegible]ach lung extends from the first rib above to the dia-[illegible]elow, and is so situated as to present for examina-[illegible]rfaces, two borders, an apex and a base.

The Apex of the lungs extends, during a deep inspiration, above the first rib, into the root of the neck. It is con-



LUNGS AND BRONCHI.
5, thyroid cartilage; 10, larynx; 7, 11, 12, 13, main bronchus; 16, 19, 21, right bronchus; 15, 16, 17, 21, 19, left bronchus.

ical in shape, as are the lungs, taken as a whole. The base is concave, on account of the convexity of the diaphragm above.

The Exernal Surface of the lungs is convex and is smooth, conforming to the side of the chest, being much deeper behind than in front.

The Inner Surface.—On account of the heart and great vessels, also the bronchi, the inner surface of the lungs is concave, presenting a deep fissure corresponding to the root of the lungs; this fissure is known as the "hilum pulmonis."

The Anterior Border is much thinner than the posterior, and extends across the front of the chest, slightly overlapping the pericardium and great vessels.

The Posterior Border of the lungs, on account of the shape of the diaphragm, which is higher in front than behind, extends much deeper and fills all the space between the vertebra (dorsal) or back-bone and the ribs on either side.

Each lung is divided by a fissure into two lobes, but the right lung is again divided by a smaller fissure into a triangular lobe. Thus, properly speaking, the right lung has three lobes, and the left has but two. On account of the liver pressing upward on the diaphragm, the right lung is about an inch shorter than the left, but while the left is longer, it is smaller in capacity; this is on account of the heart being placed more to the left side. The lungs are capable of holding about 230 cubic inches of air during a forced inspiration. Their weight varies somewhat in the male and female, the male lungs weighing, together, about forty-two ounces, the left being two ounces less than the right, while in the female subject their weight is approximately estimated at thirty-nine ounces.

Structure.—Each lung is composed of soft, spongy tissue, which is covered externally by a layer of areolar tissue, the parenchyma of the lungs being made up principally of the lobules and air cells. Coursing over these air cells are the capillary branches of the pulmonary artery, while to the lung tissue direct we have the capillary branches of the bronchial. As the blood in the pulmonary arteries exchanges its carbonic acid for oxygen, it returns the blood from the lungs, through the four pulmonary veins, to the left auricle of the heart. The capillaries from the bronchial arteries empty their blood into the azygos veins, and finally into the superior vena cava.

The Pleura.

Closely investing each lung, as far as its root, is a serous membrane known as the pleura. It is made up of two principal layers, one of which is reflected over the inner surface of

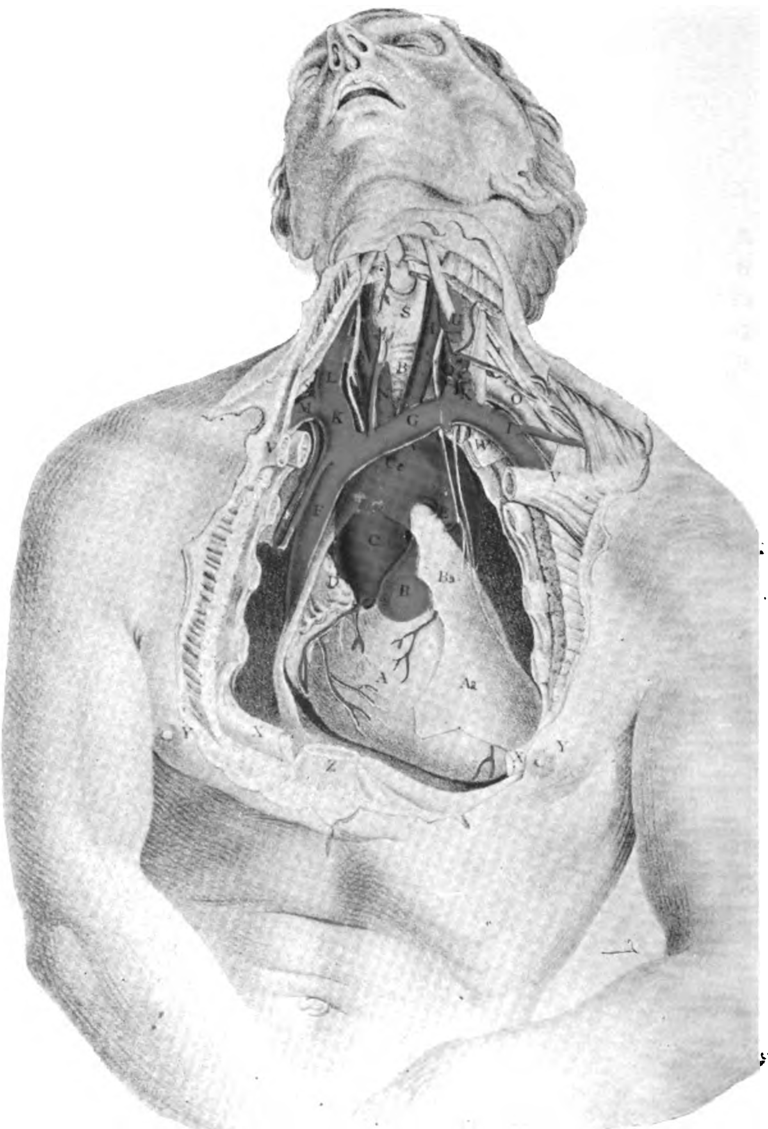


PLATE 7.

A. Right ventricle of the heart. Aa. Pericardium.
B. Pulmonary artery. Bb. Pericardium.
C. Ascending aorta. Cc. Transverse aorta.
D. Right auricle.
E. Remains of ductus arteriosis.
F. Superior vena cava.
G. Left innominate vein.
H. Left common carotid artery.
I. Left subclavian vein.
K. Right innominate vein.
L. Right internal jugular vein.
M. Right subclavian vein.
N. Innominate artery.
O. Left subclavian artery crossed by left vagus nerve.
P. Right subclavian artery crossed by right vagus nerve.
Q. Right common carotid artery.
R. Trachea (wind-pipe).
S. Thyroid body.
T. Brachial plexus of nerves.
U. Upper divided portion of left internal jugular vein.
V V. Clavicles cut across and displaced downward.
WW. The first ribs.
X X. Fifth ribs cut across.
Y Y. Right and left mammæ.
Z. Lower end of sternum (breast-bone).

the chest wall known as the parietal layer of the pleura, or the pleura costalis. The other layer is reflected over the external surfaces of the lungs, forming a complete investment, the two layers forming a closed sac, which does not communicate with its fellow of the opposite side at any point—the only place where the two surfaces of the lungs come in contact with each other being in front and just beneath the middle piece of the sternum. During life the costal layer and the pulmonic layer are so closely attached that there is but very little space between them, but after death, when the lungs become somewhat collapsed, considerable space may exist between these two layers. The space between the layers of the pleura is known as the cavity of the pleura.

During life the pleura secretes a thin serous fluid, which prevents any friction between the lungs and the inner surface of the chest walls, but when it becomes inflamed or diseased the serous fluid becomes thickened and is increased in quantity. This fluid sometimes increases so much in advanced stages of pleuritis and dropsy of the pleura as to push the heart to the extreme left of the thorax, or to the extreme right, if the disease affected the left pleura.

Blood Supply.—The blood supply of the pleura is obtained from the intercostal, the internal mamary, pericardic, musculo-phrenic and thymic arteries. The blood is returned from the pleura by veins bearing the same names as the arteries.

The Heart.

The heart is the central organ of circulation. It is placed between the lungs, is conical in shape, and occupies the space known as the middle mediastinal cavity. Laennec has compared the size of the heart to the fist of the subject, but this comparison is too indefinite to afford any satisfactory estimate, and we will be obliged to seek other and more exact observations in this respect. The most accurate writer in recent times upon the subject of the dimensions of the heart, Mr. Peacock, says its circumference is about 9.209 inches in the male subject, while in the female it is slightly less. Its

FIG. 1.

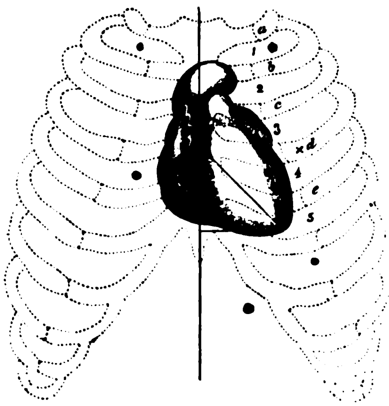


Plate No. 1 illustrates the true relation of the adult male heart to the bony walls of the thorax; a, first rib; b, second rib; c, third rib; d, fourth rib.

Figures number 1, 2, 3, 4 and 5 mark the intercostal spaces.

The vertical line denotes the median line. The right angle triangle extending over a portion of the surface of the heart denotes the superficial region of the heart. The viscus at this point lies closest to the thoracic wall in front.

The X on the fourth rib shows the situation of the nipple.

The relations of the ventricles, auricles apex base, aorta, etc., are sufficiently delineated.

The black dots indicate points selected for the many operations in cavity embalming, removing blood from the heart, etc.

FIG. 2.

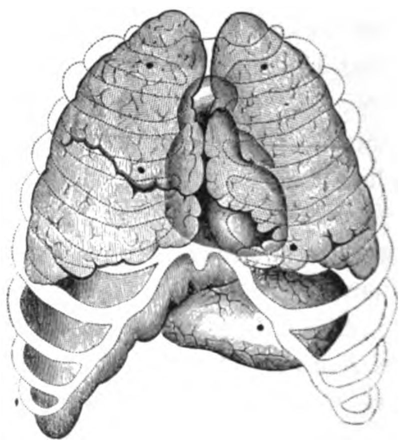


Plate No. 2 illustrates the relation of the Heart to the Lungs, Liver, Stomach, etc., and shows the part of the Heart uncovered by the pulmonary structures. The position of all the organs is presented in their true relations to each other.

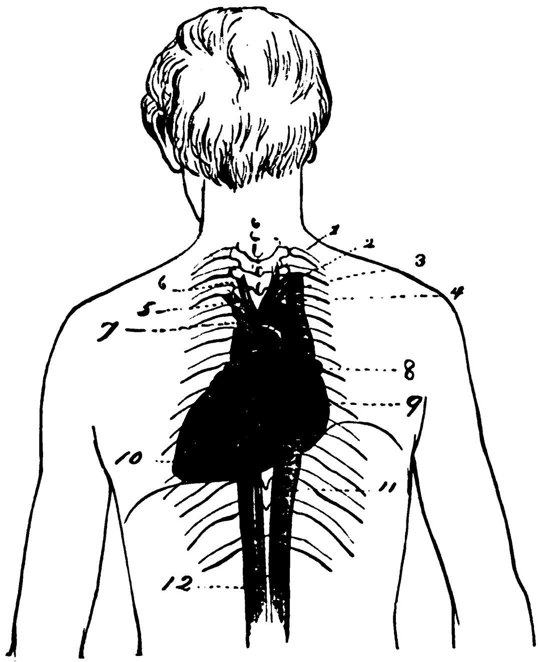
position varies after death, according to the disease the person died with, and the general condition of the abdominal and chest cavities.

Position.—Anterior View.—The heart of the human subject is a pear-shaped muscular organ situated in the thoracic cavity between the lungs, in what is technically known as the middle mediastinal space, with its base about in the median line and its apex in the fifth inter-costal space midway between the median line and a perpendicular line dropped through the left nipple, the apex resting upon the diaphragm. **The base** of the heart is held in position by the great vessels and their attachments in the posterior wall of the thorax, while **the apex** is free and capable of a certain degree of motion. The whole organ is enveloped in a fibrous sac called *the pericardium.* This sac is lined by a serous membrane which is attached to the great vessels at the base of the heart. The pericardial sac will hold about two drachms of fluid. This permits of the heart movements without any friction. It may be said that the base of the heart will correspond to a line drawn around the upper border of the third rib.

Posterior View.—The description of the heart, together with the illustrations which appear above, will suffice to give the reader an intelligent idea of the position of the heart from the anterior aspect. Cuts numbers one and two give the relation of the heart to the thoracic walls and the abdominal and thoracic viscera. This is viewed from the front of the body, and as the heart presents several points of interest from the posterior view, I have illustrated this position with the cut showing the heart in the dead subject as viewed from the back. The position of the vessels, auricles and ventricles varies to such an extent that in the examination of eleven bodies no two presented exactly the same position. In one instance the top of the arch was in front of the upper portion of the body of the third dorsal vertebra, in seven cases it was in front of its lower portion, and in three it was in front of the fourth dorsal vertebra. The lower boundry of the left ventricle varied in position from the level of the lower edge of the body of the eighth, to that of the upper third of the tenth dorsal vertebra. In five cases the upper boundary of the left auricle was on a level with the fifth dorsal vertebra.

The upper border of the left auricle was situated in front of the upper part of the seventh dorsal vertebra, or just above it, and its lower border in front of the body of the eighth dorsal vertebra.

During life, when the back of the heart and great vessels are brought into view, the lower boundary of the left ventricle

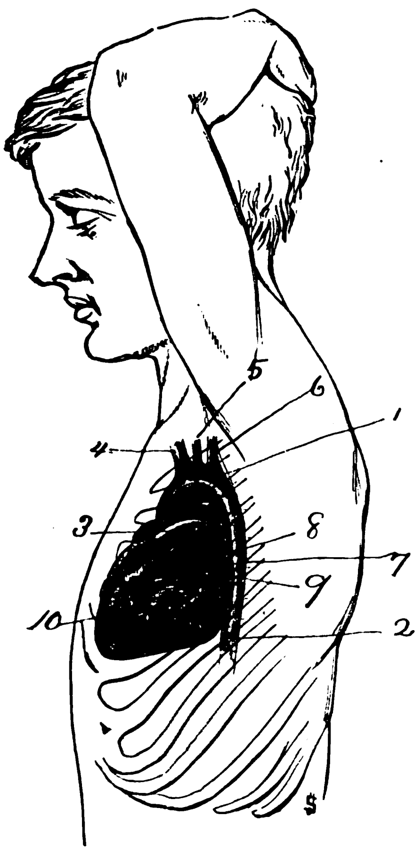


EXPLANATION OF THE CUT.

1. Right Common Carotid Artery.
2. Right Subcalvian Artery.
3. Innominate Artery.
4. Formation of Superior Vena Cava by Innominate Veins.
5. Left Subclavian Artery.
6. Left Common Carotid.
7. Arch of the Aorta.
8. Left Auricle.
9. Right Auricle.
10. Left Ventricle.
11. Inferior Vena Cava.
12. Abdominal Aorta.

resting upon the floor of the pericardium will conceal the under surface of the heart. When the floor of the pericardium is removed, the under surface of the heart is visible from behind. The under surface inclines from behind downwards and upwards, and it presents posteriorly the lower border of the left ventricle from base to apex; anteriorly, the lower surface of the right ventricle; and intermediately, the posterior longitudinal furrow of the heart.

Side View.—It is plainly evident that in the recumbent position the heart must change its position, which it does, more so after death than in life. The pericardial sac and the central tendon of the diaphragm give a great deal of support to the heart, and if it were not for these attachments to the sternum and the diaphragm by means of these ligaments, the heart would fall upon the œsophagus and the great vessels thus interfering with the passage of food down the œsophagus and the circulation of blood through the aorta when a person would be in the recumbent position.



SIDE VIEW OF HEART

After death, on account of the relaxed condition of the lungs and the gradual weakening of the ligaments, the heart will fall backward upon the bodies of the dorsal vertebra, thus causing considerable change in the position of the organ. If we look at the heart from the side, several points of interest will present themselves. The relations of the vessels to the heart and ribs and the relation of the organ itself to the bony walls of the thorax may be easily ascertained by an examination of the accompanying cut which shows the heart as we would view it from the left side of the body. This engraving being fourth on the position of the heart in the normal condition, the remainder of the article and the cuts to follow will show the changes in the position of the heart caused by death and disease. The normal and pathological changes in the ar-arteries will then be taken up and all of those cases where the embalmer experiences some difficulty in the injecting of the arteries will be explained and illustrated.

It is seldom required of the embalmer that he puncture the heart from the side, but in order that he may be familiar with the exact position of the organ when inserting a trocar for the purpose of tapping the heart for the removal of blood, it is well that he know the position of the auricles and ventricles from the side. It will be seen from the engraving that the left auricle and ventricle occupy fully as great a proportionate amount of space at the left side of the heart, as the right auricle and ventricle do at the front and right sides of the heart. This should always be borne in mind during the operation of injecting the left ventricle. It can be reached with the same length of trocar, but the position being to the left and backward, resting in the dead subject on the bodies of the dorsal vertebra and the great aorta, the trocar should be directed downward and inward toward the center of the thoracic cavity.

The left ventricle of the heart occupies by much the largest share of the left side of the organ, and its double convex cone-shaped outline is completely exposed to view from its base to its apex when the left side of the heart is examined laterally. The transverse furrow which divides the left auricle from the left ventricle, follows a direction from above downward and somewhat backward, the left auricle, as will be seen in the engarving, rests on the descending aorta and the œsophagus, thus the auricle, transverse groove and the mitral valve rest in front of the body of the eighth dorsal vertebra posteriorly, while in front the left auricle is placed between the third and fourth intercostal spaces.

The upper border of the left ventricle is nearly as high as the right auricle. The position of the ventricle, which is downward and to the left, corresponds to the direction of the ribs; thus the left ventricle and the transverse furrow are covered throughout by the fourth, fifth and sixth ribs.

The position of the heart on the right side is much easier to understand than the position of the auricle and ventricle on the left. If one will examine the right side of the chest in the same position as the examination shown of the left side, the right auricle and ventricle will be different in position than the corresponding parts on the left side.

When we examine the heart from the right side, the right auricle, the right ventricle, the vena cavas and the pulmonary artery are plainly visible; while on the left the left auricle, left ventricle and the pulmonary veins are seen. The relative position of the lower boundary of the heart, the upper and the position of the base is somewhat different from that of the left. The upper boundary of the right ventricle is on a level with the seventh dorsal vertebra, while its lower boundary encroaches on the body of the tenth dorsal vertebra; the right ventricle occupies the anterior portion of the mediastinal space, which is situated between the sternum in front and the back bone posteriorly. The right auricle, including its appendix, occupies the posterior part of the space, thus when the operator desires to enter the right auricle of the heart from the right side the trocar should be inserted between the third and fourth intercostal spaces about one and a half inches from the sternum. The trocar should be directed downward and inward to the posterior part of this space, when it will enter the right auricle of the heart. But as this operation in the hands of an unskillful person endangers the arterial circulation through rupture of the aorta at its arch or the vena cavas, I do not recommend it as a safe procedure in the practice of modern embalming, where it is desirous to secure a complete circulation through the vascular system.

Cavities.—The heart contains four cavities: the right and left auricles and the right and left ventricles.

The Right Auricle.—The right auricle receives the blood from all parts of the system, from the superior and inferior venæ cavæ, and empties it into the right ventricle. The auricle presents a principal cavity, or sinus, with a little appendix attached which is called, from its resemblance to a dog's ear, the auricular appendix. In the right auricle of the heart there are two openings for the ascending and descending venæ cavæ, and a small opening for the coronary vein, which returns the blood from the substance of the heart itself, and another large opening placed between the auricle and ventricle, known as the auriculo-ventricular opening, through which the blood passes from the auricle to the ventricle. The walls of the right auricle are very thin as compared with the walls of the ventricle. They will measure about one-twelfth of an inch. They are composed of muscular fibres which are composed of two layers. These muscular fibres are involuntary in their action, and as the auricles are merely the reservoir to receive the blood from the system, the muscular fibres are very much less than that found in the ventricles. There are no valves at the opening of the inferior venæ cavæ, or the superior venæ cavæ, into the right auricle of the heart. The eustachian valve, which is quite prominent in the fœtal state, almost entirely disappears in adult life. There is a valvular fold in the coronary vein.

The Left Auricle.—The left auricle does not differ very materially in its anatomy from that of the right. It receives the blood which is returned from the lungs by the four pulmonary veins. It is a little smaller than the right and its walls are thicker. It has *five* openings, four of which are for the pulmonary veins, and the other the auriculo ventricular opening, for the passage of the blood from the auricle into the left ventricle. The pulmonary veins have no valves. In adult life the right auricle and the right ventricle are entirely separated from each other by a thin muscular septum. Before birth they communicate by means of a large opening, the foramen ovale. (See fœtal circulation).

The Right Ventricle.—The right ventricle receives the blood from the right auricle. The walls are much thicker than the walls of the auricle, and,according to some authorities, its capacity is greater. The right ventricle forces the impure blood to the lungs and back to the left side of the heart.

Left Ventricle—The left ventricle receives the pure blood from the left auricle. It is the thickest and most muscular part of the heart, being from two to three times as thick as the walls of the right ventricle, and several times thicker than the walls of the auricles. The average thickness of the walls of the right ventricle is about one-fourth of an inch, and the average thickness of the walls of the left ventricle is a little over one-half of an inch. Both ventricles are triangular or conoidal in shape, the right being broader and shorter than the left. The inner surface of both ventricles is marked by peculiar ridges and muscular fibres which are called the columnæ carnea and the chordæ tendinæ. These latter are attached to the free edges of the auriculo-ventricular valves.

Capacity of the Cavities.—It is stated by many authorities that the capacity of each cavity of the heart is about two ounces, but in an experiment performed by injecting the heart with warm solutions of wax the estimate was made by calculating the amount of liquid displaced by the moulds of the different cavities. In this experiment care was taken to make the injections before cadaveric rigidity had set in or after it had passed away. The comparative results obtained by the experiment are as follows: First, it was decided that more wax was forced into the cavities of the heart than it could possibly contain during life. The capacity of the right auricle was from one-tenth to one-third greater than that of the left. The capacity of the right ventricle was from one-tenth to one-third greater than that of the left ventricle. The capacity of the ventricles was greater than that of the auricles. The absolute amount of each ventricle under distension with heated wax solutions is four and one-half ounces. This, of course, is much greater than the average capacity of these cavities during life, which is about two ounces.

Weight.—The average weight of the human heart is estimated at nine ounces and seven drachms. In some deaths from acute diseases this weight may be increased, but in death from chronic diseases it will usually weigh less. In cases of hypertrophy, or in chronic enlargement of the heart, it may weigh several pounds. In the female subject the heart weighs a little less than in the male, the mean weight being about eight and one-half ounces.

Blood Supply.—The arteries which supply the heart with blood for its nutrition are derived from the aorta. They are the first branches given off from this vessel and are known as the right and left coronary arteries. These arteries carry the blood to the structure of the heart. It is returned from the heart by means of the coronary veins, which empty it into the right auricle.

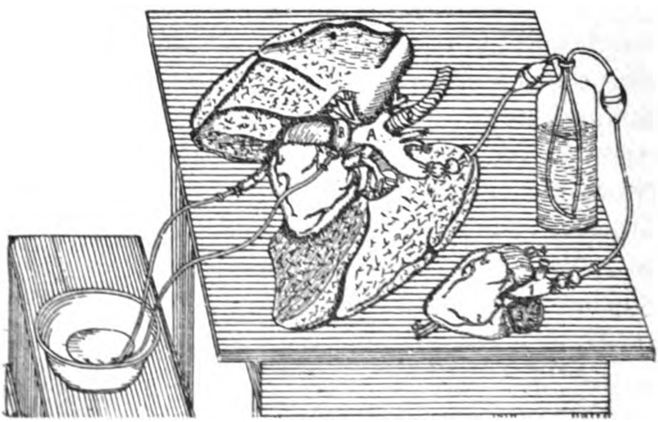
Valves.—The valves of the heart are the *auriculo ventricular*, between the auricles and ventricles, the *pulmonary* and the *aortic*. The pulmonary is situated at the orifice of the pulmonary artery in the right ventricle, and the aortic valve is placed at the orgin of the aorta in the left ventricle. There are no valves in any of the vessels entering either the right or left auricles of the heart.

Auriculo Ventricular Valves.—The auriculo ventricular valves prevent the regurgitation of blood from the ventricles to the auricles. As the ventricle fills up with blood coming from the right and left auricles, the valves are approximated, and when the ventricle is completely distended with blood the valve is entirely closed. When a contraction occurs the blood is thrown into either the pulmonary arteries or the aorta.

Aortic and Pulmonic Valves.—The action of the semilunar valves is nearly the same in both the aorta and the pulmonary arteries. In the intervals of the ventricular contractions they are closed and prevent the regurgitation of blood into the ventricles. The systole, however, overcomes the resistance of the aortic and pulmonary valves and forces the contents of the ventricles into the arteries. The cups of the valves point in the direction the blood is to flow. Thus as the blood flows from the left ventricle into the aorta there can be no expansion of the valve and the valves are nearly approximated to the wall of the vessel, but just as soon as the contraction ceases and the heart begins to expand, the blood falling back against these cups dilates the valve and it instantly closes.

Action of the Valves of the Heart When Fluid is Introduced into the Arterial System.—Although it is the general impression among embalmers that the fluid injected into the brachial artery goes to the heart first, thus preserving that organ, it is a mistake, as these valves act after death just the same as they do in life, and exactly similar to the action of the valves in the veins of the extremities. It is impossible to force fluid through the valves of the heart, just the same as it is impossible to extract blood from a vein when there is a valve intervening between the opening and the heart, for just as soon as the aspirator is put into action the valve closes against the passage of the blood and it will not flow.

In the experiments that I have performed in the demonstrating rooms of the college these facts were very clearly illustrated. A subject was placed upon the table and the thoracic cavity was laid open; the pericardium was divided, so as to exhibit the action of the heart while the fluid was injected into the brachial artery. The first effects of the syringe was to force the fluid into the aorta, which soon became filled, and the fluid was then seen taking a course over the general or systemic circulation. As it was impossible to tell in this first experiment whether any of the fluid escaped into

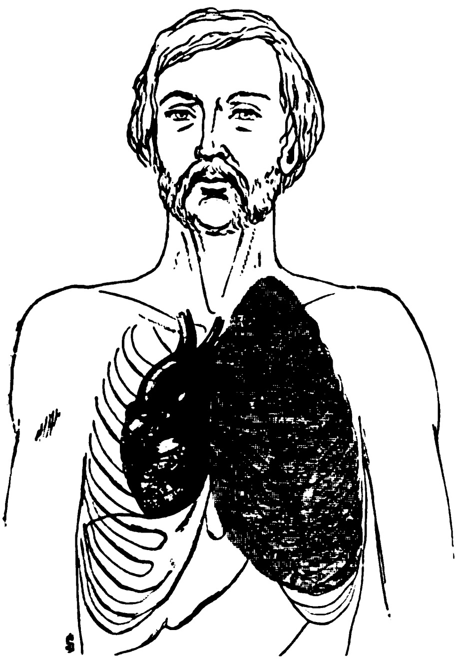


EXPERIMENT ON LUNG CIRCULATION AND ON THE ACTION OF THE VALVES IN THE HEART.

the left ventricle, we adopted another form of experiment and investigation. This time the heart and lungs were removed from the cavity of the chest entirely; the heart and lungs were exposed by being divested of their coverings, and the openings in the vessel secured. The aorta was divided in the center of the arch between the innominate and the left carotid. A tube was introduced into the aorta at this point and held in position by a ligature, which prevented any leakage. The first few strokes of the syringe caused the vessel to swell nearly three times its normal size, but the injection was kept up until it was next to impossible to inject any more fluid. While the aorta swelled to this extreme degree without rupturing, there could be noticed no appreciable change in the walls of the left ventricle. The injecting apparatus was released and pushed on down into the cavity of the ventricle through the valves of the aorta. The injecting apparatus was again tied securely and the second injection begun. This injection caused the ventricle to swell, which, however, did not begin to approximate the swelling or extension shown in the aorta, but in time the same effects followed as in the first injection. The pressure in the ventricles became so great that it was impossible to inject any more fluid. In this injection the aorta was tied to the injecting apparatus just at its origin from the ventricle. While the ventricle was still distended, and in order to make sure that no fluid had reached the auricle, I made an incision with the scalpel through its superior border, and, on laying it open, it contained nothing but a small amount of blood and serum. The action of the mitral valve in the auriculo-ventricular orifice was very clearly demonstrated, the experiment proving beyond doubt that the valves of the heart are impervious to the fluids injected into the aorta. The third experiment was to test their action when injected through the veins. The inferior vena cava having been securely tied, the injection was begun in the superior vena cava, the tube having been securely tied and held in position by a ligature placed around the vessel and the injecting tube. This experiment was just as any one would expect; the fluid at first entered the right auricle from the superior vena cava, then it passed through the tricuspid valve in the auriculo-ventricular orifice, and entered the right ventricle, taking the course of the lesser or pulmonic circulation the fluid entered the pulmonary artery and was carried to the lungs, where it soon made its appearance in the pulmonary veins. After a few more strokes of the injecting apparatus, the fluid began to escape from the openings of the veins into the left auricle and could be seen through the openings made in the superior border of the left auricle in the experiment made by injecting the aorta. Through the kindness of Mr. W. W. Harris, of Sioux City, Iowa, I have the pleasure of reproducing the cut showing the experiments on the valves of the heart, which he performed in order to demonstrate the incorrectness of Mrs. F. H. Wilson's article on discoloration and leakage, and will serve the purpose of illustrating these very important experiments.

Flint, in performing an experiment on the action of the aortic and pulmonary valves, tied a piece of tubing into the pulmonary artery and also into the aorta, and by means of the Y connection he introduced fluid into both the arteries at the same time. The aortic semi-lunar valves opposed the passage of the liquid so effectually that it ruptured before the valves gave way, but the semi-lunar valves of the pulmonary arteries showed a considerable degree of insufficiency at this high pressure, and fluid escaped into the right ventricle.

Change in Position of the Heart Caused by Diseases of the Thoracic Viscera, Etc.—If a person dies of pneumonia and bronchitis, the lungs will be found large and filled with gas, the chest walls being much expanded; the diaphragm is pressed downward, and the heart, which is filled with blood in both the right auricle and right ventricle, is lowered much below its normal position during the living state; thus the guides generally given for tapping the right auricle of the heart are not always correct. The general rule is, that after death the lungs become smaller and contracted in appearance. In this class of cases the heart, instead of being lowered, is raised and the right auricle can readily be reached by a trocar puncture between the second and third ribs. If the abdominal cavity is flaccid, there being no gas present, the stomach and intestines being empty, the heart will be found much lower, on account of the descent of the diaphragm; the apex of the heart resting on this structure is considerably lowered in position; in an extreme case a trocar would have to be interted between the fifth and sixth ribs in order to reach the right auricle of the heart. But should the abdominal cavity be distended with gas, the stomach and intestines being full, the heart would be found higher up in the thoracic cavity.



Change in position of the heart in pleuritic effusion left lung.

The illness which the person died of has a great bearing on the position of this organ, for if the person dies of some long, wasting disease, the heart will not only be diminished in size, but will be found more deeply situated in the cavity of the chest. As a rule, as soon as death takes place, the left ventricle of the heart contracts very firmly and is thus left empty, but the right auricle and ventricle soon become distended with venous blood, and it remains in that condition until removed either by drainage tube and aspirator, or by the needle introduced directly into the right auricle or right ventricle of the heart.

The heart is the most freely movable organ in the human body, and is so altered and changed in its position in so many diseases and conditions, that I have decided to consider the pathological changes in this organ first, before commencing the description of the arteries and veins. The accompanying cut will give the reader a conception of the extreme changes from the normal position of the heart.

Diseases of the heart itself will alter its position slightly, but not to the extent found in cases of pleurisy, emphysema, lung troubles, etc. In an autopsy held recently the heart removed from a young man about 21 years of age weighed nearly four pounds, thus being nearly four times its natural size. In this instance the heart, which was examined in section, was affected with hypertrophy (simple enlargement of the heart). All of the valves and structures of the organ were in good condition, excepting the unusual enlargement. Each ventricle would hold approximately six to seven ounces I have preserved this heart and consider it one of the most valuable specimens of this nature I have seen for some time. The heart was displaced slightly to the left side of the body; the left lung was below normal in size, while the right lung was slightly enlarged in order to compensate for the diminished amount of breathing space taken up by the change in position of the heart pressing on the left lung. The blood vessels independent of the heart in this subject were in good condition.

Even in certain diseases of the organs of the lower cavity, the presence of gas, etc., may alter the position of the heart considerably. Enlarged liver or the presence of an abcess in the left lobe of this viscus will cause the heart to be displaced upward and toward the left. Gas in the abdominal cavity will cause the heart to be forced upward so that the auricle will be on a line drawn between the second and third ribs. In pleuritic effusions, where the serum secreted by the pleural sacs is extensive, the heart may be displaced completely from one to the other side of the thoracic cavity, while collapse of the lung or abcess in the structure will cause considerable change in position of the heart, according to the side of the cavity the disease is located. If on the left side, the heart, in collapse of the left lung, will fall downward and backward to that side, while the same condition occuring in the right lung would displace the organ in the same axis toward the right side of the cavity.

In cases of emphysema, which disease causes an increase in the size of the lungs, the heart will be forced downward upon the diaphragm, and the apex may be found, in extreme cases of this disease, nearly three inches below the ending of the sternum (breast bone). Such a change in position as this would make considerable difference should the embalmer desire to remove blood by some of the old methods of tapping the heart with a trocar either from below the diaphragm or between the third and fourth intercostal space. I am not in favor of removing blood from this organ by the methods commonly in use, as every one of them endangers the circulation, and in the hands of an unskillful person the trocar is sent through the aòrta or vena cavas, which would prevent a successful arterial injection. At the present time I am not using either the trocar or the flexible silk tubes for the removal of blood, as neither of them give satisfaction.

In emphysema, even after death, the distended condition of the lungs remains, and will maintain the displacement of the heart downward against the action of the gases of putrefaction in the lower cavity which have a tendency to raise the structure and would thus tend to counteract this change in position of the organ. The pulmonary artery in this disease is generally filled with blood and the pulmonary vessels occluded with the fluid, the right side of the heart, both the auricle and the ventricle, will be filled with dark colored blood, and in injecting a subject dead of this disease it is next to impossible to obtain a complete circulation of the fluid, as all of the pulmonary vessels are more or less filled with coagulated blood.

The Pericardium.

The pericardium, the covering of the heart, consists of two layers of tissue—an inside, serous, and an outside, fibrous. This covering of the heart extends two inches above the base of the heart, and surrounds the great vessels leading to and from the organ. It extends to the upper border of the diaphragm, where it becomes intimately connected to its central tendon, but being situated more to the left than to the right side. On account of the frequent cases of dropsy of this membraneous sac, and consequent effusions of serous fluid in pericarditis, etc., the embalmer is obliged to aspirate and remove the accumulations before proceeding with the arterial injection. This may be accomplished by introducing the trocar between the fifth and sixth ribs, on the left side, near the lower border of the sac, and attaching the aspirator.

Blood Vessels.—The blood vessels which supply the pericardium are derived from the descending, thoracic, aorta, and the internal mammary and its branches.

This description of the lungs and their coverings, the heart and its covering, together with a description of the contents of the mediastinal spaces, previously referred to, completes the visceral and regional anatomy of the three main cavities of the body, namely: the cerebro-spinal, the abdominal, and the thoracic. The histology of the arteries and veins having been described under "Anatomical Elements" (pages 63, 64, 65), we will next proceed with a description of the blood circulation and the arterial system, beginning at the aorta, the largest artery, and ending at the capillaries, the smallest branches of the arterial system.

CHAPTER V.

Human Blood.

Blood is the most complex of all the animal fluids. In man and the vertebrate animals it is an opaque fluid, which varies in color from a bright red to a dull red color, accordingly as it is taken from an artery or a vein.

The opacity of the blood is due to the refraction of the rays of light by the elements of which it is composed. The color in the blood is the result of the hæmoglobin found in the red blood corpuscles; this coloring matter is slightly altered by the increase or decrease of oxygen. While the blood is heavily charged with oxygen, as in the arteries, the blood is of a bright scarlet, but as it approaches the capillaries the color is slightly altered, and when it reaches the veins the color is changed to that of a deep purple.

The Amount of blood in the human body is estimated to be about one-eighth of the whole body weight, or from eighteen to twenty pounds in an individual weighing from 140 to 150 pounds avordupois.

Different physiologists have given various methods for estimating the amount of blood in a human body. Dr. Carpenter, the great physiologist, makes the statement that the average human body of an adult man will contain from twelve to fifteen pounds of blood. Bischoff gives the quantity of blood as one-thirteenth of the body weight. There is a difference in the quantity in the newly born and in the adult. Welcker gives the quantity as one-nineteenth in the child. According to Halliburton, the average is one-twelfth to one-fourteenth of the total body weight. Welcker's method of estimating how much blood is in an individual is as follows: A small quantity of blood is removed from the animal by opening a vein. This blood is defibrinated, measured and diluted to known extent to serve as standards of comparison. The animal is then bled to death by severing the arteries and veins of the neck. Thus all of the blood that will possibly drain from the animal is taken from these parts. This blood is also defibrinated. The vessels of the animal are next washed out with water or saline solutions. These washings are added to the blood in the receptacle. Lastly the whole animal is very finely minced with water or saline solutions. The extract is filtered and added to the diluted blood previously obtained, and the whole is measured. The color of all this blood taken from the animal is then compared with the standard solutions made from the few drachms of blood which were first removed, until one is discovered which has the same tint as the mixture. The amount of blood in the corresponding standard solution being known, the total quantity in the animal body can in that way be easily calculated.

The Composition of human blood is a very important study for the embalmer, since it enables him to determine, in certain cases, the exact condition of this fluid and whether it can be removed, but before taking up the pathological conditions of the blood, it will be well to consider the blood in its normal aspect.

Human blood is composed of red and white corpuscles, and plasma, or liquor sanguinis.

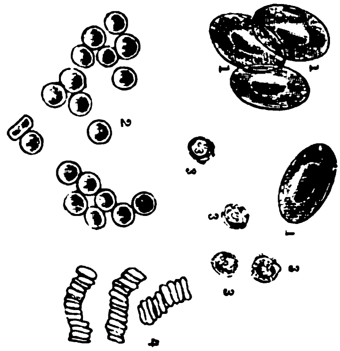
The relation of plasma and serum to the clot can be seen at a glance by following the scheme below.

Blood	Plasma	Serum	
		Fibrin	
	Corpuscles	Red	Clot or Crassamentum
		White	
		Blood Tablets	

It is estimated that in every one hundred parts by weight of blood there will be sixty to sixty-five parts of plasma and thirty-five to forty parts of corpuscles.

The Specific Gravity of the blood is from (1050.) to (1075.), but in certain cases this specific gravity may be increased or diminished.

The Liquor Sanguinis is a transparent, colorless fluid, which is the medium in which the blood corpuscles are suspended. The plasma comprises nearly 60 per cent. of the



BLOOD CORPUSCLES.
1, Elliptic discs of amphibia. 2, Human red corpuscles. 3, White or lymph corpuscles. 4, Roleaux of red discs.

entire amount of the blood, the corpuscles—red and white—only amounting to 40 per cent. of the quantity.

The Red Blood Corpuscles measure about one-thirty-five-hundredths of an inch in diameter.

The White Corpuscles are much larger and measure one-two-thousandth of an inch.

Having now considered the composition of the blood in life, we will see what changes take place after death. Blood in life, owes its fluidity to the presence of sodium salts contained in it, but as soon as death takes place, the effect of this salt is not produced since the blood begins to coagulate almost immediately; it does this in nearly every case, the cases where the blood does not coagulate after death being those of asphyxia, narcotic poisoning, septicæmia or blood poisoning, and also poisoning from prussic acid. The coagulation which takes place after death in most bodies, should not be confounded with that taking place during life; for during life, when an artery or vessel is severed, the coagulum formed is very hard, but after death, the blood, instead of becoming hard, becomes of a fluid consistence, the coagulation being very mild. This weak coagulation of the blood after death, is first due to the action of the fibrin contained in it, but as soon as this has been acted upon and putrefaction begins, the blood become of a fluid consistence, the corpuscles begin to break up and become granular, finally being dissolved entirely. This process of decomposition generally takes place in the capillaries and veins, since the blood has a tendency to leave the arteries and escape into the veins soon after death takes place. This point, together with those already stated, concerning the different cases where the blood remains fluid, should receive especial attention by the embalmer, as the removal of blood is a very essential thing in the operation of a successful embalmment. In consumptive cases, on account of the fibrin being consumed by the disease, the blood, after death, remains thin, there being but little if any coagulation.

Phenomena in the Blood and Circulatory System after Death.—As previously stated, the blood after death leaves the arteries and escapes into the veins, capillaries and tissues of the body. Although many have given reasons for this phenomenon, I cannot agree with most of them. Certain it is that the heart which was the power to force the blood during life exerts no power whatever in setting up a post mortem circulation such as the gradual passage of the blood from the arteries into the veins after death This post mortem circulation is more prominent in some subjects than in others. It is especially noticeable in all who die of yellow fever.

After the blood passes to the capillaries and veins, it accumulates and discolors the most dependent parts of the body, such as the back of the neck, the back of the arms, legs, and the tissues of the posterior part of the trunk. The ancients observed the phenomenon of blood being found only in the venous system and capillaries after death. This gave rise to the belief among them that the arteries were all air conducting tubes. In order to explain the subject of how the blood leaves the arteries and escapes into the veins after death, I desire to quote an experiment by Flint, who says: "If the artery and vein of a limb be exposed in a living animal, and all the other vessels be tied, compression of the artery does not immediately arrest the current in the vein, but the blood will continue to flow until the artery is entirely empty. The artery, when relieved of the distending force of the heart, reacts on its contents by virtue of its contractile coat and completely empties itself of blood." An action similar to this takes place after death throughout the entire arterial system. When a person dies respiration ceases and the heart stops beating, thus there is nothing to force the blood into these vessels. The muscular coat of the arteries is supplied with motor and sensory nerves and these are capable of causing contraction for several hours after death. Thus the arteries react on their contents and gradually force all the blood into and through the capillaries to the veins, which are capacious, distensible and but slightly contractile, having a capacity of nearly three times as much as the entire arterial system. The contraction in the arteries begins immediately after death, or just as soon as breathing and circulation ceases, and it seems that as soon as the blood has passed to the venous system the rigor mortis begins to manifest itself in the muscles and tissues of the face and neck, and thus all of the voluntary, as well as the involuntary, muscle fibres contract. After the blood is once in the venous system it animals hunted to death no coagulation occurs, and it was stated by Hunter, a century ago, that no coagulation occurred in those killed by lightning or electric shocks or by blows upon the epigastrium. However, his statement is far from being true, and Gulliver has made observations which prove in all of these numerous cases that the blood may coagulate. However, the coagulation is very imperfect. All blood must coagulate before putrefaction commences; but putrefaction must not be confounded with some of the diseased conditions described under the head of anaemia. In addition to the strong solution of neutral salts mentioned above which tend to retard the coagulation of blood, the same effect can be produced by many vegetable substances, particularly those of the narcotic and sedatative class, such as opium, belladonna, aconite, hyoscyamus and digitalis. Nitre also has a good effect in preventing the coagulation of the blood. Gulliver by means of this drug kept a horse's blood fluid for fifty-seven weeks. This is certainly remarkable. Polli observed a case where coagulation of the blood did not take place until sixty-five days after it had been removed from the body, and no putrefaction occurred in the blood until thirty days had passed after the time of its removal. In death due from cold or freezing the blood remains fluid, and in addition to the other post mortem appearances the surface of the body is marked by stains and spots of a cherry red color. These spots closely resemble the stains met with in cases of poisoning by carbon monoxide. In death from sunstroke the red corpuscles in the blood are sometimes entirely destroyed. In death from lightning the blood has been described as dark and fluid, but in the course of a few hours after the stroke it may coagulate as in other bodies. In those who have been burned to death by scalding, or otherwise, the blood frequently presents a bright red color similar to that found in asphyxiated bodies. In cases of starvation the heart is generally reduced in size, and may contain a small amount of blood in all of its chambers. There seems to be little alteration in the blood itself except the diminished amount. In cases of poisoning from sulphuric acid the blood has been observed to be dark and tarry. Blood in the living state is alkaline in reaction, but in death from sulphuric acid poisoning it may be acid. In death from poisoning by opium and morphine the blood is generally dark and in a fluid condition, but cases are also found with the blood coagulated. In poisoning from belladonna and atropine the blood is generally of a dark color and in a fluid condition. In death from poisoning by phosphorus the blood is commonly dark, and although in a fluid condition it is of a sirupy consistence. In phosphorus poisoning the corpuscles are said to undergo complete disintegration. In poisoning with antimony, Mr. Richardson observed the heart to be greatly distended, both sides filled with blood, the lungs dark and filled with blood. This blood is loosely coagulated and generally in a fluid condition. In poisoning by arsenic the blood in the dead body is usually fluid. In death by poisoning from hydrocyanic acid the blood will be found dark and fluid, or if the poisioning has been slow, and of long duration, the blood will be black and coagulated. The blood in all cases of poisoning by coal gas has a deepened tinge of color; it is of a dark scarlet and remains so a long time after death. There seems to be a difference of opinion among authorities on the condition of the blood in death by strangulation, smothering, etc. Woodman and Tidy hold that it is of a dark color and of a fluid consistency, while others claim that the blood retains its scarlet appearance and resists slow combustion and putrefaction.

Circulation of Blood.

For convenience of study the circulatory system is divided into the heart and vessels. The vessels are also divided into three kinds: the arteries, which carry the blood from the heart to the system; the capillaries, which distribute the blood more or less abundantly in the different parts of the system, and the veins, which return the blood from the general system to the right auricle of the heart.

Although the term "artery" is derived from the Greek, from a word which meant to contain air, Galen, one of the earliest writers of medicine, is quoted as refuting this statement. But, while he said that the arteries and veins contain blood in the living state and that the arteries are only empty after death, it remained for the practice and experience of several centuries to clear up the mystery. About the year 1615, Dr. Harvey was appointed Lumlian Professor at Bartholomew Hospital in London, Eng. One year later, during the latter months of 1616, Dr. Harvey conducted a series of experiments which resulted in the discovery of the circulation of blood. He proved this before a class of medical men by injecting into the vascular system a colored fluid which much resembled the color of blood. The year 1616, then, becomes illustrious because of the fact that the discovery of the circulation of the blood was ushered into existence at that time. It was not until the year 1619 that he felt it his duty to make his discovery public. This caused so much comment that nine years later he published his first monographs on the circulation of the blood which makes him famous at the present day. Experiments conducted on the circulation, since Harvey's time, have divided the circulation into five different and separate divisions, namely: the pulmonary, the systemic, the portal, the fœtal and capillary.

The Pulmonary Circulation.—The pulmonary circulation is that which exists between the right and left sides of the heart. It begins at the right ventricle; the pulmonary artery receives from the right ventricle the venous blood which has been emptied into it from the auricle, which has received it from all parts of the system. It conveys the blood, by means of a right and left branch, to both lungs; these right and left branches dividing and subdividing until they cover the tissues of the lungs with one vast net-work of capillaries. At this point the blood gives off its deleterious substances in exchange for oxygen from the air; becoming purified, it is taken up by the capillaries and poured into the veins, which gradually converge until they form four large venous trunks, two coming from each lung. These veins empty the pure blood into the left auricle of the heart. This completes the pulmonary circulation. It will be seen that the pulmonary artery carries impure blood, and that the four pulmonary veins carry pure blood, there being only one other instance in the body where the veins carry arterial, and the artery, venous blood. This exception takes place during gestation, or while the child is in utero. The cord which connects the fœtus to the maternal structures is composed of two arteries and a single vein with mucoid tissue to protect them, there being no nervous fibres in the cord. The umbilical arteries return the blood (*impure*) from the fœtus, and the umbilical vein conveys the *pure blood* from the placenta to the child in utero.

The Systemic Circulation.—The systemic circulation begins at the left ventricle of the heart, receiving the blood from the left auricle, it is forced into the aorta by the contraction of the ventricle, and sent, by means of the aorta and its branches, to all parts of the body. The vessels finally become so small in size that they measure, on an average, one-thirty-five-hundredth of an inch in diameter. The veins begin at this point and collect the blood which has been sent to the capillaries by the heart and arteries, and return it to the right auricle of the heart. The circulation of the blood from the left side of the heart, through the arteries and capillaries of the general system, thence through the veins to the right side of the heart, constitutes the greater or systemic circulation.

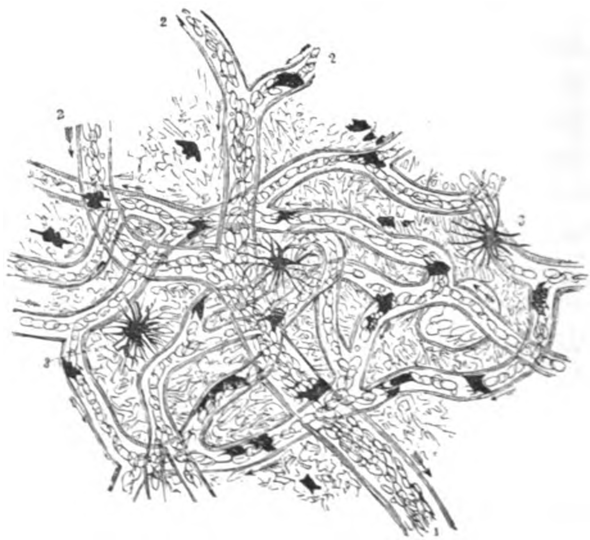
The Portal Circulation.—This circulation is that which exists between the chylopoietic viscera, namely: the intestines, the stomach, the spleen and the liver. It is made up of the superior and inferior mesenteric veins, the splenic and the gastric veins. The gastric veins return the blood from the capillaries of the gastro-epiploic and vasa breva arteries, and returns the blood into the splenic, as does also the inferior mesenteric vein, which returns the blood from the rectum, sigmoid flexure and the descending colon. The superior mesenteric and the splenic vein unite near the posterior surface of the pancreas to form the portal vein. This vein ascends to the transverse fissure of the liver, where it penetrates that viscus and divides again into capillaries, which empty into the hepatic veins. The return of the venous blood from the chylopoietic viscera (stomach, spleen, pancreas and intestines) to the under surface of the liver, thence into the gland, and finally into the hepatic vein, which empties into the inferior vena cava, completes the portal circulation.

The Fœtal Circulation.—The fœtal circulation is that circulation which exists between the vascular system of the mother and the child in utero. The placenta, or afterbirth, serving as the medium of purification during the latter months of gestation. In the early period of gestation the communication between the child and the mother is maintained through the medium of the spongioles of the chorion and the membrana decidua, until the third month: after this period the sole connection seems to be through the placenta. This placental circulation is a very interesting study, being almost analagous to that circulation which takes place in the lungs and which is known as the pulmonary circulation.

The impure blood from the child in utero is returned to the placenta by means of the umbilical arteries. Here it gives off its waste and receives oxygen in return from the mother's blood, which is circulating very freely in the maternal side of the placenta. The pure areated blood is now returned to the child by means of the umbilical vein. The circulation in the child is very different from that which we have in adult life or immediately after the child is born. The blood, returning from the placenta after having received oxygen and given off carbonic acid gas, is carried by the umbilical vein through the abdominal parites to the under surface of the liver; here a portion of it passes through the ductus venosis into the ascending vena cava, while the remainder flows through the liver and passes into the inferior vena cava by means of the hepatic vein. The blood is now emptied into the right auricle by means of the inferior vena cava. It is now carried from the right auricle, to the eustachian valve, through the foramen ovale, into the left auricle; thence into the left ventricle, and so into the aorta to all parts of the system. The venous blood from the upper extremities and the head empty the impure blood into the superior vena cava, which empties the blood into the right auricle; thus the blood, after it reaches that point, is partly impure. A portion of the blood escapes into the right ventricle and into the pulmonary artery, but, owing to the collapsed condition of the lungs, only a small portion of the blood reaches the pulmonary capillaries. The greater part of the mass of blood sent through the pulmonary artery passes through the "ductus arteriosis," which connects the polmonary artery to that of the aorta. This duct is situated a little below the origin of the carotid and subclavian arteries. The mixed blood passes down the aorta to supply the lower extremities, but a portion of it is directed, by the hypogastric arteries, to the umbilical, and thence to the placenta to be again oxygenated. At birth the ductus venosis closes, as does also the foramen ovale, the opening between the right and left auricles, and the ductus arteriosis, the opening between the pulmonary artery and the aorta. The circulation then gives place to that of the adult.

Capillary Circulation.

The Capillaries (from *capillus*, a hair) are the smallest of the blood-carrying vessels in the body. They mark the end-

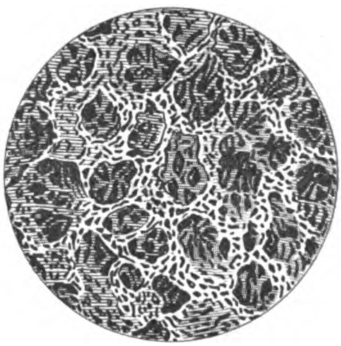


Capillary circulation as seen in the web of the frog's foot. 1. Beginning of the vein; 2. ending of the artery; 3. stellated cells. Columns of flattened corpuscles are seen passing through the capillary branches.

ing of the artery and the beginning of the vein. All capillaries in the body form a network which is so complete that it is impossible to prick the skin with a needle without rupturing some of them. A peculiar thing about the capillaries is that they maintain nearly the same diameter throughout their course, their usual size being about one-three-thousandth of an inch. The smallest capillaries are those of the brain and the mucous membrane of the intestines. The largest are hose of the skin and the marrow of bone. Some of the capillaries of the skin and in the marrow of bone will measure as much as one-twelve-hundredth of an inch. The form of the capillary net varies in the different tissues of the body. The meshes are generally rounded and elongated. The accompanying drawings are from microscopic examinations of capillary vessels in the muscles; in the tissues surrounding the air cells of the lungs, and from the web of the frog's foot.

It is questionable whether some of the fluids now on the market ever pass through the capillaries during an injection. The blood corpuscles are larger than the capillaries them-

Capillary circulation in muscle tissue.



Arrangement of the capillaries of the air cells in human lung.

selves, and in order to pass through these small vessels they must double upon themselves and pass through in a single column. Thus fluids containing a great deal of sediment will permit only of the fluid portion passing through the capillaries, the sediment remaining on the arterial side and congesting those tissues. It makes little difference, however, in the injection of fluid through the arterial system, whether it passes through the capillaries or not; so the fluid and the preserving chemicals are carried to the capillaries is all that is necessary, as the capillaries reach every part of the human anatomy. The veins merely return the blood back to the heart. The walls of the capillaries are much thinner than the walls of the arteries or veins. They are composed of a transparent membrane which is continuous with the endothelial layer of the arterial and venous sytems. In very plethoric individuals where there is a large amount of fat it is difficult to obtain a free capillary circulation of fluid, as the microscopic examination of these tissues does not reveal the presence of any large amount of capillary blood vessels. Thus in the injection of such a subject the fluid is not carried into the fatty tissues at all, and for that reason a hasty decomposition of the subject is the result, unless the fluid contains gaseous elements which will permeate the fatty tissue during its power of diffusion through the body.

The Removal of Blood.

The removal of the blood from the body greatly aids the absorption of the embalming fluid into the tissues. It does this by, *first*, relieving the veins of the body of a fluid which has a complex chemical composition, which has a tendency to prevent osmotic action; *second*, by relieving the veins of the blood they contain, the fluid injected into the arteries penetrates more readily through the capillaries and into the veins; *third*, when the blood is removed from the body the weight of the subject is consequently diminished from one-tenth to one-fifteenth, a vacuum is created in the vascular system, allowing an increase of the amount of embalming fluid injected corresponding to the amount of blood removed; *fourth*, the removal of blood from the body prevents those discolorations from appearing which are caused by the decomposition of that fluid, or which might occur through congestion of the veins of the face and neck, or from the putrefaction of the blood, giving rise to those forms of discoloration commonly known as "post mortem staining" and "post mortem discoloration."

A great many ways have been devised for the removal of the blood, but while some have claimed almost innumerable ways of removing it, they can be reduced to two methods:

1st. Tapping the right auricle or right ventricle of the heart with a hollow needle or small trocar, and removing the blood by means of an aspirator.

2nd. By opening the veins at some part of their course and introducing a flexible catheter or tube which is of sufficient length to enter the right auricle of the heart.

Removing Blood from the Heart.—In order to remove the blood from the body without opening the veins, the embalmer should tap the right auricle or the right ventricle of the heart. The instruments required for this operation are very simple, being a hollow needle or trocar, to which has been attached an aspirator or other instrument capable of causing a vacuum. The needle should be introduced between the third and fourth intercostal space, on the right side, close to the breast-bone (sternum), and should be directed downward and inward toward the center of the thorax, when it will enter the right auricle of the heart. By using the aspirator the blood from both the inferior and superior extremities of the body may be removed. On account of the loose anatomical attachment of the heart and its covering (the pericardium), gases arising from below the diaphragm may elevate its position so that the puncture between the ribs would not enter the right side, but, in order to be certain that the trocar has penetrated the substance of the heart, the embalmer should move the trocar up and down while it is in position and see if there is any weight to the end of it; a little delicacy of touch will enable the operator to determine when he has penetrated through the walls of the heart. Should the trocar penetrate the right ventricle, instead of the right auricle, it would make little difference, since the natural course of the blood is from the auricle into the ventricle, through the auriculo-ventricular opening. Some embalmers have objected to this method of removing the blood, offering as a point of argument, that it caused an opening in the heart and thus ruptured the circulation. This is correct. It does cause an opening in the right side, but—since the fluid injected into the arteries goes first to the aorta, which arises from the left ventricle, and thence all over the arterial system, thence through the smallest capillaries, and finally back to the right side of the heart through the inferior and superior venæ cavæ—it does not cause a leakage until the whole system has been saturated with the preservative solution.

Removing Blood from the Veins.—The instruments required for the removal of blood from the veins consist of two or three flexible silk tubes of assorted sizes, so that the one best adapted to the caliber of the vein may be used. A good aspirator should be at hand, which should be attached to the end of the catheter, and after the latter has been introduced upwards into the vein, or until it reaches the right auricle of the heart, suction should be made, so as to start the flow of blood into the tubing and into the receptacle provided to receive it.

The vein chosen for the operation should correspond to the artery which is to receive the injection of the preservative fluid. If the operator decides to inject the brachial artery, he should choose the left, as the left basilic vein offers the best advantages; but if he decides to inject the femoral, I find that the catheter can be introduced as well through the left as through the right. I prefer the left, on account of its anatomical relations, the left femoral not being overlapped so much by the iliac arteries. The right may be used with equally good result, but I have found that it was more difficult to introduce the tubing into the right than it was the left.

The tubing required for drainage from the femoral vein is much longer than that used for drainage from the basilic, or jugular veins. This is on account of the greater length of the femoral, iliacs and inferior vena cava over the basilic, axillary, subclavian, innominate, and superior vena cava. A catheter sixteen to eighteen inches in length being long enough for drainage from the basilic, while for drainage from the femoral vein, the tubing should be from twenty-four to thirty inches in length.

Having selected the vein to use, and chosen the size

OPERATOR REMOVING BLOOD FROM THE BODY; FLEXIBLE SILK TUBE INSERTED INTO THE LEFT BASILIC VEIN AND ENTERING THE RIGHT AURICLE OF THE HEART.

tubing that is best adapted to the caliber of the vessel, the operator should open the vein in the long axis of the vessel, making an incision through the upper wall about one-half inch in length; the catheter should be oiled or covered with a small amount of vaseline—this will permit of its easy introduction into the vessel. After you have introduced the tubing to the right auricle of the heart, it should be carefully tied in position and the aspirator attached. In a great many cases it will be found that as soon as you enter the auricle the blood will begin to flow. One case that came under my observation—that of a woman who died of strychnia poisoning—as soon as I introduced the catheter through the axillary vein the blood began to escape from the end of the catheter, nearly two quarts escaping from the vessel; this was aided somewhat by an injection of fluid into the brachial at the same time.

If the blood does not flow in sufficient quantity after opening the vein, the aspirator should be attached to the tubing, and the blood removed by means of this instrument. If the blood does not flow as it should after attaching the aspirator, the embalmer should introduce some fluid through the tubing, so that if blood clots be present they may be broken up. A better solution to introduce into the veins for dissolving the clots, is composed of sulphate of sodium and water, using about twelve per cent. of sulphate of soda; this has a tendency to dissolve out the fibrin in the blood. If this is not at hand, a ten per cent. solution of chloride of sodium (common salt) will answer the purpose, as it has a tendancy to act on the fibrin and break up any clots that might form in the veins. It is claimed that magnesium sulphate, twenty-five or twenty-six per cent., completely prevents any coagulation of the blood. By injecting the arteries, the blood will flow from the opening in the veins. In this process the injection should be continued until the fluid returns in a clear condition.

The directions for locating, raising and injecting the brachial, femoral, and carotid arteries, will serve to explain the methods of locating and removing blood from the veins accompanying them, the embalmer bearing in mind the relations of the vein to the artery and surrounning structures. (See Anatomy of Arteries and Veins).

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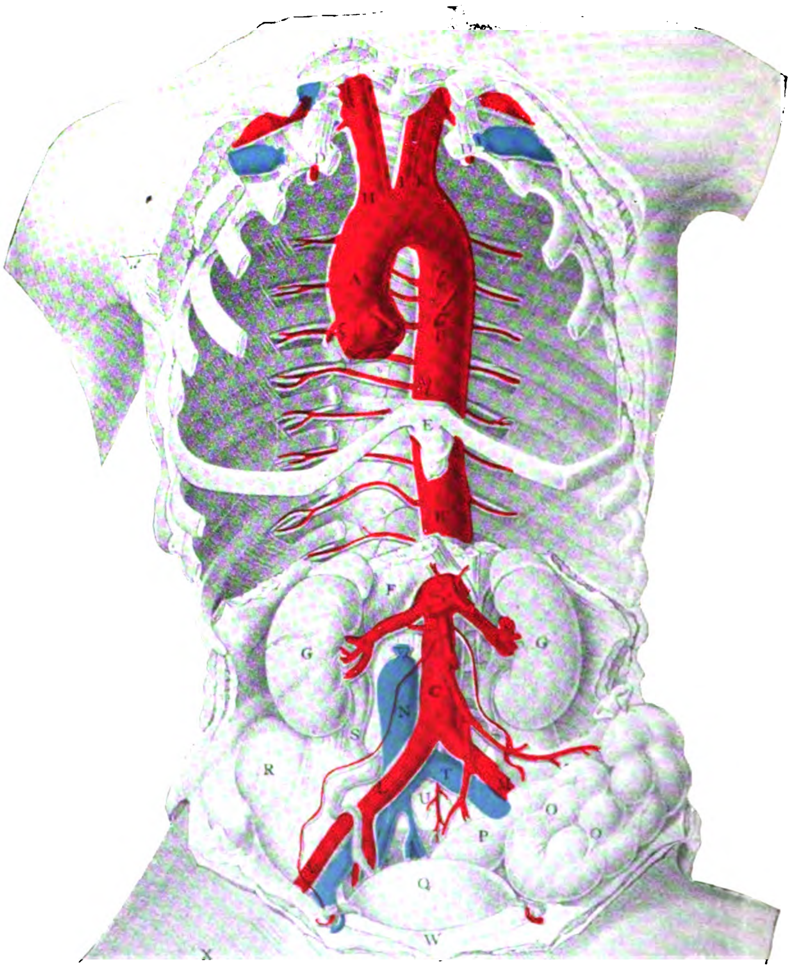
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PLATE 8.

A. The arch of the aorta.
B. The descending aorta, giving off the intercostal branches.
C. The abdominal aorta.
DD. First pair of ribs.
E. Xyphoid cartilage.
GG. Right and left kidneys.
H. Innominate artery.
I. Left common carotid.
K. Left subclavian artery.
L. Right common iliac artery at its point of bifurcation.
D. Left common iliac artery, covered by the meso rectum.
N. Inferior vena cava.
OO. Sigmoid flexure of the large intestines.
P. The rectum.
Q. Urinary bladder.
R. Right iliac fossæ.
SS. Ureter (tube leading from kidneys to the bladder).
T. Left common iliac vein, joining right common iliac vein to form the inferior vena cava, the largest vein in the body.
U. Fifth lumbar vertebra.
V. External iliac artery, right side.
W. The symphysis pubis.
X. Incision over the course of femoral artery.
bb. Dorsal intercostal arteries.
c. Cœliac axis.
d. Superior mesenteric artery.
f f. Renal arteries.
g. Inferior mesenteric artery.
h. Vas deferens bending over epigastric artery and the os pubis after passing through the internal abdominal ring.

CHAPTER VI.

The Arteries of the Human Body.

The Aorta.

The aorta, the largest artery in the body, arises from the left ventricle and takes a course upward and to the right until it reaches a point corresponding to the upper border of the second costal cartilage, where it becomes arched and curved transversely across the chest, inclining a little backward toward the vertebral column. It then describes a course downward on the left side of the vertebral column and penetrates the diaphragm and enters the abdominal cavity, to terminate, opposite the fourth lumbar vertebra, into the two common iliac arteries. For convenience of description this vessel is divided into the ascending aorta, that part which extends from the third costal cartilage to the upper border of the second costal cartilage; the transverse aorta, or that part which extends transversely across the chest from the upper border of the second right costal cartilage to the lower border of the fourth dorsal vertebra; the thoracic aorta, or that portion of the vessel which extends from the lower border of the fourth dorsal vertebra to the aortic opening in the diaphragm; the abdominal aorta, or that portion which extends from the opening in the diaphragm to the fourth lumbar vertebra.

The Ascending Aorta is about two inches in length, and at its beginning in the left ventricle is supplied with a valve (see discription of heart) which prevents the regurgitation of blood. The only branches given off of this part of the vessel are the two coronaries—right and left—which supply the heart. *The transverse portion of the artery*, or arch of the aorta, gives off three large branches, which are distributed to the head and upper extremities; they are the innominate, the left common carotid, and the left subclavian.

The Descending Aorta, or, more properly speaking, the thoracic and abdominal aorta, gives off many branches of large size, which supply the organs and tissues of the thorax and abdominal cavities. The branches of this vessel given off in the cavity of the thorax are:

the bronchial, posterior mediastinal,
the intercostal, and
the pericardiac, œsophageal.

The bronchial arteries are distributed to the lungs, where they supply both the right and left lung with pure blood. It should be remembered that the pulmonary artery does not supply the lungs with blood for their nutrition, as they carry impure or venous blood.

The intercostal arteries—eleven in number—arise from the posterior part of the thoracic aorta, and supply the muscular tissue of the intercostal spaces on both the right and left sides. On account of the position of the aorta, the right intercostal arteries are the longer. The superior intercostal space is supplied by the intercostal branch of the subclavian; the second intercostal space is supplied by the superior and the aortic intercostals.

The pericardiac branches are distributed to the pericardium covering the heart. The four or five œsophageal arteries supply the œsophagus or gullet and anastomose very freely with the arteries from the root of the neck, the ferior thyroid, etc. The posterior mediastinal are distrib- to the contents of the posterior mediastinal space.

e Abdominal Aorta, on account of the number of es which spring from it, becomes gradually lessened in size until at its termination it is not as large by one-third as it was at its commencement at the left ventricle. The branches given off to the viscera of the abdominal cavity are the following:

Cœlic axis, from which arise three branches of large size, known as the gastric, hepatic and splenic;

phrenic,	superior mesenteric,	spermatic,	supra-renal,
renal,	inferior mesenteric,	lumbar,	sacra-media.

In the female subject we have given off, in the place of the spermatic, the ovarian artery, which is distributed to the surface of the ovary.

The cœlic axis is a short artery, but is of very large size and springs direct from the anterior part of the aorta, in front of the diaphragm.

The Gastric Artery is the smallest branch given off from the cœlic axis. It is distributed to the great or cardiac end of the stomach; it also supplies the lower end of the œsophagus and has a very free anastomosis with the splenic artery.

The Hepatic Artery is not quite as small in size as the gastric, being intermediate between the gastric and the splenic. It is distributed to the upper part of the stomach, the duodenum, and to the under surface of the liver, supplying the right and left lobes of that organ.

The Splenic Artery, the largest of the three branches of the cœlic axis, is distributed to the spleen and is remarkable for the length and curves in it. Some of its branches are distributed to the great end of the stomach and the pancreas.

The Phrenic Artery is usually the first branch given off from the abdominal aorta. It supplies the diaphragm and, together with its fellow of the opposite side, anastomoses on the under surface of this membrane; they send branches to the supra-renal capsules, the liver, the inferior vena cava, and a part of the œsophagus.

The Superior Mesentery Artery is one of the largest arteries given off from the front of the aorta. It arises just below the cœlic axis and is distributed to the intestines. It supplies the whole of the small intestines, with the exception of a small portion of the duodenum; it also supplies the cæcum, the ascending and the transverse colons. The superior mesenteric vein accompanies this artery nearly the whole length of its course.

The Inferior Mesenteric Artery is smaller than the superior, and is distributed to the remaining part of the large intestines, its branches supplying the descending colon, the sigmoid flexure and the rectum. It arises about two inches above the division of the right and left common iliacs and from the left side of the aorta.

The Renal Arteries—two in number—arise from the right and left sides of the aorta, a little below the superior mesenteric. On account of the position of the aorta on the left side of the vertebral column, the right renal is the longest and passes beneath the inferior vena cava. The renal arteries, just before reaching the kidneys, divide into four or five branches, which surround the ureter and the renal veins. One of these branches is usually sent to the supra-renal capsules.

The Supra-renal Arteries which arise from the aorta, near the superior mesenteric, are small in size as compared to the vessels in the fœtal state. In the child these arteries are nearly as large as the renal. They pass on the under surface of the diaphragm to the under surface of the supra-renal capsules, supplying the glands and having a very free anastomosis with the other glands terminating in the supra-renal capsules.

The Spermatic Arteries, one on each side of the aorta, arise a little below the renal and are distributed to the sub-

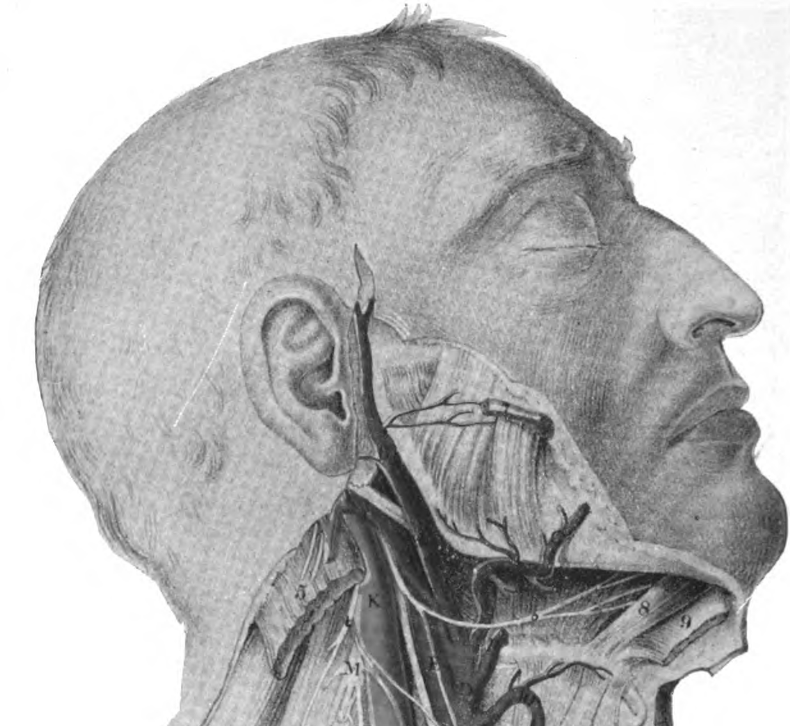

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PLATE 9.

A. Innominate artery at point of bifurcation into common carotid and subclavian arteries.
B. Subclavian artery crossed by vagus nerve.
C. Common carotid artery, vagus nerve to outer side and descendens noni nerve crossing it.
D. External carotid artery.
E. Internal carotid artery.
F. Lingual artery.
G. Facial artery.
H. Temporal maxillary artery.
I. Occipital artery.
K. Internal jugular vein, branch of cervical plexus crossing it.
L. Spinal accessory nerve.
M. Cervical plexus of nerves.
N. Vagus nerve.
O. Hypoglossal nerve.
PP. Branches of brachial plexus.
Q. Subclavian artery.
R. Posterior scapular artery.
S. Transversalis humeri artery.
T. Transversalis coli artery.
U. Posterior scapular and external jugular veins. Jugular vein divided near its union. Both veins empty into subclavian vein by common trunk.
V. Posterior head of omo-hyoid muscle.
W. Part of subclavian vein above collar-bone (clavicle).
X. Scalenus muscle separating subclavian artery from vein.
Y. Clavicle (collar-bone).
Z. Trapezius muscle.
1. Sternal origin of sterno-mastoid muscle.
2. Clavicular origin of sterno-mastoid muscle, divided.
3. Scalenus posticus muscle.
4. Splenius muscle.
5. Mastoid insertion of sterno-mastoid muscle.
6. Internal maxillary artery.
7 Stenson's duct.
8. Genio-hyoid muscle.
9. Mylo-hyoid muscle.
10. Superior thyroid artery.
11. Anterior head of omo-hyoid muscle.
12. Sterno-hyoid muscle, cut.
13. Sternoid-thyroid muscle, cut.

stance of the testes, the epididymus, the vas deferens, and the tissue in the immediate vicinity of those parts.

The Lumbar Arteries, eight in number, four on each side of the aorta, are distributed to the muscles of the lumbar region, the spinal column and the substance of the spinal cord.

The Sacra Media is a small artery given off just above the bifurcation of the aorta. It is distributed to the sacrum and the coccyx, some of its branches supplying the substance of the vertebra at that and the posterior surface of the rectum. It anastomoses with the small branches of the hemorrhoidal arteries.

The Ovarian Arteries, in the female, are analogous to the spermatic arteries in the male. They are distributed to the ovary, round ligament, broad ligament and the uterus. Those branches entering the uterus anastomose with the uterine artery.

Arteries of the Head and Neck.

The arch of the aorta gives off five branches: two of small size — the right and left coronary,— and three of large size — the innominate, the left common carotid, and the left subclavian. The coronary arteries are the arteries which supply the heart with nutrition. They are given off just above the opening of the aorta into the left ventricle. The first large artery given off from the arch of the aorta is the innominate.

The Innominate Artery.—This artery arises from the aorta just opposite the fourth dorsal vertebra, a little to the right and in front of the left common carotid artery. It is the largest branch given off from the aorta, and extends from the point of origin to the right sterno-clavicular junction, where it divides into the right common carotid and the right subclavian arteries. It varies from one to two inches in length.

Of all the arteries in the human body, the innominate artery is *the best artery* for the purpose of injecting the subject. In the first place, with our new method of operating on the innominate and carotid arteries by a transverse incision, such as is shown in the accompanying cuts, no incision whatever can be seen in the skin of the neck after the operation is finished. The innominate artery is always an artery of large size, is seldom, if ever, out of its true position, and it has alongside of it the ending of the jugular vein and the beginnihg of the innominate vein. Where we ordinarily take up the common carotid artery, it must be remembered that the arterial nozzle opens into the innominate artery, and the injection is thus made from this artery. In a great many bodies after death the blood remains in the arteries as well as the veins, and if any injection is made through the innominate artery and blood should happen to be in the arterial system, the force of the injection is downward toward the iliacs and the arteries supplying the lower extremities. Thus this blood which is in the arterial system, "*and in all cases you will find blood in the aorta and its posterior branches*," it can be seen that this blood is forced to the feet, thus no discoloration can occur in the face and neck if the innominate artery is the artery selected for the injection. In no other artery have we this advantage. If we inject the brachial or femoral there would be a tendency to drive this blood into the face and neck, and thus discoloration would be the result.

Method of Locating, Raising and Injecting the Innominate Artery.—The operator, in order to be able to take up and inject the innominate artery, must be familiar with the anatomical landmarks in the vicinity of the sterno-clavicular junction (junction of collar bone to breast bone). The artery is situated in the thoracic cavity at its origin, but it rises out of the cavity a little to the right of the center of the first piece of the sternum, and at about a half-inch above the junction of the collar bone to the breast bone it bifurcates into the common carotid artery and the subclavian artery. The incision should begin at the center of the breast bone and should be directed along the superior border of the collar bone to about the junction of the inner and middle third of that bone.

Jugular vein and carotid artery—artery held by the blunt hook, vein to the right.

This incision will be about three inches in length. Before making the incision, however, it will be well to loosen the skin and subcutaneous tissues covering the right side of the neck and that over the pectoral muscles of the chest. After the skin has been loosened it may be drawn up and put on the stretch, and while in this position the incision should be made from the top of the breast bone outward along the top of the collar bone for the space of three inches. Then the sterno-mastoid muscle will come prominently into view. This may be cut off, or if you have an assistant he may place an aneurism needle around it and pull it to one side, when the fascia covering the innominate artery and jugular veins will come into view. Divide the sheath covering the arteries and expose the vessels. The innominate artery lies to the inside and the internal jugular vein and subclavian to the outside. This point also offers the best advantages for the removal of blood without the use of a flexible silk tube or tapping the heart with a trocar. Tapping the heart with a trocar is a dangerous procedure even in the hands of an experienced anatomist. The introduction of tubes into

Line of incision, after operation.

the femoral and basillic veins does not give satisfaction, is a frequent source of embarrassment, and in many cases the operator has actually thrown them down with disgust. The basillic vein is often of small size and even if it is of large size the drainage tube may in its introduction impinge against the internal anterior thoracic nerve, or on account of the rigidity of the muscles and the peculiar anatomical relation of the axillary vein, the operator in many cases is unable to pass the tube into the right auricle of the heart.

The internal jugular vein on the right side offers the best possible advantage for removing blood from the human body. This may be done while the operator is injecting the innominate artery, by means of a Barnes rubber drainage tube. The blood may be removed from the right auricle of the heart first. *Second*, it may be thrust downward into the right ventricle of the heart, and all of the blood that is in the right ventricle of the heart may be removed. *Third*, the tube is then slightly withdrawn into the auricle, then by inclining it a little forward and inward, it may be pushed down into the inferior venæ cavæ and all the blood in the inferior venæ cavæ and its tributaries, such as the femorals, hepatic, renals, iliacs, etc., may be removed with the aspirator. This drainage tube is a blunt tube with large openings and blood will not clot in it. By this method all the blood that it is possible to remove from the body can be removed in about ten minutes, while by the old methods a half hour to an hour was sometimes spent in the operation of removing the blood.

The Common Carotid Arteries.— These arteries, one on each side of the neck, have a very different origin. The right common carotid artery arises from the innominate just at the posterior part of the sterno-clavicular junction, while the left, which is the longest of the two, springs direct from the highest part of the arch of the aorta, a part of it being contained in the thoracic cavity, while no part of the right common carotid is found in the chest cavity. As soon as the common carotid arteries enter the neck at the sterno-clavicular junction, they take almost the same course. At the point corresponding to the sternum or breast bone, the arteries lie very close together, being separated only by the trachea, or wind-pipe, and the tissues in that vicinity, but as they ascend towards the angle of the jaw they become more widely separated by the larynx, pharynx and thyroid body. Each of the common carotid arteries are inclosed in a sheath derived from the deep cervical fascia. In this sheath, alongside the artery, we have the internal jugular vein and the pneumogastric nerve. The vein is placed to the outer side of the artery, while the nerve is placed in the center, a little posterior or back of each. The artery, at the lower part of its course, is very deeply situated, but as it approaches the upper border of the thyroid cartilage, where it divides into the internal and external carotid arteries, it becomes very superficial and is easy to take up and inject.

How to Locate and Inject the Common Carotid.—This artery is the artery most employed by the medical colleges of the United States in injecting the bodies for dissection. It presents several advantages over the other arteries, and, were it not for the fact that the mark of incision always shows when it is taken up, it would be used in the private practice of the embalmer as much as the brachial or femoral is now. It is larger than these arteries and is very easy of access; it is also nearer to the aorta, and a more direct pressure can be applied through this artery than any other, unless it be the aorta itself.

Linear Guide.—Draw a line from a point midway between the lobe of the ear and the ramus of the jaw (inferior maxillary bone) to the prominence of the sterno-clavicular junction (junction of collar bone to breast bone), the line will correspond to the course taken by the carotid artery.

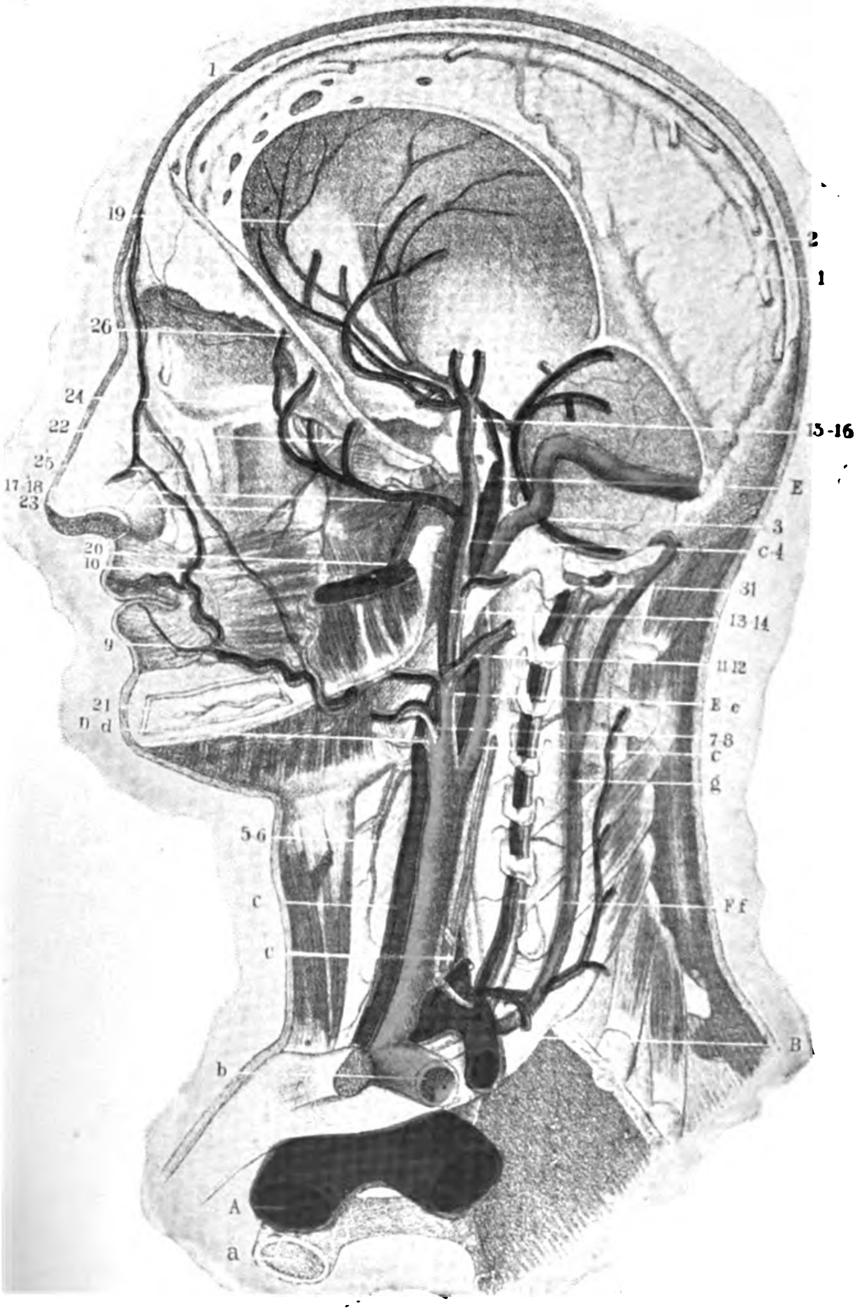
Anatomical Guide.—The artery lies along the inner border of the sterno-mastoid muscle, which muscle forms the prominent cord-like appearance when the neck is turned to one side, the trachea and the throat forming the inner boundary. At the upper part of its course, near its termination, it is very superficial and is only covered over by the platysma, the skin, the deep fascia, and the inner border of the mastoid muscle. The operator should begin his incision between the trachea and the inner border of the muscle, in the groove or hollow formed by these two structures, carefully dissecting away the skin, superficial fascia, and continuing the incision on down upon the sheath of the vessel which is formed by the deep fascia.

The sheath should be taken up by the forceps and gently dissected away from the surrounding tissue, and the whole raised up into the wound by placing the handle of the scalpel beneath the sheath. The sheath should then be divided, and the position of the vessels and nerves ascertained. Sometimes, on account of unskillful manipulation, the sheath is so twisted that the vein will occupy the position of the artery, but, as the reader has already been informed how to tell the difference between the arteries and veins, this will cause no embarrassment. The vein should be separated from the artery and should be opened, and if any blood exists in it, it should be allowed to drain off, after which a flexible silk tube should be introduced into the vein and pushed into the right auricle of the heart, and as much blood as possible should be removed from this part. The artery should then be taken up and an incision made in it corresponding to the long axis of the vessel. This incision should only extend through one side of the walls of the vessel. The arterial tube should be introduced into this opening in the artery and securely held in place by tying it in the vessel. The arterial tube can be held still more firmly by applying a piece of tape to the tubing and around the arm. With the arterial nozzle pointing toward the heart, the injection should now begin. The injection should begin slowly at first, and at no time should undue haste be used, as it would endanger the capillary circulation and might possibly cause a rupture of the vessels. I have injected the arterial system by turning the point of the arterial tube towards the head. An experiment which I conducted with such an injection proved that the anastomosis of the vessels of the brain are even more complete than is generally supposed. A single injection with the ordinary continuous flow syringe, which usually carries about an ounce and a half with each injection, caused the fluid to enter the arteries of the head, to complete the circle of Willis, and make its appearance in the common carotid artery of the opposite side, and the vertebral branches of the subclavian, in the transverse processes of the spinal column.

How to Raise the Common Carotid by Transverse Incision.—The common carotid artery may be taken up and injected by making an incision transversely across the neck, beginning at the center of the top of the breast-bone, and continue the incision just along the collar-bone, dividing the sterno-mastoid muscle at its insertion at the sternum and collar-bone (clavicle). The incision should end at a point corresponding to the junction of the inner and middle thirds of that bone. The sterno-mastoid and the tissues of the neck will have a tendency to draw up in their sheaths, thus making the operation very easy. Care should be taken, in this operation, not to rupture the subclavian artery or its accompanying vein. This operation is recommended by some, on account of the incision being hidden after the neck is dressed. (See innominate artery.)

Internal Carotid Artery.—The internal carotid artery begins just opposite the upper border of the thyroid cartilage, where the common carotid artery bifurcates into the internal and external carotid. From this point of origin it takes a course directly upward along the inner border of the sterno mastoid muscle, and enters the cavity of the skull through the carotid foramen, in the inferior surface of the petrous portion of the temporal bone. At this point it becomes curved upon itself, and describes a curve in the bone, shaped much like the italic letter "*f*." After passing through the carotid canal, the artery passes through the cavernous portion of the bone, and finally enters the cavity of the skull.

It is divided into several different parts in its way to the under surface of the brain. That part of the artery which is situated in the neck is known as the cervical portion; that portion of the artery which is placed within the petrous



Anterio-Posterior Median section of the head and neck showing Internal Carotid and branches, Internal Jugular Veins, Sinuses, etc.

PLATE 10.

A. Aorta. a, Second rib.
B. Subclavian artery. b, Subclavian vein.
C. (upper) Internal carotid artery.
C. (lower) Internal jugular vein.
C-4. Internal carotid.
d. Facial vein.
E. Internal carotid passing through carotid canal in temporal bone.
E-e. Tempero-maxillary vein.
F. Vertebral artery.
g. Spinal vein.
1 & 2. Longitudinal sinus and tributaries.
3. Lateral sinus.
4. Carotid.
5-6. Superior thyroid artery.
7-8. Origin facial branch external carotid.
9. Facial artery.
10. Vein to internal jugluar.
11-12. Internal jugular vein.
13-14. Ascending pharyngeal artery.
15-16. Middle meningeal artery.
17-18. Internal maxillary.
19. Anterior branch of middle meningeal artery.
20. Inferior dental.
21. Termination of inferior dental.
22. Tympanic artery.
23. Vein.
24. Anterior branches internal maxillary artery.
25. Anterior venous tributary to internal jugular vein.
26. Infra orbital artery.

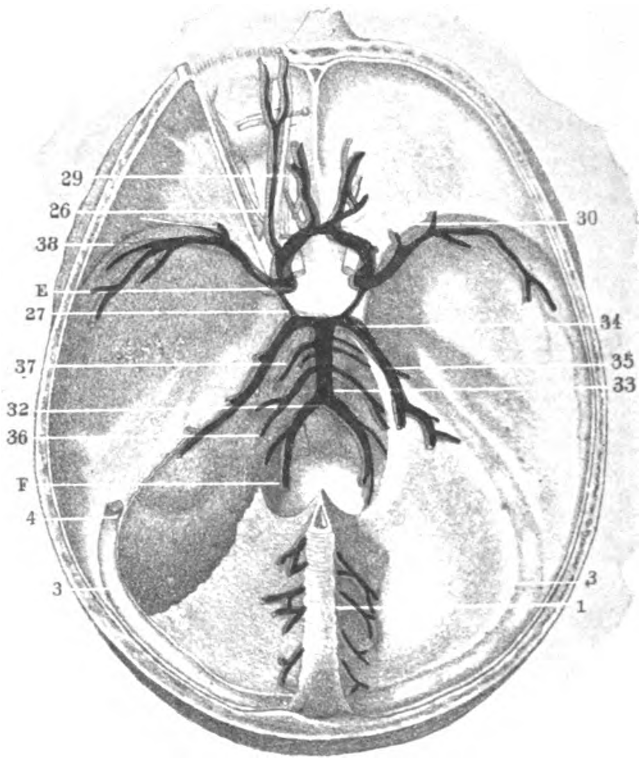
portion of the temporal bone is known as the petrous portion; the portion of the artery which occupies the cavernous portion of the bone is known as the cavernous portion, while that part of the artery which aids in the formation of the circle of Willis, and supplies the brain and its membranes, is known as the cerebral.

In the course of the artery several branches are given off. All of these are derived from the petrous, cavernous, and cerebral portions of the vessel, the cervical portion giving off no branches. The deep tympanic is derived from the petrous portion of the artery. The ophthalmic artery, which gives off eleven small branches to supply the eye and its appendages, and the arteria receptaculi, and the anterior meningeal arteries, are derived from the cavernous portion of the vessel. Those branches which play so important a part in the formation of the circle of Willis are derived from the cerebral portion of the artery; they are: the cerebral, the anterior choroid, and the posterior communicating.

The External Carotid Artery is that branch of the common carotid artery which supplies the tissues of the face and anterior part of the neck. It arises, or branches off from the common carotid artery at the upper border of the thyroid cartilage, and ascends toward the head, passing between the condyle of the lower jaw and the lobe of the ear. Just about this part of the course of the artery, it divides into its terminal branches—the temporal, and the internal maxillary. The external carotid artery becomes very superficial just opposite the upper border of the ear, where it emerges from the parotid gland. The beating of this artery, or pulse, can be felt very easily at this point. The internal maxillary branch of this vessel gives off fourteen branches, which give to the tissues and the inferior maxillary bone a very large blood supply. The temporal branch is smaller than the internal maxillary branch. It is distributed to the temple and tissues in the vicinity of the ear. The main branches of this vessel are: the transverse facial, the anterior temporal, the orbital, and the posterior temporal. The two temporal branches of the carotid supply the scalp and forehead; also, the tissues of the ear and the muscles in the upper margin of the face. They anastomose very freely with the one of the opposite side; also, with the posterior occipital branch. The carotid arteries, on account of the number of branches given off, form nearly the whole blood supply to the head and neck, the vertebral and the basilar branches being the remaining ones to complete the circulation of these parts.

The Circle of Willis.—The circle of Willis is that circle of arteries which is placed at the base and under surface of the brain. It is formed by the two internal carotid arteries and the basilar, the branches of these vessels uniting to form the circle. The two anterior choroid branches of the internal carotid are joined together by the anterior communicating artery, which completes the front or anterior part of the circle. The back or posterior part of the circle is formed by the two posterior cerebral branches of the basilar artery, which is joined to the branches of the internal carotid artery by the posterior communicating artery, which thus completes the circle. For experiment on the anastomosis of this circle, see Common Carotid Artery.

The Subclavian Arteries — two in number — arise, one on each side of the arch of the aorta. The right subclavian is a branch of the innominate artery, but the left is a direct branch from the arch of the aorta and is somewhat longer than the right. It will thus be seen that, since these vessels have a different point of origin, their relations will be different, at least in the first part of their course; the second and third parts of the subclavian artery are nearly alike, the difference being so slight that it would be out of place to describe them separately in a work of this kind.



Base of the Skull, and Circle of Willis.

PLATE 11.

E. Internal carotid.
F. Vertebral arteries.
1. Occipital sinus.
3. Lateral sinus.
4. Lateral sinus divided.
26. Frontal branches internal carotid.
27. Posterior communicating artery.
29. Anterior cerebral (choroid) arteries.
30. Anterior communicating artery.
32. Formation of basilar by vertebral arteries.
33. Basilar artery.
34-5. Posterior cerebral artery.
36. Anterior cerebellar branch of basilar.
37. Branch of basilar.

The left subclavian artery, on account of its origin, takes a more vertical course than the right, and ends just at the inner border of the scalenis anticus muscle. As the artery ascends toward the axilla it is crossed by the internal jugular veins, also the vertebral veins, which are much smaller than the jugular. On the right side, the subclavian artery arises just back of the sterno-clavicular junction (breast-bone to collar-bone), and can be taken up at this place by making an incision just above the bone and then taking up the artery by means of a hook and forceps. The artery, at its ending at the scalenis anticus muscle, emerges into the axillary artery, which is slightly smaller than the subclavian. The vertebral is a branch of the subclavian. It forms, with its fellow of the opposite side, the basilar artery, which supplies the brain.

The Axillary Artery.

The axillary artery, which begins at the lower border of the first rib, describes a gentle curve downward towards the inner side of the arm, until it reaches the lower border of the insertion of the latissimus dorsi muscle, where it becomes the brachial artery. Beginning just at the lower border of the bicipital groove of the humerus (arm bone) the brachial artery extends on to the center of the elbow. As the axillary artery emerges from the under surface of the costocoracoid ligament, the axillary vein lies to the inner side, but, as it approaches the humerus (arm bone), the vein changes its relations and is found lying in front, and a little above the artery. The branches of the axillary artery are very numerous, being seven in all. They are as follows:

superior thoracic, thoracica acromialis,
inferior thoracic, thoracica axillaris.
anterior circumflex, subscapular,
posterior circumflex.

These branches are nearly all of large size and are distributed to the tissues of the axilla and the muscles covering the front and back part of the thorax. Some of the branches are distributed to the serratus magnus muscle at the sides of the chest.

The Brachial Artery.

This vessel, on account of its location and the ease with which it may be taken up and injected, is the artery most fre-

Operator Raising Brachial Artery in its Middle Third.

quently used by the embalmer. It is placed at the upper and inner side of the arm and extends from the lower border of the bicipital groove of the humerus to the center of the elbow, where it divides into the radial and ulnar arteries. As it approaches the elbow joint it is placed more anteriorly and in front of the arm, while at the beginning, and a little below, it lies more to the inner and posterier part of the arm. This artery is the direct continuation of the axillary artery, which ends just at the end of the teres major muscle. At this point the artery is placed just between the coraco brachialis muscle and the biceps muscle above and the triceps muscle below

FIG. 1.

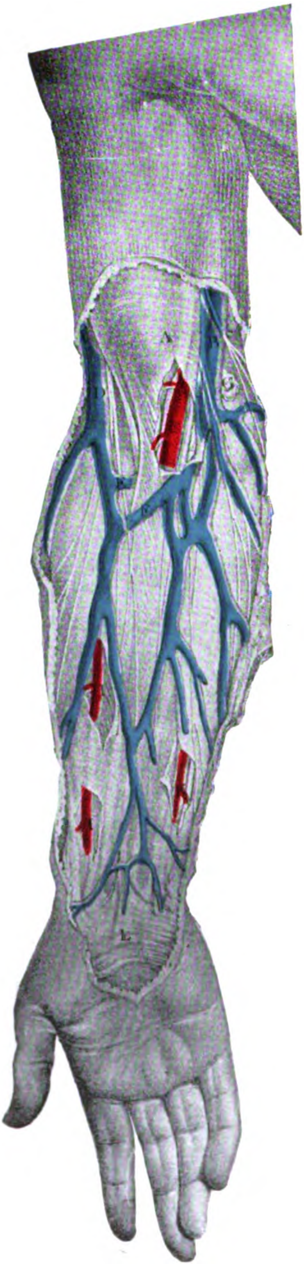


FIG. 2.

PLATE 12.

FIG. 1.

A. Fascia covering the biceps muscle.
B. Basilic vein.
C. Brachial artery with venæ comites.
D. Cephalic vein.
E. A communicating vein joining the venæ comites.
F. Median basilic vein.
G. Lymphatic gland.
H. Radial artery.
I. Radial artery at the wrist, where it may be taken up and injected.
K. Ulnar artery and ulnar nerve.
L. Palmaris brevis muscle.

FIG. 2.

A. Biceps muscle.
B. Basilic vein.
C. Brachial artery, lying to inner side of basilic vein.
D. Median nerve. d, Ulnar nerve.
E. Brachialis anticus muscle.
F. Origin of radial artery.
G. Supinator radii longus muscle.
H. Aponeurosis of the tendon of the biceps muscle.
I. Pronator teres muscle.
K. Flexor carpi ulnaris muscle.
L. Flexor carpi radialis muscle.
M. Palmaris longus muscle.
N. Radial artery, with radial nerve to outer side.
O. Flexor sublimus digitorum muscle.
P. Flexor pollicis longus.
Q. Median nerve.
R. Lower end of radial artery.
T. Lower end of ulnar artery.
U. Extensor metacarpi pollicis.

and anteriorly, but, as the artery approaches the lower third of its course, it is slightly overlapped by the fascia of the biceps, and rests upon the brachialis anticus muscle. The brachial gives off five branches, which are distributed to the humerus, or arm bone, and the muscles of the upper arm. These branches are:

the { muscular, superior profunda,
nutrient, inferior profunda,
anastomotica magna.

The superior profunda and the anastomsing branches are the ones principally concerned in the collateral circulation of the arm, when the artery is divided and a ligature placed around it. It is by these branches inosculating with the branches of the recurrent ulnar and articular branches of the radial that the fluid injected into the artery reaches the lower part of the arm when the arterial nozzle is turned towards the heart, and the vessel ligated.

Linear Guide.—The linear guide for taking up the brachial artery is formed by a line drawn from the anterior and middle third of the axillary space, or arm-pit, to the center of the elbow. This guide applies to the arm when the palm of the hand is turned up or placed in a supinated condition, but if the hand is not so placed, the linear guide would be somewhat changed and should correspond to a line drawn from the center of the arm-pit to the inner condyle of the humerous (prominence on the inner side of the elbow joint). This latter guide applies to taking the artery up in its middle and upper thirds.

The Anatomical Guides.—The brachial artery is very superficial in the greater part of its course, being covered over by the skin superficial and deep fascia, while at the lower part the bicipital fascia covers over it, and near its middle third it is crossed by the median nerve. The artery, together with the accompanying veins (venæ comites), will be found lying in the groove formed by the biceps and coraco brachialis muscles above and the triceps muscle below. The basilic vein lies to the inner side; then comes the artery, while to the upper and outer side we have the nerve. The two small veins which accompany the artery are generally connected together by small branches. The vessels and nerves found in this groove, and which prove of so much trouble to the beginner on account of the difficulty of separating the veins and nerves from the artery, are the median basilic vein, the ulnar, internal cutaneous and median nerves, the basilic vein and venæ comites. In order to diagnose these structures from one another the reader is referred to the chapter on the Histology of the Arteries and Veins (Anatomical Elements), pages 63, 64, 65.

Anomalies of the Brachial Artery and Peculiarities as Regards Its Course.—More often in the dark races, and sometimes in white persons, the brachial artery, instead of following its usual course, will be found taking a direct course straight down the arm to the inner side of the humerus (internal condyle), from which it regains its usual position and divides into the radial and ulnar arteries about one-half inch below the center of the elbow joint. Another anomaly, which is sometimes met with, is where the artery divides into two—just at the point of its origin—and is continued down the arm as two arteries, which are about half the size of the single artery; these subsequently unite just above the elbow, to form a single trunk, which gives off the radial and ulnar in their usual places. In other cases, the artery divides high up in the arm and forms two arteries, which may continue on down to the palmar arches as single vessels; this division of the artery high up in the arm, forming two small branches, is the most frequent anomaly of this vessel, but, according to the writings of those who have made a great many dissections on these parts, the exact percentage varies. R. Quain says

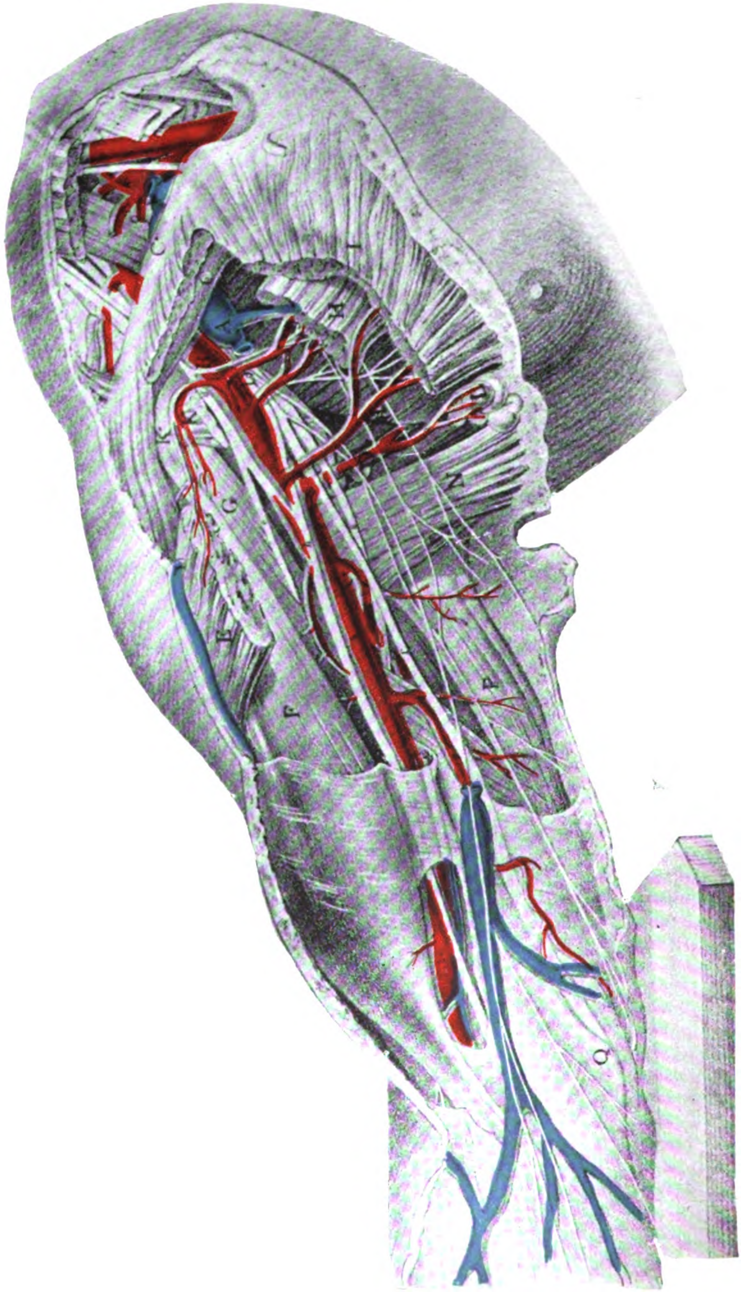


PLATE 13.

A. Axillary vein cut and tied.

B. Axillary artery. b, Brachial artery in the upper part of its course, having (h) the median nerve lying to its outer side; b, the artery in the lower part of its course, with the median nerve to its inner side.

C. Clavicle (collar-bone), and (c) subclavius muscle beneath.

D. Axillary plexus of nerves.

E. Humeral part of pectoralis major muscle.

F. Biceps muscle.

G. Coraco brachialis muscle.

H. Thoracic end of pectoralis minor muscle.

I. Thoracic end of pectoralis major muscle.

K. Coracoid attachment of the pectoralis minor muscle.

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.

that this anomaly takes place in one case in every five and one-ninth persons, while from the statistics of Gruber and Sheppard, who have made double the dissections of Quain (one thousand seven hundred arms), this division or anomaly occurs in one case out of every eleven and six-tenths cases. This variation in the course of the brachial artery should be remembered by the operator, for, should the vessel not be found in its usual position, he could locate the remaining vessels, which are somewhat smaller and are placed more to the sides and deeper in the tissues of the arm, or should continue the incision upward to the ending of the axillary.

How to Locate, Raise and Inject the Brachial Artery.—In order to inject the brachial artery, the arm should be placed at a right angle to the body, with the palm of the hand turned upward. This has the effect of bringing the artery to a more superficial position, and of placing it in a straight course, corresponding to the linear guide previously given. The operator, after noting the linear guide and feeling for the groove between the muscles, should begin his incision at about the junction of the lower and middle thirds of the artery, or about three inches above the elbow. The first incision should be made in the line of the vessel and divide the skin and superficial fascia; these should be carefully dissected aside, and then the deep fascia, which forms a partial sheath for the vessels and nerves in this region, should be divided by catching it up with the forceps and cutting through it with the scalpel. As soon as you have cut through the deep fascia of the arm the vessels will be exposed and can be seen in their true position. The basilic vein is placed to the inner side, then the brachial artery, and on the outer or external part you have the nerve. The artery is of a creamish-white color, while the veins are slightly bluish and contain more or less dark, fluid blood. By rubbing the hands over the course of the veins of the fore-arm, from below upward, the blood will make its appearance in the veins and will be noticed by the operator. The nerves are white tense cords, which can be separated by dividing them with the sharp hook (tenaculum) or the scalpel.

After you have separated the artery from the veins and nerves, it should be lifted partly out of the wound and an incision about one-half inch in length should be made through the walls, being careful not to cut through both sides of the artery. The arterial nozzle or tube should then be introduced, pointing toward the heart, and then tied in position, after which a ligature should be placed around the lower end of the vessel. The tubing should now be connected to the arterial nozzle and the injection begun, the operator using his own judgment as to the amount of the fluid required, but in no case should the injection be performed hurriedly, as it tends to rupture the capillaries and cause discoloration of the face. A great many embalmers have a preference for either the right or left brachial artery, but in reality one is just as good as the other. The left brachial artery has the most supporters, because the left basilic vein, which lies alongside of it, presents the best advantages for the removal of blood, and on this account it is more generally used.

The Radial and Ulnar Arteries.

The Radial Artery is given off from the brachial artery just below the bend of the elbow, and takes a course along the radial side of the fore-arm to the wrist, where it changes its course, and, after curving around the back part of the thumb, penetrates between the heads of the dorsal interosseus muscle, enters the deep tissues of the palm of the hand and crosses to the ulnar side, to form the deep palmar arch. This artery is quite superficial just above the wrist joint, where it is very easy to take up and inject. On account of its small size, it cannot be used to any good advantage, except

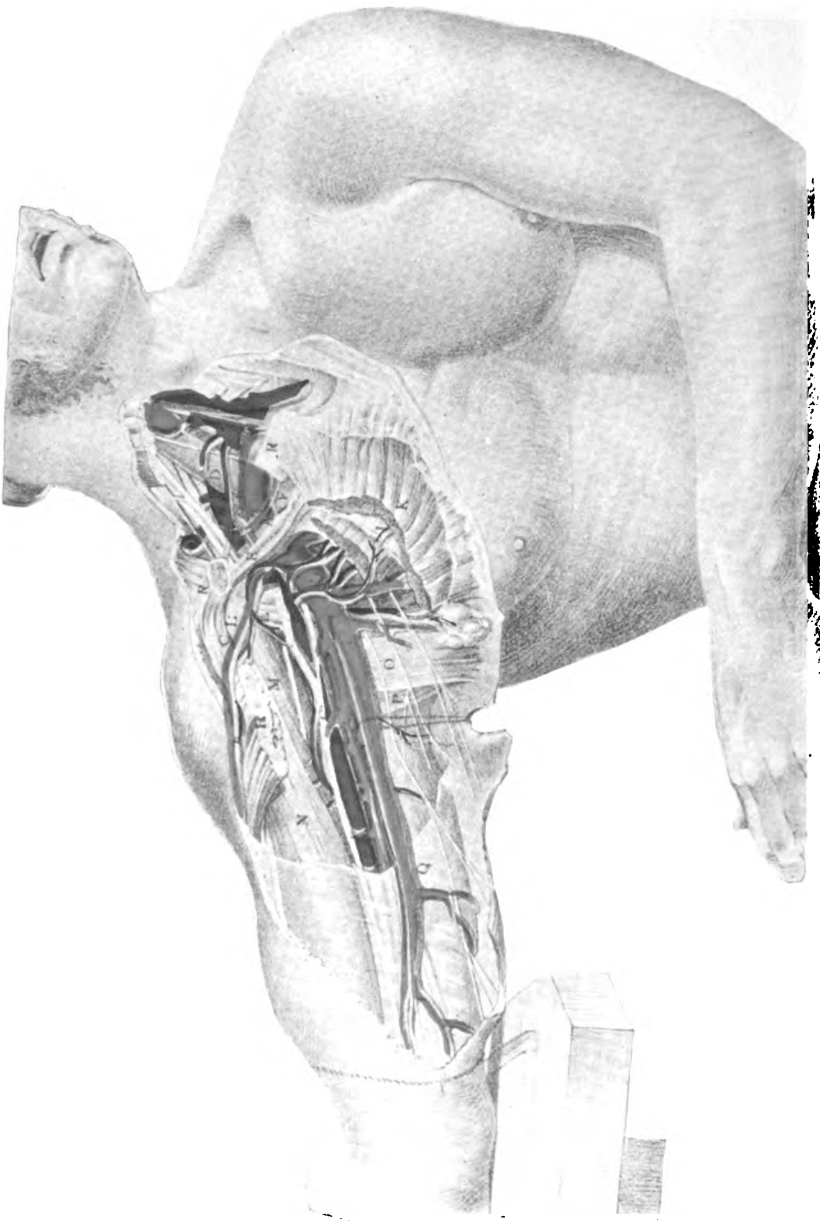


PLATE 14.

A. Subclavian vein after having received the axillary, cephalic and venæ comites of brachial.

B. Subclavian artery.

CC. Brachial plexus of nerves.

D. Anterior scalenus muscle.

E. Subclavius muscle.

FF. First rib.

G. Clavicular attachment of deltoid muscle.

H. Humeral insertion of great pectoral muscle.

I. Fascia covering pectoralis minor muscle.

K. Thoracic portion of pectoralis major muscle.

LL. Coracoid process of scapula and coracoid attachment of pectoralis minor muscle.

M. Coraco brachialis muscle.

N. Biceps muscle.

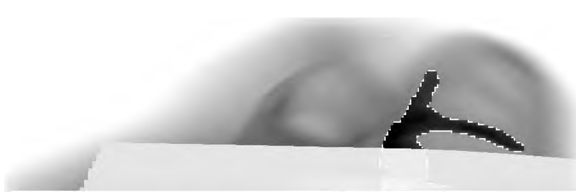
O. Tendon of the latissimus dorsi muscle.

P. Teres major muscle.

Q. Brachial fascia.

RR. Scapular and sternal ends of collar-bone (clavicle).

S. Cephalic vein coursing between the deltoid and pectoral muscles, to enter the axillary vein in the cellular tissue beneath E—subclavius muscle.



in an adult subject, but in those cases where the subject to be embalmed is a female, and where the sleeves are tight, and in order that no exposure take place, or cutting of sleeves, this artery answers the purpose very well; but, even in this case, the posterior tibial is larger and is much better to use than the radial. The radial artery, in the lower part of its course, where it is usually taken up, is placed between the tendons of the supinator longus and flexor carpi radialis muscles. An incision through the skin and fascia between these two muscles, will expose the radial artery and its accompanying veins.

The branches given off by the radial artery are eleven in number:

the {
recurrent radial, and the muscular to the fore-arm;
superficialis volæ, anterior and posterior carpalis; dorsales policis and metacarpales, to the wrist;
princeps policis, radialis indicis, interosseous, and perforantes, to the palm of the hand.

The Ulnar Artery is a trifle larger than the radial, and takes almost a similar course down the arm, on the ulnar side, to the wrist, where it crosses the annular ligaments and forms the superficial palmar arch by uniting with the superficialis volæ of the radial artery. This artery is seldom used by the embalmer, on account of its small size and the difficulty of locating it, because of its depth, being placed deeper than the radial. It has accompanying it, the venæ comites and, in the lower two-thirds of its course, the ulnar nerve. The branches given off by the ulnar are:

the	anterior recurrent,		interosseus,
	posterior recurrent,		anterior and
	muscular,	digitales,	posterior carpalis.

How to Inject the Radial Artery.—The operator should place the arm in a position almost similar to that for inject-

ing the brachial artery, only the arm need not be placed at so much of a right angle. The palm of the hand should be turned upward and the hand bent backward upon itself. This [illegible] the flexor tendons on a stretch and will raise the radial artery to a more superficial position just beneath the skin [illegible] the tendons on either side. These tendons are [illegible] the [illegible] a small groove or [illegible] between them [illegible] be used as a guide in raising up the artery. The operator should begin about two

FIG. 3.

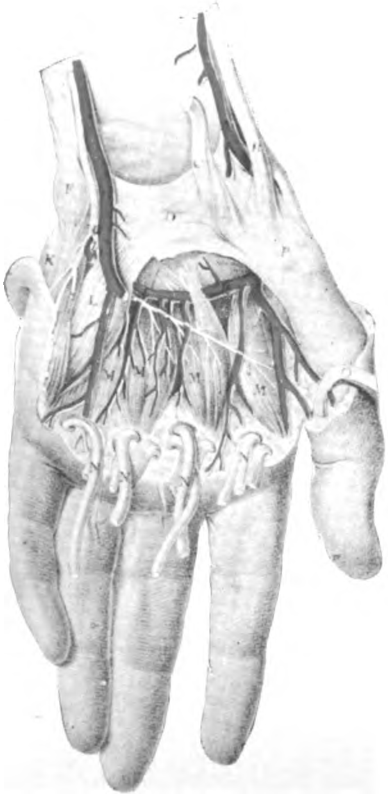


FIG. 2.

FIG. 1.

PLATE 15.

FIG. 1.

A. Radial artery.
B. Median nerve and branches.
C. Ulnar artery forming F—superficial palmer arch.
D. Ulnar nerve.
G. Pisoform bone covered by tendon.
H. Abductor minimi digiti.
I. Tendon of flexor carpi radialis muscle.
K. Opponens pollicis muscle.
L. Flexor brevis muscle.
M. Flexor brevis pollicis muscle.
N. Abductor pollicis muscle.
OOOO. Lumbracales muscles.
PPPP. Tendons of flexor sublimus digitorum muscle.
Q. Tendon of flexor longus pollicis muscle.
R. Tendon of extensor meticarpi pollicis.
S. Tendons of extensor sublimus digitorum muscle.
T. Tendon of flexor carpi ulnaris muscle.
U. Union of digital arteries.

FIG. 2.

AAA. Tendons of extensor digitorum communis.
B. Annular ligament.
C. End of radial nerve.
D. Dorsal branch of ulnar nerve.
E. Radial artery.
F. Tendon of extensor carpi radialis brevior.
G. Tendon of extensor carpi radialis longior.
H. Tendon of third extensor of thumb.
I. Tendon of second extensor of thumb.
K. Tendon of extensor minimi digiti joining aponeurosis of extensor communis.

FIG 3.

A. Radial artery.
B. Tendons of extensor muscles of thumb.
C. Tendons of extensor carpi radialis.
D. Annular ligament.
E. Deep palmar arch, formed by radial artery giving off "e" branch to join deep palmar branch of ulnar artery.
F. Pisoform bone.
G. Ulnar artery.
H. Uluar nerve and branches.
K. Abductor minimi digiti muscle.
L. Flexor brevis minimi digiti muscle.
N. Tendons of flexor sublimus digitorum profundus and lumbracales muscles.
O. Tendon of flexor policis longus.
P. Carpal end of metacarpal bone.

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inches above the thumb in the center of the groove caused by the tension of the supinator longus and the flexor carpi radialis muscles, and should be deep enough to cut through the skin the first time; then the fascia will appear, which may be dissected aside, and the artery will be brought into view.

Carefully dissect away the surrounding cellular tissue and the fascia, and by means of a hook lift the artery and vein out of the wound and place the handle of the scalpel, or other instrument, beneath it. Next, dissect the vein away from the artery, and then make an incision in the vessel similar to that described for the brachial artery. On account of the small size of the artery as compared with the brachial, it is necessary to have a much smaller injecting tube, and for this purpose the embalmer should have assorted sizes of these tubes, so that he can secure the exact size that he desires. After you have injected sufficient fluid, tie the vessel at both the distal and proximal ends, remove all superfluous fluids by means of absorbent cotton, then bring the sides of the wound together, using the stitch commonly known as the "base ball stitch." This stitch brings the tissues close together and closes the wound very neatly, after which a small piece of court plaster will hide all marks of the incision.

Arteries of the Lower Extremities.

The arteries of the lower extremities are larger in proportion to the arteries of the upper; thus it will be found that the femoral artery in the thigh, which corresponds to the brachial in the arm, is much larger than the latter vessel, and is a good artery to inject. Having considered the arteries of the head and neck and upper extremities—also the aorta and its branches as far as the common iliac arteries—I will now describe those vessels and the remaining arteries which supply the viscera and lower parts of the abdomen, also the femoral and its branches.

The Common Iliac Arteries.—As soon as the abdominal aorta descends on the left side of the fourth lumbar vertebra, it divides into the right and left common iliac arteries. These arteries are about two and one-half inches in length; the right, on account of the aorta being placed on the left side of the spinal column, is a little longer than the left. The common iliac arteries take a course downward and outward towards the center of Poupart's ligament, but just as the artery crosses the sacro-iliac symphysis it divides into the external and internal iliac arteries. It is said by some anatomists that in old persons the common iliacs are more curved in their course, and that the diameter of the vessel is increased.

The relations of the two vessels is somewhat different. The right common iliac in its course toward the thigh is in relation posteriorly with the common iliac veins, while external to it we have the psoas magnus muscle; in front it is touched by the peritoneum and is crossed, just opposite the sacro-iliac symphysis, by the ureter, the tube leading from the kidney to the bladder and which serves to convey the urine from the pelvis of the kidney to the bladder. The left common iliac is in relation with the peritoneum in front, is crossed by the rectum and superior hemorrhoidal artery and at the bifurcation by the ureter, while externally it is in relation with the psoas magnus muscle and posteriorly with the left common iliac vein. In the female subject the bifurcation at the aorta is much more acute than in the male subject.

The Internal Iliac Artery.—This artery, which branches from the common iliacs just opposite the sacro-iliac symphysis, is the artery which supplies the viscera and muscles of the deep parts of the pelvis. It is a short, thick vessel, varying in length from one to one and one-half inches, and in some cases two inches, dividing into an anterior and a posterior branch. The vessel rests upon the head of the pyriformis muscle, and is in relation in front with the ureter, while the iliac vein will be found just posterior or back of the artery, which in the whole of its course rests on the sacral plexus of nerves. The branches given off from the internal iliac are eleven in number. Those from the anterior branch are:

the { middle hemorrhoidal, middle vessicle, umbilical, }

ischiatic,
internal pudic,
uterine, } in the female.
vaginal, }

Those given off from the posterior trunk are:

ilio-lumbar, gluteal,
obturator, lateral sacral.

The middle hemorrhoidal artery supplies the rectum, base of the bladder, prostate glands and vesiculæ seminales. It finally anastomoses with the superior and external hemorrhoidal vessels.

The middle vesical artery is distributed to the back and lower part of the body of the bladder, the prostate gland and the vesiculæ seminales, and the tissues in the vicinity of the neck of the bladder. Sometimes this artery is given off as a branch of the umbilical.

The umbilical artery is the commencement of the fibrous cord through which the umbilical artery of the fœtus is converted after birth. The superior vesical artery is a branch of the umbical artery in the adult; it supplies the upper and anterior walls of the bladder.

The ischiatic artery and the internal pudic artery are the two terminal branches of the internal iliac artery. The remaining vessels worthy of mention are those which supply the uterus, or womb, and the vaginal, which is distributed to the vaginæ.

The uterine artery is one of the most tortuous arteries in the body of the female. It is placed between the folds of the broad ligament, then enters the substance of the womb, supplying that organ with blood. The vaginal artery is distributed to the mucous tissues of the vaginal canal. It is not as large as the uterine. In the pregnant state the uterine artery increases in length on account of the increase in size of the uterus; at the same time the calliber of the vessel is slightly increased.

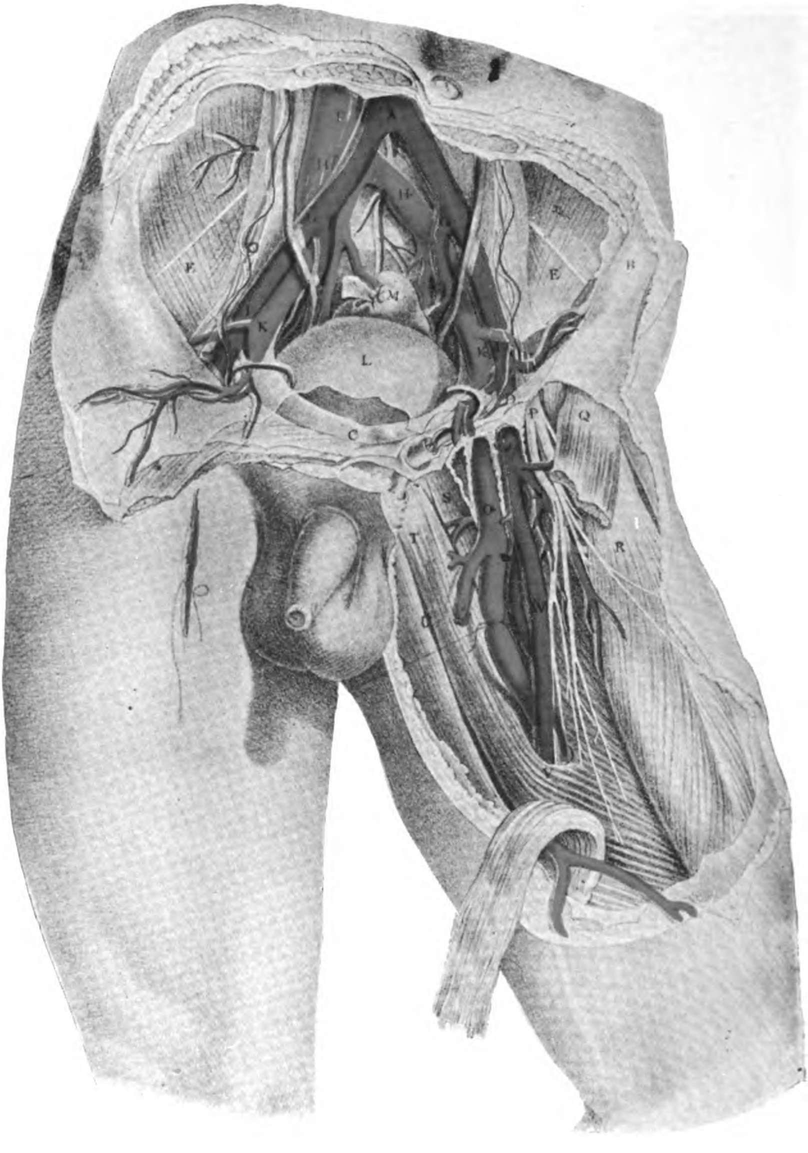
The External Iliac Artery.—This artery is the direct continuation of the common iliac. It passes out of the abdomen along the inner side of the psoas muscle, until it reaches the under surface of the center of Poupart's ligament, or femoral arch, where it becomes the femoral artery. The external iliac vein accompanies the artery which is in relation, in front, with the peritoneum and a thin layer of fascia; this fascia forms a partial sheath for the artery and vein. The artery gives off several small branches and two large branches—

the { epigastric,
circumflex ilii.

The epigastric branch takes a course upwards along the under surface of the rectus muscle, a few small branches being distributed to the substance of that muscle, after which it is continued on up to the under surface of the ensiform cartilage (end of breast-bone), where it anastomoses with the branches of the internal mammary.

The circumflex ilii is given off just opposite the epigastric, or close to it, on the external side of the external iliac; it takes a course upwards and backwards along Poupart's ligament, until it reaches the crest of the ilium (hip-bone), where it is distributed, by means of numerous branches, to the internal and external oblique and transversalis muscles.

The Femoral Artery.—The femoral artery is, probably, next to the brachial artery, the one most used by the undertaking profession. It is larger than the brachial, and easy to raise and inject. The femoral artery is the direct continuation of the external iliac artery, which artery takes a direct


A
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R

PLATE 16.

A. Aorta at its point of bifurcation.

B. Anterior superior iliac crest (prominence of hip-bone).

C. Symphysis pubis.

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

EE. Right and left iliac muscles, external cutaneous nerve.

F. Inferior vena cava.

GG. The common iliac arteries giving off the internal iliacs.

HH. Right and left common iliac veins.

I I. Right and left external iliac arteries crossed by the circumflex iliac veins.

KK. Right and left external iliac veins.

L. The urinary bladder partially covered by peritoneum.

M. Rectum.

N. Superior profunda branch of femoral artery.

O. The femoral vein. o. Internal saphenous vein.

P. Anterior crural nerve.

Q. Sartorious muscle divided.

S. The pectinaeus muscle.

T. Adductor longus muscle.

U. Gracillus muscle.

V. Tendinons sheath in the adductor magnus muscle, through which the femoral artery and vein pass, commonly called Hunter's canal.

W. The femoral artery. This vessel is covered by the sartorious muscle in the space between the letter and Hunter's canal.

course from the sacro-iliac symphysis to the middle or center of Poupart's ligament. Just as soon as it passes beneath Poupart's ligament it becomes the femoral artery. It takes a course from the center of the ligament, downwards and inwards, to Hunter's canal, where it pierces the muscular part of the thigh, and becomes the popliteal artery, just back of the knee joint in the popliteal space.

In the course of the artery, several large branches are given off. These branches supply the upper and anterior part of the thigh with blood. The branches given off from the artery, from above downward, are as follows:

superficial epigastric,	profunda,
superficial circumflex iliac,	external circumflex,
superficial external pudic,	internal circumflex,
deep external pudic,	three perforating,
muscular,	anastomotica magna.

The most important thing concerning these arteries, to the embalmer, is the collateral circulation or anastomosis of the vessels. By a knowledge of the anastomosing branches he is able to tell just how the fluid reaches the lower arteries and vessels of the leg, when the injection is made into the femoral artery in scarpas triangle, the nozzle turned towards the heart. All embalmers, who have performed injections into the arterial system, have noticed that, after a successful arterial injection, the fluid would leak out of the lower divided end of the vessel, although no fluid was injected that way; this is caused by the collateral circulation, or the inosculation of one artery with the branches of another.

In the femoral artery, if the injection is performed on the common femoral just beneath Poupart's ligament, then the anastomosis will take place through the branches of the gluteal and circumflex iliac arteries above, anastomosing with the external circumflex branch of the profunda below. When the artery is taken up in its superficial course, or at the lower third of the triangle in the thigh, then the anastomosis takes place through the profunda artery, which enlarges and sends off branches which inosculate with the superior articular branches of the popliteal artery back of the knee joint. Thus, the branches of the profunda, which accompany the sciatic nerve, and the superior articular branches of the popliteal, and sometimes the branches of the anterior and posterior tibial artery, form the principal channels of collateral circulation after the femoral is ligated.

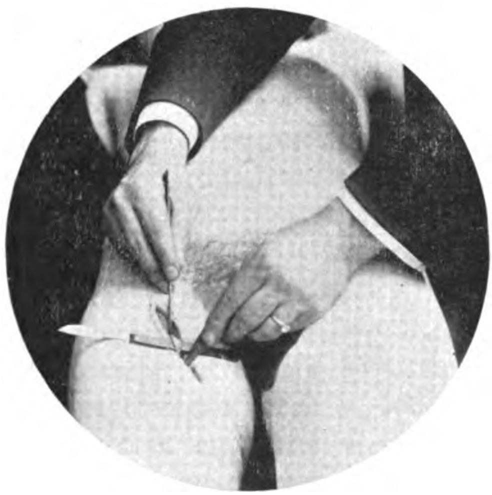
Linear Guide for Locating The Femoral Artery.—In order to locate the femoral artery, the embalmer should become familiar with the surface markings; these are formed by first drawing a line from crest of the ilium (prominence of the hip bone) to the spine of the pubes, or the front part of the pelvis at the lower central part of the abdominal cavity; the line drawn from the spine of the pubes to the crest of the ilium will correspond to the course of Poupart's ligament. The second line should intersect the first line at the center, and should be drawn from the center of Poupart's ligament to the inner side of the knee joint; the foot should be turned outward. The line drawn from the center of Poupart's ligament to the inner condyle of the knee joint will correspond to the course taken by the artery. If the incision is made on this line in the upper third of the thigh, the operator will have little trouble in locating the vessel.

Anatomical Guide.—The anatomical guide for the femoral artery is formed by scarpas triangle. This triangle is situated in the upper and anterior aspect of the thigh. It is formed by muscles and ligaments, being bounded externally by the sartorious muscle, which extends from the crest of the ilium in front to the internal condyle of the knee joint, being inserted into the tibia. The internal boundary is formed by the adductor longus muscle—the muscle which adducts the thigh—while the upper boundary is formed by

Poupart's ligament. The femoral vessels and nerves describes a course right through the center of the triangle, the base of which is formed by Poupart's ligament. The floor of the triangle is formed by the adductor longus, adductor brevis, iliacus, psoas and pectineus muscles; the course of the femoral artery then being over these muscles and through the center from base to apex.

Method of Raising and Injecting the Femoral Artery.

The operator, in order to raise and inject the femoral artery, should begin his incision at a point corresponding to the



middle third of the artery, or at the lower border of scarpas triangle. At this place the artery is very superficial, and at the same time you are below the profunda branches which play so important a part in the collateral circulation; thus it is the best place for injecting it. The first incision should be deep enough to divide the skin and the fatty tissues beneath; this will bring you down upon the superficial fascia, which is very close to the sheath of the vessel. The next incision should be made with care and in the long axis of the vessel, carefully dissecting away the superficial fascia and the deep [illegible] n the direction of [illegible] long enough to admit the [illegible] The arterial nozzle [illegible] this opening and carefully [illegible] below the point of entrance [illegible] The injecting apparatus should now be [illegible] necessary for the preservation [illegible] should be introduced. After [illegible] have injected sufficient [illegible] the vessel with [illegible] at hand, use silk or [illegible] the next step [illegible] The super- [illegible] absorbent [illegible]

PLATE 17.

A. Muscular part of external oblique, (a) its aponeurosis.
B. The umbilicus (navel).
C. Anterior superior iliac spine (prominence of hip-bone).
D. The spine of the pubis.
E. The cremasteric fascia.
F. Muscular part of internal oblique.
G. The linea alba (median line).
H. Iliac portion of fascia lata.
I. Femoral vein receiving internal or long saphenous branch.
K. The femoral artery.
L. Anterior crural nerve.
M. Sartorious muscle.
N. Sheath of femoral vessels.
O. Internal saphenous vein.
P. Pubic part of fascia lata.

being in the middle third of its course, this mistake would not occur, unless the embalmer continues his incision deep into the muscular parts of the thigh. However, it would make little difference whether you injected the main trunk or the deep femoral, since there is but very little difference in their size.

Relations of the Artery to Surrounding Tissues.—The superficial femoral artery has covering it, in front: the skin, fascia, internal cutaneous and internal saphenous nerve; it is also partly overlappled by the inner border of the sartorious muscle. Behind, it is in relation with: the femoral vein, the profunda artery and vein, and the muscles known as the adductor longus and adductor magnus; also the pectineus muscle. To the outer side of the artery we have: the vastus internus muscle, the femoral vein lying a little posterior, along with the saphenous nerve. On the inner side we have the adductor magnus, the adductor longus, and the sartorious. It will be seen that these relations correspond to the superficial femoral in the lower part of its course, but, as the artery approaches Poupart's ligament, the vein will be found on the inner side, and the nerves to the outer side.

Popliteal Artery.

The popliteal artery is the direct continuation of the femoral. It begins at the opening in the adductor magnus muscle, and continues directly through the center of the popliteal space to the lower border of the popliteus muscle, where it divides into the anterior and posterior tibial arteries. This artery is seldom used by the embalmer, as it is situated just back of the knee joint and is placed in such a position as to render the taking up of it a very hard task, as the subject would have to be turned, more or less, to the side. It has many branches, which are principally distributed to the tissues around and entering into the formation of the joint.

Branches.—The first branches given off by the popliteal artery are the two muscular, superior and inferior. The remaining branches are as follows:

superior external articular.	cutaneous.
superior internal articular.	inferior external articular.
azygos articular.	inferior internal articular.

This artery is frequently the seat of aneurisms. It may also [illegible] above the usual place, forming an anomaly of the [illegible] similar to that found in the [illegible] in one of every [illegible] arms. One of the peculiar phenomena concerning the [illegible] artery in the dead subject is the ease with which [illegible]

[illegible]

FIG. 1.

FIG. 2.

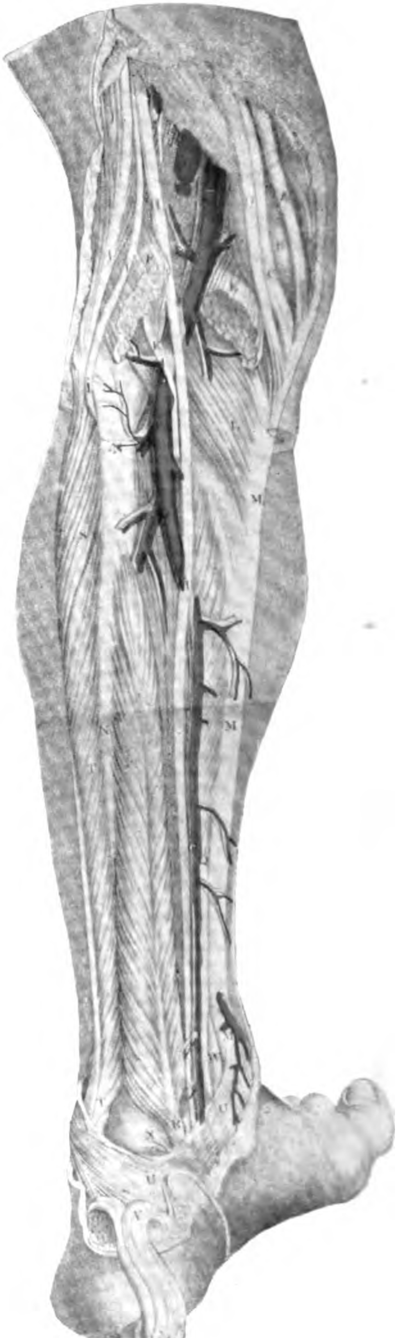


PLATE 18.

FIG. 1.

A. Tendon of the gracilis muscle.

BB. Fascia lata.

CC. Tendon of semi-membranosis muscle.

D. Tendon of the semi-tendinosis muscle.

EE. The two heads of the gastrocnemius muscle.

F. Popliteal artery.

G. Popliteal vein.

H. Middle branch of sciatic nerve.

I. Peroneal (outer) branch of sciatic nerve.

K. Posterior tibial nerve.

L. External or short saphenous vein.

MM. Fascia covering the gastrocnemius muscle.

N. Posterior saphenous nerve, showing its relation to the vein.

O. Posterior tibial artery, after emerging from beneath the soleus muscle, showing relation to the vein, and the location where it may be taken up and injected.

P. Soleus muscle joining the tendo-achilles.

Q. Tendon of the flexor longus communis digitorum muscle.

R. Tendon of the flexor longus pollicis muscle.

S. Tendon of peroneus longus muscle.

T. Peroneus brevis muscle.

UU. Internal annular ligament binding down the tendons, arteries, veins and nerves.

VV. Tendo-achilles (largest tendon in the body).

W. Tendon of tibialis posticus muscle.

X. Venæ comites of the posterior tibial artery.

FIG. 2.

A, C, D, E, F, G, H and I indicate the same parts as in Fig. 1.

B. Inner condyle of the femur.

K. The plantaris muscle lying upon the popliteal artery.

L. Popliteus muscle.

MMM. Tibia.

NN. Fibula.

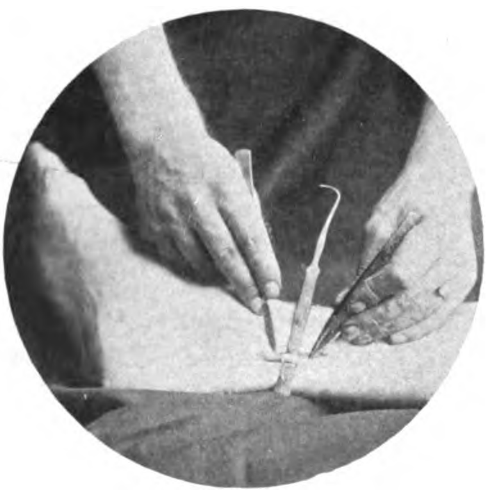
OO. Posterior tibial artery.

P. Peroneal artery.

X. The astragalus.

Q, R, S, T, U, V and W indicate the same parts as in Fig. 1.

ior part of the leg, piercing the large oval aperture above the interosseous membrane. It is continued on down on the anterior surface of the interosseous membrane and finally, at its lower part, lies on the bone. It crosses the anterior ligament of the ankle to the bend of the joint, where it becomes the dorsalis pedis artery; this artery is continued on down between the great toe and the next one to it, being superficial in this part of the course. I have taken up this artery, which is quite small, and injected it successfully. On account of its depth in the upper part of its course, and on account of its small size in the superficial part of its course, it is seldom used for injecting the body.



The Posterior Tibial Artery.

The posterior tibial artery is much larger than the anterior, and may be used in embalming—especially in the case of ladies, where it would not be advisable to take up the brachial, femoral or carotid arteries. It begins at the lower border of the popliteus muscle, just back of and a little below the center of the knee joint. It takes a course obliquely downward along the tibial side of the leg to the groove between the inner ankle and the heel, where it divides into the internal and external plantar arteries. The best place to raise the artery for the purpose of injecting would be at its most superficial part, which is its lower third. At this point the artery is only covered by the integument and the fascia beneath. The branches given off by the posterior tibial are:

the { peroneal, nutrient, muscular, internal calcanean. communicating, At its bifurcation it divides into the internal and external plantar.

The Internal Plantar Artery, much smaller than the external, is distributed along the inner part and sole of the foot, extending as far forward as the great toe, where it communicates with one of the digital branches. The external plantar, the larger of the two plantar arteries, takes a course obliquely across the sole of the foot to the base of the fifth metatarsal bone, where it becomes curved upon itself and passes over towards the under surface of the great toe. In this part of its course, from the base of the fifth metatarsal bone to the under surface of the great toe, it gives off several branches which supply the tissues in this vicinity of the foot, but just between the first and second metatarsal bones the artery anastomoses with the communicating branch of the dorsalis pedis artery, completing the plantar arch.

Method of Locating, Raising and Injecting the Posterior Tibial Artery.

Should the embalmer decide upon injecting the posterior tibial artery, he would be guided in its location by certain anatomical and linear guides, which will enable him to take up the artery in its proper place.

Linear Guide.—The embalmer, in order to locate this artery by surface marking, should draw a line from a point

FIG. 1.   FIG. 2

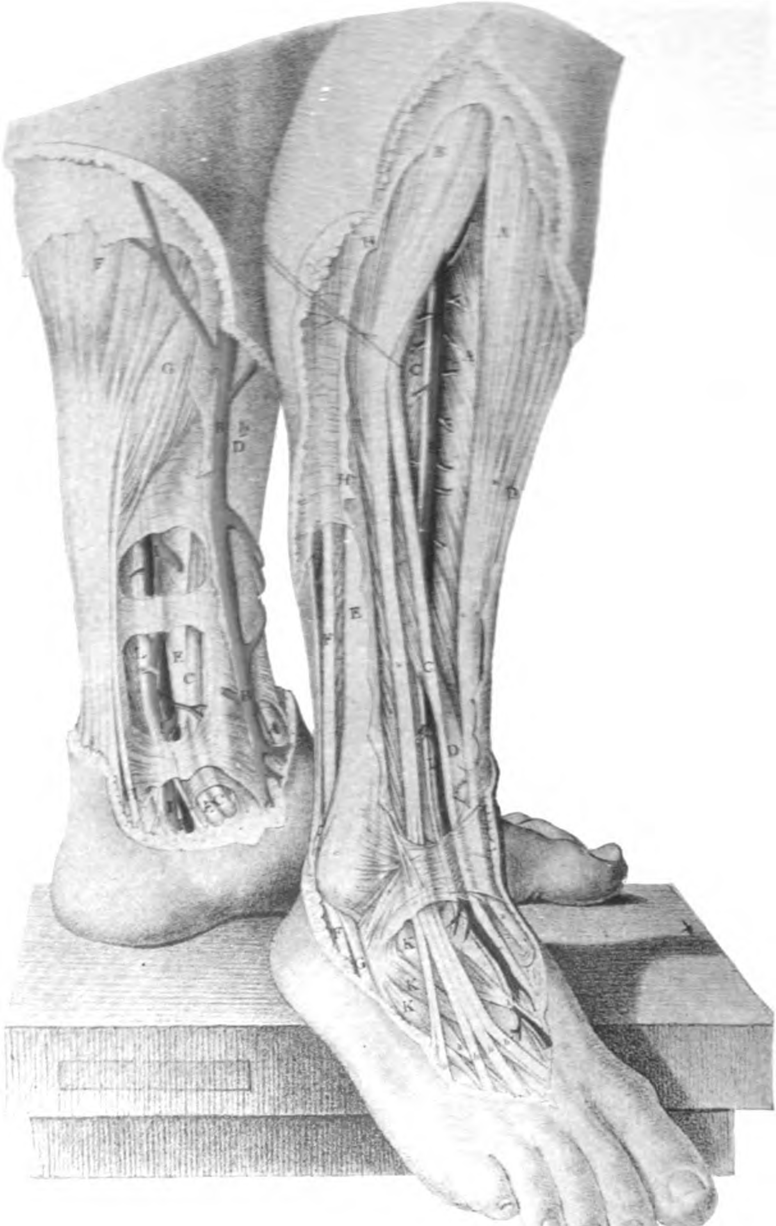


PLATE 19.

FIG. 1.

A. Tibialis anticus muscle.

BB. Internal or long saphenous vein.

CC. Tendon of tibialis posticus muscle.

D. Tibia and prominence of inner malleolus (ankle).

EE. Tendon of flexor longus digitorum muscle.

F. The gastrocnemius muscle.

G. The soleus muscle.

H. The tendon of plantaris muscle; the tendons of F, G, H form the tendo achilles.

I. I. The venæ comites of posterior tibial artery.

KK. The posterior tibial artery.

LL. The posterior tibial nerve.

FIG. 2.

A. Tibialis anticus muscle.

B. Extensor longus digitorium muscle: bbbb, its tendons.

CC. The extensor longus pollicis muscle.

D. The tibia.

E. The fibula.

FF. Tendon of pereoneus longus muscle; peroneus tertius.

HH. Fascia.

K. Extensor brevis digitorum muscle; kk. its tendons.

LL. Anterior tibial artery.

corresponding to an inch below the center of the popliteal space, to the center of the hollow groove formed on the inner side of the ankle by the prominence of the tibia and the convexity of the heel.

The Anatomical Guide.—This is formed by the tendo achilles, and the flexor longus digitorum muscle. The vessel will be found along the outer margin of the flexor longus digitorum muscle. The incision should be made along the inner border of the tendo achilles, carefully dividing the skin, integument and fascia, until the vessel is exposed. This artery has accompanying it the two venæ comites and the nerve, which is a little external to it.

I prefer making a circular incision, beginning about an inch above the inner ankle, and then curving the incision to the groove between the inner ankle and the convexity of the heel. This will be directly over the course of the vessel. After the sheath of fascia has been dissected aside, the handle of the scalpel should be passed beneath the vessel and the artery raised into the wound. Make an incision in the long axis of the vessel and insert the arterial nozzle, which should then be held in position by a strong ligature. As soon as the arterial nozzle has been securely placed in position, the injection may begin, continuing it until the body is thoroughly saturated with the preservative.

Method of Telling When the Body Has Received a Thorough Injection of the Preservative Solution.

This may be told in several ways, one of which is to notice the veins and see whether they are becoming prominent on the surface, which is an indication that the fluid is being poured into them through the capillaries and that the circulation is complete. Another way is to make an incision along the under surface of the great toe and see if any fluid escapes. If fluid escapes, it is an indication that the body has been saturated with the preservative. These two signs are the most certain, and when either one is present it is a sure indication that the injection of the fluid has been complete. If the circulation is complete, then withdraw the injecting apparatus and proceed to close the wound in the same manner as given for suturing up the incision over the brachial or femoral arteries, for which see pages 171, 172.

This will conclude the anatomy of the arteries, so far as is necessary for the embalmer, but before taking up the veins of the system it would be well to call your attention to the large number of branches given off by certain arteries, like the internal iliac and the internal maxillary branch of the external carotid. On account of these branches of the arteries and the anastomosis, or communication between one arterial branch and another, the whole body receives a complete blood supply. These branches divide and subdivide until they are of microscopic size, when they are termed capillaries. These are the smallest arterial vessels and are so evenly distributed over the body and the tissues thereof that it is next to impossible to stick a pin into the body without rupturing some of them. The capillaries are smaller than the blood corpuscles themselves, being a little less than one-thirty-five-hundredth of an inch in diameter. In life the blood corpuscles are capable of making themselves smaller, so as to pass through the capillaries into the veins, but after death the blood generally becomes fluid and the corpuscles soon become granular and take on putrefactive changes which allow all of the blood in the arteries to pass through the capillaries and into the veins.

FIG. I.

FIG. 2.

PLATE 20.

FIG. 1.

A. The calcaneum.

B. The plantar fascia, and flexor brevis digitorum muscle.

C. The abductor minimi digiti muscle.

D. The abductor pollicis muscle.

E. The flexor accessorious muscle.

F. The tendons of the flexor longus digitorum muscle.

G. Tendons of the flexor pollicis longus muscle.

H. The flexor pollicis brevis muscle.

K. The external plantar nerve.

L The external plantar artery.

M. The internal plantar nerve and artery.

FIG. 2.

A. The heel covered by integument.

B. The plantar fascia and flexor brevis digitorum muscle, cut.

C. The abductor minimi digiti muscle.

D. The abductor pollicis muscle.

E. The flexor accessorious muscle, cut.

F. Tendons of the flexor longus digitorum muscle.

G. The tendon of the flexor pollicis.

H. The head of the first metatarsal bone.

I. Tendon of tibialis posticus.

K. External plantar nerve.

LL. The arch of the external plantar artery.

MMMM. Interosseous muscles.

N. The external plantar nerve and artery, divided.

FIG. I.

CHAPTER VII.

Veins of the Human Body.

The veins of the body return the dark or impure blood to the right auricle of the heart after it has been circulated by the arteries and capillaries to the tissues of the body. There are two exceptions, however, where the veins carry pure or arterial blood instead of impure or venous. The pulmonary veins, which return the blood from the lungs to the left auricle of the heart, carry pure blood, as does also the umbilical veins in the umbilical cord—the cord which extends from the umbilicus or navel of the unborn child to the under surface of the placenta in the mother's uterus. The coats of the veins are much thinner than those of the arteries, and when emptied of the blood they assume a flattened or collapsed appearance. The blood remains in the veins for several days after death, and in many instances it may be found after several weeks; but this is rare, as the blood has a tendency to gravitate towards the parts of least resistance, or to the posterior part of the body, causing the discoloration commonly known as post mortem discoloration. The veins begin by minute radicles in the capillaraies and gradually get larger in their diameter as they approach the heart, the combined diameter of the venous system being much larger than that of the arterial.

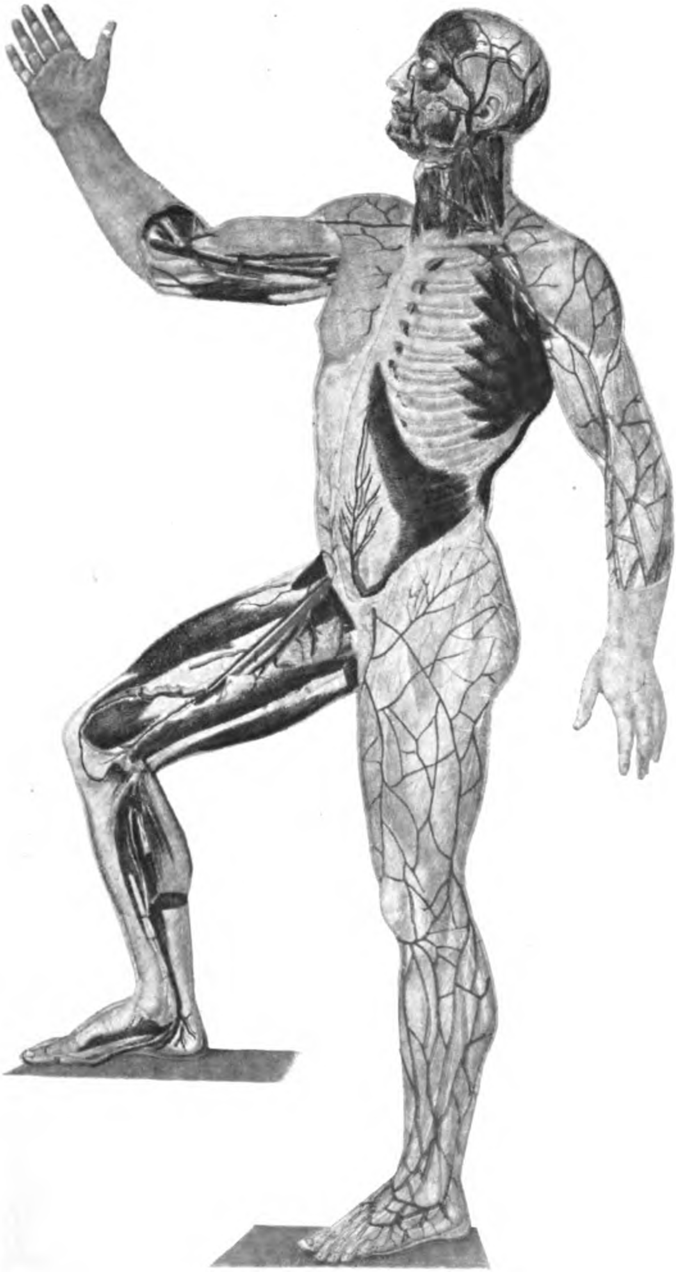
Divisions.

The veins of the body admit of three main divisions, according to their location and structure. Thus, those veins which are placed just beneath the skin are called superficial veins, while those that accompany the ateries and course through the muscular tissue of the body are known as "deep veins." The veins on the inner surface of the skull, spinal column and other parts, or which have their channels excavated in the structure of the bone or organ, are called sinuses.

The Superficial Veins return the blood from the superficial parts of the body, being found coursing between the layers of the superficial fascia and the cellular tissue beneath the skin. They follow this course until they arrive at some convenient part of the structure, when they pierce the deep fascia and terminate by emptying their contents into the deep veins. The superficial veins are never employed in the removal of blood from the dead body, the deeper veins having the preference on account of their location alongside the deep artery, and also on account of their larger size.

The Deep Veins are placed in the deep tissues of the body and in many instances will be found accompanying the arteries. Thus, the tibial, femoral, radial and ulnar arteries have the veins enclosed in the same sheath with the artery, but in the neck the carotid is only accompanied by a single vein—the internal jugular—as is also the subclavian and axillary arteries, which have but a single vein in relation to them. In those cases where the veins accompany the arteries, as the brachial, radial, tibial, etc., they are termed venæ comites (accompanying veins), and usually have a very free communication between them by means of small transverse branches which extend from one vein to the other. It is said that the veins not only have a larger average diameter than the arteries, but the anastomosis is much freer than that existing between the branches of the arteries.

The Sinuses differ from the veins in the muscular structure of the body, in as much as they are placed within the substance of the organ through which they course, having deep grooves to protect them in the cavity of the skull, while in the tissue of the uterus they have special openings in the



Topography of the Superficial and Deep Veins of the head, neck and extremities.

muscular tissue of that organ. The spinal veins communicate or anastomose very freely with each other. They are also very numerous, forming what is known as plexuses (a large collection of veins in one particular part of the body).

The veins, like the arteries, have three coats, and, if we consider the submucous coat as a complete coat, they may be said to have four (see Anatomical Elements—"Veins" page 56). This is different in the sinuses, which only have a single coat—the serous coat—which corresponds to that of the veins in the muscular tissues. In the cavity of the skull, the dura mater forms the outside covering of the sinuses. The veins are found to contain less elastic tissue than the arteries, but they differ from the arteries in as much as they contain valves. It will be remembered that the only arteries which contain valves are the pulmonary and the aorta, while all the veins of the extremities, and especially the deep veins, are well supplied. These valves are formed of fibrous membrane strengthened by a double layer of epithelium. They, for the most part, consist of two segments or flaps, the concavity of which faces the cardiac end of the vessel; thus, while blood will flow freely through them towards the heart it is prevented from regurgitating by the action of the valves, the pressure of the blood backward being sufficient to close the valves. Some of these valves consist of three flaps, while others consist of a single flap arranged in a spiral direction and which only acts as an impediment to the backward flow of the blood. The cup shaped or semi-lunar valves can be seen by pressing on some of the superficial veins of the forearm, when they become prominent and form a knotted appearance along its course.

Veins of the Head and Neck.

The most important veins of the head that the embalmer is required to be familiar with are the jugulars. But, before taking up such important veins as the jugulars, I will describe the veins that enter into their formation. This will include the veins of the exterior of the skull, and, second, the veins of the interior of the cranium. The veins returning the blood from the external tissues of the skull are: the facial, internal maxillary, frontal, supra-orbital, and angular from the front of the face, while the temporal, tempero-maxillary, posterior auricular, and occipital return the blood from the sides and posterior part of the face.

The Facial Vein is the continuation of the frontal, which begins on the anterior part of the skull in a venous plexus formed by communicating branches from the temporal. It takes a course down the middle of the forehead to the root of the nose. It pases down along the side of the nose under the name of angular vein, but as soon as it passes beneath the zygomatic muscles of the face it becomes the facial vein. From the point where it passes beneath the muscles it takes a course similar to that of the facial artery, crossing the body of the maxillary bone in the same groove that the artery occupies. It then passes beneath the lower jaw to enter the submaxillary glands, and after penetrating them, from which it receives some branches, it passes on downward until it empties into the internal jugular vein. Thus it will be seen that one of the most prominent veins of the face is drained by the internal jugular, while the external jugular receives the veins from the sides and posterior parts of the face.

The Internal Maxillary Vein arises, by a number of branches, from the pterygoid and zygomatic fossæ: these branches are very numerous and communicate so freely as to form a plexus. It passes behind the neck of the lower jaw, where it joins the temporal vein and becomes the tempero-maxillary vein.

The Supra-Orbital Vein begins on the frontal portion of the occipito-frontalis muscle. Its course is downward and towards the inner angle of the orbit, where it communicates with the frontal vein and forms the angular. In its course over the muscle it receives numerous branches from the veins of the forehead, and communicates by a small branch with the anterior temporal.

The Angular Veins are formed by the frontal and the supra-orbital near the inner angle of the orbit. They receive the small branches from the alæ of the nose, and from the upper eyelid. This vein has a very free anastomosis with the ophthalmic vein and with the foramen cæcum, by means of this vein.

The Temporal Vein begins on the vertex and side of the skull by a large number of branches which communicate with the frontal and supra-orbital in front and with the posterior auricular and occipital behind; from these branches it is re-inforced by a branch of large size which drains the blood from the temporal muscle and the tissue in the immediate vicinity of the temporal fossæ. These veins unite to form the main trunk of the temporal vein just above the zygoma. From this origin the vein takes a course downward through the substance of the parotid gland, lies just between the external auditory canal (opening of the ear) and the condyle of the lower jaw. It unites with the internal maxillary vein and forms the tempero-maxillary vein.

Tempero-Maxillary Vein (formation of the external juglar). The tempero-maxilary vein is formed by the temporal and the internal maxillary veins. It passes through the substance of the parotid gland in front of the ear, continues downward to its lower border, when it becomes the external jugular vein. It receives several branches from small veins of the face and sides of the skull. The transverse facial, the anterior auricular, the masseteric and parotid veins all empty into the tempero-maxillary.

The Posterior Auricular Vein commences just above and behind the ear on the sides of the skull in the form of a plexus which communicates with the temporal and occipital veins. Its course is downwards along the back part of the ear, where it joins the tempero-maxillary vein, forming with this vein the external jugular. In the course of the vessel along the back part of the ear it receives several small branches from the lobe of the ear. The stylo-mastoid vein enters it near its termination.

The Occipital Vein begins at the posterior part of the skull by a plexus formed much the same as the remaining plexuses on the sides and anterior part of the face. It generally follows the course of the occipital artery, and in many cases continues as two veins which, after receiving the mastoid vein, empties into the internal jugular vein, and in some instances into the external jugular. This vein is situated very deeply in the muscles of the back part of the skull and upper back part of the neck, and as it communicates with the mastoid vein it has, or forms, a very important anastomosis with the internal sinus on the inside of the skull. This anastomosis or communication can be very clearly demonstrated by using the needle process.

Sinuses or Veins on the Interior of the Skull.

The sinuses of the skull are analogous to the veins. They have two coats—the internal, which is the continuation of the internal coat of the jugulars, and the external, which is formed by the dura mater or covering of the brain. Thus it will be seen that these sinuses are very thin and the penetration of fluids through them is readily accomplished. They have no valves and are formed principally by the veins of the brain. The cerebral veins, which form the sinuses, are very thin, their coats being less than half as thick as the coats of the veins in the muscular tissue. They are also noted for the absence of valves. The principal cerebral veins are the superficial cerebral veins, the superior cerebral veins, the median cerebral veins, the inferior cerebral veins, the deep cerebral, the cerebellar veins, and the venæ corporis striati and choroid vein. The superficial cerebral veins ramify on the surface of the brain, and they return the blood from the surface of the brain to the sinuses; the superior cerebral veins return the blood from the convolutions of the superior surface of each hemisphere and communicate directly with the superior longitudinal sinus, while the median cerebral veins return the blood from the middle surface of the hemisphere and empty into the superior cerebral veins, or directly into the inferior longitudinal sinus. The inferior cerebral veins, as their name implies, return the blood from the outer and inferior surface of the cerebral hemisphere; some of the branches forming the vein return the blood from the anterior lobes of the brain. They terminate in the cavernous sinus. Other large veins—such as the middle cerebral, the great anastomotic vein of Trolard—terminate in the cavernous sinus, while four or five smaller veins from the base of the brain empty into the superior petrosal and lateral sinuses. The deep cerebral or ventricular veins are formed by the venæ corporis striatus and the choroid vein. They are usually two in number, but before their termination in the straight sinus they unite to form a single vein. The remaining veins of the brain are the cerebellar veins, which begin on the under surface of the cerebellum and then branch out to form three separate veins which empty into the straight sinus, the inferior branch terminating in the lateral sinus, while the lateral branch returns the blood directly into the superior petrosal sinus.

Besides the sinuses of the brain, we have those of the dura mater proper, which are: the superior longitudinal, inferior longitudinal, straight sinus, lateral sinus, and occipital sinus.

The Superior Longitudinal Sinus begins in the foramen cæcum, which corresponds to the root of the nose in the frontal bone, and extends directly backward along the median line of the skull, ending in a deep groove in the occipital bone, known as the torcular herophili. At the beginning it receives several small branches from the nasal fossæ, then gradually increases in size until its termination. For the most part of its course it is triangular in shape and receives the openings of the superior cerebral veins, the veins from the diploe and numerous smaller branches from the dura mater, the external covering of the brain.

The Inferior Longitudinal Sinus begins at the anterior margin of the cerebrum and lies just posterior and inferior to the longitudinal sinus. It is circular and increases in size from before backward, where it terminates in the straight sinus.

The Straight Sinus begins in that part of the brain commonly known as the junction of the falx cerebri with the tentorium cerebelli. It takes a course from this origin downward and backward toward the torcular herophili (junction of the lateral and longitudinal sinuses), with which it is connected by a communicating branch. The straight sinus receives the branches of the venæ galeni; also the inferior longitudinal sinus and the superior cerebellar veins.

The Lateral Sinus is, with the longitudinal, the largest sinus of the inner walls of the cranium. It begins at a point corresponding to the internal occipital protuberance in the occipital bone, the bone being grooved very deeply for its reception. The sinuses may differ somewhat in caliber,—the left lateral may be larger than the right, or vice versa. In a skull among my collection the right lateral sinus is almost obliterated, the grooved surface of the bone not being as large as some of the grooves for the meningeal arteries). The lateral sinus takes a course outward toward the temporal bone, and ends in the jugular foramen in the temporal bone by forming the internal jugular vein. Just as soon as it joins

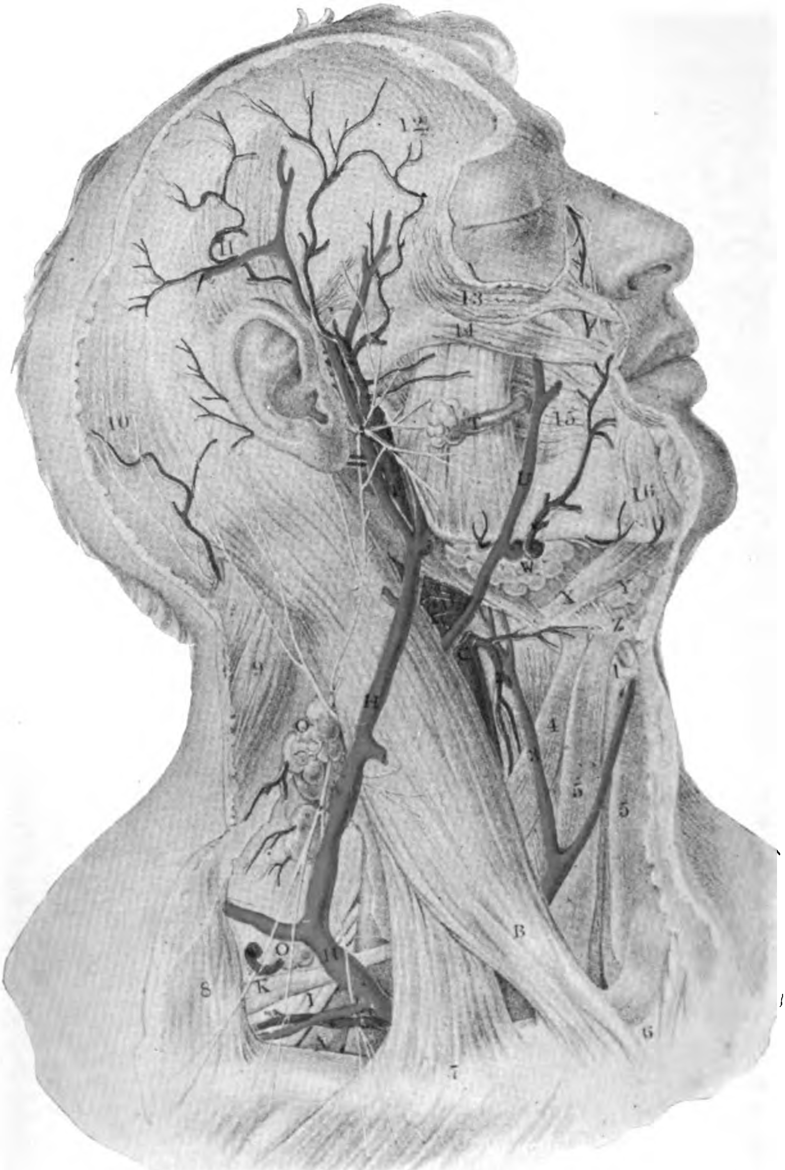

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PLATE 22.

A. Subclavian artery.

B. Sterno-mastoid muscle.

C. Common carotid artery near its bifurcation into internal and external carotid arteries.

D. External carotid artery giving off the lingual, facial, temporal and occipital branches.

E. Internal carotid artery.

F. Tempero maxillary branch of external carotid artery.

G Temporal artery and vein.

H. External jugular vein.

I. Brachial plexus of nerves; their relation to A—subclavian artery.

K Posterior head of omo-hyoid muscle.

L. Transversalis coli artery.

M. Posterior scapular artery.

N. Scalenus anticus muscle.

O. Lymphatic glands.

P. Superficial branches of cervical plexus of nerves.

R. Occipital artery and nerves.

S. Portia dura (motor branch of seventh pair of nerves).

T. Stenson's duct.

U. Facial vein.

V. Facial artery.

W. Submaxillary gland.

X. Digastric muscle.

Y. Lymphatic body.

Z. Hyoid bone.

1. Thyroid cartilage.
2. Superior thyroid artery.
3. Anterior jugular vein.
4. Anterior head of omo-hyoid muscle.
5. Sterno-hyoid muscle.
6. Breast-bone (sternum)
7. Clavicle (collar-bone).
8. Trapezius muscle.
9. Splenius capitus and coli muscle.
10. Occipital origin of occipito-frontalis muscle.
11. Temporal muscle.
12. Frontal insertion occipito-frontalis muscle.
13. Orbicularis palbebrarum muscle.
14. Zygomaticus major muscle.
15. Buccinator muscle.
16. Depressor anguli oris muscle.

the internal jugular vein, the sinus, instead of having the one inner coat corresponding to the mucous coat of the vein and the fibrous covering of the dura mater, receives the third coat as soon as it leaves the jugular foramen. Thus, it will be seen, on account of the extreme thinness of the sinuses of the brain, and on account of their large size, the fluid injected into the cerebro-spinal cavity will readily pass into the lateral sinus and then into the jugular vein, its direct continuation.

The Occipital Sinus is the smallest of the cranial sinuses. It communicates with the spinal veins and also with the small veins around the foramen magnum in the occipital bone. It terminates by emptying its blood into the torcular herophili.

The Jugular Veins.

Having considered the veins of the external tissues of the head and studied the formation of the external jugular vein, also the cranial sinuses and the formation of the internal jugular, I will describe the veins of the neck, which are:

the	anterior jugular,	internal jugular,
	posterior jugular,	external jugular.

The Anterior and Posterior Jugulars, as their names imply, are situated at the front and back part of the neck, respectively. As the embalmer has nothing to do with them in any of the various methods of removing blood, I will pass to the description of the external jugular.

The External Jugular Vein receives the greater part of the blood from the sides of the face and the posterior parts of the cranium. It begins in the substance of the parotid gland, being formed by the tempero-maxillary and the posterior auricular veins. From this origin the vein passes downward, through the substance of the gland, across the sternomastoid muscle and over the platysma myoides, being placed just between the superficial fascia and the muscles, the integument and fascia forming its only external covering. Its course is indicated by a line drawn from the angle of the jaw to the center of the clavicle. It may be opened in any part of its course, but as it is considerably dilated between the valves, it is best to perform the operation between them. The first valve is placed about an inch above the collar-bone, while the second is placed just at its termination in the subclavian, in front of the scalenus anticus muscle. These valves in the external jugular form no impediment to an injection upwards; fluid will pass through them whether introduced above or below the valves.

The external jugular vein receives several tributaries of large size, among them being the posterior external jugular, the transverse cervical veins, and the supra scapular. It communicates with the internal by a small branch given off in the parotid gland, and in the lower part of its course it receives a branch from the anterior jugular. The external jugular vein at one time was very much used by the embalmers for the removal of blood from the face, but of late years the veins of the arm and thigh, and the internal jugular are used in preference.

The Internal Jugular Vein is formed by the confluence of the lateral sinus and the inferior petrosal sinus, at the lower border of the jugular foramen. At this part of its origin it forms a considerable dilitation, called the sinus or gulph. In its course towards the innominate vein, it receives many branches from the anterior parts of the face and the sides of the cranium; thus it drains not only the interior of the cranium, but the tissues of the face and front of the neck, the drainage being from the superficial parts of the face, while in the neck it receives the deeper veins from the muscular tissues of the neck. Its course is indicated by the same guide as given for the carotid artery. The vein first lies to the outer side of the internal carotid, then to the outer side of the common carotid, being enclosed in the same sheath with the carotid arteries. The pneumogastric nerve lies to the center and back of the artery and vein. The glosso-pharyngeal and hypoglossal nerves are also situated in front of the sheath. There is a slight difference in the anatomy of the two veins—on the left side, toward the root of the neck, the vein lies over the artery, while on the right side the vein, as it nears its termination, is placed about a half inch from the artery, and crosses the subclavian artery. The veins vary somewhat in size, but the left is generally the smaller of the two. On account of its larger size, and also on account of it draining the superficial parts of the face, the internal jugular vein is more generally used than the external in removing blood and discolorations from the front part of the face and sides of the neck. This vein is provided with a single pair of valves, generally placed near its termination in the innominate vein, but, like those of the external jugular, they form no impediment to an upward injection, or the regurgitation of blood from gaseous pressure in the thoracic or abdominal cavities, where it would act, by indirect pressure, on the diaphragm and vessels contained in the chest cavity. (See article on "Discoloration.") In order to take up the internal jugular vein, the incision should be made just above the junction of the breast-bone with the collar-bone, the line of incision being along the anterior border of the sterno-mastoid muscle, and between this muscle and the throat. The incision will have to extend about an inch downward, when the sheath containing the carotid artery, jugular vein and nerves, will be exposed. Separate the artery from the vein, and then open the vein by an incision, which will permit the blood to escape from the face and tributary veins, but, in order to remove the blood from the remaining veins of the body, from this point, a tube or catheter should be introduced downward, through the internal jugular and innominate vein, through the superior vena cava, to the right auricle of the heart, when, by attaching an aspirator to the tubing, the fluid blood from all parts of the body may be successfully removed.

The tributaries to the internal jugular are six in number: the facial, occipital, lingual, pharyngeal, and the superior and middle thyroid veins. It will be seen that these tributaries are from those parts of the face most frequently presenting discolorations, and when the internal jugular is opened the best results will be obtained, since the fluid will be removed and hence the discoloration.

Veins of the Arm and Upper Extremities.

The veins of the arm are very numerous and are divided into two classes—those of the superficial structures of the arm and those of the deep. The first are known as the superficial veins, while the veins that may accompany the arteries are known as the deep veins or venæ comites (accompanying veins). Both the superficial and the deep veins are supplied with valves, the deep containing more than the superficial. There are ten superficial veins which, for the most part of their course, are regular and have received special names, while others are so irregular that it is impossible to give them any exact description. Those that are classified as superficial veins are the anterior ulnar, the posterior ulnar, common ulnar, radial, basilic, median basilic, median cephalic, cephalic, and the median.

The Anterior Ulnar Vein begins by a collection of capillaries on the anterior and ulnar side of the hand and wrist. It takes a course directly upward along the anterior surface of the ulnar side of the fore-arm to the bend of the elbow. Just below the bend of the elbow it unites with the posterior ulnar vein to form the common ulnar vein. Sometimes this vein empties into the median basilic vein instead of the common ulnar.

The Posterior Ulnar Vein arises by numerous branches on the posterior surface of the hand and wrist. Its course is directly upward toward the bend of the elbow on the posterior surface of the fore-arm. Just below the bend of the elbow it unites with the anterior ulnar to form the common ulnar, or joins with the median basilic to form the basilic.

Common Ulnar Vein.—This vein is sometimes absent, but when present it is formed by the anterior and posterior ulnar veins. It is a very short vein and its course is upward and outward, joining with the median basilic to form the basilic vein.

The Radial Vein begins beneath the integument on the dorsal surface of the wrist, taking a course toward the bend of the elbow, where it unites with the median cephalic to form the cephalic vein. The radial vein has several communicating branches with the deeper veins of the fore-arm, forming a very complete anastomosis.

The Basilic Vein.—This vein, especially the left, is one of the veins most frequently selected by the embalmer for the removal of blood from the body; this is on account of its superficial course, and also because it lies alongside the brachial artery, the vessel most used for arterial embalming. It is a vein of considerable size formed by the median basilic and common ulnar vein, when the latter vein is present, and when absent the anterior and posterior both unite with the median basilic to form the basilic. Its course is indicated by that of the brachial artery, taking a course upward along the inner and posterior aspect of the biceps muscle in the same fibrous sheath with the artery and nerves. It terminates by emptying into the axillary vein near the point of entrance of the two accompanying veins of the brachial. On account of the large size of the basilic vein, the embalmer will have little trouble in separating the vein from the venæ comites, which are much smaller in size.

Median Basilic Vein.—This vein is a short vessel of large size, which communicates with the median and the basilic, forming the basilic by uniting with the common ulnar. Its course is obliquely upward and inward.

Median Cephalic Vein.—The median cephalic vein is also a short vessel which passes obliquely upward and outward towards the outer side of the biceps muscle, passing between the groove formed by the tendon of the biceps and the supinator longus muscle. It joins the radial vein just above the bend of the elbow and forms the cephalic vein.

Cephalic Vein.—This vessel is of considerable size and its location is even more superficial than the basilic, but on account of its increased curvature it is seldom used for the removal of blood, although I have employed it with some degree of success. Its course is along and in the grooves formed first by the biceps and triceps muscles on the outer side, then it follows the groove formed by the pectoralis major and the deltoid muscle, at the upper part of which it pierces the costo-coracoid ligament and empties its blood into the axillary vein just beneath the clavicle. The vein sometimes communicates with the external jugular or the subclavian vein by a small branch which crosses in front of the clavicle.

The Mediam Vein commences on the anterior surface of the fore-arm near the wrist and ascends toward the bend of the elbow, where it divides into the median basilic vein and the median cephalic. It communicates with the anterior ulnar and radial veins by several short trunks.

The Deep Veins of the Upper Extremities.

The deep veins of the arm follow the course of the arteries, and are generally two in number, one on each side of the artery, forming the venæ comites, or accompaning veins of the artery. The deep veins communicate very freely with each other, by short branches passing from one to the other. The digital veins accompany the digital branches of the palmar arch, beginning at the ends of the fingers and extending along the sides to the deeper tissues of the palm of the hand, when they take the course of the superficial palmar arch, forming the venæ comites of that arterial trunk. From the palm of the hand the deep veins ascend toward the elbow, first entering the deep tissues of the wrist, where they follow the course of the radial and ulnar arteries. They communicate very freely with each other and, also with the interosseus and superficial veins of the arm. The venæ comites finally terminate by emptying into the venæ comites of the brachial artery, forming the brachial veins. These veins, like those of the radial and ulnar, run alongside of the artery. They are placed one on each side of the artery and are closely connected by several small branches. The brachial veins unite with the basilic to form the axillary vein.

The Axillary Vein commences at the lower margin of the axilla, receiving its origin from the basilic and accompanying veins of the brachial. From this point of origin it describes a course similar to that taken by the axillary artery, and as it approaches its termination beneath the clavicle at the lower border of the first rib it receives many small branches, and some of large size, which increase the caliber of the axillary vein considerably. Near its termination it receives the cephalic vein. Both the axillary and the cephalic veins are provided with valves, those of the cephalic being found near its termination in the axillary. The axillary vein lies to the thoracic side of the axillary artery, and a little in front of the vessel; it is also held in position by the fascia of the parts which protects it and prevents it from collapsing after death.

The Subclavian Vein is a large vein about three inches in length which extends from the lower border of the first rib to the inner border of the sterno-clavicular junction, where it unites with the internal jugular vein to form the innominate vein. The subclavian vein lies in front of the subclavian artery, being separated by the muscular fibres of the scalenis anticus and the phrenic nerve. The subclavian vein is usually supplied with valves, which are placed nearly opposite the termination of the external jugular and about an inch from the ending of the vein in the innominate.

The Venæ Innominatæ.—These large venous trunks are placed one on each side of the root of the neck, being formed by the junction of the subclavian with the internal jugular. The right innominate is much the shortest of the two vessels, being a little less than an inch in length, while the left is more than double that length, being from two to three inches long. The relations between the two vessels are consequently very different, the right taking almost a vertical course downward in front of the innominate artery and joins the left innominate vein to form the superior vena cava. The left innominate vein is much larger than the right and describes a gentle curve across the upper and anterior part of the chest, joining the right innominate just below the lower border of the first rib with the right end of the first piece of the sternum, where it forms the superior vena cava. The left innominate is placed in front of the artery, and also crosses the large branches from the arch of the aorta on that side. The innominate veins are destitute of valves, which makes the operation of passing a drainage tube through them a very easy task. It will be seen from the description of the innominate veins that on account of the curvature existing in the left it is more desirable for the introduction of a drainage tube from the left basilic than the right, which begins almost at a right angle from the subclavian.

The Superior Vena Cava is the largest vein placed above the heart. It is from two to three inches in length and extends from a point corresponding to the lower border of the first rib where it joins the sternum on the right side, to its termination in the right auricle of the heart, corresponding to the upper border of the third rib at its point of junction with the middle piece of the sternum or breast-bone. Its course is nearly vertical, with the exception of a slight curve near its entrance into the pericardial sac. The convexity of this curve is placed to the right side. There are no valves in the superior vena cava.

Veins of the Lower Extremities—The Inferior Vena Cava and Its Tributaries.

The veins in the lower extremity, like those in the upper, are divided into the superficial and the deep. They are provided with valves, which are more numerous than in the veins of the upper extremities, the deep veins of the leg containing more than the superficial. The superficial veins are placed just beneath the integument and superficial fascia, and converge to form two large veins known as the internal and external saphenous. The deep veins follow the course of the arteries and form the venæ comites of the anterior and posterior tibial and peroneal arteries.

The Internal or Long Saphenous Vein begins by a branch from the inner side of the venous arch formed on the back or dorsum of the foot. This arch is superficial, being placed just over the metatarsal bones beneath the integument. It receives several digital branches from the toes, and other branches from the upper part of the foot, thus forming a venous plexus, which gives origin, on the inner side, to the internal or long saphenous vein and, on the outer side, to the external or short saphenous vein.

The Internal Saphenous Vein describes a course upward and in front of the inner malleolis (ankle bone), then back of the tibia along the inner side of the leg to the popliteal space. Passing along the inner side of this space, it ascends along the inner side of the thigh to a point about an inch below Poupart's ligament, where it terminates in the femoral vein. The internal saphenous vein communicates by short branches with the deep veins of the thigh and leg; it also receives tributaries from the superficial veins of these parts, and near the saphenous opening in the fascia lata it receives the superficial epigastric, superficial circumflex iliac, and external pudic veins. It has from four to six valves, which are more frequent in the upper part of its course than in the lower. It empties into the femoral vein about an inch below Poupart's ligament.

The External Saphenous Vein begins by a branch from the outer side of the arch formed on the dorsum of the foot and takes a course along the outer side of the foot to the external malleolis (external ankle bone), passing behind that bone to the outer side of the tendo achilles, which it crosses, then makes a course along the outer and posterior aspect of the leg to the lower border of the popliteal space, where it unites with the popliteal vein. In its course it receives several large tributaries from the superficial and deep veins, and at its termination, in the popliteal, gives off a communicating branch to the internal saphenous vein. The external saphenous vein is supplied with from three to nine valves, placed at varying points along its course.

The Deep Veins of the Lower Extremities.

The deep veins of the lower extremities, as before stated, follow the course of the arteries, forming the venæ comites of those vessels. The external and internal plantar veins unite to form the posterior tibial, which receives the venæ comites of the peroneal artery. The venæ comites of the anterior tibial artery commences by a continuation of the accompanying veins of the dorsalis pedis artery, following the course of the dorsalis pedis over the annular ligament at the front of the ankle, then penetrates the deep tissues between the tibia and fibula to the upper part of the leg, where they pierce the interosseus membrane and terminate by opening into the popliteal vein.

The Popliteal Vein commences at the lower border of the popliteal space. It is formed by the junction of the venæ comites of the anterior tibial and the posterior tibial veins. Its course is similar to that of the popliteal artery. It is at first placed to the inner side of the artery, then becomes superficial to that vessel and, towards the upper part of its course, it lies more to the external side. On account of the large number of tributaries, and also on account of their large size, the popliteal vein is a vein of very large caliber. It ascends upward to the opening in the adductor magnus muscle, where it forms the femoral vein. It is supplied with from three to four valves.

The Femoral Vein is used by the embalmer for the removal of blood from the body nearly as often as the basilic vein in the arm. Many seem to favor the femoral, on account of its large size, preferring the right to the left. (See "Removal of Blood.") The femoral vein is the direct continuation of the popliteal. Commencing at the opening of the adductor magnus, it follows the course of the femoral artery, being placed first to the external side of the vessel, then, as it approaches the middle third of its course, it passes behind or posterior to the artery, but about an inch below Poupart's ligament it is placed to the inner side of the artery. It receives the internal saphenous vein near Poupart's ligament and in different parts of its course it receives several branches of large size from the muscular tissues of the thigh. It is provided with four or five valves placed at different parts of its course.

The External Iliac Veins are the direct continuation of the femoral. They begin just below Poupart's ligament and take a course upward and inward along the external iliac artery, terminating just opposite the sacro-iliac symphysis in the common iliac vein by joining the internal iliac. The relations of the right and left external iliac veins are very different; the right is first placed to the inner side of the external iliac artery, but as it nears its termination it passes behind or posterior to the vein, while the left external iliac vein is placed only along the inner side of the artery, joining the internal iliac vein at the sacro-iliac synchondrosis to form the common iliac vein. The external iliac vein has from one to two valves placed near its termination in the common iliac veins.

The Internal Iliac Vein follows the course of the artery of the same name. It receives numerous branches from the external tissues of the pelvis, and also from the organs making up the genitalia, the vaginal plexus, the uterine veins, hemorrhoidal, and in the male the vesico-prostatic veins empty into the internal iliac. These veins, together with those from the muscular tissues of the pelvis, are provided with numerous valves, but the internal iliac vein is devoid of valves. It terminates by uniting with the external iliac vein to form the common iliac.

The Common Iliac Veins commence just opposite the sacro-iliac junction, being formed by the internal and external iliac veins. From this origin they pass upward and inward to a point corresponding to the intervertebral cartilage, placed between the fourth and fifth lumbar vertebræ, where they terminate by forming the largest vein in the human body — the inferior vena cava. The relations of the right and left common iliac vein are very different. This point should be remembered by the embalmer during the operation of passing a flexible tube into the vein for the removal of blood. *The right common iliac vein* at first passes to the inner side of the artery and then behind and finally to the outside of the common iliac artery. It is nearly verticle and appears to be the direct continuation of the inferior vena cava. On account of the position of the inferior vena cava on the right side of the vertebral column, the right common iliac vein is the shortest.

The left common iliac vein is placed at the inner side of the artery at its beginning, but as it approaches its termination it is found behind the artery. It is longer than the right, and has a more acute angle than its fellow of the opposite side. There are no valves in the common iliac veins; they receive the blood from the posterior parts of the pelvis. The ilio-lumbar and lateral sacral veins terminate in the external iliac.

The Inferior Vena Cava — the largest vein in the body—commences just opposite the interval between the fourth and fifth lumbar vertebræ, being formed by the common iliac veins. From this point of origin the vessel takes a course almost vertically upward along the right side of the aorta on the vertebral column, terminating in the right auricle of the heart, which it penetrates at its lower and posterior aspect. In its course upward it first passes through the fissure for the inferior vena cava on the under surface of the liver, then it pierces the central tendon of the diaphragm, enters the pericardial sac at its lower border, and finally enters the auricle of the heart. In its course upward it receives many branches of large size, the renal veins of the kidneys being, possibly, the largest tributaries. Besides these veins, we have, terminating in it, the lumbar, right spermatic, supra-renal, phrenic and hepatic veins. It will be seen from this that the inferior vena cava returns all the blood from the inferior extremities and from all the tissues below the diaphragm. The inferior vena cava is supplied with a single valve, which is placed at its termination in the right auricle of the heart; this valve is known as the eustachian valve and is much larger in the fœtal state.

The Spinal Veins.

The bones of the spinal column, and the structures contained in the spinal canal, are very freely supplied with blood from the branches of the aorta and subclavian arteries. The vertebral artery supplies the upper or cervicle vertebræ, while the sacra media and the lumbar branches of the aorta supply the lower vertebræ. The blood thus distributed to these parts is returned by means of the spinal veins, which are divided into four sets—those placed on the outer sides of the vertebral column, those in the interior of the spinal canal, the veins of the bodies of the vertebræ, and the veins of the spinal cord.

These veins return all the blood from the spinal cord and its covering. They are remarkable for the thinness of their coats and also from the fact that they are destitute of valves. They are very numerous, forming the so-called venous plexuses of the vertebræ. The veins on the external walls of the vertebræ terminate by emptying their blood into the vertebral veins in the neck. Some of the branches terminate in the intercostal veins of the thorax, while those in the lumbar and sacral regions terminate in the sacral and lumbar veins.

The remaining veins of the spinal column also terminate in these veins, but the veins of the spinal cord ascend towards the medulla oblongata and terminate sometimes in the vertebral veins and at other times in the inferior cerebellar veins or in the inferior petrosal sinus. One of the most remarkable facts connected with the veins of the spinal column is the enlargement of the veins of the bodies of the vertebræ in advanced age.

For description of the portal and pulmonary veins see "Pulmonary and Portal Circulation," pages 132 and 134.

CHAPTER VIII.

Chemistry of the Human Body.

The human body may be divided, chemically, into fifteen different elements. These elements cannot be subdivided, neither are they found in equal proportions in all bodies, but the following percentages, given below, will be their approximate amounts:

Oxygen, O	72.00
Carbon, C	13.5
Hydrogen, H	9.10
Nitrogen, N	2.50
Sulphur, S	1.47
Phosphorus, P	1.15
Calcium, Ca	1.3
Sodium, Na	.10
Potassium, K	.026
Magnesium, Mg	.001
Chlorine, Cl	.085
Flourine, F	.08
Iron, Fe	.01
Silicon, Si	Trace
Manganesium, Mg	Trace

It will be seen that of all these fifteen elements, oxygen, carbon, nitrogen and hydrogen make up ninety-seven per cent. of the whole body, the remaining eleven elements only amounting to three per cent. of the whole body weight. Oxygen, hydrogen and nitrogen are mobile and elastic, possessing great atomic heat, while carbon, hydrogen and nitrogen are distinguished for their chemical inactivities and the feebleness of their action. The carbon found in the body has the greatest atomic cohesion. Oxygen is noted for the great number of chemicals it will combine with, and also for the intense amount of chemical activity it possesses.

All of these chemical elements, with the exception of the gases, which are found in the body—which are: oxygen, hydrogen, nitrogen, etc., are in a state of combination with other elements, such as sodium and chlorine, as chloride of sodium in the blood, and all fluids and solids, except enamel of the teeth. The compounds thus formed are known as the proximate principals of the human body.

The proximate principals of the human body are further subdivided into inorganic, organic non-nitrogenized, organic nitrogenized, and principals of waste. Of these four different divisions, there are about one hundred chemical compounds.

The Inorganic Proximate Principals.

Oxygen,	calcium chloride,
hydrogen,	calcium carbonate,
nitrogen,	calcium phosphate,
carbonic anhydrid	magnesium phosphate,
carburetted hydrogen,	sodium phosphate,
sulphuretted hydrogen,	potassium phosphate,
water,	sodium sulphate,
sodium chloride,	potassium sulphate,
potassium chloride,	magnesium carbonate,
amonia chloride,	sodium carbonate,

potassium carbonate.

These chemical compounds are found in all parts of the body, but each one being found in some particuiar fluid or organ: thus—

The oxygen in the body is found in the blood and the lung issue.

The hydrogen is found in the stomach and the intestinal tract, from the duodenum to the rectum. Besides the hydrogen gas found in the intestines, they also contain a large amount of nitrogen; this substance is also found in the blood.

The carbonic acid gas is found in the expired air from the lungs, and in the remaining or residual air left in them after death.

Carburetted hydrogen and sulphuretted hydrogen may be detected in the lungs and in the intestines.

Water is found in all the solids and fluids of the body. It constitutes about 70 per cent. of the entire weight of the body. The water is taken into the system in the form of drink and, also, as a constituent of all kinds of food. There is also a probability that water is formed in the body, by the union of the hydrogen with the oxygen.

Chloride of sodium (common salt) is found in all fluids and solids of the body, except enamel. Its principal function is to regulate osmotic action, and to hold the albuminous principals of the blood in solution. By regulating the amount of water in the blood tissues it preserves the contour and consistence of the cellular structures and the form and consistence of the blood corpuscles.

Potassium chloride is found in all the muscular tissues of the body, also in the liver, saliva, gastric juice, etc.

Ammonia chloride may be detected on chemical examination of the urine, gastric juice, tears, and other fluids of the body.

Calcium chloride is found, principally, in the bones, teeth, and urine. Calcium carbonate has been detected in the blood; it is also found in the teeth, bones and the cartilages; also in the internal ear.

Calcium phosphate is, like water, very abundant in the human body, it being next to water the most abundant of all the inorganic principals of the body. It is found very abundsolids of the body. As it passes through the intestinal tract, and also in its passage through the stomach, it combines with a molecule of water, and by the fermentative action of the fluids in these parts, it is converted into equal parts of dextrose and glucose. If saccharose be injected in the blood, it will be eliminated by the kidneys, thus proving that it is non-assimilable and is not absorbed in its original chemical composition.

Glycogen is found normally in the body, being a normal constituent of the muscular and other tissues. It is at first absorbed by the blood and taken to the liver by the portal vein and its tributaries. It is stored up in the liver and then sent to all parts of the body, as the tissues require it. The sugars, like oxygen, are great heat producers. They are eliminated from the body in the form of carbonic acid gas and water.

Neutral Fatty Acids.

Palmatin. Stearin. Olein.

The natural fats, when combined in proper proportion, constitute a large proportion of the fatty acid constituents of the body. The fats are soluble in ether, chloroform and hot alcohol, but are insoluble in cold alcohol and water. The neutral fats liquefy at a high temperature in the presence of an alkali and water. It is changed by a process of decomposition into glycerin and a fatty acid. This acid combines with the alkali and forms an oleate, palmitate or stearate, according to the amount of the fat used in the transformation.

The fatty acids which have been isolated are palmitic acid, stearic acid, oleic acid, butyric acid, propionic acid and caproic acid. These fatty acids combined with potassium, sodium, calcium, etc., are found in various parts of the body as salts. These salts are found in the blood, chyle, fæces, etc. Butyric acid is found in milk, phosphorized fats in nervous tissue, propionic acid is found in the perspiration.

The fats are derived from the food, both animal and vegetable, being deposited in the form of small globules in the cells of the different tissues. The fat is found in all parts of the body just beneath the skin; it is also deposited around the substance of various viscera of the human body. Fat is also produced in the body from the partial decomposition of albuminous compounds. It is a non-conductor of heat, gives roundness to the form and protects the various structures from injury. On account of the oxydation which takes place in the body, fat forms one of the principal heat-producing elements. It is eliminated from the system during life in the form of carbonic acid gas and water. One of the first tissues of the body to show the effects of putrefaction is the fatty tissue. This is very well shown in the sunken eyes of the body a few days after death, showing the decomposition of the fatty cushion back of the globe of the eye.

Alcohols.

Glycerine. Cholesterin. Alcohol.

Glycerine is set free during the process of pancreatic digestion. It is chemically a triatomic alcohol in combination with the neutral fats of the body, and is supposed to be directly concerned in the production of glycogen.

Cholesterin is a chrystalizable substance found in the bile and other fluids of the body; the bile contains more than double the amount found in any other fluid or tissue. It is supposed to be a waste product of nervous matter.

Alcohol is supposed to form as the direct result of alcoholic fermentation in the intestines. It has also been detected on chemical examination of the urine.

Organic Nitrogenized Principals.

The proteid or nitrogenized compounds are organic in their origin, being derived from the animal and vegetable kingdom. They are taken into the body as food, absorbed by the tissues and form their organic base. The organic nitrogenized principals of the body possess certain properties not found in any other chemicals in the human body, viz.: a molecular mobility which permits isomeric modifications to take place with great facility; second, a catalytic influence in virtue of which they promote, in favorable conditions, chemical changes in other compounds, as, during digestion, salivin and pepsin cause starch and albumin to be transformed into sugar and albuminose. These proteids all possess certain amounts of water, which they lose by evaporation, dryness or dessication, becoming solid, but upon exposure to moisture absorb water, and regain their original position in the chemical products of the body. The proteids are hygroscopic. Under the effects of heat, alcohol, etc., the proteids all undergo coagulation.

The nitrogenized principals of the human body are amorphous, having a more complex and just as definite composition as the non-nitrogenized principals. They differ from the later in not being crystalizable.

As soon as death takes place the organic nitrogenized principals of the human body take on certain putrefactive changes caused by the bacterium termo. Under the action of this germ these chemical compounds give off carburetted and sulphuretted hydrogen gases and other gases of a pungent odor. In order that these changes may take place, it is essential that certain conditions be present, viz.: atmospheric air, or some media containing oxygen (although this has been proven unnecessary in certain cases); moisture also hastens this chemical change, as does also a temperature varying from 60 to 90 degrees Fahrenheit.

The nitrogenized principals in the human body have been arranged in the following groups:

Native albumens,	Derived albumens,	Globulins,
peptones.	albuminoids.	fibrin.

Native Albumens are present in nearly all the animal fluids and solids. They are proteid bodies, soluble in water, also in many of the acids and in a few of the alkalis. They coagulate at a temperature varying from 140 to 165 degrees F.

Derived Albumens are proteid bodies, different from the native albumens in the fact that they are not coagulable by heat; they are also insoluble in pure water and in saline solutions. They are soluble, however, in both the acid and the alkaline fluids. There are three forms—acid albumen, alkali albumen, and casein.

Acid Albumen is present in the stomach during the first stages of digestion. It is caused by the action of hydrochloric acid upon the albuminous particles of the food.

Alkali Albumen is caused by the action of the alkalies upon the albumen of the foods while in the intestines. It only takes place during pancreatic digestion.

Casein is present in the milk. It is easily precipitated by the addition of acetic acid.

Globulins are proteid bodies, freely soluble in saline solution, but insoluble in water. Globulin is found in many of the tissues of the body, but is largely present in the crystalline lens, a refractive body between the anterior and posterior chambers of the eye.

Myosin is present in all the muscular tissues of the body. In the living state it is found in a fluid condition, but as soon as death takes place the myosin in the muscles coagulates takes on an acid re-action and causes the characteristic stiffening of the body after death, known as rigor mortis (see "Rigor Mortis").

Paraglobulin is present in the blood of the body. It is isolated from this medium by passing a stream of carbon dioxide through it; it may also be precipitated by adding a strong solution of chloride of sodium (salt water).

Fibrinogen is found in the serous fluids of the body, also in the blood. It may be detected by the use of chloride of sodium solutions (15 per cent.) or by prolonged use of carbon dioxide.

Peptones are formed in the stomach and small intestines by the action of gastric and pancreatic juices upon the albumens of the food. Peptones are soluble in alkaline and acid solutions, also in water. They are very diffusible, and are detected by the use of alcohol and tannic acid, which precipitates them.

Albuminoids are products formed during digestion, also by various external influences. They are formed by the action of the digestive juices upon albumins.

Mucin is a thin, colorless fluid secreted by mucous membrane. It is acid in reaction.

Chondrin is present in all cartilages of the body.

Gelatin is found in the bones, also in connective tissue, tendons, ligaments, etc.

Keratin is found in the hair, nails, dermis, epidermis, etc.

Elastin is present in the elastic tissues of the body.

Fibrin is present in the blood. It is a filamentous albumin, insoluble in water and mineral acids, obtained from the blood by washing in water.

It is a notable fact that the chemical compounds entering into the formation of the sugars, starches and fats are possessed of no great chemical affinity and are noted for their unusual chemical inertia and instability, while the albuminous compounds, in which sulphur and phosphorus are combined with the four chief elements, molecular mobility exists in a high degree.

These products, on account of such chemical affinities, are well fitted to take part in the composition of organic bodies, in which there is a continual change of composition and decomposition. The latter, however, never taking place unless through the action of putrefactive bacteria upon these compounds.

Principals of Waste.

Urates	urea,	hipuric acid,
	creatin,	calcium oxalate,
	creatinin,	sodium,
	chloesterin,	potassium,
	xanthin,	ammonium,
	tyrosin,	calcium.

The products of waste included under the general term "urates" are of organic origin, being the products of disassimilation or retrograde metamorphosis in the body. These substances are taken up by the blood current, carried to the liver, kidneys, skin and other excrementitious organs, when they are eliminated from the body. The products of waste, together with the chemical composition of the various tissues of the body, will complete the study of the chemistry of the human system.

The Amount of the Chemical Elements and the Proximate Principals of the Body Weighing 153 Pounds.

	lbs.	oz.
Oxygen	111	..
Hydrogen	14	..
Nitrogen	3	8
Carbon	20	..
Calcium	2	..
Phosphorus	1	12
Sodium	..	12
	153	
Water	111	..
Albuminoids	23	7
Fats	12	..
Calcium phosphate	4	13
Calcium carbonate	..	3
Sodium sulphate and other chemicals	..	9

According to Huxley the skin will weigh 10 pounds; bones, 23½ pounds; muscles and their attachments, 68 pound; fat, 28 pounds; brain, 2 pounds; heart and lungs, 3½ pounds; abdominal viscera, 11 pounds; blood, which would drain from the body, 7 pounds; in all 153 pounds.

CHAPTER IX.

Cavity Embalming.

Cavity embalming, although not as generally used as in former years, on account of the general increase of intelligence and the gradual discontinuance in favor of the more scientific methods of arterial and needle injection, is still practiced by hundreds of embalmers throughout the United States. While cavity embalming is a poor substitute for the arterial or needle embalming, there is seldom a complete embalmment without it.

Instruments Required for Cavity Embalming.

The instruments required for cavity embalming are very simple indeed, an ordinary trocar and bulb syringe is all that is necessary to introduce the fluid into the cavities. But to manage every detail of cavity injection the embalmer should have two or three sizes of trocars, or injecting needles, so that he may use the one best adapted to the subject. He should also be supplied with scalpels, needles, ligatures, etc., for closing any openings made by the trocar or knife.

The age of the subject to be embalmed will influence you in regard to the amount of fluid to inject. Of course, you would not inject as much fluid into a child as into an adult cavity, and the amount to be injected into bodies of comparatively the same size will sometimes be a matter of conjecture. We may be able to inject into one side of the body—say the ply of fluid is the mediastinal space. This space can be reached by pushing the trocar inwards toward the center, so that it will be just over the heart and beneath the breast-bone.

Place of Injection.—The best place to inject the disinfecting fluid into the thoracic cavity is at its upper border, because by this method you can place the fluid into the cavity between the pleura and the lungs, and, entering the cavity at the top or superior border, you have the effect of floating the lungs in the pleural sacs, or just the same as if you had them floating in a bottle. The needle or trocar should be inserted between the second and third ribs, about two and one-half inches from the sternum on either side, entering the needle or trocar just below the lower border of the second rib. The trocar should be directed downward and inward to the depth of three or four inches, after which you may begin the injection of the fluid. Proceed slowly at first, or until the fluid begins to find its way into the spaces, then increasing it as your judgment may direct. A slight swelling of the thoracic wall will be the signal that you have injected enough into that side. Then withdraw the trocar and proceed just the same with the opposite pleural cavity, carefully watching the result. As soon as you have placed sufficient fluid around the lungs, withdraw the trocar nearly out of the cavity, then direct it over towards the center of the chest and surround the heart and the structures of the mediastinal spaces with the fluid, when the embalming of the thoracic cavity will be completed.

Embalming the Thoracic Cavity by a Single Needle Injection.

This is recommended by some as a better method than the above, since there is only one puncture made in the thorax. I am not in favor of injecting both the cavities in the chest by this method, as it endangers many of the large arteries and veins, and if it became necessary afterward to do arterial embalming, it could not be performed, as the vessels would be ruptured.

Place of Injection.—The place selected for the injection by this method is just above the sternum (breast-bone) in the median line of the neck. The trocar should be of the curved form, as it can be used more successfully and with less danger than the straight instrument. On account of the important vessels in this vicinity, the operator, in order to do the work successfully, should have a knowledge of the anatomy of these parts, even down to the most minute detail. The trocar should be driven straight back towards the center of the spinal column, and after it has entered the trachea (wind-pipe) a small amount of fluid should be allowed to enter the bronchus and air cells of the lungs. Then the instrument should be turned to the side and directed backward, downward and outward, towards the upper lobe of the lungs, when sufficient fluid should be injected to preserve the organs. It will be remembered that the lungs lie more to the back of the thorax than the front. The trocar should then be drawn nearly out, when it should be directed to the opposite lung in the same direction as for the former—backward, downward and outward. The cavity may now be filled in the same manner as the opposite, when the trocar can be removed. On account of the small opening left in the center of the neck, the operator, before introducing the trocar, should stretch the skin from below upwards, and while it is in this position the trocar should be introduced.

When the trocar is removed, the skin will approximate itself to its original position, which would in this case be over the breast-bone. Some operators prefer to introduce the trocar in such a way that it will hug the breast-bone. In doing this, the trocar should not be inserted more than a half inch through the tissues; it should then be turned upward toward the under surface of the sternum, and pushed downward until it rests over the base of the heart; from this point it can be pushed to either side of the chest.

Anatomical Relations.—When this method is used, the trocar being inserted along the under surface of the breastbone, we have to the right of the instrument the innominate artery and vein; farther up, the common carotid artery and internal jugular vein. While to the left of the trocar we have the common carotid artery, internal jugular vein and pneumogastric nerve. Behind, we have the bronchus, the thoracic duct, the œsophagus, and the descending part of the aorta.

It will be seen that, in either of the above methods, the trocar approaches very closely some of the largest arteries and veins of the thorax, while the method of injecting between the second and third ribs is entirely free from such danger. The amount of fluid to be used in the embalming of the thoracic cavity should be determined by the operator's individual judgment, and the size and age of the subject.

Methods of Preserving the Abdominal Viscera.

This cavity, on account of the number of important viscera it contains, is one of the most important to the embalmer. The frequent and early development of decomposition, together with the formation of putrefactive gases in this part of the body, should be sufficient in itself to cause every student in embalming to become familiar with its boundaries, contents, etc. (See "Boundaries of Abdominal Cavity," page 99.)

Presuming that the reader is already familiar with this cavity, its contents, etc., I will take up the subject of

Putrefactive Gases and the Method of their Removal.

The gases contained in the stomach and small intestines, in life, are: oxygen, hydrogen, nitrogen, and carbonic acid gas. The function of these gases in the living state being to distend the intestines, aid peristalis, prevent pressure and increase the capillary circulation. As soon as death takes place and decomposition begins, the bacteria of putrefaction forms other gases, such as sulphuretted hydrogen, ammonia, carburetted hydrogen, etc.

As soon as the embalmer is called upon to care for the body he should begin the search for these gases and remove them. If there is gas present in the thoracic cavity, it is best removed by inserting the trocar at the upper border of the cavity, between the second and third ribs, and about three inches from the breast bone. This will relieve all the gas from the cavity of the chest and pleura. The injection of fluid can be made through these same openings. If the lungs are distended with gas, it can be removed by turning the body on the side, pulling out the tongue, and then making a pressure below the diaphragm and on the lower ribs upward. This will usually remove all the gas from the bronchial tubes and their alveoli. After the gas has been removed from the thoracic cavity, the abdominal cavity should next receive attention. If there is gas in the abdominal cavity—and there always is more or less gas accumulated there—you can remove it by tapping with the trocar or hollow needle.

The trocar should be inserted a little above and to the left of the umbilicus (navel). This will prevent injuring any of the large blood vessels. The stomach should then be punctured, and then the intestines; this can be accomplished by a single opening in the cavity, merely directing the sharp end of the trocar toward the part of the alimentary canal that you wish to puncture. The removal of this gas from the abdominal cavity is greatly aided by pressure upon the abdominal walls with the hands, which facilitates the expulsion of gas to a great extent. If the abdomen collapses and becomes flabby, you have succeeded in removing the gas and the work has been successfully accomplished. But any person who has had any great experience is well aware of the fact that there are many cases where you cannot let off the gas by trying to puncture with the trocar; that is because the intestines have become so full of gas that the trocar, instead of entering them as it should, rolls off and strikes the tissue planes of the back and sides. When such an extreme case as this is encountered, it will be necessary to make an incision with the scalpel in the median line of the abdomen, beginning just at the umbilicus (navel) and continuing the incision upward about three inches. As soon as you have opened the abdominal cavity, the intestines should be caught up with the forceps and opened with the scalpel or scissors provided for the occasion.

A great deal of the odor which would necessarily escape can be neutralized by saturating a cloth with the preservative solution, or, better still, with a reliable disinfectant, and allow the gas to penetrate the cloth or sponge before entering the atmosphere of the room. This will not only destroy the odor of the gas, but will kill any disease germs that might escape with it, thus protecting the operator and those who would be required to enter the death chamber. After the gas has been removed from the abdominal cavity, you may proceed to inject the preservative solution, which, for cavity use, should be a little stronger than that usually employed for the arterial injection.

The stomach tube is the best instrument to use in removing gas from the stomach and small intestines. In using this instrument the head should be inclined backward, and the rigidity of the muscles of the neck and lower jaw should be broken up. The tube may be introduced per mouth and œsophagus into the cavity of the stomach. Fluid should be injected after the gas has been removed.

Place of Injecting the Abdominal Cavity.—The best place to make the injection into the abdominal cavity is in the umbilical space, about two inches to the left and two inches above the umbilicus (navel). The fluid can be introduced through the trocar from this point to any part of the abdominal cavity. The abdominal cavity should receive any-

where from one pint to three quarts of fluid, according to the size of the subject and the judgment of the operator. After the fluid has been introduced, the wounds made by the trocar or scalpel should be neatly sewn up and covered with plaster; this will hide all marks of the opening.

Other Methods of Cavity Embalming.

Some embalmers in this country prefer to inject both the thoracic and abdominal cavity, by inserting the trocar into the right or left hopochondriac space, just beneath the ribs.

Another method is to enter the trocar at the umbilicus, push it upward through the diaphragm to the right ventricle of the heart, thus removing the blood from that organ, then withdrawing it slightly and pushing it on upward into the right and left pleural cavities, saturating these parts with the fluid, and then, before removing the trocar, distributing the fluid to all parts of the abdominal cavity. In performing any method of cavity embalming, where the diaphragm is to be punctured, the operator should insert the trocar or embalming needle through the upper attachment of the membrane, just beneath the lower end of the breast-bone. (See "Barnes' Simplex Method.") Prof. W. P. Hohenschuh prefers to insert the trocar just beneath the ribs on the left side of the body. The gases are first removed, then the thoracic and abdominal cavities are injected with the preservative. Prof. Hohenschuh punctures the diaphragm immediately beneath its attachment to the end of the sternum (breast-bone). Mr. James J. Morris, superintendent of the Chicago City Morgue, first punctures the stomach in the epigastric space, then injects fluid into both the thoracic and abdominal cavities.

CHAPTER X.

Arterial Embalming.

Having considered the methods of cavity embalming, I will consider the method of embalming known as the arterial process. The method of preserving the body by an injection into the arterial system was first practiced by Frederick Ruysch, of Amsterdam, Holland, between the years 1665 and 1717. Ruysch filled the chair of anatomy during this period and had ample opportunity for practicing the art, but, on account of his selfish nature, he died without leaving the world with the secret of his process or the chemicals employed.

Ruysch's methods did not awaken very much interest, since they were but little known, and for this reason some authors have doubted that he was the discoverer of the arterial method. It remained for J. N. Gannal, of France, to awaken a scientific interest in the method of preservation by arterial injection. Gannal, in the year 1834, claimed a discovery of a new method of embalming the body without eviserating or mutilation, but while he made known the method (that of injecting the arterial system) his preservative solution was kept a secret. On account of the wide interest awakened in the subject of embalming by Gannal and his contemporary, M. Suquet, who disputed some of Gannal's statements, the discovery of the method of injection through the arterial system is generally accorded the latter, and justly so, for any person making a discovery that is of so much importance to the whole world, who jealously keeps it secret, is not deserving of the honor of being the discoverer.

Cavity embalming is merely temporary in its effects, while arterial embalming is permanent. The former does little in a sanitary point of view, while the arterial method is invaluable, since it destroys every germ in the body.

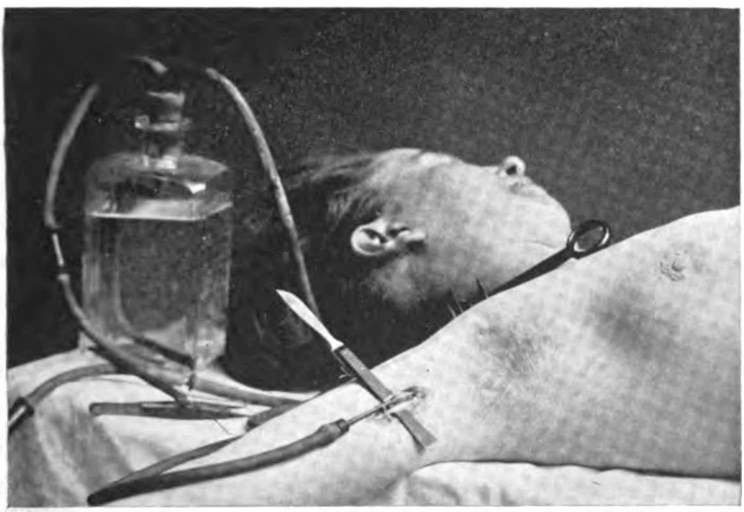
Reasons for Embalming the Dead.

A great many reasons have been advanced for embalming the dead. Some of these are plausible, while some are, perhaps, fanciful, but in the majority of cases the principal reason is to prevent the appearance of putrefaction until such time that the body may be viewed by the friends of the deceased, or until it can be conveyed to a suitable resting place. This is the first and prime reason why embalming is practiced so extensively in this country. Since the discovery of the cause of putrefaction in animal tissues, and also since the discovery of the germ theory of disease, we have added the second, but by no means the least important cause, viz.: that of disinfecting the body. The importance of this subject can hardly be overestimated, since, by the introduction of the disinfecting fluids into the body by means of the arterial system, the fluid penetrates every tissue, and, by the aid of osmotic action percolation and imbition enters even those tissues not supplied by the blood current, killing the germs of contagion and putrefaction, and thus preventing the spread of contagious or infectious diseases or the development of poisonous gases, which might have serious effect on the living.

Other reasons for embalming are those that relate to the preservation of a body until it may be identified. A fanciful reason for embalming is that the body is made to look lifelike. Some of the fluids on the market, especially those containing the arsenate of soda, have the tendency to produce a redness of color to the cheeks and exposed mucous surfaces.

The Method of Arterial Embalming — Instruments Required.

The instruments required for arterial embalming should be of the very best make. The operator should have one or two scalpels, a bistoury or sharp pointed curved knife, an aneurism needle, a sharp hook, and a pair of dissecting forceps. These will complete the instruments necessary for making the dissection and taking up the artery to be injected.



The remaining instruments are such as are employed for making the injection into the arteries, and the drainage tubes used for removing the blood from the veins. The operator should have two or three sizes of injecting pipes or arterial nozzles, also an aspirator or vacuum pump, or, this being absent, a bulb syringe, such as is often used in the household, will answer the purpose. Special apparatuses have at times been devised for injecting the arteries, but those mentioned in the preceding lines will suffice for all ordinary cases.

The Condition of the Body to be Embalmed.

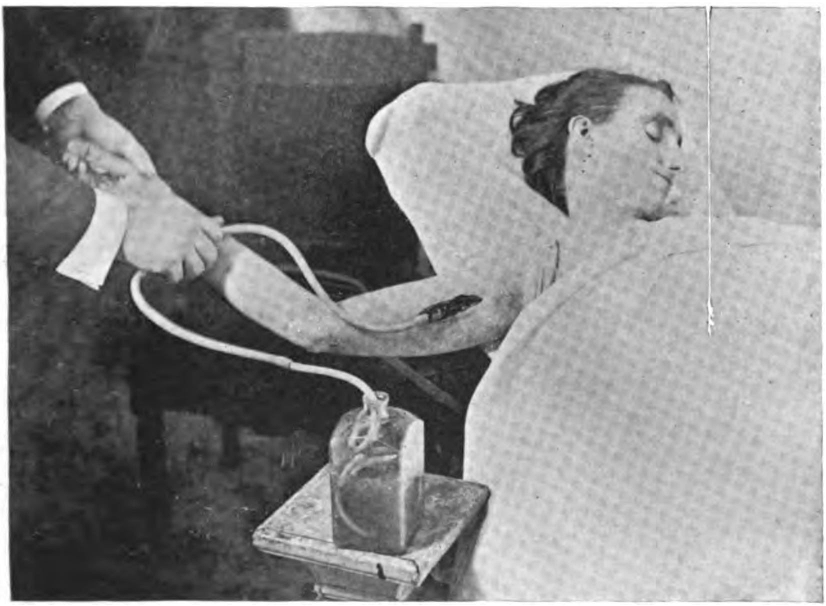
The condition of the body should be taken into consideration before commeucing the arterial injection. The time which has elapsed since the death of the subject, together with the presence or absence of rigor mortis, or the appearance of putrefaction, will cause many changes to be made before injecting the preservative solution through the system. If the person has been dead only a few hours, then it will not make much material difference and the injection can begin without taking any preliminary steps, but should the body be one that had died a day or two previous to your being called, then it will be necessary to proceed with care. First examine the abdominal and chest cavities and search for the presence of gas, carefully examine the face and neck and observe whether any discolorations of a putrefactive nature have made their appearance; examine over the region of the external and internal jugulars and see whether there is any post mortem staining along these vessels, also whether there is any blood present. If there is venous congestion and the veins of the neck are filled with blood, caused by the gases in the thorax and below the diaphragm pressing upward on the large venous trunks, whose valves above the heart offer no impediment to the regurgitation of the blood, it will be best not to relieve the gas until you have made the dissection over the artery you desire to inject, as by opening the accompanying vein along the course of the artery, such as the basilic or femoral, the blood may be withdrawn much easier, since the pressure of the gas aids the blood to escape from the opening made in the veins. After this has been accomplished and the blood removed, then the abdominal and chest cavities should be relieved of the gases contained therein and the arterial injection begun. Should the rigor mortis be present, it should be broken up by flexing and extending the limbs until they become quite supple; the neck should also be turned from side to side, so as to break up the rigidity of the muscles in that locality. (See "Barnes' Needle Process.")

The advantages gained in breaking up the rigor mortis before beginning the arterial injection are several. Firstly, the fluid, on account of the suppleness of the body, enters the circulation much freer than when it is present; secondly, the rigor mortis not returning after once being thoroughly broken up permits of the easy penetration of the fluid into the muscular tissues; thirdly, the veins not being compressed allows the return of the fluid to the right side of the heart. Thus it will be seen that the body, in order to receive the most complete embalmment, should be in a state of suppleness, so that nothing will impede the circulation at any point. It has been advised by foreign authors that the body should be placed in a warm bath, so that the rigidity should be broken up and the capillary system dilated in order to permit of the easy injection of the fluid. This has been practiced by some of our colleges in this country; not so much for the embalming of the body as it was to secure a thorough injection of wax or starch compounds into the arteries for the purpose of arterial demonstrations. In the injection of such compounds for this purpose, the heating of the body by immersion in a warm bath—130 deg. F.—enlarges the capillary system and prevents the too rapid cooling of the substance when injected. I have found, however, that this is entirely unnecessary, for, if the rigidity of the body be completely broken up, then the arteries can be made to stand out permanently by the injection of a warm solution of plaster of Paris, which has been colored by some of the analine dyes—red can be used for the injection of the arteries and blue for the veins. For the purpose of demonstrations, this excels anything I have ever used. Having dwelt for a few minutes on the conditions which are liable to be present in all bodies, merely admonishing the reader to be careful not to be too hasty in making the injection, I will proceed with the remainder of the chapter.

Selection of the Artery to Receive the Injection.

After the preliminary examination of the body has been completed, the next step is toward the selection of the artery that will be best adapted to the case. Richardson says, if the upper limbs are the best developed, then the brachial will answer the purpose best. This artery, he adds, should be taken up in the upper third of its course, but if the lower limbs are best developed, then the femoral artery in scarpas space will answer the purpose best.

I have given very little attention to the development of the upper or lower limbs in their relation to embalming, but if the size of the vessel is the main object sought for, then I would choose either the femoral or the carotids, for in ninety-nine per cent. of the cases these vessels are larger than the brachial in the arm. It is not so much the size of the vessel as it is the convenience in operating and injecting. The right arm offers the best advantage to a right-handed person, and vice versa; the left being preferred by left-handed operators. I use the left brachial artery in preference to the right because it has alongside of it the left basilic vein, which, on account of its gradual curve towards the heart, is the best vein for the removal of blood. The femoral should never be injected in a lady subject, as it causes unnecessary exposure which, in some cases, will cause a great deal of criticism. Should the lady be already dressed when you are called, it would be very difficult to inject the brachial without removing the clothing; in this case neither the femoral or the brachial should be used, as the radial at the wrist, or the posterior tibial artery will answer the purpose best. The posterior tibial should be raised in its course just back of, and between the inner ankle and the tendo achilles. If the subject be that of a well-developed man, I prefer to use the brachial artery in the left arm, for reasons before stated, but should the body be only of medium stature, then it is preferable to use the right common carotid. In children I find this artery is one of the best arteries to use, principally on account



Operator injecting brachial artery with bulb syringe.

of its size, and also because the jugular vein (internal) is placed alongside of it, thus offering very favorable conditions for the removal of blood from the face and neck and all parts of the body. On account of the position of the brachial artery in the arm, I believe that nine-tenths of all the bodies embalmed in the United States receive their injection of fluid through this artery. Demonstrators in medical colleges prefer to inject the right common carotid in the neck, as it is a large artery and is very easily taken up and injected. On account of the free anastomosis of this vessel with the opposite common carotid, also its relation with the great aorta, it is possibly the best artery in the body to use for the purpose of embalming.

The operator having made the selection of the vessel he desires to inject, he should begin to raise it at the best possible point. On account of the anastomosis or collateral circulation, the brachial will receive the best injection when taken up in its middle third, while the femoral should be taken up at the junction of its upper and middle thirds, or below the division of the profunda. Should the brachial be the artery decided upon, the embalmer will begin his incision between the biceps and triceps muscles, midway between the arm-pit and the bend of the elbow; after cutting down through the skin and superficial fascia, the deep fascia should be siezed with the forceps and carefully divided, so as to expose the vessels. The artery should be exposed fully two inches, so that the operator will have little trouble in inserting the arterial nozzle. The artery should be raised and brought more to the surface by placing the handle of the scalpel, or other instrument, beneath it. The incision should be made, first crosswise, then a second incision intersecting this at the center; this second incision will be in the long axis of the vessel and should not exceed a quarter of an inch in length. The scissors answers this purpose better than the sharp-pointed bistoury or scalpel. Through the opening made by the scissors the arterial tube best adapted to the sise of the vessel should be introduced, pointing toward the heart.

This tube should be pushed up in the lumen of the artery for an inch or more and should be carefully tied in position with ligatures. On account of the improvement recently made in injecting tubes, a single ligature will be sufficient, but should the tube be of the straight and unnotched variety, then the operator had better apply two ligatures. It is not necessary to ligate the distal end of the exposed artery until the effect of the collateral circulation, when it should be tied. After everything is in position, the tube held to the arm by means of a piece of tape, the injection of the fluid should begin.

Mode of Injection.

So many instruments have been placed on the market in the past three years, for the purpose of forcing the fluid into

Operator Injecting Arterial System with Vacuum Pump.

the circulation, that several of them are worthy of some attention in this work. The older instruments for injection were devised on the plan of hydrostatic pressure; an ordinary fountain syringe or other receptacle was charged with the preservative solution and a piece of rubber tubing was connected to the arterial tube. After this had been accomplished, the receptacle containing the fluid was placed from twenty-four to thirty-six inches above the level of the body, the fluid being allowed to enter the circulation very slowly. Injecting the body by this method is still practiced in some of the institutions of the United States, but it has almost disappeared, or has been discarded entirely by the undertaking profession. The Wagner injector, the Taggart aspirator and the Allen embalming pump have been the latest devices used for forcing the fluid over the circulation.

I have used all of these different injecting apparatuses, and find that the bulb syringe, the Taggart aspirator and the ordinary form of Potain's aspirator or vacuum pump answers the purpose best. These instruments can be obtained in almost any instrument house, or in any of the various casket factories of the United States, who keep a full line of them. The injecting apparatus should be connected to the arterial nozzle and, according to Richardson, a small amount of ammonia vapor should first be thrown into the arteries, in order to dilate the smaller vessels. It should also be remembered that ammonia is a very efficient antiseptic. After this has been completed, the injection of the solution proper should begin. It is not altogether necessary for the injection of the ammonia vapor, to insure successful embalming, the advantages in using it being first to dialate the vessels, and, second, to act as an antiseptic and as a slight preservative. One thing the operator should remember, in beginning the injection of the body, is to have patience. Never begin the injection in a hasty manner. The nearer the fluid can be allowed to enter the circulation of its own accord, the better, as there is no danger of rupturing the circulation and the fluid escaping into one or the other cavities of the body. From one-half to one hour should be taken up in a successful arterial embalmment. If the fluid is entering the circulation properly, the veins of the forehead and on the dorsal surface of the feet will begin to become prominent. This will sometimes occur when only a small amount of the fluid has been introduced; especially is this so where the venous system is pretty well filled with blood. The injection should be continued until there is some resistance to the further entrance of the fluid; at this point the operator should stop. The tube should be disconnected from the arterial tube and a cap placed over the arterial nozzle so as to prevent the escape of the fluid from the system.

If the preservative solution has entered the system and has penetrated into the tissues, it may be detected by needle punctures in the bottom of the feet, or punctures with the scalpel in the muscular part of the toes; the fluid will escape from these punctures or openings if the circulation is properly filled. The escape of an ounce or two of the fluid will not make much material difference in the process of a successful embalmment.

Effects of a Successful Arterial Injection.

If the chemicals introduced are exerting any power as a preservative, they will soon begin to manifest the condition by causing a slight mottling of the tissues of the face, although with some very good preservatives this does not take place, but in this case, instead of causing a mottled condition of the tissues, they are changed uniformly, either to a whitened condition or to a life-like appearance, the cheeks and lips changing their pallor to that of a slightly reddish color. In this respect it is very easy to detect, by this appearance, whether the preservative solution employed contains arsenic or zinc chloride. If the fluid is made of the arsenical preparations, combined with alum, corrosive sublimate, and other chemicals in a watery or alcoholic menstrum, the effects of the preservative will be to change the tissues more to a life-like appearance, while fluids having zinc chloride for their base first cause a mottling of the surface, which subsequently hardens the tissue, and the whole body becomes a marble-like whiteness.

These changes do not take place for several hours after the preservative solution has been introduced, and in some bodies, possibly on account of variations in their chemical composition, these changes do not take place at all.

Second Injection. In such cases it is well to make the second injection of the embalming fluid. At least twelve hours should elapse between the first and second injections of the fluid, but if the process be delayed for a few hours longer it will make little difference, as the amount of fluid introduced at the first injection will be sufficient to preserve the body for several days.

If you have decided to make the second injection, the same fluid should be used as was previously employed, as one fluid might form an incompatible with another, and the whole process would thus be a failure. Attach your tubing to the arterial nozzle, which had been left in position, and begin the second injection with as much caution as the first, taking plenty of time. The arteries have a tendency to empty themselves of the fluid injected into them in the course of eight or ten hours, and it will be found that you may inject as much fluid during the second operation as was injected during the first. This is very easily explained; the fluid when first injected is confined almost exclusively to the vascular system, but in the course of a few hours, or as soon as osmotic action takes place, the fluid is absorbed from the vessels and passes into the tissues, thus the second injection merely refills the arteries and veins and forces the imbition of the fluids by the tissues.

In the course of twenty-four to thirty-six hours after the embalmment, if the body becomes rigid and the tissues take on a stony hardness, it is a most favorable sign of a successful and permanent embalmment. This having been secured, the embalmer should remove the arterial tube from the vessel and proceed to close the wound. If the fluid used contained chloride of zinc, the vessel may be securely plugged or occluded by injecting from four to six ounces of silicate of soda just before removing the nozzle. The silicate, when it comes in contact with the chloride of zinc, forms a coagulum which prevents any fluid from entering or passing through it, but in the fluids generally employed in this country, it will be necessary for the operator to ligate the artery as soon as he removes the injecting tubes. This will prevent any further leakage, and is less trouble than injecting the silicate of soda solution. Having removed the arterial nozzle and ligated the vessels, the surplus fluids should be taken up with a small piece of absorbent cotton, and the wounds closed with linen or cat-gut ligatures, the best stitch to use being the ordinary anatomical stitch or that generally employed in covering base balls.

A little care in stitching the wound over the vessel will prevent the sutures from showing. The stitches in all cases, however, should be covered with a piece of court plaster.

Amount of Fluid to be Injected.

The amount of fluid required for a subject depends, first, on the quality of the fluid as a preservative; second, on the size and age of the subject; and third, on the judgment of the operator. If the subject to be embalmed is that of a small child between the ages of five and ten years, from one to two pints of the fluid injected into the circulation will be sufficient, but for the adult subject the weight is an important feature for the estimation of the amount of fluid to be used. If the subject is of average weight, 150 pounds, from two to three quarts will be required, while in a plethoric subject I have injected as much as six quarts of fluid, without forcing the circulation or causing any rupture of the vessels. The importance of injecting enough fluid into the body of a plethoric individual cannot be overestimated, as these cases, on account of the large amount of fatty tissue they contain, undergo putrefaction with alarming rapidity, even after good fluids have been introduced. The cause of this decomposition in such cases is the result of the incomplete fluid supply to the fatty tissues. Hardly any blood vessels can be detected in them, thus the fluids must reach these parts by percolation or imbition.

Skin-Slip.

Slipping of the skin is an indication that signifies the beginning of putrefaction between the two layers of the skin. It occurs in all those subjects who die of diseases causing rapid decomposition, such as drowning, dropsy, childbirth, and in fact any case where there is an increase in the watery constituents of the body.

It will also occur in any dead body after putrefaction commences in the *rete mucosum*, the fatty layers or cellular layer just beneath the outer layer of the skin. The putrefactive bacteria cause liquification of the tissues at this part, and the slightest pressure will cause the outer layer of the skin to become detached. There is only one successful method of preventing skin-slip, and that is the injection of a fluid containing Formaldehyde. On account of the hardening and tanning effect on the skin caused by this chemical, I have seen cases of advanced skin-slipping (putrefaction) suddenly stopped, and the skin subsequently hardened so that it was next to impossible to remove it with the hands.

After Treatment.

The arterial embalming having been completed and the wound neatly sewn up, the next step will be to surround the organs contained in the abdominal and chest cavities with the preservative. The gases having been removed from the abdomen by the long hollow needle or trocar, the fluid should be introduced and distributed to different parts of the abdominal cavity, so that it will come in contact with all the organs. Sometimes the needle puncture will not be sufficient to remove the gas and you will have to resort to the use of the scalpel or bistoury. In such cases the incision should be made in the median line just below the umbilicus (navel), and should not be more than an inch in length. The intestines can be caught up by the forceps and incised, when the gas will escape. Another method to remove the gas without making the open incision, is to take the sharp-pointed bistoury, introduce it through the same opening previously made by the embalming needle or trocar, and turn it in several ways after it has entered the cavity, when it will cut through some part of the intestinal tract and the gas will be allowed to escape. There are objections to this method, however, as the knife might cut off some of the branches of the mesenteric arteries and the fluid previously injected would escape into the cavity.

The thoracic cavity should next receive attention, the fluid should be injected into the right and left pleural spaces through a puncture between the second and third ribs. About one pint of the preservative solution should be injected into each cavity and after this has been completed, the operator should inject from four to six ounces into the mediastinal spaces. This will complete the injection of the cavities. The openings made by the trocar or scalpel should be neatly closed by being brought together with a stitch and afterwards covered with plaster.

If the body is only to be kept a short time, it will not be necessary to bandage it, but if the body is to be preserved indefinitely it should be carefully wrapped in bandages made from cheese cloth. These bandages should be from three to six inches in width, and before applying should be saturated in the following mixture:

Carbolic acid, three parts.
Collodian, twenty-two parts.

The collodian keeps the air from coming in contact with the body and keeps the skin soft, preventing the dessication and slipping usually present in bodies where the bandaging is left off. Carbolic acid, being one of the strongest disinfectants, prevents the development of any bacteria of a putrefactive nature. The bandaging should only invest the body as far as the neck, thus permitting it to lie in state or to be viewed by the friends and relatives of the deceased.

If the body is to be transported, by rail or sea, it will be necessary to have the casket made so as to fit the body as perfectly as possible; it should be heavily padded, and at the sides of the head small pillows or blankets should be placed to prevent the head from concussion or from turning on the side, thus favoring the gravitation of the fluids to the parts resting on the bottom of the casket. This will always cause more or less discoloration, as was the case in the body of ex-Minister Gray, which was shipped from Mexico to Indianapolis, Indiana.

If the body has been treated by the method above described, it can be placed in a covered casket and retained for any length of time without any fear of it undergoing any change from decomposition.

CHAPTER XI.

Needle Embalming.

Needle embalming was first introduced by Benjamin Ward Richardson, of London, England, in 1884. Dr. Richardson's process is generally known in this country as the "eye injection." It consists of injecting the vascular system by and through the cerebro-spinal cavity.

This process, for reasons which will be explained in the few pages following, has almost entirely been discarded by the profession in this country. The eye method was first taught in the United States by F. A. Sullivan, who claimed it as his own discovery and that he could embalm the whole body by an injection by means of a hollow needle introduced into one of the orbits of the eye. He had not progressed very far in his teachings until he was challenged by J. H. Clarke, of Springfield, Ohio, to an open debate to take place either in Chicago, St. Louis, Cincinnati, Baltimore, Philadelphia, New York or Boston.

From the nature of Prof. Clarke's challenge, it seems that he does not state any impossibility of performing the method known as the eye injection, but the debate is to decide which is the best method — the eye injection or the arterial method. The challenge was never accepted and neither of these principals ever offered any scientific reason for or against the method.

The Eye Process.

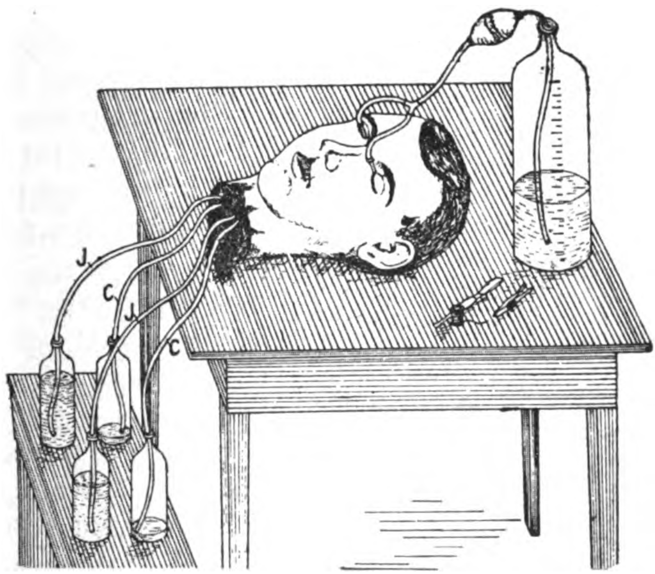
The body, to be embalmed by this method, should be placed on a table, with the head slightly elevated; all clothing which would press upon the large venous trunks of the neck should be carefully removed so as to permit of an easy flow downward through the jugulars. The operator should have at hand a small hollow needle, from four to six inches in length, and a suitable injecting apparatus, the ordinary bulb syringe answering the purpose admirably.

The needle should be introduced at the inner corner of the eye and directed backward and along the sphenoidal fissure until it enters the cavity of the cranium. The needle should be introduced into this cavity for the length of three or four inches, when the injection may begin. It is claimed by some that the needle enters the optic foramen in the apex of the orbit, but this is a mistake, for, should the needle enter this foramen it would be pointing towards the outer canthus of the eye, instead of the inner. From eight to twelve ounces of the fluid should be introduced by this method, when the veins of the head and neck will become prominent, on account of the fluid entering their substance and proceeding towards the heart. After two or three pints of fluid have been injected, the operator should introduce several more ounces into the thoracic and abdominal cavities, completing the operation by injecting into the extremities from four to eight ounces more. It is also advisable to inject the muscles over the thorax and abdomen, and wrap the body in bandages saturated in the solution given on a preceding page. The addition of tannin, gum benzoin, and eucalyptus to this mixture will greatly increase its preserving qualities, and will give a pleasant odor, which will fill the atmosphere in the vicinity of the body.

Experiments on the Eye Injection.

After the controversy between Clarke and Sullivan, neither one having produced statements to prove their assertions for or against the "eye injection," Mr. W. W. Harris, whom I have the honor of being personally acquainted with, settled the dispute by conducting the following experiments:

The head was decapitated and placed upon a table, as shown in the illustration. Two needles were introduced through the sphenoidal fissure and into the cavity of the cranium, these needles being connected to a single syringe by rubber attachments and a "Y" connection. Arterial nozzles were inserted into the carotid arteries and internal jugular



EXPERIMENT ON EYE PROCESS.

EXPLANATION OF CUT—A bottle having been filled with embalming fluid, two eye process needles are introduced through the orbit into the cerebro-spinal c avity; an injecting apparatus is attached to the needles; the fluid injected finds its way into the jugular veins, JJ, and, second, into the carotid arteries, CC.

veins, where they had been severed in the decapitation. The same were securely tied and tubing attached, leading each to a separate bottle. These bottles, for convenience, were placed on a bench somewhat lower than the table. After the connections were completed, the injection was begun. The first few contractions of the bulb forced the fluid out of the spinal canal, from which it flowed freely and as fast as the operator would naturally pump. This opening was then stopped as securely as possible, almost entirely arresting the flow of fluid, and the injection begun for the second time. The fluid at once made its appearance in the bottles containing the tubes leading from the internal jugular veins; as long as the injection was continued the fluid flowed in a steady stream from these vessels. At the same time a very small percentage of the fluid was deposited in the bottles containing the tubes leading from the carotid arteries.

This completed the test as far as the eye injection was concerned. The embalming needles were removed from the brain, and the stoppage removed from the opening in the spinal canal. The syringe was then attached to the arterial nozzle in one of the carotid arteries, which was then injected. The fluid at once flowed from the spinal canal, and did so as long as the injection was continued.

I am inclined to believe the fluid which came from the spinal canal during the injection of the carotid artery, was not due to any free anastomosis or communication with the canal direct, but came from the divided ends of the basilar artery and some of its immediate branches. The results of these experiments on the arteries and veins of the head and neck are about as follows: The tendency of a fluid injected through a hollow needle introduced into or through one of the orbital openings in the cranium, is, first, to the spinal canal; second, to the large venous sinuses, and lastly, to the arteries.

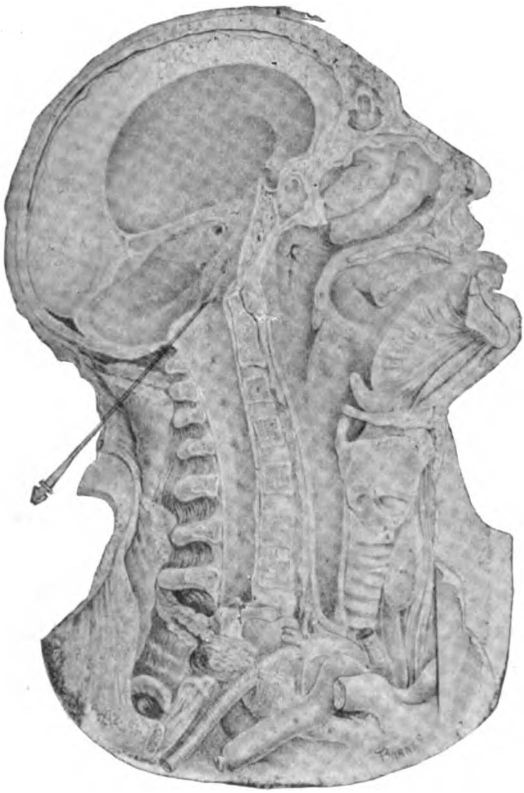
Since the experiments on the eye method of injection, another method—the most scientific, and at the same time the simplest method of them all—has been discovered. This method does away with any instrument of a cutting kind, the needle reaching the most central part of the cerebro-spinal vity, without entering the structure of the eye or the openings at the apex of the orbits. This is now widely known as "The Barnes Needle Process."

The Barnes Needle Process.

Nations as widely separated, geographically, as the Assyrians and Persians, in the old world, and the Mexicans and Peruvians, in the new world, have attempted to preserve the bodies of their dead. Each nation employed its own peculiar method, and the success which they attained varied, not with the intelligence of the people, but with the climate peculiar to the country. Thus we find that Egypt, on account of the climate and the superior advantage of skilled embalmers, penetrated into the very depths of one of the purest of all sciences, and the mummies existing to-day are the monuments of their skill. But while their process was in a high degree successful, it necessitated considerable mutilation, and eviseration almost completely.

But the days of the Egyptian embalmer came to a sudden halt and the art was lost. Experimenters and investigators took it up again later on, but seeing so many discrepancies in the writings of Diodorus, Sicilus and Herodotus, they were led into different channels of thought; theory was coupled to theory, fact was coupled to fact, genius made perfect the idea, and a scientific truth was born. Gannal had reduced the art of embalming to one of the most simple kind—a process still in vogue. He proved that evisceration and mutilation of the body in order to preserve it were not necessary, and in 1834 the first arterial injection of the body complete was accomplished. This is but a few years ago, yet at that time the scientists had agreed they had reached perfection. Nothing more is heard of any further discovery until Benjamin Ward Richardson, of England, performs for the first time the "eye process" in 1884 From 1834 up to the time when Richardson discovered the "eye process" there had been no radical change in the methods of introducing the fluids into the system. The workers in the profession turned their attention to the perfection of embalming fluids, and the improvement in that line has reached a very high degree. Bacteriological science has been the latest aid in the making of these fluids, for from it we have added to our preservatives such chemicals and antiseptics as will unquestionably kill any disease or putrefactive bacteria in the body, if properly and skillfully introduced.

The eye process was taken up in this country and given a severe test, but it has stood all the tests that the critic could apply. It had its drawback, however, since, in the great majority of cases, swelling and bulging of the eye were a prominent feature, and caused many an operator to abandon it and go back to the method of arterial injection. We find then that the eye process, which had been advanced by a person who unscrupulously claimed it as his own discovery, was cast aside because it disfigured the eyes, and, second, because it could not be tolerated by the relatives and friends of the deceased. Inserting a needle through the orbit alongside of that delicate organ, the eye, was a trying ordeal for the friends of the deceased, and disgusting to the operator, indeed, when he accidentally caused a disfigurement of the eye-ball. The process which I will now describe for the first time by any demonstrator in the world, does away with the eye injection, yet reaches the same cavity and secures as complete circulation as though the fluid was injected into the brachial artery itself. The body to be embalmed is to receive its circulation by and through the cerebro-spinal cavity. This cavity is reached by using a small four or six inch hollow needle inserted into the posterior part of the neck and through the foramen magnum in the occipital bone. The needle introduced into the cavity by this method penetrates the cerebro-spinal cavity more direct than when the needle is inserted into or through the sphenoidal fissure at the apex of the orbit, and at the same time there is no danger of rupturing the circle of Willis. That circle of arteries which is formed by the anastomosis of the internal carotids with the branches of the basilar, lies anterior to the opening in the occipital bone, and rests more on the basilar process;



BARNES NEEDLE PROCESS.

Antero posterior median section of the head and neck: needle introduced between the atlas and througn the foramen magunm in the occipital bone, penetrating the cerebro-spinal cavity. Anatomical relations of the trachea (wind-pipe) and the œsophagus (gullet).

thus, when the needle is introduced you insert it behind the arteries and a little to the side, while when we inject through the bony openings in the orbit we are in danger of penetrating the anterior branches of the circle and breaking the circulation. It makes little difference if you do go through the longitudinal sinus by the eye method, but in using the needle through the foramen magnum you reduce the danger of rupturing either the arteries or veins to a minimum; because, as before stated, the circle of Willis lies anterior to the foramen magnum in the occipital bone, while the lateral sinus and the torcular herophilii lie back of the opening and from one and one-half to two inches posterior to it. The longitudinal sinus cannot be reached by this method by using a six-inch needle, for, since the direction of the needle is towards the opposite eyebrow, the needle would strike to the sides of that great sinus.

The needle which has been inserted into the parts is so made as to be attached to an injecting apparatus, which is supplied with the fluid for the preservation of the subject. This being completed the injection may now begin. The embalming fluid is forced into the canal very slowly at first, or until the circulation is fully established, when you may increase the work of the injecting instrument. In the adult subject it is an easy matter to inject from one to three quarts into the body in less than a half hour, although undue haste should be avoided in all cases. If the fluid is entering the circulation properly, the veins in the neck will soon be seen to rise up, followed later on by the swelling of the facial and frontal branches of the external jugular, then the fluid will pass downward through the jugulars into the subclavian, and finally into the superior vena cava to the right auricle of the heart. After the fluid has once reached the right auricle of the heart it takes the natural course of the pulmonary circulation, i. e., from the right auricle of the heart to the right ventricle, thence through the pulmonary arteries to the lungs, after which it is returned to the left auricle by the four pulmonary veins; it then pases through the mitral valve to the left ventricle of the heart, and then it enters the aorta to be distributed to the extremities through the general or systemic circulation, along with the fluids now coming down the carotid and vertebral arteries.

As soon as the veins in the extremities begin to appear prominently on the surface, it is an indication that the circulation is complete, which proves that the fluid is entering the circulation very freely, or with as much ease as though it were injected into the brachial artery direct.

First Effects of the Injection.

When the first few ounces of fluid have been introduced into the cerebro-spinal cavity, that cavity becomes completely filled, the fluid first filling up the cerebral part of the canal and next the spinal canal, which in the living state is filled with the spinal fluid, entering these cavities which are one and formed by a complete investing membrane. The fluid naturally takes the direction of least resistance, which is through the delicate membraneous covering of the spinal cord and into the spinal veins, then into the lateral and longitudinal sinuses, and finally into the jugulars to follow the course above given.

Anatomy of the Parts and Method of Entering the Cavity.

In order to enter the cerebro-spinal cavity through the foramen magnum in the occipital bone, the operator should be familiar with the prominent landmarks on the bone itself, and also with the soft tissues on the posterior part of the neck. A few hours' study will be enough to familiarize yourself with these important parts. The occipital bone is situated at the posterior part of the skull, is curved upon itself and shaped very much like a cockle shell. It has numerous grooves and depressions on the external surface, which serve for the attachment of muscles. By feeling toward the center and most posterior part of the bone you will discover a prominent eminence which is known as the occipital protuberance, which gives attachment to the ligamentum nachæ. In some of the lower animals this prominence is very large.

The foramen magnum or opening in the occipital bone lies about two inches inward and towards the base of the

LINEAR GUIDE.
Needle in position. Operator injecting the body.

skull. It is more accurately located by feeling for the articulation between the atlas, the first bone of the vertebral column, and the occipital bone. The foramen magnum is about the size of a half-dollar and is almond-shaped. On account of the numerous ligaments attached to the atlas from the occipital bone, the space between these two bones is very limited, and unless the operator takes the precaution of bending the head downward upon the chest, at the same time inclining it to one side, he will not be able to insert the needle into the proper channel. It is next to impossible to introduce the needle into the foramen magnum when the head is erect, but just as soon as the head is inclined laterally and bent downward upon the chest, the ligaments relax and there is a space left between the two bones of half an inch, through which the needle will readily enter. If the rigor mortis is present at the time you arrive at the house, it should be broken up before attempting to introduce the needle. The axis, the second bone of the spinal column, has a projection known as the odontoid process which protrudes through the opening in the atlas and partly enters the foramen magnum. This protuberance prevents the embalmer from entering the cavity directly from the back of the neck, as the needle will surely strike it and it will be impossible to enter the cavity.

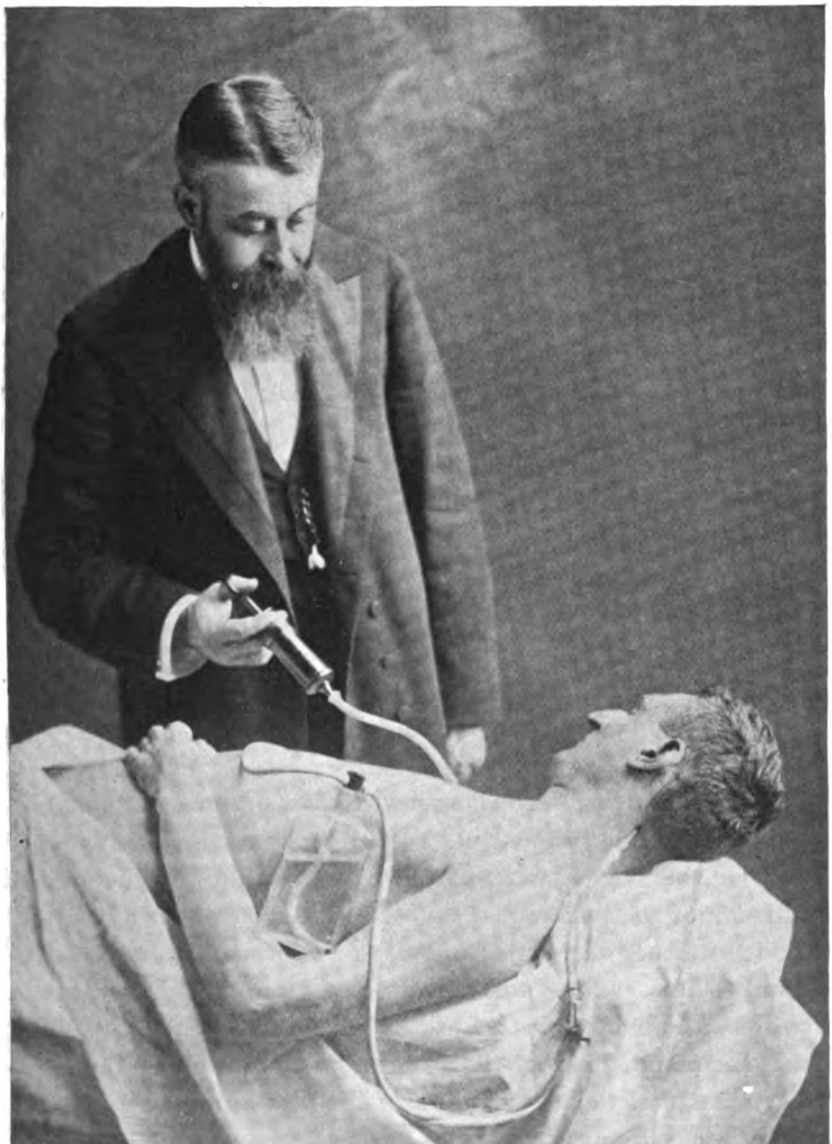
Linear Guide.

Draw a line from the lower angle of the jaw straight around the neck. Then a second line from the mastoid process of the temporal bone to the center of the clavicle or collar-bone. The lines will cross just back of, and a little below the lobe of the ear.

The needle should be introduced at a point corresponding to about one inch from the point of crossing posterior on the line drawn from the point of the jaw-bone to the back of the neck, directing the needle upward and inward toward the opposite eye-brow, when the needle will enter the cavity with ease. If the needle has entered the cavity, it can be moved around very freely. A little practice will enable anyone to introduce the needle into this part with a great deal more accuracy than entering the opening in the orbit. Then again, a needle introduced into the eye will not reach the cerebro-spinal cavity as direct as when it is introduced into the back part of the neck.

Advantages Gained by this Process Over all Other Methods.

First and above all, it does away with any instrument of a cutting kind, and leaves no mark or disfigurement that might become objectionable or questionable to the friends of the deceased. Second, it overcomes all the disagreeable features of the "eye process," leaving no openings in the orbits and preventing any bulging of the eye-ball, since by this method there is no rupture of the membrane surrounding that delicate organ. The reason the eye bulged out or swelled in using the eye process, was because the needle penetrated, first, the conjunctiva; second, the fatty tissues at the posterior part of the eye-ball, and lastly, before entering the cavity of the skull it penetrated the lining membrane of the orbits and the intra-cranial covering of the skull, thus it made an opening through which fluid could readily enter and become diffused into the surrounding cellular tissue in the back part of the eye-ball, and cause the bulging or swelling of the part. All swelling could have been prevented if care had been taken not to inject too much fluid, but the embalmer has no real method of determining by the eye method when he has injected enough fluid, while by the Barnes needle process he can inject from two to three quarts with impunity. No membrane in the eye being ruptured, the fluid cannot enter the part, because of the intra-cranial membrane which lines the bony framework on the inside of the skull and prevents the effusion of fluids into the cavity of the orbit. Third, the fluids entering the veins of the head and spinal column before reaching the arterial system, completely drains the face and



The Barnes Needle Process.

neck of all blood and removes this greatest of all causes of discoloration. Fourth, the principal objection of the anti-embalmers is completely obviated. It must be remembered that while the eye process brought into use no instrument of a cutting kind, the most serious objections were raised by the friends of the deceased because of entering such a delicate organ as the eye, which might of itself cause a possible disfigurement.

The improved needle process overcomes all of these objections; even the most fastidious will permit the introduction of a needle into the back part of the neck of the body to be embalmed. As the needle is introduced into a part where it cannot be seen after the face has been turned upward in the casket, it is next to impossible for any one to tell how the body received its supply of fluid. All the advantages gained by injecting the brachial artery, and more, too, are gained by using this process. It is so simple a child can use it after once being shown the method of introducing the needle.

Cases in Which the Needle Process Should be Used With Care.

The embalmer, in the course of his experience, finds many cases where it is impossible to inject the arterial system, caused either by disease in the artery, or by a mechanical occlusion of the lumen of the vessel, the result of coagulated blood; in either case injection of the arterial system is next to impossible. The same result often happens where the arteries are affected with syphilis, atheroma, or Bright's disease, the result of which is to cause inflammation of the vessels (endarteritis), thus preventing the flow of fluid. In these cases the needle process succeeds in over sixty per cent., as the fluid is gradually absorbed by the veins and then equally distributed to the arterial system.

I have found in those cases of parotiditis (mumps) where the infiltration of the glands had spread backward near the foramen magnum, that on account of the diseased condition of the tissues, the fluid would cause some swelling, but since this is comparatively rare, it makes but little difference. In all those cases where there is a tarry condition of the blood, the arterial system had better be opened; as also in cases of childbirth. Those cases where the rigor mortis is set very firm should have it broken up before trying to introduce the needle; this can be accomplished by turning the head, flexing and extending it upon the chest.

The Apparatus.

A set of Barnes' improved needles, one six inches long and the other five, will be sufficient in all cases. These different sizes will enable you to use the one best adapted for the age and weight of the subject. These needles are an improvement over any other needle, and are in two parts; they are so arranged that it is impossible for the needle to become stopped up or filled with coagulated blood. There is also an attachment which prevents to an absolute certainty any rupturing of the arteries or veins after the needle is inside of the cranium. The needle is so arranged that should the pressure become too high it can be let off immediately without any possible harm resulting. After you have made a selection of the needle to be used, a good aspirator or injecting apparatus with the bulb attachment should be secured, as this method secures a slow and steady stream of fluid. A quart bottle is the most convenient size to use; with the fluid at hand, this will complete the apparatus, and is all that is necessary to complete the process. Begin the injection very slowly at first, until you secure complete osmotic action. Then after the circulation takes it up you may increase it slightly, but never in a hasty manner.

Two quarts of the fluid will be sufficient to embalm a body of 125 pounds weight; more should be added in proportion as the subject increases in weight above this amount. In conclusion I will say that the condition of the body to be embalmed should be carefally studied before making any kind of an injection, either arterial or by the needle. If the body is one that has met death from some malignant disease, say cancer of the intestines, liver or other viscus, it may be necessary to inject the part itself. Those cases which die from empyema, hydrothorax (dropsy of the thorax) or ascites should never be injected with the fluid until the serous material has been removed from the cavities. Serous fluid, when left in the cavities, often presses on the large vessels to such an extent as to prevent the circulation of the preservative solution through them, and in this way putrefaction may begin in parts least suspected. The needle process can be used in dropsical cases to the best advantage, and should be used in every case.

Before using the needle process or injecting an artery, we should be very careful to note whether the rigor mortis has passed off, for if the body remains stiff and rigid it will prevent a free circulation of embalming fluid. In order to avoid this, the stiffening should be broken up by flexing and extending the limbs. If there is a great deal of venous congestion in the veins of the head and spinal column, such as is often met in diseases of the brain and spinal membranes, the needle process will work a little slow at first, but if the fluid is made on scientific principles it will soon dissolve the coagula and the circulation will be restored. The fluid will be taken up and distributed to the tissues of the whole body by the circulation. Extreme care should be taken in using the needle process, as in some subjects where the foramen magnum is small and the atlas, the first bone of the vertebra, large, it will embarrass the operator and the needle will not enter as easily as it would in ordinary cases; these are the cases where one should be very familiar with the anatomy of the parts.

You can always get into the canal by this method, while by the eye method the optic foramen is sometimes so small as to prevent the free entrance of the needle. If you should be so careless as to inject fluid before entering the foramen magnum, you would cause a swelling of the neck and the tissues over the lower jaw, but this will be entirely prevented if you succeed in entering the opening between the bones, and you will then secure a complete embalmment of the whole body by a single needle injection, and will have performed the most scientific method of embalming ever known.

Embalming Arterially by Injecting the Left Ventricle.

Simplex Method.—The left ventricle of the heart may be as easily injected with the preservative solution as any other cavity in the body. It requires a knowledge of the location of the left ventricle as compared with the right. But it is just as safe to attempt to inject the left ventricle as it is to attempt to remove blood from the right. Embalmers in the past have paid little attention to the location of this part of the heart, contenting themselves with a knowledge of the location of the right auricle and ventricle and the manner of removing blood from that part of the heart. Tapping the heart with an embalming needle is a dangerous procedure even in the hands of an experienced anatomist, as a slight mistake may cause a rupture of the aorta and branches, and thus prevent a successful arterial embalmment. For this reason those who desire to inject through the left ventricle of the heart should be familiar with the anatomical landmarks in this location, especially the relation of the descending thoracic aorta to the posterior wall of the left ventricle. In a great many cases one desires merely to inject the cavities. In all of these cases the body will keep better if the arteries are injected through the left ventricle, at the time of performing the cavity injection.

Method of Locating and Injecting the Left Ventricle.

The operator may choose two points for injection, both of which should be on the left side of the body. He may introduce the trocar between the fifth and sixth ribs in one instance, or in the upper part of the left hypochondriac space in the other (see page 106). In either one of these locations the operation may be performed successfully.

By introducing the trocar between the fifth and sixth ribs, the gases which have accumulated in the thoracic cavity may be removed; then by pushing the instrument through the diaphragm, close to its insertion at end of breast-bone, the transverse colon of the intestines may be punctured and the gases removed. The stomach being placed in this situation also, the gases in this organ may be removed at the same time. Having removed the gases from the body, the blood should be removed by inserting the trocar into the heart until it penetrares the right ventricle. By applying the aspirator the blood may now be removed; in case it does not flow readily at first, introduce a little embalming fluid or solution of sulphate of soda, which will have a tendency to dissolve any "heart clots" that may have accumulated. After you remove the blood, then withdraw the trocar about an inch, when the opening will be in the left ventricle. You can now inject the circulation through the heart; beginning at the left ventricle the fluid enters the aorta, the largest artery in the body, and is distributed by its branches to every tissue in the body. After the arterial system has been filled by this method, then withdraw the trocar from the heart and proceed to embalm the cavities. The trocar should be pushed as high as possible in the thoracic cavity towards the upper border of the right lung; then, after sufficient fluid has been injected into the cavity to preserve it, the same operation should be performed with the left pleural cavity. After you have finished the thoracic cavity, then you should insert the trocar into the abdominal, through the same part that you did in the removal of the gases, and enough fluid introduced into this cavity as will preserve the abdominal organs. All of this may be performed with a single puncture with the trocar, the only instruments necessary for the process is a trocar and an aspirator. Before this method of embalming is performed the student should have a thorough knowledge of the heart and its relations to the diaphragm and the thoracic cavity.

After Treatment.

Discolorations.—All bodies after death have a tendency to take on certain changes, chemical or molecular, which give rise to discolorations varying in size from a split pea to an area covering several inches. These discolorations may be present before the injection has commenced, or they may arise during the injection or after the injection has been completed. The causes of these discolorations are well understood, but the methods of removing them are little known. I have never seen a classification of the different forms of discoloration which appear on the surfaces of the dead body, and I will offer no apology for introducing the following classification:

Discolorations may be divided into three general classes:

First—Those caused by chemical and putrefactive changes in the blood current.

Second—Those caused by chemical and bacterial changes in the tissues of the body.

Third—Those caused by changes in the coloring matter or pigments of the skin itself.

The first, caused by changes in the blood current, may be again subdivided into three divisions, namely:

- Post mortem staining.
- Post mortem discoloration, or hypostasis.
- Venous congestion.

Post Mortem Staining is caused by changes in the blood while it is in the veins. The blood during the progress of decomposition is so changed that it has been given the name of fluid blood in contradistinction to the normal blood. The red blood corpuscles become granular and give off their oxygen, which escapes through the walls of the veins and, carrying with it the hæmaglobin or coloring matter of the blood, stains the tissues over the superficial veins a purplish red color. This form of discoloration appears only on the ventral surface of the body and along the course of the large superficial veins.

Post Mortem Discoloration or Hypostasis is caused by the extravasation and imbition of the fluid blood into the dependent tissues of the body, no matter what the position of the body may be. These discolorations are of a dark bluish color, or even black in some instances, and closely resemble contusions or bruises which might have been inflicted during life. Post mortem discoloration is very frequently met with along the posterior part of the neck, also the lobule and back parts of the ear. The blood within the body after death coagulates just the same as blood from the living body coagulates, but the degree of this coagulation is influenced by certain conditions, diseases, etc. In diseases such as diminish the quantity of fibrin almost entirely, such as consumption (phthisis), the blood after death will scarcely coagulate at all.

It is interesting, in a legal aspect, to be able to differentiate between post mortem discoloration after death and bruises which were inflicted during life. In the latter, where the discoloration is the result of a bruise or contusion, the whole skin, both true and false, is affected, and an incision into the part will cause quite a good deal of the extravasted blood to flow. While in those cases of simple post mortem discoloration the color is confined almost exclusively to the rete-mucosum, and an incision into the discolored spot will cause only a drop or two of blood to escape. Should the case, however, be one of dropsy, the embalmer should be careful not to confound the dropsical serum, which might exude from an incision with the scalpel, for that of a true contusion or bruise which had been inflicted during life.

Venous Congestion.—This is a term here employed to designate that class of discolorations caused either by gaseous distension or by unskillful injecting of the vascular system. Gas arising or forming in the abdominal or thoracic cavities will so press upon the heart as to empty it of all blood, causing it to be forced upwards into the large venous trunks of the head, neck and axilla. The effects of gases within the dead body have been studied by various authors. It has been known to be sufficiently strong in its action to expel the fœtus from the uterus, and I have seen two cases where the gas was forcible enough to burst the abdominal walls. A case is reported in Woodman & Tidy's work on toxicology, where a leaden coffin was broken by the gases which formed in the dead body, but I am inclined to accept this story with the usual grain of salt. All embalmers are familiar with that flushing of the face which often appears when the arterial system has been injected in a hasty manner. It causes the veins and capillaries of the face and neck to become congested with fluid blood, and is thus practically the same condition as that caused by the formation of gases in the cavities. Those congested spots which appear beneath the eyes and along the sides of the nose and at the angle of the mouth are usually caused by changes in the vascular system and the blood, which, undergoing decomposition, permeates the cellular tissues of the face, which are found in the region of the orbit, the sides of the nose and along the angle of the mouth.

Greenish Tinge of Putrefaction.—This discoloration appears generally about the second day, unless preservative fluids have been applied to prevent it. It first begins in the ileo-cæcal region or lower part of the abdomen. The skin covering these parts assumes a browhish color which shades to yellow, yellowish green, and finally a green color. This green discoloration will in a few days spread all over the surface of the body. It is caused by the bacteria of putrefaction.

Discolorations Caused by Coloring Matter or Pigment of the Skin.

This form of discoloration is generally present before death, becoming more marked after dissolution has taken place. In some cases it is caused by the bilirubin of the bile which, escaping from the gall bladder, enters the circulation and stains the skin a yellow or brown color, while in other instances it is caused by chemical changes in the coloring matter of the skin itself, or in the cellular tissue immediately beneath the true skin. A continued drain on the lymphatic circulation, caused by death from hemorrhages or child-birth, will also cause a yellow discoloration of the skin.

How to Remove Discolorations.

The success in removing discolorations will depend, to a great extent, upon the time the discoloration has existed, and also on the particular kind to remove. There is very little trouble in removing all those discolorations that are the result of some change in the blood, unless they be of several days standing, when the tissues take on a permanent staining, which can only be removed by the hypodermic syringe. The discolorations coming under the head of post mortem staining, congestion, etc., are removed very effectively by the Barnes needle process, also by tapping the heart and removing the blood, or opening the basilic vein in the arm and aspirating the blood from the body by means of a catheter and pump suitable for the purpose. Another way of removing these discolorations when they appear only at the upper part of the neck immediately under the jaw, is to take a hollow needle and inserting it into the axilla, it should be directed towards the internal jugular vein in the neck, the finger of one hand guiding the needle into the sheath of the vessel. In this way a great deal of blood may be withdrawn from the side of the face where the needle was introduced. But as this method endangers the arterial system, it is not very generally employed.

In order to be able to remove the discolorations from the head and neck by opening the jugular veins, the embalmer should be familiar with the anatomy of the parts.

The external jugular vein is situated just beneath the skin and superficial fascia, and can be reached by a single stroke of the scalpel. On account of its importance, it is one of the most frequently used to remove discoloration from the posterior part of the face and the sides of the neck. To open this vein, it will be necessary for you to draw an imaginary line from the angle of the jaw to the center of the collar-bone, or rather the middle of the collar-bone; the vein lies just beneath it and can be picked up in any part of its course. While this vein connects with the internal jugular vein, you cannot depend upon it for the successful drainage of the entire face. In order to make a complete drainage from the face, the embalmer should always open the internal jugular vein. To do this it will be necessary to make an incision along the anterior border of the sterno-mastoid muscle near its insertion into the head of the clavicle or collar-bone. Continuing the incision downward for about one-half inch until you come to the sheath containing the common carotid artery, the internal jugular vein and the pneumogastric nerve. The location of the vein differs somewhat on each side of the neck. On the right side the vein lies to the right or outer side of the artery, while on the left side it either overlaps it or passes directly across the artery. The nerve will be found between and back of each. After opening the sheath and dissecting down upon the vein it should be raised by one of the blunt hooks or, preferably, an aneurism needle should be used. The embalmer should next incise the vein in the manner in which he is accustomed to do, either crosswise or longitudinally. The location of the right auricle of the heart should be carefully studied, as from that point we have been more successful in removing blood than from any other. The directions laid down for locating this part of the heart have been described over and over again, so I will not consume time by repeating them here, only I wish to say there are a great many cases in which the heart is not situated in its customary place, being moved over to one or the other side of the chest by accumulations of pleuritic fluid or tumors within the cavity of the thorax. When you get a case of this kind it will be necessary for you to palpate the chest wall so as to definitely locate the organ. As the region over the heart always gives a dull sound in palpating and the lung a hollow sound, it can be located very readily. In these cases, as soon as the dropsical fluid is drawn off, the heart returns to its proper place, and the directions previously laid down can then be used. It is quoted from excellent authority, that if we could remove all the blood from the body we would have no discoloration. The blood is not always the origin of these discolored spots. Other agents have to be considered; for instance, that worst form of discoloration, "the greenish tinge of putrefaction," may be caused by the decomposition of cellular tissue in which there may be no blood whatever.

The greenish tinge of putrefaction may appear on any part of the body. It can be removed only by an injection of antiseptics directly into the tissues affected. One of the best formulas I have ever employed for the removal of this class of discolorations is composed of alum, chloride of zinc, alcohol and corrosive sublimate in the following proportions:

Alum	Gr. 5
Corrosive sublimate	Gr. 2
Chloride of zinc	Gr. 10
Alcohol (pure)	Ounces 2

Mix.

This solution should be used hypodermically, a small amount should be injected into the discolored spot and rubbed in by means of the fingers, so that it may be so diffused as to cover the whole surface of the discoloration. This solution restores the natural color of the skin. It is equally applicable to all those discolorations which cannot be removed by the needle process or by removing the blood. An excellent bleaching solution is made by dissolving one ounce of salt-petre in one pint of alcohol and then adding one ounce of glycerine to increase its penetrative properties.

Use of Bleachers and Hot Dry Woolen Cloths.

The method of removing discolorations from the face by means of cloths which have been saturated in diluted embalming fluid was, I believe, employed before any of the modern methods, such as opening the venous system, tapping the heart, or using the needle process. In a great many cases bleaching solutions exert but little influence in changing a discoloration; this is on account of the different action of the same fluid when injected into the system and when it is applied externally. A fluid might be the best kind of a preserver when injected into the arterial system, yet when applied externally it would not have sufficient penetrative qualities to enter the skin and remove the discolorations.

The best bleachers are such as are composed of chemicals which will readily unite with the coloring matter of the blood, which is the cause of nine-tenths of all forms of discolorations.

But since these chemicals which unite with the blood are seldom employed in embalming, one can readily see why bleaching compounds have been laid aside for the more direct and radical operations as laid down on another page. However, some of the fluids do have a tendency to remove the discolorations from the face, and there is no harm in using fluids half diluted with water. They at least serve one benefit. While they have but feeble powers as bleachers, they keep the face moist and prevent rapid dessication; they will also prevent the formation of mould, providing the fluid contains sufficient antiseptics. It has long been known by many embalmers that strong vinegar was a good bleaching agent.

This is very true, as it contains nearly four per cent. of acetic acid, which readily unites with the coloring matter of the blood, so altering the color as to restore the parts to their natural life-like appearance.

A solution of sodium sulphate will have the same properties as acetic acid or strong vinegar, and should be used in those cases where it is unadvisable to open the venous channels or make any operative interference. I find the solution employed in the following strength to give the best results:

Sodium sulphate............................1 oz.
Aqua Dest..........................qs ad 1 pt.
Mix.

This solution should be applied full strength, by means of a cloth, direct to the face and parts which are discolored and should be left on the parts several hours, so as to get the full effects of the chemical. It has been recommended by some that pounded ice and salt applied to bruised and discolored spots will remove them. This is erroneous in the case of bruised spots caused before or after death, but it might exert a slight beneficial influence in cases of mere post mortem discoloration. The only advantage I see in the use of cold to a discolored spot is to liquify the blood so that it may be rubbed downwards toward the heart. It should be remembered that cold prevents the coagulation of the blood, and acting as an agent of this nature its use would be confined only to those cases caused by congestion or coagulation of the blood.

Before applying bleaching solutions of any kind the embalmer should make use of hot, dry woolen cloths. For convenience these cloths should be twelve inches square and made of thick woolen material. These should be immersed in hot water, then wrung out until they are as dry as possible, when they should be applied to the face and left covering it for a few minutes, or long enough to limber up the blood, which, after the coagulation is removed, may be made to flow down the veins into the heart.

These cloths should be applied very frequently, the operator always rubbing the face downward, or following the natural course of the veins. I am not in favor of using the lance or removing discolorations from the back of the ears or angle of the mouth; if these discolorations refuse to yield to the treatment above laid down, then it will be best to use the hypodermic syringe with the solution given on a previous page, which should be injected into the subcutaneous tissues of the discolored parts, when the discolorations will disappear, leaving no mark or disfigurement which might become objectionable to the friends or relatives of the deceased.

Embalming, with a Post Mortem Examination.

Bodies that have been subjected to a post mortem examination for scientific purposes require more care than those subjects not so treated. In this country all, or nearly all, post mortems are made by physicians or experts appointed by the court or coroner. Under such circumstances, the embalming being done by a person not performing the examination, the process is all the more complicated for the operator. The post mortem, as usually performed, consists of opening the thoracic and abdominal cavities, and in a large per cent. of the cases the brain is also exposed by removing the skull cap. The person in charge should begin the incision directly in the median line of the body just below the manubrium or upper part of the breast-bone. This incision should extend to the pubic bone, being continued along the anterior part of the abdomen directly in the median line and between the two recti muscles. The lateral incision usually made below the diaphragm should be omitted. The skin should be dissected back over the anterior part of the chest until the costal cartilages are exposed; these should then be divided and the sternum reflected upon the chest, which will expose the covering of the thoracic viscera. After making the examination of the structures contained in the chest cavity the operator should next examine the structures contained in the abdominal cavity.

The abdominal parites should be held aside by an assistant, while the expert examines each organ, carefully noting its position, weight, size, the presence of any benign or malignant growths, inflammatory conditions, etc. After having satisfied himself of the cause of the death, if such existed from some defect of the abdominal or thoracic viscera, the operator should proceed to preserve the contents of the cavities.

The person performing the autopsy will have removed most of the organs in both of the great cavities, which would cause the division of the large arteries and veins, thus rupturing the circulation. It will be apparent to the reader that if these vessels are divided, it would be useless to inject the circulation, unless considerable time be taken in ligating the divided vessels, so as to prevent any leakage.

The organs which have been removed from the body by the person performing the autopsy should be returned to their respective cavities; if the brain has been removed during the examination, it is the prevailing custom to return it to the cavity of the abdomen instead of the cranial cavity.

Treatment.—Post mortem cases can be as successfully embalmed as those where one had not been held; it takes a little more time and patience but the results can be made just as satisfactorily. Some of the most wonderful specimens of embalming that have been produced were accomplished after the removal of the viscera. In some countries the method of embalming with a post mortem examination is jealousy kept secret by the co-operative societies, thus the science in those countries is limited in its advancement. When you are called out to take care of a subject upon which a post mortem has been held, you at once decide upon one of two methods: *First*—Whether to inject the vessels after taking considerable time in ligating them, or, *second*, to sponge out the cavities and apply hardening compounds, zinc chloride, etc. If the skull has been opened and the brain and spinal cord removed, the latter method is more preferable, but, if the cranium has not been opened and only one or more organs of the abdominal or thoracic cavity examined, then the arterial injection might be accomplished and a successful embalmment result. It is not a very easy task to ligate the vessels which have been severed during an autopsy, even though the operator has only removed one or two organs, and I am inclined to believe in the method known as the dry method, particularly that method used by Mr. Morris, of the Chicago morgue. In order to have the best results in preparing an autopsy case, all of the organs which have been removed should first be macerated for twenty minutes in a dilute solution of acetic acid; they should then be placed in a twenty per cent. solution of Formaldehyde for one hour. This treatment has the effect of removing the blood from the structures and hardening the tissues firmly and permanently before returning them to the cavity. If the arterial method has been decided upon, care should be taken that all the vessels that have been divided during the autopsy should be secured by ligature; this having been done and the arterial system injected with preservative solutions, the operator should sponge the cavity dry and after covering with a layer of absorbent cotton, should return the organs back into the cavity. The organs should be covered with saw dust and hardening compounds and finally a sheet of absorbent cotten one inch thick should be placed over the structures. The abdominal walls should be brought together and closed, using a close anatomical stitch. Mr.

Morris' method of treating an autopsy case, in my opinion, is the best for all cases where an autopsy has been held; it is expedient and gives as good or better results than the former method. It is as follows: If only the abdominal and thoracic organs have been subjected to an examination, the treatment is a little different than that which would be applied if the brain has been removed. In the former case all the organs are removed and placed in a receptacle to receive them, then the carotids, subclavians and iliac arteries are injected towards their distal extremities. The operation has the effect of preserving the soft parts of the head and neck and extremities. The cavities are then sponged dry and treated much after the same manner as that quoted above, but with this exception, instead of using a hardening compound, a bucket of saw dust is supplied and this saw dust is moistened with a preservative solution containing not less than ten per cent. of Formaldehyde; this mixture is then sprinkled over all of the organs as they are returned to the cavity; after covering the organs with absorbent cotton, the walls of the abdomen are brought together and stitched. If the brain has been removed it is useless to inject upwards in the carotid arteries and this part of the body will be treated with a hypodermic injection, the brain is left out of the cavity altogether and is returned to the abdominal cavity along with the other organs. The hypodermic injection of fluids into the tissues which have not been supplied by the arterial injection. should complete the process. The muscles and tissues of the abdomen, chest, and the face and neck, if the brain has been removed, should be injected hypodermically with a sufficient quantity of the preservative solution.

It should be well for the embalmer to bear in mind that in those cases where an autopsy is to be held he should not inject any fluid to preserve it for the time being, but should wait until the autopsy is completed. Fluids injected into the cavities or into the circulation will sometimes alter the appearance of the structures of the body so as to prevent a positive diagnosis of the disease. The fluids, on account of coagulating the albumen, renders microscopical examination of pathological tissues very difficult and in some cases impossible. This applies to those fluids known as non-poisonous, as well as to those containing arsenic, corrosive sublimate, chloride of zinc, etc.

A room left in a state of confusion, the soiling of carpets, chairs, utensils, etc., with drops of blood, serum or pus, not only gives offense to friends or relatives, but is cast up as an admonition against you forever. It will be well for you, then, to be very careful in the removal of blood and the drawing off of fluid from those cases of abdominal dropsy, hydro thorax, etc., that you do not leave the room with this material spotted over the carpet. If you do accidentally get some blood spots on the carpet, they can be removed by rubbing with a cloth saturated with dilute acetic acid.

Post Mortem Wounds.—If in preparing a body for burial or in holding an autopsy, making a dissection, etc., on a dead body one should accidentally cut himself, he should be very careful to prevent infection (blood poison). The weight of authority tends to prove that micro-organisms may enter the absorbent and circulatory systems, whether or not one has received a cut or abrasion of the surface of the skin. The operator should carefully cover his hands and wrists with carbolated vaseline and should rub it well into the pores of the skin before beginning an operation. The following rules for procedure in case of dissection wounds will possibly be of some service to the reader:

Rules.

First. Seize the edges of the cut portion between the thumb and index finger of the uninjured hand and stop circulation.

Second. Wash the part in warm water.

Third. If your teeth are healthy and in good condition suck the wound; if not—

Fourth. Cauterize with nitrate of silver (lunar caustic) or strong carbolic acid. "All cuts should be cauterized."

Fifth. Cover with collodian.

Sixth. Plaster the wound so as to effectually exclude air or moisture.

It occasionally happens that one cuts himself before finishing a dissection or autopsy. In this case, the one receiving the infection should treat the wound as given above and could go on and finish the work or turn it over to an assistant. Most operators prefer to take their chances, and if cut they cauterize and finish the work.

CHAPTER XII.

Treatment of Special Cases.

Sudden Deaths.

Sudden deaths include some of the most difficult cases the embalmer has to contend with, and include apoplexy, asphyxia, sunstroke, accidents and all cases of sudden death due to heart failure in any of its various forms, or the accidental or intentional administration of poisons, such as morphine, opium, arsenic, strychnia, carbolic acid, etc., and also sudden deaths due to gunshot wounds, cut throats, electric shocks, etc. In nearly all cases of sudden and unexpected deaths an autopsy is usually required, and no matter what the post mortem conditions might have been, the embalmer is usually required to treat the case the same as that laid down in the chapter devoted to embalming with a post mortem examination; but in order to acquaint the reader with some of the post mortem conditions present in some of these cases, I will describe those which most frequently come under the observation of the medico legal expert. Nine-tenths of the bodies brought to the morgue are cases of suicide, murder or sudden and unexpected deaths from heart failure. The great majority of those who die by their own act take their life by taking a lethal dose of morphine or other narcotic drug; next to morphine, carbolic acid is the drug most commonly used, while now and then one meets a case of poison by some of the corrosive drugs, such as arsenic, corrosive sublimate, hydrochloric, nitric acid, etc.

Morphine Poison—Opium and its alkaloids, "morphine, narcotine, codeine, etc." In deaths due from opium or morphine, the capillary system is firmly contracted and there is congestion in many of the organs of the body. In many of the cases there is extensive hyperæmia of the brain and its membranes and infrequently discolorations are present in the form of hypostatic spots under the eyes and at the angles of the mouth and over the internal jugulars. If opium has been swallowed the odor is oftentimes very perceptible. The post mortem examination reveals a congested condition of the gastric mucous membrane. This, however, is by no means constant. There may or may not be extensive congestions of blood in the lungs very similar to that of asphyxiated subjects. This accounts for all such cases of deep discoloration or congestion of the superficial veins of the head and neck. The blood is dark and in a fluid condition, but in some cases it has been found very firmly coagulated.

Carbolic Acid.—In those who have met death by carbolic acid, there will often be found stains about the angles of the mouth produced by the poison. The mucous membrane of the mouth is of a greyish white appearance and this membrane in the oesophagus is usually thickened and congested. The stomach is usually thickened and corrugated and of a brown leathery color. The brain is oftentimes congested and the fluid found in the ventricles has a strong smell of the acid. The lungs are usually gorged with the blood, in fact, it seems that the blood in a majority of cases tends to congest in these structures leaving both sides of the heart comparatively empty, although the condition of the heart varies and one or both sides may be filled with dark colored blood. The bladder is in a majority of cases found empty and the urine present is of a dark color. The blood in most cases is very dark in color but of a fluid consistance. In some instances the body resists putrefaction.

Arsenic.—The bodies of those who die from the effects of arsenic take on rigor mortis very early after death. It is very firm and unless the body is straightened or laid out, the body stiffens in the position it was during the last agony of death. The body may present a somewhat shrunken appearance; the eyes somewhat sunken, but open and staring, although this is by no means invariable. The most frequent internal post mortem condition in this class of cases is congestion of the stomach and intestines.

Strychnia.—The most prominent post mortem appearance in those who have met death by strychnia is the firm rigor mortis that appears and remains for a considerable time. The brain, spinal cord and the membranes are usually found congested. The condition of the heart varies. It may be expanded and full of blood or contracted and empty; ofttimes there is a congestion of the bronchial mucous membrane. Blood remains fluid and does not coagulate as rapidly as in ordinary cases.

Chloral.—There is no permanent characteristic appearance of those who die from the effects of chloral. It has been stated by some that putrefactive changes are delayed, although this is not generally the case. The organs and tissues are about the same as would be found in death from heart failure or other disease. The color of the blood is not altered and is in a fluid condition.

Bichloride of Mercury (Corrosive Sublimate).—In those who die from the effects of mercuric chloride the mucous membrane of the mouth, tongue and œsophagus is usually of a grayish white color. The membranes are oftentimes corrugated and eroded. The stomach is softened and swollen, is deeply injected and of a bright scarlet color. There is a great deal of stasis in the capillary blood vessels, especially those of the lungs; whether this blood stasis in the capillaries is due to the changes of the red corpuscles or to liberation of fibren ferments, is not certain — it may be due to both.

Heart Failure.—This a broad term given to sudden deaths due to valvular insufficiency or degenerations in the structure of the organ, terminating suddenly in death. No surgeon should ever give an autopsy report signed "*Heart Failure.*" The failure of the heart's action must be due to either a degenerative nervous supply, fatty degeneration of the tissues of the heart, to a rupture of the valves of the heart, to an enlargement, an atrophy or some mechanical occlusion of the vessels of the heart, such as a thrombus or fatty tumor. "These islands of fat" are generally found in the right side of the heart obstructing the tricuspid valve; sometimes there is a congestion of the large veins of the head and neck, at other times all of the structures and viscera may be in a normal condition.

Cut Throats.—Suicides and those where death has been caused by severing some of the large vessels of the neck is very common, especially in large cities. The treatment all depends upon the nature and extent of the wound. If both carotid arteries and jugular veins are severed, then it will be necessary to catch up all divided vessels, excepting the one to be injected. The injection should be both upwards and downwards. If only one vein has been severed, it is only necessary to catch it up and tie it before beginning the injection. In two cases of cut throats that have come under my observation, the knife was used with so much force as to cut into the cervical vertebra and sever the vertebral arteries, as well as the carotids. In all cases of cut throats the operator should inject one of the divided vessels both downwards toward the heart and upwards toward the brain; the other vessels should be tied off so as to prevent a leakage. For the peculiar conditions attending a case of cut throat, such as rigor mortis, cooling of the body, etc., see pages 42, 43, 44, 45.

Alcoholic Paralysis (Delirium Tremens).—The principal post mortem condition in this class of cases is the usual tendency towards decomposition and the enlarged condition of the capillaries in all parts of the system. There is also a fatty degenerative condition of the tissues of the body generally, and not infrequently the organs and viscera are congested. In excessive beer drinkers the liver is generally affected with scirrhosis (hob nail liver), a rough, hardened condition of the organ.

How to Embalm a Body Dead from Gun-shot Wounds, Hemorrhage, Railroad Accidents, Injuries, Etc.

The special treatment of any of the above-named cases will depend to a considerable extent upon the knowledge of the embalmer, as there are no two cases alike.

In a case of gun-shot injury the treatment will be based upon the location of the wound, the extent of the injury, and whether there have been any vessels severed by the ball. A great many of these cases require a post mortem to be held, and if such is held you will treat the case as a post mortem. Should no post mortem be held and the wound has not divided any important vessels, then needle embalming or arterial, followed by cavity injection, will be all that is required; but if the ball in its course has cut off some important blood vessel, providing it was not in the head, it will be well for you to locate the vessel and ligate it if possible, at the same time the blood which has escaped into one or the other cavities of the body can be removed by sponging. It will be found in those cases where the person has been wounded in the abdominal cavity, where the mesenterics are divided, that an immense amount of blood will fill the cavities. This, on account of the coagulation which takes place, cannot be removed by the aspirator, and should be sponged out. If it is impossible to open the body or to find the divided vessel, then all you can do is to inject the arteries, apply the needle method and follow with a cavity injection; the fluid injected by the needle method will find its way into the vessels of the upper part of the chest, but will leak out as soon as it comes to the divided vessel. But it will have the effect of clearing the face and preventing any discoloration.

Fill up the cavities and, if necessary, make several needle punctures over the trunk and into the muscular tissues of the extremities. If a person dies from cut throat or hemorrhage from the jugular veins or carotid arteries, you can use the same artery to inject the system, treating the case as an ordinary embalmment. There will seldom be any discolorations, as the blood has escaped from the body.

In railroad accidents, mine injuries, etc., the body is oftentimes so badly mangled that it is impossible to do very much towards preserving the remains, but with your knowledge of the arterial system, cavity and needle embalming, and the use of hardening compounds, alcohol, etc., you will be able to make a great many of these cases so they may be viewed by friends or relatives.

Sun-stroke, Insolation.

On account of the early appearance of putrefaction, and the presence of discolorations, sun-stroke or insolation cases should receive prompt and careful treatment from the start. The blood in cases of sun-stroke is of a dark color, imperfectly coagulated, sometimes remaining in a fluid condition and congesting the large veins of the body. The left ventricle is found empty and the heart is generally contracted. The right ventricle may contain a small amount of dark colored blood. Small discolored spots make their appearance on the surface of the body. The lungs are generally congested and full of blood, leakage taking place when the arteries are filled with fluid, on account of rupture of some of the capillaries. There is also congestion of the blood vessels of the brain, while that organ and the cord are oftentimes softened and changed from their natural color.

The embalmer should remove the blood as early as possible; this will prevent the discolorations from appearing, and will also aid in the injections of the preservative. The arterial system should be thoroughly injected and the cavities filled with the fluid, after which the treatment should be the same as in ordinary cases.

Apoplexy, Cerebral Softening, Abscess, Etc.

Apoplexy or cerebral hemorrhage is caused by a rupture of a cerebral vessel and the extravasation of fluid into the substance of the brain. If the death is sudden, the rupture complete, there will be a large amount of blood in the cavity of the skull and the face dark and discolored from venous congestion, but should the person survive the immediate effects of the attack and live for several days afterward, the treatment will be different, as there will only be a slight amount of blood in the brain. In the latter case ordinary treatment will be all that is necessary, while if the death be sudden and accompanied by considerable hemorrhage, it will be necessary to use other and more effectual treatment. The needle process answers the best of all in apoplexy, since, on account of the ruptured vessel and the empty condition of the large vessels, the fluid will readily enter the circulation from this point and the body may be thoroughly embalmed.

At the same time the blood may be removed by using the needle introduced into the brain as a drainage tube and removing the blood by gravitation or applying the aspirator. The needle method should be followed by a thorough arterial and cavity injection. If the blood has coagulated in the cranial cavity and the absorption of the fluid is complete, the artery should be injected. The first demonstration of the Barnes needle process was performed on a case of this kind (apoplexy). Three quarts of fluid was introduced into the system, two quarts having previously been introduced by the arterial method.

In all those cases of brain trouble, such as cerebral softening, abscess, etc., the cerebro-spinal cavity should receive careful consideration; from one to two quarts of the fluid should be introduced through the opening between the atlas and the foramen magnum in the occipital bone.

How to Embalm Asphyxiated Subjects, the Care of Drowned Bodies, Etc.

The treatment of asphyxiated cases has always called forth considerable attention from the embalmer, the reason of this being the changes in the blood current in some of its various forms, while in others the appearance of deep discolorations, which refused to yield to treatment, was the second factor; while in some of the cases the appearance of putrefaction formed the principal source of the embarrassment, in others just the opposite condition would take place. It will probably seem strange to the reader that we could have so many different changes in the same method of death, but nevertheless any and all of the above forms are met with in some one or another condition, where death was the result of asphyxia.

Asphyxiated cases are such as those who die from suffocation, drowning, hanging, etc.; in fact, any case in which life is threatened by any interception whatever of the respiratory function is, or should be termed asphyxia. The changes which take place in the blood current of those who are suffocated with any of the carbon gases, such as carbon monoxide, charcoal gas, etc., are very remarkable; instead of the blood being a dark venous color, as one would naturally expect and which is also found in some of the various forms of asphyxia, it is of a bright red color, will resist slow combustion, and in many cases putrefaction is delayed for a considerable time.

The conditions or changes which take place in the body of one who has been suffocated with charcoal gas, are not only peculiar, but differ in some respects from any other case of asphyxia. The post mortem lesions vary somewhat on the time which has elapsed since the death. The most characteristic lesion is the appearance of rose-colored spots, which vary somewhat in size, over the abdomen, chest and thighs; these spots are not found in any other death, except that which has resulted from the inhalation of charcoal vapors. Unlike post mortem staining or any other form of discoloration, they seem to be unaffected by any kind of treatment, even the hypodermic injection of certain strong bleachers and antiseptics will not change their color. These spots will remain long after putrefaction has set in, thus showing that it affects not only the outer skin, but penetrates through the true skin and into the cellular tissues beneath. It will thus be seen that it would be next to impossible to remove such a discoloration.

In this kind of a case there seems to be little change in the degree of resistance to putrefaction ordinarily seen in a dead body, but, unlike asphyxia from natural gas, the body has no more resistance to decay than in any other case. Discolorations frequently appear in all these cases and affect principally the veins of the brain, head and neck. But as the blood remains fluid it can be easily removed by introducing drainage tubes into the right side of the heart or into any of the large veins of the upper extremities or by using the needle injection.

Drowning.

Where the person has been asphyxiated by immersion in water or from drowning, the blood does not become saturated with water immediately, but, instead, it is saturated with oxygen. The changes which would naturally come up vary according to the length of time the body has been in the water. If the body has been in the water only a few hours, then it will not need any more treatment than an ordinary case, except emptying the stomach and the lungs of the water which they contain. This can be accomplished by turning the body on the side, pulling out the tongue, and making pressure over the region of the stomach and on the sides of the chest cavity, or failing to remove the water by this method, you can remove it by the aspirator, the tubing introduced down the œsophagus or gullet into the stomach, or through the wind-pipe into the lungs. Some discoloration may appear under the eyes and along the nose, caused by the congested condition of the jugular veins and their tributaries; this can be removed by any of the usual methods. But should the person have remained in the water for several days and the tissues become saturated with the water, which they will in this length of time, it will be very hard to keep the body, and the condition will certainly be vastly different from that of a body just recently drowned or that has only remained in the water a short time. The human body normally contains about 75 per cent. of water, and after it has been immersed in water for several days this is increased considerably, thus when it is injected with a chemical or solution of chemicals which will preserve a body in the ordinary condition where the tissues contain 75 per cent.,the fluid fails because it is diluted too much by the increased amount of water which has been absorbed into the system. A very notable thing concerning these bodies that have lain in the water several days is the swelling which takes place a few hours after they are brought into the air. This is explainable under two headings, namely: more favorable means for the development of the germs of decomposition, and second, the action of the air upon the saturated or watery tissues.

The drowned subject always presents certain forms of discoloration; these are the result of the venous congestion so common in other forms of asphyxia; the blood rushes to the brain and tissues of the face, and death usually leaves the left ventricle and the right ventricle firmly contracted, thus preventing the blood from entering the cavities of the heart, and forcing it into the large venous trunks of the face and chest. Water gains admission into the stomach and the lungs, and, if left there, soon begins fermenting, causes purging and distension of the parts with gas. It would be out of place in this article to tell how this process of fermentation begins or just how the hydrogen of the water is separated from the oxygen and forms carburetted hydrogen, sulphuretted hydrogen, etc. The only study the embalmer has to contend with is the removing of the gases and the water and to prevent decomposition from advancing any farther than it is when the case is turned over to him. As soon as the body is removed from the water it should be placed in some receptacle which will exclude as much of the air as possible. Since embalming fluids have but little effect on the subjects saturated with the water, it will be best to surround them with hardening compounds, or lower the temperature to 30 deg. F.

In Chicago deaths from drowning are of common occurrence. If the body has been in the water for several days it is impossible to remove the blood, as it will be firmly coagulated. The arteries and cavities should be injected with a strong solution of Formaldehyde and the body should be covered with a sheet saturated with this agent; this prevents skin-slip.

The effects of sawdust, zinc sulphate, sodium chloride, nitrates, etc., are very well known. Hardening compounds thrown around one of these saturated subjects will have a tendency to absorb much of the water from the tissues. The lowering of the temperature to 30 deg. F. does not alter this chemical change in the least. The moisture of the body will readily enter the chemicals above named and will pass into the sawdust. The change of the fluids from the chemicals to the sawdust requires some little time, but when once set up it is continuous. Subjects treated by this method have a tendency to turn yellow, but if we succeed in arresting decomposition and retain the remains long enough for identification, we have accomplished our work. The treatment of a body that has only been in the water a few hours is not widely different from that of a death from any of the ordinary diseases. The blood should be removed, also the water and gases, and the body should receive an arterial and cavity injection, or an injection by the needle method, followed by cavity injection. The body that has been in the water several days or weeks may be considerably benefitted by local injections of fluid into the muscular parts of the chest, arms, legs, neck and abdomen. When these methods fail, freezing, or placing the body in a temperature below 32 deg. F., is all you can do. If the body has been identified, bury as soon as possible.

Lightning, Electric Shocks, Etc.

One of the most phenomenal changes in the muscular system of one struck by lightning is the fact that no rigor mortis occurs, or if it does it passes off too soon to be observed. There is a paralysis of the central nervous system and blood is generally found in both the arterial and venous systems. This blood is but little altered in color from normal living blood, but sometimes the corpuscular elements are changed considerable. Oftentimes there is no mark or apparent post mortem change whatever, while in other cases the body may be more or less burned, the vessels of the brain may be congested, and arteries, veins and viscera ruptured, the surface of the body discolored in the form of hypostatic spots, etc. The tendency is towards early decomposition in the bodies of those struck by lightning, while in those electrocuted by mechanical means, live wires, etc., the body stiffens and takes on considerable rigor mortis which does not readily pass off. The blood retains its scarlet appearance for many hours and its corpuscular elements are but slightly altered. Gibbons claims that electricity does not kill and that if proper means were resorted to all bodies could be restored that are shocked by live wires or are electrocuted for the expiation of crime. As those struck by lightning putrefy rapidly it is best to remove as much blood as possible and inject the arteries and cavities. Should discolorations appear remove with the needle process.

Congestion of the Lungs.

Congestion of the lungs is a condition signifying an increase in or abnormal fullness of the capillaries of the air cells of the lungs; *active* congestion when due to an abnormal increase in the circulation, and *passive* when caused by an impeded outflow from the capillaries.

This disease oftentimes proves fatal within a few hours, and as the pulmonary circulation is entirely cut off by coagulated blood in the lumen of the vessels, the injection of fluid through the arteries does not always penetrate the structure, as the bronchial vessels are also affected by the disease.

Post Mortem Appearances.—The hyperæmic lung has a bloated, dark-red appearance, its vessels are distended to the uttermost with dark, coagulated blood, the tissues are succulent and relaxed, a bloody, frothy liquid is present in the bronchi, and the alveolar walls are so much swollen that the congested lung shows scarcely any indication of its cellular structure, and in many instances resembles the tissues of the spleen.

Treatment.—The most important fact for the embalmer to remember is the condition of the lungs. Purging is of very frequent occurrence and will yield only to the most heroic treatment. Inject the thoracic cavity with as much fluid as the cavity will hold, then follow with arterial and needle embalming. The nasal tube should be used and the bronchial tubes should be saturated with the preservative. Plugging the nose and throat with cotton should be sufficient, but if purging still continues use some of the methods laid down in a previous chapter of this work.

Pleurisy.

Pleurisy is a plastic inflammation of the pleural sacs, characterized by sharp pains in the side, a dry cough, difficulty in breathing, fever, etc. It sometimes follows an attack of pneumonia, being a complication of that disease; it is also secondary to small-pox, pericarditis, Bright's disease, or rheumatism. In all those cases where death has resulted from pleurisy, either acute or chronic, there will be found in the pleural sac of the affected side a large amount of serous fluid. This fluid is principally composed of albumen, but oftentimes contains tubercle bacilli and other micro-organisms, such as the pus bacteria, etc. On account of this accumulation in the pleura, the heart is pushed to one or the other side, according to the side which is affected with the disease. If it be the left side, the heart will be found a little more to the rignt and in extreme cases it may rest on the diaphragm and be almost entirely on the right side. During my lectures and demonstrations to a class in the Ohio Medical University, in February, 1895, I was demonstrating the methods of cavity embalming, when in introducing the trocar between the first and second ribs of a female subject, which was on the dissecting table, I was surprised by a large amount of pus appearing at the opening in the trocar. With this knowledge alone I knew that the patient had died of pleurisy. I removed the trocar from the upper part of the thoracic cavity and inserted it on the side, between the seventh and eighth ribs, and was able to remove nearly a quart and a half of purulent material which was rapidly undergoing decomposition. The heart in the case of this subject was found almost wholly on the left side.

Treatment.—In order to successfully embalm a body dead of pleurisy, the embalmer should aspirate the pleural sac and remove all the serous fluids; after which the treatment will be much the same as an ordinary case, unless there be a complication, such as small-pox, pneumonia, Bright's disease, etc., when the methods of treatment laid down under the chapter devoted to those diseases should be employed in conjunction with those already given. Embalm by the arterial and cavity injection, or by the needle and follow with a cavity injection.

Dropsy.

Synonyms: *Anarsaca, Bright's disease, chronic diffuse nephritis, etc.*

It would be out of place in a work of this kind to enter into an exhaustive description of Bright's disease, since we, as embalmers, are only required to handle the case after death; it is more important that the treatment be thorough and complete.

This disease causes an increase in the watery constituents of the body, and when the dropsy is general there is hardly a tissue that is not overcharged with this fluid, even the marrow in the bones will contain a large amount of it. If the case be an extreme one, the eye-lids and face will be congested and swollen, as will all the other parts of the body; the abdominal cavity and the thoracic cavity will contain a large amount of serous fluid. Not infrequently the pericardial sacs and the pleura will be filled with the fluid also. The rapidity with which a dropsical case begins decomposition is a factor that calls for the most urgent treatment from the start (see Putrefaction). In a very few hours after death, on account of the moisture in the body, the skin begins to form vesicles which soon rupture and allow the contained fluid to escape: slipping of the skin follows this, or it may occur without the formation of these vesicles or blisters. Gases arise within the cavities and press upwards upon the large blood vessels, causing the face to discolor (venous congestion), while at the same time, if the pressure is sufficient, you will have capillary hemorrhage from the lungs and stomach, which will manifest itself in the purged material which will soon make itself present at the mouth and nostrils. The amount of dropsical fluids in the body can be estimated by the pressure of the fingers on the limbs. If a large amount of water be present in the tissues, the fingers will sink down into the parts nearly an inch, leaving the mark of the finger, which does not disappear very readily.

The treatment of a dropsical case is the same whether it be in the morgue or in private practice, the difference being only in the care to prevent serous material from staining the carpets, etc. In the morgue these things are always looked after in advance. As soon as you are called to take care of a dropsical case, see that all the gases are removed from the different cavities. This may be accomplished by inserting a trocar into the abdomen and into the chest cavity. The gases having been removed, the next step will be to remove, as much as possible, the serous accumulations from the body. First, remove all the fluids from the cavities by tapping with the trocar and aspirating. The trocar should be inserted just above the pubic bone in the median line of the abdomen. A puncture at this part of the cavity enables the operator to drain from the lowest part, but in many cases, even when the trocar is inserted at this point, there is only a small amount of fluid removed. In this case it will be well for you to open the abdominal cavity in the median line, beginning the incision at the umbilicus (navel) and continuing it down to the pubic bone. After cutting through the peritoneum, take a large sponge and sponge out the cavity. In this way I have been able to remove several quarts of fluids after I had failed to do much good by the use of the trocar and aspirator. While the abdomen is open you should insert the trocar through the diaphragm and into the right and left pleural spaces, and if there be any serous accumulations they should be removed. The pericardial sac should also be punctured by the trocar and the fluids removed.

After you have removed the fluids from the cavities, you should next proceed to remove it from the extremities. This can be very successfully accomplished by the aid of a suction leecher and bandages. I find that a rubber bandage about four inches in width and five yards in length answers the purpose best, although the ordinary cotton roller bandage will answer the purpose admirably. If the lower limbs are to be worked on first, the bandaging should begin at the feet, as it should begin at the hands in case the fluid is to be removed from those parts. Beginning at the feet, the operator should bandage as firmly as possible, gradually approaching the knee. He will find that the fluid in these parts will begin to make pressure above the bandage, in the form af a watery tumor just beneath the skin; wherever this appears the leecher should be applied or the scalpel should be used in making several punctures into the tissues at the place where the swelling appears. These punctures will allow the fluid to be drained off, after which the bandaging should be continued upward and the operation repeated until all the fluids have been removed. It will surprise you how much fluid you can remove from a dropsical subject.

After the fluids have all been removed, you will find that the face and neck are still swollen and possibly discolored. You should proceed to remove this by elevating the body to an angle of forty-five degrees. Use the needle process and drain all the blood from the face, which in cases of dropsy always remains thin. The arteries and cavities should then be injected. In case the artery is injected, the blood should be removed from the vein by inserting the flexible silk catheters commonly used for such purposes. After the needle method is applied the discoloration will disappear, and if the head is properly elevated, the face, which was somewhat swollen, will approach its natural appearance. You should use as much fluid as possible in injecting a dropsical case, but unnecessary flooding of the tissues should be avoided. After you have embalmed the body arterially, either by the needle method, the combined artero-needle or the arterial method alone, the cavities should receive attention. The chest cavity should receive from one to three quarts of fluid, and if it has been necessary to open the abdomen, the cavity should be saturated with the following compound, after which it should be closed, using a very close stitch and bringing the parts as neatly together as possible:

Arsenious acid......................one pound.
Zinc sulphate........................one pound.
Saltpetre..............................one pound.
Sawdust.................qs ad to fill the cavity.

Or should this not be at hand the operator should use sawdust saturated with a Formaldehyde fluid. In fact no other fluids except those containing Formaldehyde should be used in the dropsical subject.

A body treated after the above method will give the most satisfactory results, and may be kept as natural as any case dead of some other cause. If the body is to be kept a long time, or is to be transported a considerable distance, *although it is not necessary*, it will be advisable to bandage the body in bandages which have been saturated in the following solution:

Pure tannin......................one ounce.
Collodian ....ten ounces.
Ethylic alcohol, pure.........twelve ounces.
Balsam tolu....................two ounces.
Oil gaultheria...................one dram.

To this mixture add gum benzoin until it ceases to be dissolved. This makes a very fragrant mixture, which retains its odor for a long time. The bandages should be made from heavy cheese-cloth and should be about four inches in width and five yards long. Bandages of this sort afford the best results and can be made to envelope the whole body in a neat covering, which will prevent the entrance of any germs to the integument, or the dessication of the body, which naturally takes place after embalming and when the bandages are not applied.

Mother and Unborn Child.

The method of embalming in cases of pregnancy will vary according to the age of the fœtus, or the length of time which has elapsed since conception took place. If the mother is only in the second month of gestation, then the treatment laid down for ordinary cases will apply very well; arterial and cavity injection will be all that is required, unless the mother dies of some of the low type fevers, such as typhoid, etc., when it will be well to pay especial attention to the abdominal cavity, the intestines, etc. After the second month of pregnancy a change takes place in the vascular system of the mother and child, which will permit of an indirect circulation from the arteries of the mother to the vascular system of the fœtus. It is hardly probable that embalming fluid injected into the arteries of a parent who had died during the first few weeks of gestation would penetrate the embryo. This is because of the difference which exists in the vascular system of mother and child as compared with that which takes place after the third month of pregnancy.

In the early period of pregnancy the communication between the child and the mother is maintained through the medium of the spongioles of the chorion and the membrana decidua until the third month; after this period the sole connection seems to be through the placenta (see Fœtal Circulation). This placenta circulation is a very interesting study, being almost analogous to that circulation which takes place in the lungs, and which is known as the pulmonary circulation.

The impure blood from the child is conveyed to the placenta by means of the umbilical arteries. Here it gives off its waste and receives oxygen in return, and the pure, aerated blood is now returned to the child by means of the umbilical vein. The utero-placental vessels, like the bronchial arteries of the lungs, are merely nutritive, not for the fœtus but for the placenta and its appendages—hence the process of aeration and absorption of material for the fœtus takes place through the medium of the membrana decidua, which is in close contact with the maternal blood. Now, reasoning from this basis, we find that we have a membrane to deal with known as the membrana decidua. Through this membrane all nutritive material from the mother must pass in order to sustain the child.

It does this by means of osmosis and exosmosis, the maternal blood, which is coursing through the placental sinuses, is easily absorbed by the chorionic villi of the fœtal surface of the placenta. Once into the chorionic villi, the blood is taken up and carried into the umbilical vein, to be distributed to the various parts of the child.

When fluid is injected into the arteries of the mother it will take this same course. The fluid, after reaching the placenta or afterbirth, will gradually enter the umbilical vein and be carried to all parts of the child's body. If we will consider the method by which the fluid gets into the arteries and veins in the needle process, you can readily see how the fluid penetrates the membrana decidua and enters the vascular system of the child. The fluid enters the membrane by the process of absorption, percolation, osmosis, etc.

Now comes the question of osmosis again, or the transudation of fluid through animal membrane. When the needle process is used the needle is pushed into the cavity of the cranium and is plunged between the dura mater and the pia mater; the injected fluid flows down into the arachnoidian spaces until they become filled; and then from the continued pressure which is exerted the fluid is forced through the large venous sinuses in the cavity of the cranium and into the venous circulation, then gradually into the arterial. Now, this same process takes place when we inject fluid into the body of a pregnant mother; the fluid, after circulating through the uterine arteries, is carried by them into the placenta, where it is distributed to the maternal part of that organ and subsequently to the large sinuses next to the membrana decidua. Embalming fluids, being composed of various salines, the process of osmosis is favored and the fluid reaches the fœtal surface of the placenta, is carried into the chorion villi and from there into the umbilical vein and into the body of the child.

It will be seen, then, that the fluid injected into the arteries of the mother will penetrate the vascular system of the fœtus and embalm the child in utero. You can safely rely on this circulation between the third and ninth months of pregnancy. But should the mother die of some disease, where the blood is thickened or coagulated, then the circulation may be impeded and it will be necessary for you to penetrate the cavity of the uterus (womb) with a trocar and force sufficient fluid into the organ to surround the child. The trocar should enter the fundus or top of the womb, as the fluid will remain in the cavity of the organ better than when it is injected from the sides.

"Childbirth," Peritonitis, Puerperal Fever, Etc.

If the child is born, and the mother dies from hemorrhage, shock, puerperal fever, peritonitis, or puerperal eclampsia, the treatment will be vastly different from that which would apply to the mother and unborn child. It will be found that the blood of the mother is greatly increased during pregnancy, and if the death is not due to hemorrhage there will be a large amount of this blood in the body of the mother. If the mother dies of puerperal fever or peritonitis there will be a large amount of gas in the abdominal and thoracic cavity, caused by the action of the putrefactive bacteria; this gas sometimes increases so rapidly as to almost burst the cavity in a few hours after death; the gas is also very poisonous and should be avoided as much as possible by the operator. In puerperal eclampsia the gases will not arise as readily as they do in the cases just quoted, but there is always an early tendency towards putrefaction and the blood remains thin and is easily removed by opening the basilic or jugular, and draining from the right auricle. Discolorations are very apt to come up in this class of cases, and the skin will slip in some as early as twelve hours after dissolution has taken place.

Treatment.—The first thing to do in a case of childbirth is to remove the blood. This will be unnecessary if the death was caused from hemorrhage, in which case it will be found that yellow discolorations will appear on the sides of the face and under the eyes. The blood should be removed by opening the basilic vein (left) and inserting a flexible tube until it enters the right auricle, when the fluid blood may be drained from all parts of the body. A small amount of fluid should be left in the bottle which is to receive the blood that is withdrawn, as it will sterilize or disinfect it.

The blood in this class of cases is literally alive with the germs of septicæmia and puerperal fever, and the operator should use care not to allow any abraded spot on his hands to come in contact with this infected fluid. After the blood and gases have been removed, an injection should be made into the vascular system either by the needle process or by the artery direct. Enough fluid should be used at the time of the first injection to distend the superficial veins on the forehead and on the dorsal surface of the feet. Thorough cavity injection should complete the process.

In the course of the next ten hours after the embalming has been performed, it will be found, in a great many cases, that there is a leakage from the vagina; this should be stopped by tamponing the cavity with pledgets of cotton. On account of the enlarged condition of the uterus and vagina at the termination of gestation, you will be able to use a large amount of the cotton, which should be soaked in fluid and then squeezed dry before placing them in the cavity. A competent lady assistant in this class of cases will not only be a great help to you, but will gain you many friends that will be lifelong admirers of your work and skill. If the body is not keeping well on the second day, it will be wise to inject the arteries again, using as much fluid as they will take up, and if the abdominal cavity continues to swell from the gaseous distension, it will be advisable to open the cavity in the median line and sponge out the contents. Then use a solution of chloride of zinc and collodian, spreading it on all the surfaces, afterwards filling the cavity with hardening compound, or use the formulæ given for the treatment of the cavities in dropsy. It will be found in this class of cases, where the peritoneum is at fault, that the fluid will not enter the structure on account of the occlusion of branches of the superior and inferior mesenteric arteries, and nothing short of opening the cavity and sponging will do any good. We also have in peritonitis, in addition to the germs already quoted, both varieties of the pus cocci, the bacillus colli commune and bacillus lactis aerogenes. These germs, together with those of puerperal fever, causes the hasty dissolution of the tissues and the rapid formation of gases so prominent in this class of cases.

CHAPTER XIII.

Sanitary Science.

The principles of sanitary science embrace a very comprehensive subject, as it relates to inquiries into all influences affecting or tending to affect injuriously the health of a locality.

It involves a knowledge of the importance of perfect purity of our surroundings—the air which we breathe, the food we eat, and the water we drink—also a knowledge of the soils, whether healthy or unhealthy; seeking to discover and guard against any and all diseases that may be caused by impurities in any one of these agents. As nearly every city, town and hamlet in the United States has appointed efficient local and state boards of health to look after such of these sanitary conditions as tend to affect the masses of the people, I will only consider that part of sanitary science in which the funeral directors of America should be especially versed. Being brought in contact with some of the most virulent forms of contagion and infection, he should be able at all times to prevent spreading these diseases. He should proceed with caution, lest he become infected himself, and he should have sufficient knowledge of the cause of these diseases, so that he would not communicate them from the
d to the living through the medium of blood-stained in-
nts or clothes which have been left in contact with the
dy of one who has died of a contagious or infectious
. The undertaker should also be careful about his

own clothing, as these garments afford an easy lodgment for certain germs of contagion, such as emanate from diphthe retic, scarlatinal, or small-pox cases. The specific cause of the disease diphtheria, has been isolated and discovered to be a germ, rod-shaped, thus being classed under the general term bacilli. The exact cause of scarlatini, yellow fever and small-pox is as yet unknown, although it is generally accepted to be caused by a germ which is capable of living in the atmosphere and of being transmitted by this medium from the sick to the well.

Explanatory.

Contagious, Infectious and Miasmatic Diseases include all those diseases, which are known to have a specific cause, generally, if not always, some form of micro-organism. A CONTAGIOUS DISEASE is one capable of communication from one individual to another by means of direct or mediate contact. Thus it may be transmitted from the sick to the well by means of the atmosphere or by direct inoculation.

In ordinary use contagious is applied only to those diseases which are readily communicable from one individual to another, so that one affected with the disease is a source of danger to those in proximity to him.

Infectious Disease.—When the infectious element is eliminated from the diseased body only in such a way as by fæces, discharges, etc., that is not likely to be communicated to a second individual, but takes a round about way as through the ground and water to reach a second person, then the disease is not usually called contagious, but *infectious,* although under certain conditions it may be so.

Typhoid fever and Asiatic cholera are examples of such diseases. Infectious refers more to the cause of the disease. Contagious, to the manner of communicating the disease.

A Miasmatic Disease is one caused by an ectogenous infectious agent, neither directly nor indirectly derived from any other case of the same disease. Malaria is an illustration of a miasmatic disease.

Whether or not an infectious disease is contagious depends upon the nature of the infectious element, and especially upon its elimination and reception by the body. Most, but not all, contagious diseases are infectious. Scabies is a contagious disease but it is not infectious.

A Disinfectant is a drug, chemical or agent which destroys the specific infectious organism of contagious and infectious diseases.

An Antiseptic is a drug or chemical capable of restraining the action of putrefactive micro-organisms.

A Deodorant is an agent capable of destroying disagreeable odors.

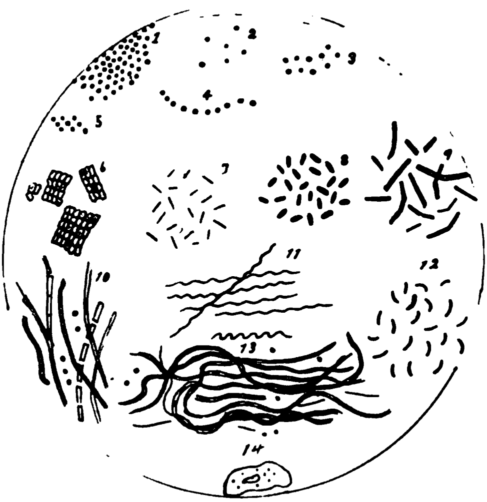
The best disinfectants known to science and those which are most generally used in this country are the following: Formaldehyde gas, sulphur dioxide, heat, dry or moist, bichloride of mercury (corrossive sublimate), chlorine, carbolic acid, chloride of lime, labarraques solution, and sulphate of copper.

Bacteria, Classification of Forms.—Authorities differ as to the exact date of the discovery of bacteria by Antony Von Leeuwenhoeck. Sternberg and Abbott say (1675) and Frankel gives the date as (1683). While all authorities are agreed as to the discoverer, hardly any two of them will agree to a definite classification of the micro organisms, thus no satisfactory classification of the bacteria has as yet been made. All or nearly all modern bacteriologists agree on the following classification:

Spherical forms of micrococci include (1) streptococci in which the individual cocci after subdivision remain in chains or strings; (2) staphylococci, in which they are clustered together like a bunch of grapes; (3) micrococcus, when usually seen, singly or in pairs or short chains. (4) When in pairs they are called diplococci.

Bacillus is a broad term which includes all the rod-shaped variety.

Sarcina, when they are shaped like coffee grains and clustered in squares. All inflammatory diseases are caused by or are accompanied by some one or another form of the



FORMS OF MICRO-ORGANISMS.

1, 2, 3, 4 and 5, micrococci: 2 and 3, diplococci: 4 and 5, streptococci; 1, staphylococci: 6, sarcina ventriculi: 7, 8, 9, 10, 11, 12, 13, bacteria: 7, bacillus tuberculosis; 8, bacillus typhosis: 9, bacillus anthrax: 10, bacillus malarie: 11, spirilla of relapsing fever: 12, bacillus cholera Asiatica: 13, chains from cultivation of bacillus anthrax; 14, cell containing micrococci.

pus organisms, such as staphylococcus pyogenes aures, staphylococcus pyogenes albus and staphylococcus pyogenes citreus, or some form of the pyogenic micro-organisms. Ferdinand Cohn shortly before 1860 showed that all of these organisms were of vegetable origin.

TABLE OF INFECTIOUS AND CONTAGIOUS DISEASES WHOSE ORGANISMS ARE KNOWN.

	Disease.	*Cause.*
1	Anthrax,	bacillus anthrax.
2	Asiatic cholera,	bacillus cholera Asiatica.
3	Bubonic plague,	bacillus of bubonic plague.
4	Diphtheria,	bacillus diphtheria.
5	Glanders,	bacillus mallei.
6	Leprosy,	bacillus lepræ.
7	Specific croupous pneumonia,	diplococcus pneumonia.
8	Relapsing fever,	spirochoete obermeirii.
9	Tuberculosis,	bacillus tuberculosis.
10	Tetanus,	bacillus tetanus.
11	Typhoid fever,	bacillus typhosis.

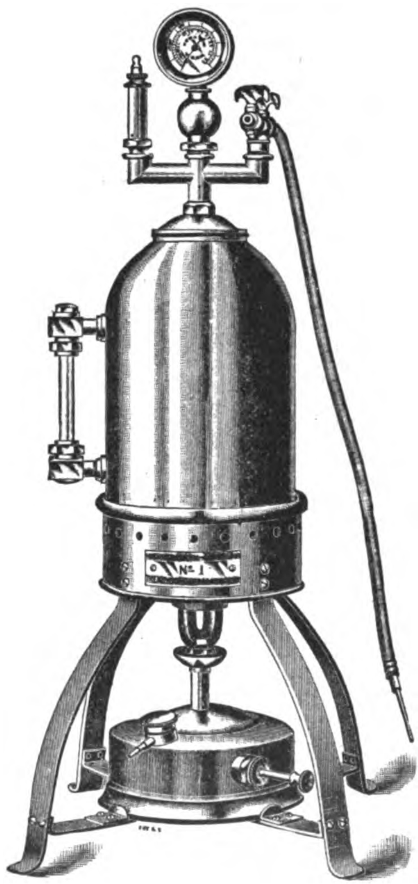
TABLE OF BACTERIA FOUND IN CADAVERS AND PUTREFYING MATERIAL.

(After Sternberg.)

1 Diplococci intercelularis.
2 Streptococcus septicus liquifaciens.
3 Bacillus of Koubasoff.
4 Bacillus cavacida havensis.
5 Proteus hominus capsulantus.
6 Proteus capsulatus septicus.
7 Bacillus pneumosepticus.
8 Bacillus acidiformans.
9 Bacillus cuniculicida havaniensis.
10 Bacillus speticus keratomalaciæ.
12 Bacillus septicus acuminatis.
13 Bacillus septicus ulcurus gangrenous.
14 Bacillus albus cadaverus.
15 Bacillus meningtiditis purulentæ.
16 Bacillus chromo aromatica.
17 Bacillus cadaveris.
18 Proteus vulgaris.
19 Proteus mirabilis.
20 Proteus zenkeri.
21 Proteus septicus.
22 Proteus lethalis.

Disinfection of Apartments by Means of Formaldehyde Gas and Other Fumigating Agents.

Since the discovery of Formaldehyde gas by Von Hoffman in 1867 up to the year 1888, the only fumigating gases



FORMALDEHYDE GENERATOR.

used by scientists for the destruction of bacteria were sulphur and chlorine. In 1888 Blum and Loew demonstrated the remarkable disinfecting properties of Formaldehyde, and investigators in all parts of the world have placed Formaldehyde gas as the ideal disinfectant of the day.

Formaldehyde, formalin or formic aldehyde ($CH_2O = H. C O H$), is a gaseous compound, is formed for the purpose of disinfection by the oxydation of methyl alcohol. Many apparatuses of merit have been invented for the purpose of generating this gas, or in one, a cut of which is found in this chapter, the gas is not only generated by the apparatus, but is generated under pressure, and by means of a rubber tube and nozzle the gas can be sent into a room or apartment through the key hole. I have used all of the different generators and prefer the apparatus shown in the cut. During my services as Medical Inspector for the State Board of Health of Illinois, this apparatus was used in the disinfection of all the railway cars arriving in Chicago from the infected yellow fever districts. Forty-five pounds of gas was used in the disinfection of an ordinary passenger coach or sleeper.

The cars, after having been disinfected, were left exposed to the gas from six to twelve hours. In the disinfecting of rooms of average dimensions, one-half this amount of gas would have been sufficient, but the exposure should never be less than five hours.

A formula composed of the following is placed in the generator and heated until the gas is developed:

1,000 parts Formaldehyde (H. C H O) 40 per cent strength.
200 parts Chloride of Calcium ($Ca Cl_2$).
400 parts Water (H_2O).

On account of Formaldehyde being readily converted into para Formaldehyde when heated or strongly concentrated, the calcium chloride is added to prevent this action (polymerization) which it does very effectually.

Hundreds of experiments have been made by various bacteriologists in order to ascertain the germicidal valve of Formaldehyde gas. Of all these experiments those conducted by Dr. J. J. Kinyon, of the United States Marine Hospital service, on pathogenic bacteria, and by Dr. J. Wortmann, of Germany, on putrefactive bacteria, moulds, etc., are the most valuable.

Dr. Kinyon, in the January, 1897, report of "Public Health," says: Boullion cultures of the following organisms were spread on cover slips and allowed to dry, then exposed under a bell jar to a saturated atmosphere of Formaldehyde, periods varying from one to sixty minutes. The slips were then planted into boullion and kept at a temperature of 37 degrees C. for 24 and 48 hours. In all instances mentioned "controls" demonstrated the vitality of the germs prior to exposure to the gas.

ORGANISM.	TIME OF EXPOSURE.			AFTER 48 HOURS.	
1. Staph. pyogenes.....	All of	1 min.	and over.	No	growth
2. Spirillum Finkler....	"	1 "	"	"	"
3. Spirillum Cholera...	"	2 "	"	"	"
4. B. Coli. Com........	"	5 "	"	"	"
5. B. Typhoid..........	"	10 "	"	"	"
6. B. Diphth...........	"	3 "	"	"	"
7 B. Glanders..........	"	2 "	"	"	"
8. Dip. Pneum. (partially dry)...............	"	2 "	"	"	"
9. Dip. Pneum. (dried)..	"	1 "	"	"	"
10. B. Pyocyan..........	"	2 "	"	"	"
11. B. Anthrac. (with spores)............	"	2 "	"	"	"
12. B. of Bubonic Plague	"	1 "	"	"	"

Experiments in the disinfection of a room conducted in a ward of the new small-pox hospital of the District of Columbia by Dr. Kinyon resulted as follows:

Room capacity, 3,300 cubic feet; percentage of Formaldehyde, 1.00; time, 22 hours.

a. Cultures on Petri dishes, covered with filter paper, and enveloped in ten layers of blanket: Anthrax, growth; diphtheria, no growth; S. pyogenes aureus, growth.

b. Cultures, spread on cover slips, placed in double envelopes, the inner one sealed with paraffin, and enveloped in ten layers of blanket: Anthrax, no growth; S. pyogenes aureus, growth.

c. Culture on Petri dishes, covered with filter paper, and wrapped in thirty-six layers of new cotton sheeting: Anthrax, growth; diphtheria, no growth.

d. Cultures spread on cover slips, placed in double envelopes, the inner one sealed with paraffin, and enveloped in thirty-six layers of new cotton sheeting: Anthrax, lost; diphtheria, no growth; S. pyogenes aureus, growth.

e. Cultures in double envelopes, the inner one sealed with paraffin, and wrapped in folds of three sheets, gathered into a bag: Anthrax, no growth; typhoid, no growth; diphtheria, no growth; S. pyogenes aureus, no growth.

f. Cultures in Petri dishes, covered with filter paper and exposed on mantel in room: Anthrax, no growth; diphtheria, no growth; typhoid, no growth.

g. Cultures spread on cover slips, placed in double envelopes, the inner one sealed with paraffin, and exposed on mantel in room: Anthrax, no growth; diphtheria, no growth; typhoid, no growth; S. pyogenes aureus, no growth.

h. Culture spread on cover slips and placed in double envelopes, the inner one sealed with paraffin, and exposed between the leaves of a closed book: Anthrax, growth; diphtheria, no growth; S. pyogenes aureus, growth.

Of over 225 samples of wool, silk, cotton, linen, leather and hair subjected to the action of Formaldehyde in conc. sol. and gaseous condition by Dr. Kinyon, no change was observed in the textile character in any instance.

He characterizes the gas as a reliable disinfectant for curtains, clothing, carpets, bed-clothing and surfaces generally. Complete success was achieved in many instances in sterilizing cultures of anthrax, diphtheria and typhoid when enveloped in ten layers of blanket or thirty-six layers of cotton sheeting.

The interior of books were disinfected with some difficulty, as were the interiors of upholstered furniture, mattresses and pillows, though as noted in his previous experiments, a comparatively small percentage of gas was employed.

He concludes that owing to the very volatile nature of Formaldehyde, perfect and speedy disinfection can be secured only by stopping closely every possible means of escape to the outer air.

Experiments of Dr. Wortmann on Putrefactive Bacteria, Mould Fungi, Etc.

Dr. Wortmann has made careful studies of Formaldehyde in its action on bacteria and moulds. He remarks that hitherto investigations of proposed antiseptics from the medical point of view have been made with few exceptions upon pathogenic micro-organisms, anthrax, the cocci of pus, typhus bacilli, cholera spirilli, etc., serving as test materials. In such experiments it has been found that if substances employed were antiseptic at all, they exhibited quite a different action upon different kinds of pathogenic bacteria, according to their degree of concentration. Further, it enabled the experimenter to form a reliable opinion as to the degree of efficiency of the agent as an antiseptic against such bacteria as play an important role in general practice.

In order to obtain a correct estimate of Formaldehyde as a general germicide, Dr. Wortmann selected such bacteria for test material as are characterized by a high degree of resistance to adverse conditions, abundant everywhere, and living upon any possible substratum. These are not pathogenic bacteria, cholera spirilli, typhus bacilli, etc., because they either require a specially prepared cultivation medium or make certain claims as to the nature of their substratum. Bacteria which are of universal occurrence, living under conditions where an organism not assimilating carbonic acid cannot develop, are the ordinary putrefactive bacteria which may be conveniently termed the *weeds of bacterial vegetation.* If these *weeds* can be destroyed, it is *certain* that the *exotic bacteria,* requiring special food stuffs, can also be successfully combatted with the same agent. For these reasons Dr. Wortman states he took the putrefactive bacteria to test the antiseptic properties of Formaldehyde. To estimate the antiputrefactive value of any substance, he introduced small pieces of raw beef into flasks which contained solutions of the antiseptic substance in varying degrees of concentration. If too dilute, decomposition sets in after a shorter or longer period, and a daily control of the commencement or increase of the putrefactive changes gives direct estimate of the antiseptic value of the solution employed.

The liquid used by Dr. Wortmann was a 40 per cent. solution of Formaldehyde. The results of these experiments upon pieces of meat showed that 1 part of the 40 per cent. solution in 200,000 of water (1:500,000 Formaldehyde) and 1 in 400,000 (1:1,000,000 Formaldehyde) possesses a distinctly anti-putrefactive action, and in a dilution of 1 in 50,000 (1:125,000 Formaldehyde) suppresses any development of bacterial life.

In such meat cultivations the nutritive material is not, however, in a particularly convenient form for the bacteria to attack, as only those substances serve as a pabulum which diffuse out of the meat into the liquid, which diffusion, however, always takes place slowly. In order to provide the bacteria therefore with a specially adapted and convenient food, Koch's meat boullion was employed to which Formaldehyde in solution was added in varying quantities. Control cultivations were prepared out of the same boullion diluted with half the quantity of water, but without the addition of Formaldehyde. The preceding experiments showed that one to one and one-half hours' exposure to the action of Formaldehyde solution diluted to 1 in 10,000 (1:25,000 Formaldehyde) exercises a perceptible retarding action on bacterial development, and that two hours' exposure can effect complete destruction of these putrefactive bacteria, the most resistent and hardy forms known.

Experiments on moulds were carried out. Dilutions of the solution of Formaldehyde ranging from 1 in 10 to 1 in 100,000 were used. Sterilized rolls or small loaves of bread were well moistened with these solutions and the incised surface of the rolls then sown with the spores of the green mould (pencillium glaucum). The cultivations were kept in a dark cupboard at the temperature of the room. A roll moistened only with water for control experiment was covered all over its surface with a green carpet of pencillium fruit bearers, whilst all the rolls treated with Formaldehyde solutions up to 1 in 10,000 (1 in 25,000 Formaldehyde) remained completely sterile. Experiments were conducted upon two more moulds, viz.: grape fungus (botrytis cinera) and mucor stolonifer, a hardy form.

The results of all these experiments with moulds clearly demonstrate that for practical purposes the solution of Formaldehyde diluted to 1 in 5,000 or 6,000 (a Formaldehyde solution of 1 in 12,500 or 1 in 15,000) suppresses all mouldy growth and does not allow such to appear at all.

Disinfection of Clothing.—Clothing may be effectually disinfected by exposing them to the action of Formaldehyde gas sulphur dioxide, or by boiling. Articles of wearing apparel that can be washed may be thoroughly disinfected by sending to the laundry. The chemicals used by these institutions in the process of cleansing are very efficient antiseptics. Dry or moist heat is also very generally used. A temperature of 230 deg. F. will be sufficient to destroy all known organisms of disease, in the absence of spores. Where these are present a temperature of 300 deg. F. should be secured. This high temperature has an injurious effect on woolens.

Disinfection of the Person.—Those who wait upon the sick either in the capacity of physician, nurse, or attendant should wash their hands in a one in a thousand solution of bichloride of mercury or a four per cent. solution of carbolic acid. For the bath a solution of one in five thousand of bichloride of mercury and one in a hundred of carbolic acid will be sufficient. All instruments, spoons, etc., that come in contact with the sick should be washed in the same solutions.

Disinfection of Discharges from the Patient.—A solution of chloride of lime, one ounce to the gallon of water, is the best disinfectant for the infectious discharges from the sick. A one in five hundred solution of mercuric chloride combined with the same proportion of permanganate of potash is also to be highly recommended.

Disinfection of the Dead Body.—The body of a person dead of a contagious or infectious disease should be embalmed by an arterial and cavity injection of a proved disinfectant embalming fluid, the entire body washed in this solution, all orifices stopped with absorbent cotton and the body enveloped in a layer of absorbent cotton not less than one inch thick, wrapped in a sheet and bandaged.

It is not necessary that the funeral director be a chemist or an expert microscopist, since when work of that kind is to be entered into, it is performed by men who have made those topics a special study. Leaving all this wide field of scientific investigation, then, to the various boards of health and sanitary officers, we are relieved of a great part of the work, only leaving for us the subject of sanitary arrangement of the morgue, the methods of procedure in the contagious and infectious diseases, and the best possible means of disinfecting.

The morgue, or dead room, should be so constructed as to admit of good ventilation. The walls and ceiling of the apartment should be composed of hard wood or plaster, no wall-paper being used. The floor should be made of cement, or, this being impossible, it should be left bare or covered with linoleum. A room arranged after this manner will remain in good sanitary condition, as the germs which might emanate from the dead bodies which are constantly being brought to the morgue, cannot find lodgment in the smooth walls or floor of the room, and should they become attached to these parts there is nothing for them to develop in, and in a short time they die for want of a suitable developing medium. The disinfection of a room of this kind is very easily accomplished, as you can employ Formaldehyde gas without fear of discoloring or bleaching any of the materials in the room, although the walls and ceiling may be covered with wall-paper, etc. Or if the fumigating disinfectants are not desired, the walls and ceilings can be washed with a solution of double chloride of mercury, or carbolic acid, or other suitable disinfectants. The drainage from the morgue should be arranged very carefully, and in embalming, the blood that is thrown in the drainage should at first be carefully disinfected by mixing with fluids. It is a well known fact that nearly all of these fluids contain antiseptics of sufficient strength to sterilize the blood that might be removed from the body. Frequent flushings of the drain pipes leading from the morgue will be of the greatest sanitary value, as the chemicals used in disinfecting the discharges and secretions from the body lose their strength with age, and germs of all descriptions might begin developing in the drains when they would be least suspected. These chemicals, which might restrain the germs from developing for a longer or shorter length of time, soon lose their strength and the germs may multiply with alarming rapidity.

All the clothing which is removed from the body of those subjects which are found dead, drowned cases and those which are brought to the morgue, should, after they have been identified, be burned, as the clothing might contain bacteria which could not be destroyed in any other manner, unless it would be subjecting the clothing to dry or moist heat at a temperature of 220 deg, F., which destroys all forms of pathogenic bacteria, as well as those germs that have no special function in the causation of disease.

After embalming the body, the instruments should be washed in a four per cent. solution of carbolic acid; this should be done at the house immediately after the embalmment, or if it is not convenient in private practice, you should see that they are sterilized as soon as you return to the establishment. Don't use corrosive sublimate; this chemical, on account of the corrosive action on metals, will corrode the knives and metallic instruments and turn them black. You should also be careful not to get any of this solution on the instruments while operating, as it will have the same effect.

CHAPTER XIV.

Contagious and Infectious Diseases.

The contagious and infectious diseases deserving the attention of the embalmer are anthrax, Asiatic cholera, diphtheria. erysipelas, small-pox, typhoid fever, typhus fever, yellow fever, measles, pneumonia, scarlatina, puerperal fever, septicæmia, tuberculosis and bubonic plague.

All of the above diseases possibly owe their contagious principal to a living germ, which grows at the normal temperature of the body but which does not lose its contagious principal after the body is dead, neither are they killed by the gradual cooling of the body or the fall of temperature to 68 degrees. The fall of temperature which takes place in the body after death merely restrains the germs from exerting their detrimental action, and only in rare instances will this fall of temperature kill the germ. We have abundance of proof in this by referring to the epidemics which have sprung up in comparatively recent times from the disinterment of bodies, etc. The experiments of Koch, Carpenter, Evarts and others have proved that the blood of animals dying of splenic fever, anthrax, may be dried and kept for years, and pulverized into dust, and yet the disease germs survive with sufficient power to produce infection. The plague of Modena, which broke out in 1828 in consequence of excavations made in the ground where 300 years before the victims of the plague had been buried, is proof of the endurance of some of these vegetable parasites, which in this case are not only parasitic bacteria but also saprophitic bacteria, as they maintain their existence in the fluids of the dead body and also against the chemicals (ptomaines and leucomaines) which arise from putrefaction. Similar epidemics have occurred in the present century, such as quoted by Formento at Derbyshire, Eng. The terrible violence of the cholera in London in 1854 was charged to the upturning of the soil wherein the plague stricken of 1665 were buried. These few facts, which have been gathered from various sources, are sufficient to prove that the infection and contagion which is present

Bacillus Anthrax x 1250 diameters. (From a photomicrograph).

in the body during life does not leave it with the last breath, but instead it only retards its action and at the same time forms a favorable medium for putrefactive bacteria; thus a body infected with a contagious or infectious disease is not only a source of alarming danger during life, but according to modern burial methods it remains so after interment, unless the body has been embalmed with such chemicals as will destroy the particular germ causing the disease.

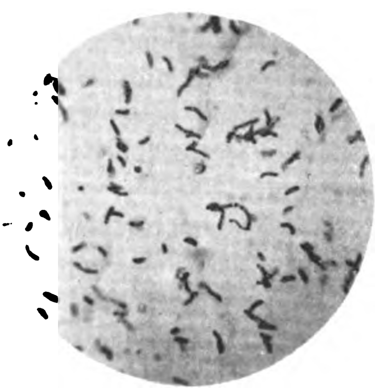
The development of the germ is more favorable in the living body than in the dead, and it will be found in those diseases, such as cholera and diptheria, that the germs develop with alarming rapidity during life, but are in a state of restraint after death, on account of the change of temperature; yet it is not sufficient to kill them, as has been demonstrated. It makes little difference in the case of yellow fever, for these germs develop as rapidly after death as they do in life, and are capable of living in the soil as well as in the dead or living body. The germs of yellow fever have been detected within a few inches of the surface of the soil over the graves of bodies that have died of this disease. In this case the body had been buried nearly a year, thus giving ample time for the germs to be carried towards the surface. Before proceeding further on the chapter of infectious and contagious diseases, it will be well to illustrate some of the different forms of germ life.

The bacillus anthrax is one of the most resisting germs yet discovered, on account of its spore formation functions; it resists the antiseptic effect of many chemicals; Formaldehyde, carbolic acid and corrosive sublimate should be used to kill it.

Fortunately it is a rare disease in man, being confined to the lower animals and generally restricted to damp countries, or where the soil is heavy. The contagious principle of anthrax is not equaled by any other contagious or infectious disease, unless it be that of small-pox. Any part of the body of an animal affected with anthrax is capable of transmitting the disease. The contagion clings to the hair, bones, teeth and nails, and is found in all the fluids and tissues of the body; the blood is a favorable medium for its development. The germs of anthrax also cling to anything that may be brought in contact with the affected animal or person, such as harness, blankets, clothing, etc. The germs may also be carried in the clothes of stablemen who have taken care of an infected animal. It is claimed upon reliable authority, that the plants growing over the spot where an animal, which had died of the disease, had been buried, were the means of setting up a fresh attack in a well animal, but later experiments tend to prove that the germs float in the atmosphere, and enter the system through the air passages.

From this description of the contagious nature of anthrax it will be seen that every undertaker should be careful in preparing the body for burial, as the germ is capable of living in or on any part of the body. The operator should be very careful about removing blood or any secretions from the body, as in this disease the blood and fluids of the body contain millions of the germs. The treatment of the case depends very much upon the conditions of the subject. Rigor mortis appears almost immediately after death and is very firm, thus putrefaction is somewhat retarded. The body resembles, in a great many instances, the appearance of a subject dead from small-pox. The whole body should be injected in both the cavities and arteries, washed in the disinfectant fluid enclosed in a layer of absorbent cotton, and bandaged; all orifices should be stopped with absorbent cotton.

Asiatic Cholera is defined as an acute, epidemic, infectious disease, characterized by excessive vomiting, violent serous purging accompanied by severe cramps, and followed by collapse. This disease is indigenous in India, existing in that country the year round. Whenever favorable conditions present themselves, this disease spreads from this country in epidemic waves, usually traversing the entire civilized world before it subsides. While the home of the coma bacillus is in India, a great many epidemics of the disease originated in countries remote from India, and in places where the existence of the infection was not suspected. The last epidemic of this disease which appeared in this country first broke out in New Orleans, from whence it spread to the Central States and over the Mississippi valley, causing a very large mortality. The specific cause of Asiatic cholera was first discovered by Robert Koch in 1883–4. This eminent bacteriologist, while experimenting in Egypt and afterwards in India, announced the discovery of the characteristic germ of Asiatic cholera, but it was several months afterwards before he was able to prove the correctness of his discovery. This was finally conclusively proven by injecting a quantity of the como bacillus into the healthy duodenum of the rabbit, the amount injected



Bacillus Cholera Asiatica—x 1250 Diameters. (From a Photomicrograph.)

being one one-hundredth of a drop of a pure culture of the organism. The animal soon developed symptoms of cholera and in a few hours died of the disease. The examination of the intestinal tract and the discharges showed millions of the germs, thus proving their development in the intestinal canal. These germs are only found in the intestinal canal and the appendages below the stomach, there being none in the blood current or in any of the fluids of the body remote from the intestinal tract. The como bacillus is from one-half to two-thirds as long as the bacillus of tuberculosis; they are more convex at the ends and are slightly thicker, being curved. They will grow at the temperature of the body, developing best in a temperature varying between 30 deg. and 40 deg. C. (86 to 104 F.). They can be cultivated in meat broth, blood, serum, cooked potato, milk, agar-agar, and best of all in gelatine. When a culture is begun on this substance it will first be noticed by a small amount of serum on the top, forming a small glistening drop on the gelatine; as they begin to multiply they sink towards the bottom and soon liquify the gelatine. Water is one of the best mediums serving to carry the germs; they will thrive in this liquid at ordinary temperature, but as soon as the temperature is lowered, or at the approach of winter, the germs stop developing, but are not necessarily killed by the change from warm to cold, as is evidenced by the fact of the disease breaking out in the spring of the year, the germs being merely restrained from developing by the cold of winter, only to renew their activity at the approach of spring.

The bodies of those who die of cholera should receive the most careful attention. The undertaker should not handle the subject any more than is actually necessary, as the germs will cling to any moist surface of the patient's clothing, and are found in unlimited numbers around the exposed mucous surfaces of the body. Be careful in handling the body that you do not put your hands to your mouth, as in that way infection may be carried very easily. It has been argued by some that the cholera germ cannot live in the human stomach on account of the acid secretions of that organ. I believe that this is the truth during certain stages of digestion and when the secretions of the stomach are really acid, but, as every physiologist knows, there are certain times when the stomach is alkaline or neither acid nor alkaline in reaction; being neutral, the germs have two chances of passing through the stomach, to one where they would be destroyed by the hydrochloric acid normally present in the stomach. The drinking of lemonade acidified by the addition of a weak solution of sulphuric acid (H_2SO_4) will keep the stomach in such condition that the como bacillus will not pass through it. All drinking water, during the prevalence of this disease, should be boiled before using, as the water has been proven to be the medium of spreading the contagion.

The appearance of the subject dead from cholera is very characteristic on account of the great drain of serous material from the system. The myosin of the muscles becomes coagulated very early after death and the rigor mortis sets firm, yet the muscles will respond to mechanical stimulus or will even act spontaneously, as has often been noticed in the bodies of those who have died from Asiatic cholera. The muscles retain this power of contraction for a long time, and in the observations made by Watson, Barlow, Ward, Lawrence and others, this cadaveric rigidity or muscular contraction was strange indeed. In one case, about thirty minutes after the breathing had ceased, the muscles over the region of the lower limbs began to take on slight quivering and twitching, which gradually increased until the leg became flexed at the knee; then spreading to the opposite leg, it took on much the same phenomena as the former. These muscular contractions gradually extended to the abdomen, then to the arms, and finally the muscles of the face were fully under its influence. At one time the eyes turned upward, then downward; this was followed by movements of the lower jaw very closely resembling those which take place during mastication. At one time the fore-arm became flexed upon the arm, and upon breaking up the rigidity the arm immediately regained its flexure when attempts were made to place it in its natural position. Another case witnessed by these observers was that of a plethoric individual who had been dead but a few hours when the muscles of the body began to twich and contract, but all at once the contractions became limited to one side of the body, and on account of this strange and unaccountable action the body was turned completely on its side.

This phenomena may account for those cases of cholera that were supposed to be buried alive, because when they were afterwards exhumed they were found in a different position than they were in when placed in the grave. Aside from the general condition of stiffening of the body are many other peculiar conditions in the heart and blood vessels. One would naturally think that in a cholera case the heart and lungs would be filled with blood, but the post mortem examination of these subjects proves this to be incorrect. The lungs are bloodless, the pulmonary artery also contains little or no blood, but the right auricle and ventricle may contain coagulated blood of a tarry aspect, dark in color. The remaining blood in the large veins is also of this dark color and of the consistency of tar or pitch. The left side of the heart is empty and contains only a small amount of serum.

The external appearance of the body resembles that of a shrunken or dessicated subject; the skin clings tightly to the muscles beneath it, and the face assumes a pinched condition: the nose is pointed and deep discolorations arise in the cellular tissue of the face, especially along the angles of the mouth and nose and beneath the eyelids. The skin seems to cling to the very bone beneath it, and when pinched by the fingers, feels tough and very much like leather

The como bacillus is very susceptible to the action of antiseptics; almost any solution of alkalies or acids will kill it. It can poorly withstand the effects of sunlight and when exposed to the rays of the sun it loses its power of infection, as does also the anthrax germ. Experiments, however, along this line are not yet fully completed, but are sufficient to warrant the above statement.

Diphtheria.— Diphtheria is an acute epidemic, contagious disease, characterized by sore throat, in which membranes form on the throat, tonsils, uvula and back of the fauces. Membranes may also form on the mucous coat of the ladder, intestines and stomach, on the bronchial mucous membrane and in the posterior nares. The disease is caused by the bacillus diphtheria which grows and reproduces itself in the mucous membranes, or rather false membranes formed in the throat, nares, etc. Diphtheria is frightfully contagious, the contagium being capable of living in the air, upon the walls, or will cling to the clothing and may be carried about on instruments or other material brought in contact with the body. Many undertakers are very careless in handling a diphtheritic case; they will use the nasal tube, which may be either hard rubber or metal, to introduce the fluid into the nares or lungs, stomach, etc., and will replace it in

Bacillus diphtheria—X 1250 diameters. From a photomicrograph.

the cabinet or instrument-bag without giving it a thorough cleaning or sterilizing it in some acid solution. Instruments, brushes, sponges, etc., are very good means of spreading contagion. I once examined a brush used to clean the hands of the embalmer after working upon the body; this brush had been used for several weeks and was still in a very good condition as regards the brush, but it was found to contain several different varieties of bacteria and micro-organisms; a few of these were pathogenic, as was afterwards proved by cultures and innoculations, but the majority were non-pathogenic and were harmless. This brush was carried from house to house and was used in every case the embalmer worked upon; after cleansing his hands it was thrown in among the instruments, and could have been the means of spreading contagion. If you use any instrument on the throat of a diphtheritic case, be sure and wash it in an acid solution—preferably carbolic—immediately after you are through with it.

Treatment.—The embalming of a case of diphtheria is not widely different from that of an ordinary case, only the throat and neck should receive special attention. If the glands of the neck are swollen by the disease, don't try to remove the swelling, as it will be impossible, but be sure and use plenty of fluids and disinfectants in the throat and nose. The arteries and cavities should be injected with a proved disinfectant embalming fluid and the entire body washed with the disinfectant and all orifices, especially the nose and throat, closed with absorbent cotton. I am not in favor of using all the different fluids for disinfecting the throat, as many of them are too weak to kill the bacillus diphtheria, and I believe that the embalmer will have better success, and will certainly do more in a sanitary point of view, if he will apply some good disinfectant to the parts, such as Formaldehyde. This will also prevent the peculiar odor which is generally prevalent in this disease, while the fluids are uncertain and very few have any effect on the odor arising from the body.

Erysipelas.—This disease, while not being eminently contagions, deserves some attention from the embalmer. It is an acute eruptive fever followed by well marked constitutional symptoms, the eruptions and swelling being confined generally to the head and neck. The poison of this disease generally begins in the skin, gaining entrance to the body through an abrasion on the surface of the cuticle, although it is claimed that it is not necessary for even a scratch or abraded surface of the skin to be present; the germ is capable of penetrating the healthy skin. It will, however, penetrate much more rapidly the cicatrix of a wound, or those parts of the body where the skin is weaker than elsewhere. The contagion of this disease, like that of diphtheria, clings to the clothes, instruments, bedding, etc., and should be carefully handled. The clothing of the person should be disinfected by Formaldehyde gas or washing in a solution of corrosive sublimate and water, or a strong solution of zinc chloride or carbolic acid. One of the most peculiar phenomena associated with the disease is the disappearance of all the characteristic features of erysipelas from the skin as soon as death takes place; thus the pathology of the cutaneous process of the skin is but very little understood. Bodies dead from the effects of erysipelas are not refused transportation by railroads, and the ex-governor of Indiana, Ira J. Chase, who died in Lubec, Maine, was transported to Indianapolis for interment. The body in this case, or class of cases, should be prepared according to the rules adopted by the National Conference of State Boards of Health and approved by the American Baggage Agents' Association.

The blood is thin and can be removed very readily by opening the veins or penetrating the right side of the heart with the trocar. The embalming is the same as in ordinary cases, only the face and neck, should the swelling not go down, should receive attention. The face and neck should be completely drained by using the needle process, or by opening the venous system. The head should be raised above the level of the body, so as to allow the fluid to gravitate downwards into the thoracic cavity.

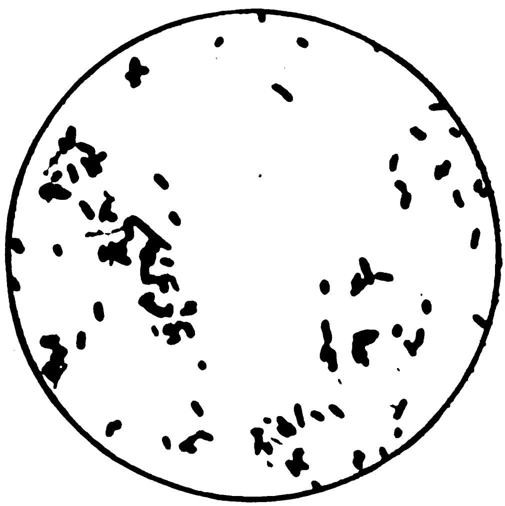
Small-Pox.—Small-pox is an acute, specific, eminently contagious and infectious disease, characterized by fever and an eruption, consisting of three stages. There is an omission of the fever and other symptoms when the eruption first appears, and a secondary fever when the eruption attains its height. This disease is due to a specific poison, possibly a vegetable parasite, but so far this has not been demonstrated. Experiments are at the present time being conducted by eminent medical men in the experimental laboratories at St. Louis, Mo. History tells us that this loathsome disease existed in the earliest ages of the human family. Its ravages at that time were keenly felt by the Egyptians, but later, after the sixth century, its victims were more than doubled by the changes which took place in the social and political standing of Europe, caused by the crusades. It is said that if we could be transported to the streets of London as they appeared in the early part of this century, that no peculiarity of dress, architecture or behavior would appeal to us in such strong terms as the number of pock-marked visages we would encounter at every turn. When Jenner, the discoverer of the preventive treatment of small-pox by vaccination, inoculated his own son, he wrote his name on the pages of history never to be erased. There are few diseases in the nosology of our text books that are feared as much as small-pox. Possibly there is but one exception, namely that of cholera.

Since Jenner's time, pathologists and bacteriologists have learned more in regard to the disease. Its contagious principle is said to remain active for days, weeks, and even months, and is capable of reproducing itself when brought in contact with a susceptible person. This disease being a specific infectious and contagious disease, is capable of infecting the well in many ways. A person may become affected by being brought in contact with an infected person, by touching his clothes, bed clothing, or other material which has been in contact with the body, by breathing into the lungs some of the volatile contagious principle which is always emanating from the body of the infected person, or by being brought in direct contact with the patient's body or any of the desquamation that has escaped from the surface of the skin. All our knowledge of this disease tells us that every tissue of the body is capable of producing the infection, even the child in the mother's uterus is not spared from its infective ravages.

It will be seen that to be able to cope with such a disease requires a good knowledge of the principles of sanitary science, the methods of disinfection, etc.

Treatment.—No undertaker should think of handling a case of this disease unless he knows the use of carbolic acid, Formaldehyde gas, sulphur and corrosive sublimate. You will be called to handle these bodies after death, just the same as the physician is called upon to take care of the body during life, and you should study how to do this in a way that will not only protect yourself and those around you, but will protect the laity in general. If you are called out to take care of a case of small-pox, take no instruments of any kind with you, as on account of the different laws now in existence, embalming such cases is out of the question. Wear an old suit of clothes, and over all of this wear a rubber coat which will come as high up on the neck as possible, at the same time reaching nearly to the ground. Your hands and face should be washed in a solution of bichloride of mercury, and the hands should be protected with rubber gloves. The body should be covered with a sheet saturated in Formaldehyde and enveloped in a layer of absorbent cotton one inch thick. No germ can pass through this, and you can handle the body with safety. The body should not be handled very much until this cotton is around it, and even afterwards avoid touching the body as much as possible. The best method of disinfecting the rooms wherein a small-pox patient has died, is by using *Formladehyde gas.* Formaldehyde penetrates, or rather the Formaldehyde gas penetrates every possible space in the room, while washing the walls with mercurial solutions, etc., is at best far from practical and not certain in its results. If sulphur is used it should be burned for two or three hours and the fumes kept as closely confined as possible, as pressure of the gas increases its power of disinfection. Sulphur has lately been supplanted by Formaldehyde. This can be employed by any one of average skill, while the use of lime, muriatic acid, chlorine, bichloride of mercury, etc., requires much skill, and at all times are dangerous to handle. Formaldehyde gas is the ideal disinfectant for the house and apartments. The disinfection of clothing, etc., will be considered later.

Typhoid Fever.—This disease is an acute infectious fever, caused by the bacillus typhosis. It has an insidious



Bacillus Typhosis. (Typhoid Fever) X 1200 diameters. From a Photomicrograph.

beginning, a characteristic temperature record, a characteristic eruption, peculiar intestinal symptoms with diarrhœa, and followed by certain characteristic post mortem conditions. The typhoid bacillus is found in the intestinal canal and in the discharges from the patient. The undertaker need have little fear in handling this disease, only he should be careful not to carry any of the contagion around on his person or on of the instruments used in embalming the body. The roublesome part of a typhoid subject is the abdominal . This cavity, on account of the inflammation of the intestines, mesentery, etc., should receive attention from the start; the blood should be removed, and at the same time it should be disinfected by allowing it to enter a bottle partially filled with a disinfecting solution. If there is any leakage from the rectum it should be prevented by plugging the rectum with absorbent cotton, or if this does not suffice, it can be drawn out with s sharp hook and tied, which will prevent any further trouble from this source. The cavities should then receive a thorough injection, and the arterial system filled the same as in ordinary cases, and the surface of the body should be washed in the disinfecting solution. If on the following day the abdominal cavity is distended with gas, and the body is not keeping as it should, the gas should be removed, also the fluid, and fresh fluid introduced; this will usually suffice, and the case will go on all right without further attention.

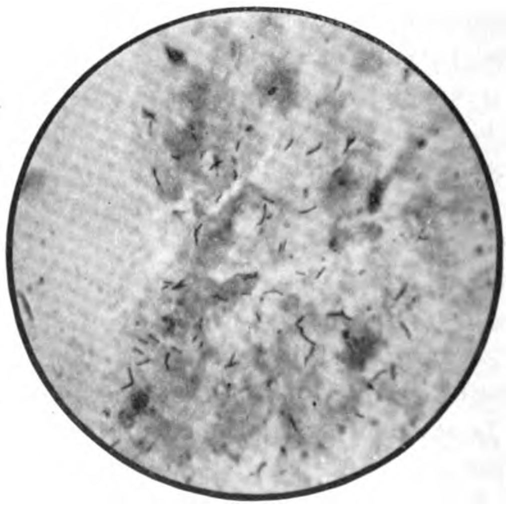
Typhus Fever.—Typhus fever is an acute contagious disease, usually occurring in epidemics. It runs its course in about twenty days. It is characterized by an abrupt commencement, great prostration and disturbance of the nervous system, and a characteristic eruption. A fatal case is generally of short duration; the disease may not continue longer than a week or ten days. While this disease is contagious, it is not generally considered so in the true sense of the term. The peculiar germ causing the disease has not as yet been demonstrated, but is supposed to be developed in the bodies of the infected and transmitted from them to the well, by actual contact or through the atmosphere. *The post mortem conditions* in this class of cases is very well marked. The rigor mortis does not set firm and there is an early tendency towards putrefaction; the eruptions that appeared during life remain after death, as does also the slight eruption beneath the cuticle. The blood is darker and very fluid-like in consistence; hence it is easy to remove the blood by opening the veins or tapping the heart. There is also frequent congestion of the internal organs. The embalmer, when called upon to take care of a case of typhus, should be as careful as possible, applying all the sanitary laws that he can command, being careful in handling the body and in coming in contact with any of the fluids or excretions from it. The embalming is the same as in an ordinary case. Cavity and arterial embalming and washing the body with the disinfectant.

Yellow Fever.—Yellow fever occurs in such climates as are peculiar to the West Indies, South America, the southern parts of the United States, Gibraltar, etc. It is a specific, infectious, communicable disease, caused by a specific germ. It has received its name, yellow fever, on account of turning the body to a jaundiced or yellow color. The contagious principle of the disease is as yet not definitely understood, but sufficient knowledge has been gathered to know that a temperature of 32 deg. F., or the freezing point, is sufficient to kill it. A high degree of artificial heat will also have the same effect upon the germ, and it is probable that such chemicals as corrosive sublimate and carbolic acid, in the solution and strength generally employed in contagious and infectious diseases, would be sufficient to kill it. If a particle of infected clothing or other paraphernalia be hermetically sealed and protected from extreme temperatures, such as extreme heat or cold, it is capable of retaining its vitality almost indefinitely, and its toxic qualities may be exhibited when an unacclimated person is brought in contact with the germs. They are also capable of developing in the earth and soil; this has been demonstrated by examination of the earth covering the graves of yellow fever subjects. The same precautions as apply to small-pox and any of the other eminently contagious diseases apply with equal force to the treatment of yellow fever. If the body is to be embalmed, this should be done most thoroughly; every tissue of the body should be brought in contact with the preservative solution, and after being embalmed it should be wrapped in the bandages and saturated in the bichloride or Formaldehyde solutions.

Scarlatina, Scarlet Fever.—These terms—scarlatina and scarlet fever—are used synonymously to designate one of the most common and fatal of the acute contagious diseases. This disease is believed to be caused by a specific germ, which is capable of living at the room temperature or the temperature of the body. It may also live in the clothing, on the walls, or upon anything to which it may become attached. It commonly enters the system by the air passages, but it may be carried into the body by the food. The blood of scarlatinal patients or subjects also contains the peculiar contagium vivum, as has been ascertained by the innoculation of the blood of a scarlatinal patient, by which scarlet fever was produced in its typical form. The epidemic scales shed during the desquamative period of the disease are also highly contagious, and it is possible that the urinary and fecal evacuations from the body contain the germs. All the clothing which has been around the patient, or any handkerchief or linen which the patient has expectorated upon should be regarded as contagious and treated as such. It is claimed by Lewis Smith that the contagium of scarlet fever surpasses that of any other acute disease, unless it be that of small-pox. The burning of sulphur in a room for several hours—from morning until evening—was not sufficient to prevent the contagium from spreading. All the clothing not of much value belonging to a scarlet fever case should be burned, and that which is not burned should be disinfected by being exposed to the action of Formaldehyde gas for several hours in a closed room, or else subjected to a temperature of 220 deg. F.

The Treatment of the scarlatinal subject is not difficult. The embalming should be performed by injecting arteries and cavities with a proved disinfectant embalming fluid, stopping all orifices and washing the body in the disinfecting fluid, but extreme care should be exercised in handling the remains or coming in contact with any of the clothing of the room. If there are children liable to come in contact with your clothing after preparing a case of scarlet fever, take the precaution of disinfecting them so that you will prevent spreading the disease.

Tuberculosis (consumption) is an infectious, contagious disease. There are two varieties—the acute and the chronic.



Bacillus tuberculosis (consumption). X 750 diameters from a sputum preparation. From a photomicrograph.

It is caused by the entrance into the system of the bacillus tuberculosis, which causes the formation of tubercles in the lung. These break down, rupture, causing hemorrhages and, ultimately, cavities to form in the substance of the lung. The disease is characterized by an accelerated pulse, cough, gradual emaciation and hectic fever. The specific germ of the disease is found in the tubercles and in the sputum and fluids of the body. It is not an eminently contagious disease, although the embalmer should be careful not to come in contact with any of the discharges from the subject, for if he be a susceptible person he might acquire the disease from preparing the body for interment.

The Treatment of a consumptive case depends to a great extent upon the condition of the lungs. If the disease has advanced very far and there are cavities in the lungs, there will be more or less leakage when the subject is injected with the preservative solution; this leakage is caused by the disease having wasted away the arteries at the seat of the tubercle. Just as soon as the disease advances far enough to cause a rupture of the vascular system of the lungs, we have cavities formed in the substance of that organ. The blood of the consumptive subject is also very much altered, is thin on account of the diminished amount of fibrin, and also diminished in amount; thus only a small amount of blood can be removed from the body of a tuberculous subject.

Treatment.—The body should receive a careful arterial injection; all of the tissues should be saturated with the fluid, but should leakage occur this will be difficult. In order to get as thorough injection as possible, enough fluid should be injected until it escapes from the ruptured vessel clear, then it will be well to stop the arterial injection and give your attention to the cavities, which, especially the thoracic, demands earnest attention. This cavity, on account of the amount of lung tissue consumed by the disease, will require more fluid than is necessary for the average case. After the chest cavity has been properly filled with the preservative, the embalmer should turn his attention to the abdominal cavity, which should receive a thorough injection of the fluid. The embalmer will seldom be bothered with discolorations appearing on the face of the subject, but should these appear they can be removed by the needle process or by hypodermic injection of fluids, or by use of alcohol, saltpetre, etc.

Pneumonia.—This disease is defined as an acute contagious croupous inflammation of the tissue of the lungs, attended by exudation into the air vesicles. In about two-thirds of all cases of lobar pneumonia, the lower lobe of the lung on the right side will be the seat of the disease; this may spread upward until the whole right lung becomes consolidated. In rare cases the disease spreads to the opposite lung, being then known as double lobar pneumonia. In this disease, on account of the large amount of blood in the lungs, they have a tendency to undergo putrefaction very early after death. Purging is not infrequent, and also, on account of the enlarged condition of the lungs, the heart is depressed and will be found much lower than its original position. There is not much blood found in the heart after death in this class of cases, although there are notable exceptions, such as are liable to come up in extremely plethoric individuals, or in those cases of chronic alcoholism, where the heart, on account of its weakened condition, allows more or less blood to remain in the auricles and ventricles of the right side. Purging is very frequent and, in some of the cases, is very obstinate, nothing short of the most heroic treatment relieving it.

The blood in the body is diminished in oxygen, caused by the occlusion of the air-cells and alveoli. It is not infrequent in this class of cases to have develop, in remote parts of the body, what are known as metastatic abscesses. These are caused by the formation of thrombi in the blood vessels, which afterwards break down and are carried to the heart, where they may act as an intense irritant, setting up inflammation of the heart, which of itself oftemtimes causes the death of the patient. The blood in cases of pneumonia, on account of the diminished amount of oxygen, is very dark in color; its weight is also very much increased, possibly on account of the absorption of deleterious material from the whole system. The lung taken from a body dead of pneumonia, where the whole structure has been infiltrated, will sink in water, while it is next to impossible to make a healthy lung sink beneath the surface.

The Treatment of a case of pneumonia is very important. First, as much blood as can be removed from the body should be removed. This will prevent, as much as possible, the putrefaction which would begin in this medium almost immediately after dissolution had taken place; it will also permit of an easier flow of fluid into the parts. This being accomplished, the needle should be inserted into the cerebro-spinal cavity, through the foramen magnum in the back part of the neck, and if any blood be in the veins of the face which was not removed by aspirating and other means, it will be removed by this method, thus clearing up the face. From one to two quarts of fluid should be thrown into the circulation by the needle process. The next thing you should do would be to give your attention to the cavities, especially the right side, for in two-thirds of the cases this will be the seat of the trouble. Fluid should be injected into these cavities by a method which will not allow its escape downwards into the abdominal space. The trocar should be inserted just between the first and second ribs so as to reach the upper lobe of the lung and also the upper part of the pleural sac; as much fluid as you can possibly force into the cavities should be inserted. The opposite lung should be treated in much the same manner, only it is not always necessary to force as much fluid into the left lung, unless it has also been affected by the disease. Enough fluid should be injected into the thoracic cavity to completely surround the lungs and the pleura, as the disease is caused by a specific germ—the bacillus pneumonia. Antiseptics thrown into the chest cavity by this method will prevent germs from developing, and in a great many instances, if the fluid is strong enough, it will kill them. If purging continues after you have removed the gases, filled the arteries, etc., you can prevent it by plugging the throat with absorbent cotton. If this fails, tie off the trachea. Make the incision just above the center of the sternum. The trachea is easily recognized by the cartilaginous rings, which are connected together by muscular tissue. To tie the trachea use a piece of tape about an eighth of an inch wide. Should purging continue after you have used all these means, you should investigate the condition of the stomach, for the purging might be caused by fermentation or putrefaction in that organ; in this case you will succeed in preventing it by ligature of the œsophagus at the same point of operation as was used for ligating the trachea. Fluid should also be injected down both the bronchial tubes and the œsophagus in a case of pneumonia, and should there be no purging from the mouth or nostrils, and the jaws firmly set, you could do this by inserting the nasal tube into the nasal cavity and forcing fluid through it, which would find its way down into the stomach and the bronchial tubes of the lungs.

CHAPTER XV.

Tissues and Organs of the Human Body.

Chemicals Which are Used in Hardening and Preserving Them.

TISSUES OR ORGANS.	HARDENING FLUID.
Brain	Bichromate of ammonia.
Bladder	Chromic acid.
Blood vessels	Alcohol or bichromate of potash.
Elastic ligament	Bichromate of potash.
Embryos	Chromic or picric acid.
Eye	Muller's fluid.

MULLER'S FLUID.

Bichromate of potash	2½ parts.
Sulphate of soda	1 part.
Bichromate of ammonia	2 per cent.
Water	100 parts.

Eyelids	Alcohol.
Ganglia	Picric acid.
Heart	Bichromate of potash or alcohol.
Injected organs	Alcohol.
Intestines	Chromic acid.
Kidneys	Bichromate of potash.
Lachrymal gland	Alcohol.
Larynx	Chromic acid.
Liver	Bichromate of potash.
Lungs	Chromic acid.

Mammary glands.........Alcohol
Marrow of bone...........Alcohol.
Muscular tissue(voluntary) Bichromate potash or zinc chloride
Nerves ....Picric acid.
Œsophagus...............Chromic acid.
Ovaries...................Chromic acid.
Pancreas ....Alcohol.
Retina....................Muller's fluid.
Salivary glands...........Alcohol.
Skin......................Alcohol.
Spinal cord...............Bichromate of ammonia.
Spleen....................Bichromate of potash.
Stomach..................Alcohol, or chromic acid.
Supra renal capsule.......Alcohol.
Tendon and Ligament.....Alcohol or sat. solu. arsenate soda.
Testes....................Alcohol.
Thymus gland............Alcohol.
Thyroid gland............Alcohol.
Tongue...................Bichromate of potash.
Tonsils ....Alcohol.
Trachea ....Chromic acid.
Ureter...................Chromic acid.
Uterus or womb...........Chromic acid.

A weak solution of Formaldehyde will harden and preserve any of the soft structures of the human body.

Chloride of zinc has a special action on the cellular tissue and the skin, causing a mottled appearance, which soon forms a distinct marble white. It has a very decided preservative effect on the tissues of the body generally.

Arsenate of soda is one of the strongest preservatives for animal tissue, and is very extensively used in the manufacture of embalming fluids. It causes a rapid dessication of the cellular tissue, especially noticed at the ends of the fingers and tip of the nose. It changes the color of the skin to a red or livid purple when used in large amounts. In special quantities the cheeks may be made to assume a natural healthy or life-like appearance.

Mercury bichloride (corrosive sublimate) has no special action as a preservative on animal tissues, except as an antiseptic. It unites with the resinous and albuminous particles of the body to form an albuminate (inert substance). It changes the tissues to a gray color.

CHAPTER XVI.

Preservative Solutions.

Chemicals Used as Preservatives—Their Antiseptic Value, Etc.

Preservatives used in the principal medical colleges of the United States.

	ANTISEPTIC IN THE PROPORTION
Acetic acid	1 : 250.
Alcohol	1 : 10.
Alum	1 : 222.
Aluminic acetate	1 : 6000.
Aluminic chloride	1 : 714.
Ammonium chloride	1 : 9.
Ammonium sulphate	1 : 4.
Arsenous acid	1 : 166.
Arsenate soda	1 : 120.
Arsenite soda	1 : 111.
Arsenite potash	1 : 8.
Benzoic acid	1 : 909.
Boracic acid	1 : 143.
Borax	1 : 114.
Camphor	1 : 214.
Carbolic acid	1 : 333
Calcium chloride	1 : 225.
Chloral hydrate	1 : 107.
Chlorine	1 : 4000.
Chromic acid	1 : 5000.

	ANTISEPTIC IN THE PROPORTION
Creosote	1 : 200.
Cupric sulphate (sulphate of copper)	1 : 11.
Ether	1 : 90.
Formalin (an acqueous solution of formic aldehyde)	40 per ct. strength.
(The best disinfectant and the strongest preservative known to science.)	
Glycerin	1 : 4.
Hydrogen dioxide (peroxide)	1 : 20.000.
Hydrochloric acid	1 : 375.
Iron sulphate	1 : 18.
Lead chloride	1 : 500.
Lead nitrate	1 : 277.
Mercury iodide	1 : 40.000.
Mercury bichloride	1 : 14.300.
Nitre	Not known.
Osmic acid	1 : 6666.
Phenol. (See carbolic acid.)	
Potassic arsenite	1 : 8.
Potassic bichromate	1 : 909.
Potassium permanganate	1 : 285.
Potassium nitrate	1 : 160.
Salicylic acid	1 : 1000.
Sodium hyposulphite	1 : 3.
Sodic chloride (common salt)	1 : 6.
Sodic bicarbonate	1 : 20.
Sulphur dioxide (sulphurous acid)	1 : 2000.
Sulphuric acid	1 : 560.
Tannic acid	1 : 207.
Turpentine	Not known.
Thymol	1 : 1340.
Zinc chloride	1 : 526.
Zinc sulphate	1 : 6.

It will be seen from this list of organic and inorganic preservatives, that the inorganic group furnish the great majority of the chemicals used in the preservation of the dead body. The organic group, which are used for the preservation of tissues, either animal or vegetable, include: alcohol, salicylic acid, glycerine, chloral, creosote, thymolic acid, etc. Of these, alcohol is the one most generally used. Glycerine is very slightly antiseptic, but is a very good preservative. It may be combined with salicylic acid, arsenous acid, carbolic acid, or creosote, in order to increase its preservative powers. Glycerine and salicylic acid are employed quite extensively in the preservation of vegetables and fruits. Glycerine mixed with arsenous acid has been recommended for the prevention of mould. I find the following formula to give better satisfaction in preventing the growth of the mould fungus:

Arsenous acid	Gr. 10.
Boracic acid	Gr. 10.
Vaseline	Oz. 2.

If the mould has already formed on the body, it is best removed by applying ether or pure grain alcohol, which have a special action on the skin. The remedy should be applied until the skin is hardened and the moisture removed. Both the alcohol and the ether have the effect of removing the moisture and the oily or resinous parts of the skin. Dr. Howse, of London, Eng., has recommended an embalming fluid composed of glycerine and arsenous acid. He uses one pound of the arsenous acid to a quart of the glycerine. It should be remembered that in order to mix this amount, the glycerine should be heated and the whole filtered before using.

It is too costly for general use, there being cheaper and more efficient preparations on the market.

Devergie, Packousky, Seseman, Santer and others have recommended various preparations containing glycerine.

Santer recommended the following formula:

Glycerine	10 parts.
Carbolic acid	1 part.
Alcohol	50 parts.
Water	40 parts.

It was oftentimes necessary to give a second injection of a stronger chemical, composed of chloride of zinc and water.

Tannic acid has been used by some as a preservative, this agent being employed in the preservation of the intestines and abdominal organs. An incision was made into the region of the stomach and the gases removed from that viscus and from the transverse colon, then the acid was sprinkled over the parts.

Chloral hydrate has been recommended as a very efficient preservative by Keen and Fletcher. This agent is very soluble in water, being completely dissolved in less than its own weight. A body injected with a saturated solution of this chemical retains its suppleness and its life-like appearance; the dessication of the tissues, caused by the injection of arsenical or zinc preparations, is entirely obviated.

Creosote has been used quite extensively in the manufacture of embalming fluids. It is not so much employed as in former years. This agent is not very freely soluble in water, hence, possibly, its discontinuance; for it is a well known fact that any chemical requiring a large amount of water for its solution is not a very strong preservative. It was formerly much used by Gannal and A. Renouard in the following formulæ:

GANNAL'S FLUID.

Creosote	4 ounces.
Arsenous acid	4 ounces.
Sulphate of alumina	4 pounds.
Water	1 gallon.

Mix.

MODIFIED FORM OF ABOVE FORMULA.

Creosote	6 ounces.
Arsenous acid	4 ounces.
Alumina sulphate	6 pounds.
Water	1 gallon.

Mix.

OTHER FORMULA CONTAINING CREOSOTE.

Creosote	5 ounces.
Chloride of zinc	5 ounces.
Bichloride of mercury	3 ounces.
Alcohol (pure)	1 gallon.

Thymol and thymolic acid are used in some of the fluids on the market to-day. It is a very efficient antiseptic and a powerful preservative. Its cost prevents its use in large quantities. It has a very pleasant odor, and is used to disguise the odor of other chemicals.

Solutions Employed by the Medical Fraternity of the United States in the Preservation of Anatomical Material.

The medical colleges of the United States, with a very few exceptions, use solutions of arsenic, zinc or choral. Some use two of these three chemicals in one solution, while one—the University of Tennessee—combines all of them in the following formula:

Arsenous acid.
Chloride of zinc.
Potassium permanganate.
Chloral hydrate.
Water.

The medical colleges in the United States which use arsenic in their solutions for the preservation of anatomical material are the following:

Bellevue Hospital Medical College—Saturated solution of arsenate of soda in water. After embalming, the body is placed in a large refrigerator with the temperature at 30 deg. F.

University of Buffalo uses a solution of arsenous acid and bicarbonate of soda, nearly equal parts; injects through the femoral artery; use pickling solution composed of simple brine.

Atlanta Medical College uses a saturated solution of arsenate of soda in water.

Cleveland Medical College uses a solution of arsenous acid and bicarbonate of soda, nearly equal parts; saturated solution in water.

The Medical College of Indiana uses equal parts of arsenous acid and bicarbonate of soda; saturated solution in water injected while hot.

The Indiana College of Physicians and Surgeons uses same solution, and preserves by immersion in pickling solution, simple brine.

Iowa State University uses equal parts of arsenous acid bicarbonate of soda; saturated solution in water; subjects then placed in refrigerator until wanted for dissection.

Kentucky School of Medicine uses arsenate of soda; saturated solution in water; then places in chill room until wanted for dissection.

Long Island Medical College uses a saturated solution of arsenate of soda in water, injected while hot; subject is not placed in pickling solution unless signs of decomposition appear.

Louisville Medical College uses same solution as other medical colleges in Louisville. All cadavers for dissection are taken to the University of Louisville, where they are prepared same as that given under Kentucky School of Medicine. At present they are experimenting with a chloride of zinc solution. The body, after receiving two injections of the fluid, is wrapped in bandages which have been saturated in a solution of carbolic acid and petroleum; this forms an air-tight coating for the body. It is then enclosed in black duck cloth and wrapped with twine. It is claimed that cadavers prepared after this method retain their suppleness, dessication is retarded and the subject is better for anatomical research.

Rush Medical College uses arsenical fluid composed of the following ingredients: Arsenous acid, alum, nitrate potash, chloride of sodium and boiling water. Glycerine, bichloride of mercury and alcohol may be added to the mixture.

University of Michigan uses a saturated solution of arsenate of sodium, the body being immersed in brine pickling solution until wanted for dissection.

Medical College of Missouri uses a strong solution of arsenate of soda and glycerine; body is placed in a chill room until wanted for dissection.

St. Louis Medical College uses a solution of arsenous acid, bicarbonate of soda, carbolic acid and water in the following formula:

Arsenous acid	8 ounces.
Bicarbonate of soda	8 ounces.
Cabolic acid	2 ounces.
Water	1 gallon.

College of Physicians and Surgeons, St. Louis, uses a saturated solution of arsenate of soda: two injections given, with a twelve to fifteen hours' interval.

University of Maryland uses a saturated solution of arsenous acid and carbonate of soda.

University of Vermont uses a solution composed of the following:

Nitrate of potash	3½ drams.
Arsenous acid	3½ drams.
Alum	3 ounces.
Chloride of soda	6½ drams.
Boiling water	4 quarts.

Mix, and after solution has cooled add four pints of alcohol and six of glycerine.

Medical Colleges Which Prefer Chloride of Zinc Solutions.

Albany Medical College uses a saturated solution of chloride of zinc and immersion in simple brine pickling solution.

Cincinnati College of Medicine and Surgery uses a saturated solution of chloride of zinc.

Ohio Medical University uses a saturated solution of chloride of zinc, afterwards placing the body in chill room, where the temperature is kept at 30 deg. F.

Georgetown University uses a solution of chloride of zinc.

Hahneman Medical College uses a solution of chloride of zinc in the following formula:

Zinc chloride	1 part.
Water	2½ parts.

This solution is injected while hot.

Harvey Medical College uses a solution of chloride of zinc, bichloride of mercury, alcohol, and water.

Jefferson Medical College uses a neutral solution of chloride of zinc, placing the cadaver in simple brine until ready for dissection.

Medical College of Ohio uses a neutral solution of chloride of zinc and injects while hot.

University of New York uses a solution of chloride of zinc and places the cadaver in brine pickling solution until needed for dissection.

University of Pennsylvania uses neutral solution of chloride of zinc; injects from one to five quarts.

University of Tennessee; formula given on page 340.

Medical College of Virginia uses a solution of chloral hydrate in alcohol or water, then places the cadaver in pickling solution containing common salt and one pound of saltpetre.

Homeopathic Medical College of Missouri uses a saturated solution of chloral hydrate for embalming.

Chicago College of Physicians and Surgeons uses a formula composed of the following:

Glycerine	40 parts.
Alcohol	8 parts.
Pure carbolic acid	11 parts.

It should be understood by the reader that solutions used in the preparation of anatomical material for dissection cannot be used with any degree of certainty in private practice. The embalming fluids now sold in the United States by special manufacturers are much superior to these preparations, and should be employed by all those engaged in the private practice of embalming. The embalmer should be careful to discriminate, however, between worthless preparations that are from time to time placed on the market, and those fluids which have been tried and have received a standard reputation.

I do not advise embalmers to make their own fluids, unless they have special apparatus for doing it and are skilled in chemistry and the allied sciences. I do not advise this any more than I would a physician to manufacture his own medicines. Pharmacy is a separate study, the same as medicine. Chemistry bears the same relation to embalming that pharmacy does to medicine. It should also be remembered that while I do not advise the making of your own fluids, I deem it necessary that the embalmer should have that knowledge of chemistry that will enable him to name such chemicals as are employed in the making of the embalming fluids now on the American market, and be able to give the antiseptic value of each, consequently its bacteriological effect and its effect when applied to the different tissues and organs of the body. This I have given briefly in this work, feeling that it was a branch of the profession which should be well understood by all. The effect of the different chemicals on the different tissues of the body, and the antiseptic value of the different chemicals used in the manufacture of embalming fluid is given for the first time in this work, no other work on embalming containing it.

CHAPTER XVII.

Rules for the Transportation of the Dead.

Adopted by the National Baggage-Agents Association and approved by the National Conference of State Boards of Health and the American Public Health Association.

RULE 1. The transportation of bodies of persons dead of small-pox, Asiatic cholera, yellow fever, typhus fever or bubonic plague, is absolutely forbidden.

RULE 2. The bodies of those who have died of diphtheria (membranous croup), scarlet fever (scarlatina, scarlet rash), glanders, anthrax or leprosy, shall not be accepted for transportation unless prepared for shipment by being thoroughly disinfected by (a) arterial and cavity injection with an approved disinfectant fluid, (b) disinfecting and stopping of all orifices with absorbent cotton, and (c) 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 and 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. The bodies of those dead of typhoid fever, puerperal fever, erysipelas, tubersculosis and measles, or other dangerous communicable disease other than those specified in Rules 1 and 2, 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 2. But when the body has been prepared for shipment, by being thoroughly disinfected by an embalmer holding a certificate as in rule 2, 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 in 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 2, 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 officer 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 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 full 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 No. 2, 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.

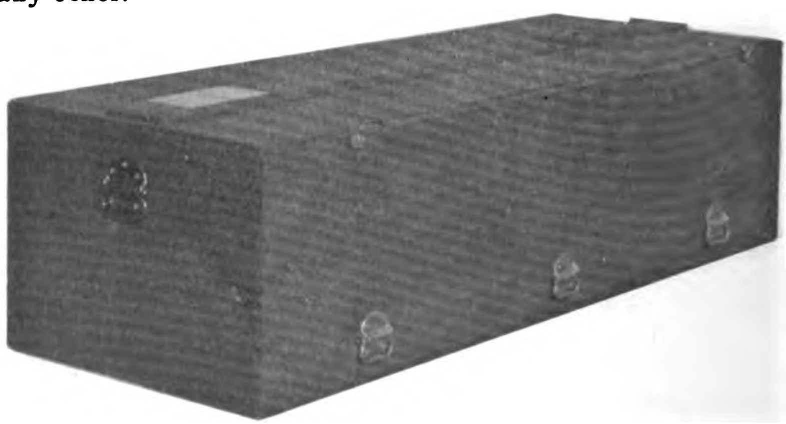
RULE 8. Every disinterred body dead from any disease or cause shall be treated as infectious or dangerous to the

Body ready for transportation.

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 (soldered) zinc, tin or copper lined coffin or box. Bodies deposited in receiving vaults shall be treated and considered the same as buried bodies.

Transportation of Bodies.

A few remarks on the preparation of bodies for transportation will certainly not be out of place in a work of this kind. This one feature of the funeral director's work is perhaps done in more different ways than any other. Why this should be so, when the box containing the casket must pass through so many hands, is hard to explain. After an experience of nearly twenty years by the writer, the method given below seems to have met with more favorable comment than any other.



Box ready for transportation to any part of the world.

It is to be supposed that the body has been properly prepared as far as embalming is concerned. The body having been injected through the arterial system with a proved disinfectant fluid, the right and left pleural cavities and the abdominal and cranial cavities also injected with the fluid, it should be washed in the disinfectant, all orifices stopped with absorbent cotton, and the entire body enveloped in a layer of absorbent cotton not less than one inch thick, and all wrapped in a sheet and bandaged. The casket should be so upholstered that the body will fit nicely, yet firmly, especially in the length. Casket rests should be placed in the bottom of the box and a paper cover should be placed over the casket and tied closely around the bottom. In lowering the casket into the box I use two pieces of webbing about nine feet in length and leave them under the casket, either tying the ends together or fastening them with pins. Always cover inside of boxes with plain white paper, especially where a cloth casket is used. If the box is of pine, stain it on the outside in some dark color.

Either use thumb screws or a patent fastening for the lid, so that it can be taken off without the aid of a screw-driver. Put three strong handles on each side, near the bottom of the box, so that the pall bearers can lift it into the car easily.

At each end, as near the top as it can be placed, have another strong handle, so that the baggageman can give necessary assistance. Place two strips on the under side of the box, extending the full length and about three inches from the edge. These should be about two inches wide, one inch thick, and rounded on the under side so that the box will slide easily. Taper off the ends of the strips so they will not catch on projecting boards on platform or in the baggage car.

The head of the casket should be plainly marked on top of the box. Directions for shipment, with each change of cars, should also be marked so that it can be plainly seen. Unless required by law that the certificate should be pasted to top of box, place it in a heavy envelope, which should be so fastened to the box that the contents can be easily examined. (See Rules for Transportation.)

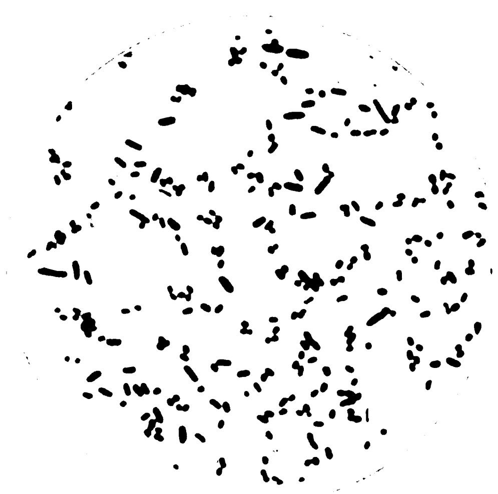
It may all be summed up in a few words. With these papers one should enclose a personal letter to the receiving funeral director, informing him of what attention the body has received and the kind of fluid used, and such other matters as you may deem of importance to him.

CHAPTER XVIII.

Dissection Wounds, Blood Poison, Etc.

The embalmer practicing his vocation is brought in contact with every imaginable disease. He operates on the body of one dead of measles to-day, while the morrow may find him preparing a case of small-pox or Asiatic cholera. To the infectious and contagious emanations from these diseases he is threatened with the additional tortures of blood poison. For this reason the embalmer should understand the nature of the infection and what he should do in a prophylactic way to prevent it. Some claim that an application of embalming fluid to the hands will be sufficient. This should be corrected, for while an embalming fluid may be a good preserver, it may be almost inert as an antiseptic. The antiseptic strength of arsenic, zinc chloride and sodium salts are very feeble indeed, and they could not be depended on in such cases, unless the embalmer knows they contain some of the stronger and more reliable antiseptics, such as mercuric chloride, Formaldehyde, carbolic acid, or other agent capable of destroying the bacteria of septicæmia.

If he does not know the contents of the fluid, he should add these chemicals in sufficient strength to guarantee immunity from infection. Cases of blood poison are not as frequent as formerly; while we hear of many cases, few of them are genuine cases of septicæmia or blood poison. It is true that possibly some embalmer might have been suffering from arsenical poisoning or mercurial poisoning, and imagined he was the victim of an attack of septicæmia, pyæmia, sapræmia, septic intoxication or other name indicative of disturbances of the blood. The embalmer when he handles fluids containing a large amount of either arsenic, corrosive sublimate or chloride of zinc, will soon learn whether his system is capable of resisting the absorption of such chemicals. If he be susceptible to the action of arsenic he may, by the constant use of a fluid containing arsenic, become affected with chronic arsenical poisoning, which no intelligent physician could possibly mistake for an attack of blood poisoning. It has been



BACILLUS COLI COMMUNE.
(Healthy intestines, man). X 1000 diameters. From a photomicrograph.

argued by many that it is necessary for an abrasion of the skin to be present in order to cause the absorption of certain poisons, and especially animal or vegetable poisons, products of putrefaction (ptomaines and leucomaines).

While this is generally true, there are many cases on record where the patient has suffered an attack of septicæmia, where no abrasion of the skin could be found. It is also true that those who are required to handle dead bodies in various stages of putrefaction, may become affected by inhaling the gases emanating from such bodies. But it has not as yet been proven that these gases which escape from the dead body contain micro-organisms. That they do contain some chemical or other substance, which is capable of setting up fever and other disturbances in the economy, is no longer a question of doubt. But for any one to say that such gases are laden with the organisms of septicæmia, without offering any experiments to verify the same, is to tread on dangerous soil. Putrefaction is a complex process due to the action of several different varieties of micro-organisms, resulting in the formation of a large number of volatile and non-volatile products.

Many of these volatile products of putrefaction are known to us only by their offensive odors, and by this sense of smell we are able to differentiate between septic and other forms of fermentation. In preparing bodies for dissection, or where a large number of cadavers are in various stages of putrefaction, the gases arising from a large number might be sufficient to overcome a person much more readily than gases from a single subject. The only case that I know of where a person was infected by handling a large number of bodies, was in the case of a prominent surgeon of this city. During his services as Demonstrator of Anatomy at one of our leading medical colleges, it became his duty to make a large number of dissections on as many different cadavers, which were in various stages of decomposition. After he had worked for several hours he began to feel sick, and was assisted to his home. He had a high fever, disturbance of digestion and diarrhœa, dryness of the fauces and thirst. This condition only lasted a few days, when he was able to resume his position. An attack of this kind would not be called blood poison, because it was not attended with such symptoms, and the cause was widely different. It was caused, however, by the gases of decomposition, and thus being a chemical agent it could not multiply in the system, and consequently was non-infective.

Suppose this man, in or at the time of his work, should have cut his finger and several of the organisms of putrefaction gained an entrance to the blood current, then he would have had an entirely different train of symptoms, redness and swelling of the part at the seat of entrance of the poison, gradually increasing and accompanied with pain of a severe lancinating character, fever and all the other symptoms of a true case of blood poisoning or septicæmia.

Now, what are we to draw from such results? First, gases of decomposition are not laden with micro-organisms capable of entering the lungs with the breath and spreading from that point through the blood to all parts of the system; and second, such gases are only poisonous in a chemical sense, and then only when the chemical is in an unusually large amount. Thus it is the chemicals arising from a single case are barely sufficient to set up symptoms of blood poison, but if it is increased, as it was in the case quoted, by the addition of several dead bodies, then the poisonous chemical in the gas is sufficient to cause a disturbance in a healthy subject. Such a condition would not be termed septicæmia, but more properly septic intoxication or sapræmia.

It should also be remembered that certain chemicals used in embalming fluids may be in proportion to kill or prevent the development of certain germs. Thus mercuric chloride, a chemical used in a great many of the fluids now on the market, is sufficient to prevent the development of anthrax spores in the proportion of 1 to 300,000 (this applies to the culture fluid). Now, it is known that anthrax spores are one of the most resisting of spores, and it only takes the amount quoted to entirely prevent the development of these spores. Yet if the same amount be added, or even in the proportion of 1 to 40,000, it will not prevent the development of certain micro-organisms and bacteria of putrefaction, for in my experience I have cultivated these organisms in a solution of the strength quoted. Arsenous acid, possibly the most extensively used chemical in embalming fluids, is one of the weakest of antiseptics. Koch found that a ten per cent. solution destroyed the vitality of anthrax spores only after a ten days' exposure, no such results being produced in six days. Miquel, whose authority should not be questioned, says that this agent is antiseptic only in the proportion of 1:166. Chloride of zinc, another chemical compound extensively used in embalming fluids, depends for its antiseptic qualities upon the power ot precipitating albumens from organic substances. In experimenting with this drug on the bacteria of putrefaction, I find that it is capable of arresting the development of putrefactive micro-organisms and bacteria in the proportion of one part in fifty-two.

It is not necessary for me to take up the action of alcohol, bicarbonate of soda, arsenate of soda, and other chemicals used in the manufacture of embalming fluids, as it is more the intention to investigate the cause of blood poisoning.

Having considered the possibility of infection from the gases emanating from the dead body, I will next consider the nature of infection in dissection wounds, or those caused by preparing the dead for burial. During the year I have known of four cases of blood poison among my own acquaintances, who are engaged in the practice of embalming. All of these have ended favorably, possibly on account of the modern ideas of treatment and our knowledge of the micro-organisms in this disease. The statistics in surgical practice in 1860 quotes the rate of mortality during the years 1850 to 1860 at eighty per cent. It will be apparent to the most casual observer that we are treating this disease to-day in the most scientific way possible. I do not wish in an article of this kind to enter into the treatment of a case of septicæmia or blood poison, but would rather admonish the reader that in case he should happen to become inoculated with the specific germs of this disease, to call on a reputable surgeon as soon as possible.

There are two principal classes of infection. One, and by far the most severe and fatal, is obtained from the dissection of fresh cadavers or bodies that have only been dead a few hours. As the embalmer deals with this class of cases most exclusively, he above all others engaged in the art of dissection, should be extremely careful and should be well informed on the nature of this class of poisons. The infection obtained in dissecting a fresh body is complicated by being intermingled with some morbid condition that existed during life.

The poison derived from the second class, or those from putrefaction, are never complicated with the morbid process or disease that existed during life, but should be considered in its true place, "Dissection Wounds." As a rule, bodies dissected in the various anatomical laboratories of this country are those of cadavers that have been embalmed with solutions of strong antiseptics and afterwards immersed in pickling solutions containing a large amount of arsenite of soda and arsenous acid. *A case of blood poison from the dissection of dead bodies that have been prepared after this method is now a medical phenomenon.* And why? Because it only proves that an injection of any antiseptic, sufficiently strong enough to arrest decomposition in the dead body, is sufficient to kill all the germs in the body and to prevent the spread of contagious and infectious diseases. In the city of Chicago alone, there are probably twelve hundred medical students who are dissecting dead bodies every day during the six winter months, yet we never hear of a case of blood poison among these men who are working over the dead continually. In this second class of poisons developed in the dead body, namely, that caused by bacteria of putrefaction, we have that additional trouble caused by the gases developed by these germs. These gases are compounds of hydrogen, hydro-sulphuric acid, carbonic acid gas, carburetted and phosphoretted hydrogen, ammonia, etc. I need not enlarge on the chemical and sensible qualities of these gases; they are familiar to all those who have been engaged in the practice of embalming. They produce a faint, sickly and indescribable odor, once experienced never forgotten.

Any one whose vital powers of resistance are lowered may be made sick by these odors, and sometimes even those in the best of health may experience some forms of depression caused by them, but to say that these gases cause blood poison by being inhaled by the operator or those who are brought in contact with the dead body, is a medical and scientific error.

It not infrequently happens that poisonous gases are absorbed in great quantity, either because they are present in unusual abundance or because the vital powers of resistance are lowered. The following may be given as an instance of their effects on the system, and the manner in which the substance is eliminated from the body. A person after he has dissected continually for several hours, or one who has been engaged in many embalmments in a single day, goes home at night tired and restless; finds himself dull, heavy, listless and indisposed, with the peculiar odor of dead bodies clinging to him. He changes his clothes and takes a thorough ablution; feeling a little refreshed from the bath, he changes to a new suit of clothes, but after a time sufficient for the skin to become active, he again detects the same nauseous smell that he had before experienced. If he be weakly inclined, he may even vomit and have a mild case ot septic intoxication accompanied by diarrhœa. These symptoms will gradually pass off, and after he is in the open air a short time the odor leaves him entirely. This is proof that the gas may be absorbed into the system, may cause a general depression or septic intoxication, that it is also eliminated by the lungs and by the skin, but we never have those symptoms of true septic infection as shown when a person receives a wound from dissecting a fresh cadaver or one that has not been injected with antiseptic solutions.

When a person receives an infection from a wound, the symptoms are different from that caused by inhaling the gases emanating from the dead. About twelve to fourteen hours after the infection has gained entrance into the body, which may be at some point unnoticed by the patient, he feels indisposed, is depressed, faint and chilly, with lowness of spirits and nausea. In about six to ten hours after these symptoms appear, the patient feels an uneasiness as though something is wrong, a severe pain may attract his attention to the shoulder of the arm through which the infection may have spread from a scratch of the finger. This soon passes off, and he feels sick at the stomach and complains of headache. Pain may now attract his attention to his hand, and noticing his finger he discovers a slight redness of an erysipelatous character, distinct throbbing of the part and localized pain. There may appear, at about the same time, a pustule, not unlike that of small-pox, while in other cases it may resemble a simple vesicle or blister. The patient may have a desire to prick it, and on opening, it is found to contain a milk-white serum. But this pustule may be unattended with any pain, and the patient may be ignorant of its existence, or may not even be aware that he has received a wound until his attention is called to it by some of his friends. As the case proceeds, the pain in the affected arm becomes more excruciating, and soon marked swelling of the arm and axilla is apparent. The patient now, possibly for the first time realizing his condition, suffers mentally, fever sets in, his breathing is quicker, his pulse accelerated, and in case of the most severe type, there is mild delirium; the countenance is haggard and the skin yellow. The patient often expires before the disease has made further progress.

The most severe case of blood poison that I have ever seen came from a dissection wound. My brother, in embalming the body of a Mr. Morris, raised the femoral artery. The day following he began to take on the symptoms above described. Finally being brought under the full influence of the disease he became delirious and remained so for several hours, his right arm swelling to about three times its normal size, the infection spreading to the bones of the hand and wrist and causing a stiffening of that joint and a partial loss of the use of his hand. The disease causing the death of this subject, from which he received the inoculation, was cellular inflammation resulting from inflammatory rheumatism.

The hands of the embalmer should be first washed in some good antiseptic, and afterwards rubbed with vaseline or some unguent, which will fill the pores of the skin and prevent absorption. This will be the safest method to use before operating on the dead body.

CHAPTER XIX.

The Funeral Director Himself.

What He Should Add to His Scientific Acquirements. How to Conduct a Funeral, from the Time of Receiving the Call Until the Body Has Been Placed in the Grave.

If I should be asked what constitutes a funeral director, I would answer, "A thorough gentleman." One who has the skill of the anatomist, the nerve of the surgeon, the untiring patience and ingenuity of the chemist; in all, a broad-minded, well-informed man.

A prominent professional gave these words of advice: What should he be? I think to inherit this goodly land he should have on the whole armor, he should be a thorough gentleman. A gentleman to-day, a gentleman to-morrow. He should not exchange his role for any other part in life's drama.

He must necessarily be somewhat acquainted with anatomy and surgery. How often does it happen in cases of accident, that the remains are mutilated and disfigured in such a manner as to be unrecognizable and unpresentable to the friends, and how easy it would be to render a service which would result in great satisfaction to the bereaved, and words of praise and commendation to the skilled hand of the undertaker.

He should understand the signs and conditions attending death, and should be able to decide whether it is death or suspended animation, and should, in all cases of sudden death, be very careful and apply all the tests before commencing to operate. Again, from an acquaintance with anatomy the undertaker has been able to render great service in cases of post mortem. He should be familiar with the laws of sanitation and health, and thus not simply be able to preserve the dead, but care for the living and preserve the general public from needless exposure, sickness and even death.

In fact, the undertaker should be equipped with the very best information and authority in his line, and thoroughly posted in all the details of the business, and must keep himself abreast of the times. He should give the public the benefit of all the modern improvements and appliances and be able to meet all demands.

The undertaker should, from the time he is called until the dismissal of the friends at the home, understand all that is to be done. He should diagram the proceedings that will be necessary before he starts in, and should be able to see the end before he does the beginning. He must know that all requests made and desires expressed have been executed and granted, and never depend on, or take for granted, that someone else will see to this or that. He should relieve the bereaved family of all responsibility, and should, as early as prudent, learn the desires and arrangements they wish made, and thus relieve them of a burden they should under no circumstances carry, in addition to the one already upon them.

The undertaker should not be pompous and commanding, but quiet, unassuming, decisive and quick of perception. Nothing can possibly be more disgusting to the relatives and sympathizing friends than to hear the rough, grating voice of some inflated wind-bag or would-be undertaker yell out in commanding tones, "Here, come this way," or "Sit down there." And nothing certainly could be more commendable than the reverse of this, for how easy a matter it is for the undertaker to have such a thorough understanding with his pall-bearers, ushers, the minister, the singers, the friends and all concerned, that it will be almost needless to have a loud word spoken, for a slight movement of the head or motion of the hand will be understood and executed, and thus will be avoided the bustling around which would perhaps occur at a most unseasonable time. The undertaker should see every opportunity for relieving or benefitting the friends' condition.

Promptness should be a marked feature of the undertaker. Always on time and never late should be his watchword, for as the undertaker is, so will the people be, whether prompt and on time or slow and late. When we see an undertaker who is always behind time we think of the Irishman's saucer. It had many good points about it, but lacked a bottom. Thus, we think promptness should be one of the corner stones in the foundation of the successful undertaker. The undertaker should, like the old family physician whom the entire community "swear by," have the confidence of the people. He must show himself a man not simply approved by men but by God, one whom they can turn their dead and loved ones over to in perfect confidence, knowing—not wishing or hoping, but knowing—they will be cared for as tenderly as if done by a member of the family, and with just as much reverence and respect.

The undertaker should be no respecter of persons; should not simply feel, but know, that the wife of a poor peasant is as dear to him as was Victoria, in all her crowned honor and gorgeous attire, to the lamented Prince Albert; and that the little curly-headed, prattling babe in the hut of the poverty-stricken widow shares as great a place in her heart as does the babe in the palace of the millionaire, and deserves the same treatment.

When he is called upon to officiate he is not supposed to be a mourner, but he is required to kindly recognize the grief of the people whom he is serving, and treat them in a kindly, considerate manner; not too profuse in conversation, neither too brief, using no profane or slangy expressions. To be a qualified undertaker and funeral director requires both tact and a variety of talent, but the first essential is, that he be a man of good moral character — honest and upright in every particular.

The location and appearance of your establishment will have a great deal to do with your progress. Select one in a genteel neighborhood, upon or very near a main thoroughfare, convenient to either a densely populated old section or a rapidly growing new one. If you were to locate on a back or unfrequented street, or other out of the way place, it would naturally suggest to the public either defective ambition or distrust of your acquirements. Have your office lighted punctually every evening at the proper hour, and in all other respects let it show attention and system. Do not let your office be a lounging room or a smoking room for politicians, dog fanciers, gamesters, horse jockeys, and others whose time hangs heavily on their hands. The public looks upon the funeral director as a person singled out and set apart and worthy of an esteem not accorded to such people or to persons engaged in the ordinary business of life. Be ethical and never talk about your competitors, who may be older in the business than yourself, but who may be totally deficient in scientific acquirements. Never speak ill of any one. Remember your opinions are carried a great ways and may be the means of doing your business considerable harm. If asked concerning certain scandals, etc., be extremely reticent, as though you were not informed on the subject. At all times take care to be neat in your personal appearance: above all else wear a clean shirt and a clean collar, for if you dress well people will employ you more readily, accord you more confidence, expect a larger bill and pay it more willingly. Do not, however, be a leader in frivolous fashions, as though your æsthetic cultivation had overshadowed everything else; nor display glaring neckties, flashy breast-pins, or any other peculiarity that indicates a swell. Even though you are poor, let it be genteel poverty, for your dress, manner and bearing should all agree with your dignified calling.

As soon as you receive a call, either by messenger or telephone, ask if the body has been washed and dressed; if not, whether they want you to do so; if they are to do it, tell the party at the 'phone to tell them to do so at once.

If the deceased is a lady or child, ask if the family want the lady attendant. If so, send for her at once.

Order you wagon at once, while you get board and cabinet and crape, tacks and hammer.

Attend the call promptly and see that everything is all right.

Before putting up crape ask the family if they prefer flowers. Always take two crapes, a good one, or a medium or poor one. You can then put up the one the surroundings demand. If the age is 35 to 45, take white crape with black ribbon, and black crape with white ribbon. Never use all black under 50. Never charge for crape or gloves; it causes dissatisfaction. You can be firm on your other prices and make up for them on other things.

In order to prevent annoyance at the house from not having something you need, we have the following rules for second man:

See that cabinet and cooling-boards are in order, fluids in bottles, knives cleaned and sharpened; soaps, needles, thread, powder, cotton, eye caps, etc., in cabinet.

Look over cabinet three times a week and see that tubes are not misplaced and pumps in order.

Keep zinc chloride solution always on hand.

When at the house be sure you are at the right place before taking cooling-board in.

While working have only those in the room who are to help, so that the work will be done thoroughly and with dispatch.

Get measure and other items for trimmer and embalmer.

See about your doctor's certificate, when they wish to bury, and when they wish to make their selection.

Do what is necessary to keep the body until you can go again.

In case of dropsy, tap at once, or report at office immediately and have body attended to.

See that the jaws are closed securely. It is better to have them closed too tight than not tight enough, for if too tight you can relax them, but you cannot set them tighter.

Be sure and put the feet straight. Tie them tightly together above the ankle, then run the cord down to below the sole, tie tight knot, then form that as a basis, draw the feet together.

As to embalming and the manner of keeping the body, I want to urge upon you to abandon, if you have not heretofore, many of the old customs for which there is no necessity in this age of advancement. The first is the use of a cloth upon the face. It should be required of every undertaker that he be able to embalm a body to be perfectly kept one week, or more, without the use of a cloth upon the face. Do not use a canopy or white sheet over the body. Close the mouth without a chin supporter, and the eyes without salt bags or weights of any kind. Do away with all these ghastly customs that were in vogue a half century ago. These things horrify even the immediate relatives. It is possible to make the dead more companionable and less repulsive to those who are watching for a few short hours the remains of their dear ones. Instead of this, dress the body complete, if possible. If the person be that of a lady use a corset if necessary to give the proper form; and if you use a robe or wrapper, select such as will not discredit you. Arrange the hair naturally, the way it was formerly worn. Drape the board with either cloth or lace and soft pillows before placing the body upon it. Or the body may be placed upon a couch with a slumber robe thrown over it, which will give it the appearance of sleeping. This improved manner of dressing and arranging the body takes away that which makes the presence of the dead so horrifying.

Try to sell people what they are able to pay for, not what they want. A $75 funeral paid for, is better than a $125 one and $75 paid on it. Tell the people plainly that you have cases and caskets at all prices, but you want them to make only such a bill as will not be a burden for them to pay. I frequently add up the items of washing and dressing, embalming, box, robe, hearse and hacks, and say: "These necessary items come to so much, now you have a basis to go on, and can add your case or casket to this."

In taking home casket, be sure you have everything in the wagon before you leave—pedestals, stools, covers, robe, slippers, flowers, etc. If the trimmer's ticket has been made out properly, it shows that the funeral goes to a church (in a certain case), therefore you send stools and covers, and not pedestals. Thus the worry of having a heavy (and perhaps expensive and easily soiled) pair of pedestals to get from house to church (on a rainy day perhaps) is avoided.

You can avoid delays in dressing the dead when the casket is taken home by using the same tact as heretofore presented. If the family are making a robe, find out definitely when they will have it done; if they cannot tell you, tell them to "'phone" when ready, so that you can do your work speedily at home. In a general way, avoid formality.

In placing the casket, try to put it across the room, and not straight with the walls. Try using a lounge sometimes for a child casket, arranging the flowers around the lounge. As a rule, I prefer to place all small cases or caskets on a stand, as that does not look so much like a funeral. But in the arrangement of the casket in the room and the position of the dead in the casket, and arrangement of the flowers in and around the casket, remember it is not what you want to do or to have done, but it is what the family want.

A large part of your success will come from your work on the face of the dead. I must assume that this has been done carefully from the first; false teeth put in before the jaws become rigid, and eyes closed by eye-caps, or otherwise, in proper time. It is simply wonderful what an amount of modeling can be done on the face of the dead by the use of cotton batting, face powder, cochineal red and the manipulation of the lips with the fingers. You can take a face which is showing age and make it look younger. You can take away the traces of pain or suffering from the corners of the mouth, and put in place a smile. You can actually do what face powders and lotions claim to do (but cannot), restore youth to the face and bloom to the cheek; and the principal aid to success in this is, work, trial, experiment; you do not know what or how much you can do until you try. A little cotton placed under the lips restores the full-teethed jaw of young life, or a little cotton placed at the corner or end of the mouth raises it and takes out the wrinkle which denotes despondency or pain. A little red put on the lips, under the eye, in the ear, and then rubbed in underneath the powder, shows the color but does not show what put it there. In using paint or powder, use plentifully, put on more than you intend to use, then rub it off. But the most important thing of all is, always rub it in with your fingers.

Have your casket so lined that you are neither afraid nor ashamed for the family or friends to examine the linings before the dead is placed therein. To line a casket thoroughly, and to line it with soft goods, and have the bottom soft, pleases womenkind, and when you have pleased women, as the colored boy said, "you have done said it all."

And now comes the important part of your work—the funeral.

You have refused point-blank, under any circumstances, to attend to newspaper notices, for fear of mistake, or of being too busy and forgetting it. A careful funeral director will never agree to attend to newspaper notices. You have told the family to get the death return in good time and send to your office or give to your man. You have left the ordering of the grave to the family, because only one family out of ten know the position of the graves on their lot, and it is better for the family to attend to it. And now you go to the house with the feeling that all preliminaries have been properly attended to, and that the box for the grave is at the cemetery.

You probably have been busy and have not been to this house before, either to prepare the body, to embalm it, or with the casket. You may know the house only by the number, and yet, by a careful arrangement of your business, you are prepared as soon as you step inside the door to know all about the arrangements. This is done by the memoranda, called the "hack list." It is a card-board slip, 6x8, folding in the center like a book. When the casket was taken home, or a few hours before the funeral, this list was handed to the family or the friend who is in charge of the arrangements, and the different items on it are discussed. And in this hack list is the sign of your mastery of the detail of this funeral. The work has been arranged with careful graded steps and business sagacity, and as soon as you step inside the door and deposit your hat and coat in a convenient place, you ask for the hack list, and like the magician's wand, it is your emblem of control. You see there will be singers, and you know where to put them; you see where the family are now, and where they will be during the services, and you see when the relatives and when the friends are to see the dead, and so your thorny pathway is made easy.

As to your assistant do not depend entirely upon him if you are a professional yourself. If necessary send him, if not, go yourself; and if, when your assistant goes and doesn't return as soon as you expected, do not complain. One never knows in just what condition the body will be found, and allowance must be made for this. It is work that cannot be hurried. I will be more likely to complain if he returns too early, for I would then fear he had hurried (or slighted) his work. Never employ or send out an assisstant who does not understand the work. He stands in your place when called upon, and should be capable.

In trimming the casket see that everything corresponds, from a tack to the main mountings. Line the casket throughout. Select a lining suitable for the body and do not upholster with old paper or shavings. Such defects are soon discovered and cause people to feel they are not getting value received. Use the best lining, hardware and casket you can in keeping with your sale. Use care when placing the body in the casket to give it an easy, comfortable looking position. Put the casket in the most suitable place in the room, paying no attention whatever to the old rule, feet to the east and head to the west.

Too much cannot be said as to the conducting of the public service, as there are such a variety of homes and circumstances. I could not make one rule so general as to be practical for all occasions. You, of course, are familiar with the homes and circumstances, and your judgment must determine your proceedure. This can be done, however: have all arrangements completed before the hour of assembling at the public service; be there on time yourself and in readiness to receive and seat people as they arrive; have seats reserved for minister, choir, pall-bearers and family. I have found it preferable to show the people the remains as they assemble and before seating them. This gives people a better opportunity, saves time and confusion, and the family and relatives are not called upon to witness the people viewing the remains, which is so trying for them.

When leaving the house, if convenient, instruct the relatives to remain seated while the pall-bearers carry out and place the casket in the car, after which assign the pall-bearers to their carriage. Then bring the people forward to their carriages and proceed to the place of burial; but never back the car to the pavement as you would an express wagon to be loaded.

Now that all has been done thus far in neatness and order, make it complete by using a decent box. I do not like the idea of shipping bodies all over the United States in fine caskets put into unpainted rough boxes, full of knots and knot-holes. The expense of painting the outside of the box and lining the inside with paper is too slight to justify you in doing otherwise. I have not used an unpainted box for the last five years, and this little additional work has brought me gratifying returns.

The etiquette of the public service is, of course, of importance, but the success of the hour does not wholly depend on the manner of directing, but that all arrangements be completed—the body in the best possible condition and arrangement. A house built without a foundation, or roofed and not sided, would look very strange; but it is equally impractical to direct the public service in true etiquette if you have not strictly adhered to the conditions before mentioned.

The advancements in the last five years have been marvelous. We may be given to think that every detail is perfected and there is no further need for exertion on our part. Let us bear this in mind:

New occasions teach new duties; time makes ancient plans quite rude; they must upward still and onward who would keep abreast the new.

Extracts from Grosjean, Kibby, Flanner and other prominent professionals.

CHAPTER XX.

Quiz Compends.

Embracing Questions and Answers Such as Have Been Asked by the Chicago College of Embalming, the Chicago Board of Health, State Boards of Examiners, Etc.

ON ANATOMY.

Name the anatomical elements in the human body.

The skin, sub-cutaneous tissues, superficial fascia, muscle, bursæ, lymphatic, synovial membranes, deep fascia, arteries, veins, nerves, viscera, ducts, mucous and serous membranes, ligaments, tendons, cartilage, bone, teeth, hair and nails.

Name the three great cavities of the body.

The cerebro spinal, the thoracic cavity and the abdominal cavity.

What is that part which contains the thoracic cavity and the abdominal cavity generally called?

The trunk of the body.

How many layers has the skin?

Two; the epidermis, or scarf skin (outer layer), and the cutis vera, or true skin (inner layer).

What is superficial fascia?

Superficial fascia is a dense fibrous membrane which covers the whole surface of the body just beneath the skin.

How many muscles are there in the human body?

About five hundred in all.

How many bones are there in the human body?

Two hnndred in all.

Define artery, vein and nerve; differentiate between them.

Arteries are vascular tubes which serve to convey the blood from the heart to all parts of the system. They are composed of three coats, an inner endothelial coat, a middle coat composed of muscular and elastic tissue, and an external or outside coat composed of connective tissue with a small amount of elastic tissue interposed. They are of a creamish white color and when cut retain their shape and form.

The veins also have three coats. The veins serve to convey the blood to the heart. The inner coat is made up of an endothelial layer which has less elastic fibres in it. The middle coat contains muscular and elastic tissues, but in less quantity than is found in the arteries. The external or outside coat is composed principally of white fibrous connective tissue intermingled with elastic fibres. The color of the veins is a pale blue. The walls of the veins are much thinner than the walls of the arteries, and when cut they have a tendency to collapse. As a rule, arteries have no valves. The only exception to this is the aortic semilunar valves at the commencement of the aorta and the pulmonary semilunar valves at the commencement of the pulmonary artery. The veins of the extremities and nearly all of the superficial veins of the body are freely supplied with valves.

Nerves are of two kinds, medullary and non-medullary. They can be distinguished from the arteries and veins by their white color, inelasticity and fibrous texture. They are hard to the touch and have no central opening.

What is the thorax?

The thorax is a conical shaped cavity, the base formed by the diaphragm, the apex by the root of the neck, bounded in front by the sternum, posteriorly by the spinal column, laterally by the ribs and the tissue planes covering these parts.

Does hair grow after death?

No.

What is a viscus?

A viscus is an organ of the human body.

Name the viscera in the thoracic cavity.

The heart and the lungs.

Name the viscera in the abdominal cavity.

Liver, gall bladder, stomach, pancreas, spleen, kidneys, supra-renal capsules, large and small intestines, urinary bladder, and in the female, uterus and ovaries.

Into how many parts is the brain divided?

The brain is divided into four separate parts known as the cerebrum, cerebellum, medulla oblongata and the pons varolii.

What is the spinal cord?

The spinal cord is the continuation from the medulla oblongata and extends from the base of the brain to the second lumbar vertebra.

What is the alimentary canal?

The alimentary canal begins at the mouth and is made up of the following parts: Pharynx, œsophagus, stomach and large and small intestines.

What is the length of the intestines in an adult man?

About twenty-six feet.

Name the divisions of the small intestines.

The duodenum, jejunum and the ilium.

Name the divisions of the large intestines.

The ascending colon, the transverse colon and the descending colon.

What is the cæcum?

The largest expanded portion of the large intestines. It marks the ending of the small intestines and the beginning of the ascending colon, and has attached to it the appendix vermiformis.

What is the ileo-cæcal valve, and what is its function?

The ileo-cæcal valve is a valve placed at the junction of the small intestines to the large intestines. It prevents the gases in the large intestines escaping back into the small intestines.

What arteries supply the stomach?

The gastric and its branches, the gastro-epiploic and vasa breva from the splenic.

What artery supplies the small intestines?

The upper part of the small intestines is supplied by branches of the hepatic and the inferior pancreatico duodenal branch of the superior mesenteric. The remainder of the small intestines is supplied by the superior mesenteric artery and its branches.

What arteries supply the large intestines?

The superior and inferior mesenteric and their branches.

What is the largest secreting gland in the body?

The liver.

What is the weight of the liver, and what is its function?

The liver weighs from four and a half to six pounds. It -retes the bile. It changes the composition of the blood sing through it. It forms glycogen and assists in the -ation of urea.

Locate the liver.

It is situated on the right side, in the upper part of the abdominal cavity immediately beneath the diaphram, its lateral portion being confined to the right hypochondriac region, the left lobe extending into the epigastric region.

Locate the spleen.

The spleen is situated in the left hypochondriac region.

What is its function?

It is as yet undecided by physiologists.

Locate the gall bladder.

The gall bladder is situated on the under surface of the right lobe of the liver in the right hypochondriac space.

What is its function?

It is the reservoir for the bile.

Locate the pancreas.

The pancreas is situated just along the posterior border of the stomach in the epigastric space, its head being in the right hypochondriac space.

What is its function?

It secretes pancreatic juice.

What are the supra renal capsules?

They are ductless glands placed just over and above the kidneys. They are always largest in the fœtal state and are supposed to have some function in the formation of embryonic tissue.

Locate the kindeys.

The kidneys are situated in the right and left lumbar spaces, one on either side of the spinal column, the upper border touches the lower border of the eleventh rib, but the right kidney, on account of the right lobe of the liver being placed on that side, displaces the kidney downward; thus the right kidney is from an inch to two inches lower than the left.

What is the function of the kidneys?

The kidneys separate certain particles from the blood and secrete the urine by means of the uriniferous tubules. The ureters convey the urine from the kidneys to the bladder.

What is the length of the ureters?

From sixteen to eighteen inches.

Locate the bladder.

Its location differs slightly in the adult and in the child. In the child it is almost an abdominal organ, being located above the brim of the pelvis in the hypogastric space. In the adult it is found below the pelvic brim in the cavity of the pelvis, and only extends into the hypogastric space when distended.

Locate the uterus (womb).

The uterus is situated in the cavity of the pelvis between the bladder and the rectum and is held in this position by several ligaments, six of which are derived from folds of the peritoneum. Strictly speaking, the uterus in the non-pregnant state is not an abdominal organ, as it is placed wholly in the pelvic cavity. In the pregnant condition after the fourth month it becomes an abdominal organ, and at the end of pregnancy it may extend as high up as the epigastric space.

What is the function of the uterus?

It contains the child during gestation.

What is the peritoneum?

The peritoneum is a serious membrane and is a closed sac, except in the female subject it has an opening for the passage of the round ligament. It consists of a greater and lesser omentum, each of which form two distinct serous cavities, the membranes of which invest the sub-diaphragmatic portion of the digestive apparatus, thus insuring their mobility upon each other in performing their respective functions, motions, etc., without friction or irritation.

What are the ovaries?

The ovaries are two ovoid bodies placed on each side of the uterus, being suspended from that organ by the broad ligaments.

What is the diaphragm?

The diaphragm is a musculo fibrous membrane which separates the thoracic cavity from that of the abdominal.

How many openings has the diaphragm?

Three openings of large size—the aortic, the œsophageal and the opening for the inferior vena cava. The small openings are for the passage of the splanchnic nerves, the sympathetic nerve trunks and the azygos minor vein.

What is the abdominal cavity.

The abdominal cavity is that cavity of the trunk placed below the diaphragm, extending from the diaphragm to the floor of the pelvis. It contains the organs of digestion.

Into how many divisions may this cavity be divided?

Nine.

Name them.

The right hypochondriac region, the epigastric region, the right and left lumbar regions, the right and left iliac regions, the umbilical region and the left hypochondriac region.

Locate the stomach.

The stomach is situated in the epigastric region. The great end encroaches on the left hypochondriac space and the lesser end on the right hypochondriac space. It is in the upper central portion of the abdominal cavity immediately beneath the diaphragm.

What is the thoracic cavity?

The thoracic cavity is the cavity contained in the thorax limited below by the diaphragm, above, by the root of the neck.

How many sub-cavities has the thoracic cavity.

Three, right and left pleural cavities containing the right and left lungs, respectively, and the mediastinal cavity containing the heart, oesophagus and great vessels.

What artery supplies the liver?

The hepatic artery.

What artery supplies the spleen?

The splenic.

What artery supplies the kidneys?

The renal.

What are the coverings of the lungs, and what cavities are made by these coverings?

The pleuræ. They form the right and left pleural spaces or cavities.

...at separates the abdominal cavity from the thoracic?

... diaphragm.

...w many lobes has the right lung?

...hree.

...ow many lobes has the left lung?

... smaller?

...pacity of the lungs?

...s.

What is the weight of the lungs?

About 42 ounces in the male, slightly less in the female.

What arteries supply the lungs with pure blood?

The bronchial artery.

Does the pulmonary artery supply the lungs with blood for its nutrition?

No, it merely carries the blood to the lungs to have it purified.

What is the function of the lungs?

They are the organs of respiration and purify the blood.

Locate the heart.

The heart is placed in the thoracic cavity between the lungs in what is known as the middle mediastinal space. The apex rests on the diaphragm. The base corresponds to a line drawn around the lower border of the third rib. The posterior part of the left auricle is on a level with the seventh dorsal vertebra.

What is the function of the heart?

It is the central organ of circulation and propels the blood to all parts of the system.

How many cavities has the heart?

Four, the right and left auricles and the right and left ventricles.

Which side of the heart contains venous blood.

The right side.

What is the average capacity of the cavities of the heart?

About two ounces.

What separates the right auricle from the right ventricle?

The auriculo-ventricular (tricuspid valve).

What are the two first branches given off of the aorta?

The right and left coronary. They supply the right and left sides of the heart, respectively.

What returns the blood from the heart to the right auricle?

The coronary veins.

How many openings are in the right auricle of the heart?

Four, two openings for the inferior and superior vena cava, one for the valvular opening, and the opening for the coronary sinus.

Where does the aorta commence?

In the left ventricle.

Name the valves of the heart.

The tricuspid valve between the right auricle and right ventricle, the mitral valve between the left auricle and left ventricle, the aortic semi-lunar valve at the commencement of the aorta, and the pulmonary semi-lunar valves at the beginning of the pulmonary artery.

What is the covering of the heart called?

The pericardium.

Describe systemic circulation.

Systemic circulation begins at the left ventricle of the heart. The blood is forced through the aorta and its branches to the capillaries in all parts of the system. It is returned to the right auricle of the heart by means of the superior and inferior vena cava and their tributaries.

What is pulmonary circulation?

Pulmonary circulation commences in the right ventricle of the heart. The right ventricle receives the blood from the right auricle and forces it through the pulmonary artery and its branches to the lungs. After it is purified it is returned to the left auricle of the heart by means of the four pulmonary veins.

What is capillary circulation?

The circulation through the capillaries, or through that part of the vascular system marking the ending of the arteries and the beginning of the veins.

What is fœtal ciculation?

Fœtal circulation is that circulation which takes place between the mother and the child in utero, for description of which see "Fœtal Circulation."

What is portal circulation?

Portal circulation is that circulation which exists between the stomach, intestines, spleen and liver. The veins from these organs converge to form the portal vein which empties the blood into the substance of the liver. It breaks up into capillaries and finally empties into the hepatic veins, which return the blood to the inferior vena cava.

What is the composition of human blood?

It is composed of red and white blood corpuscles and plasma.

What is the per cent. of human blood in the body?

About one-eighth of the body weight, or from eighteen to twenty pounds in an individual weighing 150 pounds.

What kind of blood do the arteries contain, in life?

Pure blood, there being but one exception. The pulmonary artery leading to the lungs carries impure blood.

What kind of blood do the veins contain, in life?

Impure blood, there being but one exception. The four pulmonary veins carry arterial blood. The umbilical vein carries pure blood and the umbilical arteries carry impure blood.

What is a capillary?

A capillary is the smallest blood-carrying vessel in the body. It measures on an average about one-thirty-five-hundredth of an inch. It is the ending of an artery and the beginning of a vein.

What is the largest artery in the body?

The aorta.

Name the branches of the aorta.

The branches of the aorta are the coronaries, the innominate, the left common carotid, left sub-clavian, the bronchial, the intercostal, pericardiac, post mediastinal, oesophageal, coelic axis, giving off gastric, hepatic and splenic, phrenic, superior and inferior mesenteric, renal, supra-renal lumbar, spermatic and the sacremedia.

What arteries supply the head and neck?

The internal and external common carotids, the vertebrals and their branches.

Locate the common carotid arteries.

These arteries are situated in the anterior part of the neck just between the sterno mastoid and the muscles forming the throat. A line drawn from a point midway between the lobe of the ear and the angle of the jaw to the sterno clavicular junction will correspond to the exact course of the vessel. At its lower portion it is overlapped by the anterior belly of the sterno mastoid muscle.

Of what is the common carotid artery on the right side a branch?

The innominate.

Of what is the left common carotid artery a branch?

The aorta.

cate the brachial artery.

brachial artery is placed at the upper and inner side of the arm and external from the lower border of the bicipital groove of the humerus to the center of the elbow. After emerging from beneath the coraco brachialis muscle, it describes a course between the biceps and triceps muscles, and corresponds to a line drawn from the anterior and middle third of the axillary space (arm-pit) to the inner side of the elbow.

Locate the radial artery.

The radial artery in the lower part of its course is placed between the tendons of the supinator longus and flexor carpi radialis muscles. It lies beneath a line drawn from the external side of the bicipital tendon to the center of the ball of the thumb.

Of what is the ulnar artery a branch?

The brachial.

What arteries are formed by the bifurcation of the aorta?

The right and left common iliac arteries.

Of what is the femoral artery a branch?

The femoral artery is a branch of the external iliac artery.

Locate the femoral artery.

The femoral artery is situated in the upper anterior portion of the thigh. It extends from the center of Poupart's ligament to the popliteal space. The vessel describes a course through the center of Scarpa's triangle from its base to its apex. At the lower border of Scarpa's triangle the femoral artery is completely overlapped by the sartorious muscle. A line drawn from the center of Poupart's ligament to the inside of the knee joint will correspond to the exact course taken by the vessel.

What are the branches of the femoral artery?

Superficial epigastric, superficial circumflex iliac, superficial external pudic, deep external pudic, muscular profunda, external circumflex, internal circumflex, three perforating, and the anastomotica magna.

What arteries supply the brain?

The two internal carotids, the basilar and their branches.

Locate the circle of Willis.

The circle of Willis is placed at the base and under surface of the brain. Its center corresponds to the opening of the carotid foramina. It is placed about an inch and a half anterior to the foramen magnum in the occipital bone. The branches of the circle of Willis spread out over the tissues covering all of the bones entering into the formation of the head.

What is the popliteal artery?

The popliteal artery is a direct continuation of the femoral and is found just back of the knee-joint in the center of the popliteal space.

Locate the post tibial artery?

The post tibial artery takes a course downward from the popliteal to the groove between the inner malleolus and the os-calcis. A line should be drawn from a point corresponding to an inch below the center of the popliteal space to the center hollow groove formed on the inner side of the ankle by the prominence of the tibia and the convexity of the heel. The artery lies between the tendo Achilles and the flexor longus digitorum muscle.

What is the relation of the œsophagus to the trachea?

The trachea is the continuation of the larynx. The œsophagus is the continuation of the pharynx. The trachea lies directly in the median line of the throat. The œsophagus lies back of it, posteriorly to the left.

How many kinds of veins has the human body?

Two, superficial and deep.

Where do you find the superficial veins?

They are found in the cellular tissues of the body, just between the skin and the superficial fascia.

Where do you find the deep veins?

They are found in the deeper and muscular parts of the body and usually accompany the arteries.

What are sinuses?

Sinuses are cavities of grooves in the soft or hard tissues of the human body, through which circulate blood or fluid. However, some sinuses, such as the frontal ethmoid, sphenoidal and superior maxillary, are grooved cavities in the bones which are lined with mucous membrane and contain air.

Name the most important veins of the head and neck.

The prominent veins of the head and neck are, on the inside of the head, the lateral and longitudinal sinuses; in the external tissues, the facial vein, and the four jugulars, internal and external, anterior and posterior.

What forms the internal jugular vein?

The lateral, and the inferior petrosal sinus.

What forms the external jugular vein?

The external jugular vein is formed by the temporo maxillary and the posterior auricular veins.

What are the largest sinuses in the interior of the skull?

The superior longitudinal sinus, the straight sinus, the lateral sinus, and the occipital sinus.

Name the prominent veins of the arm.

The radial, the anterior and posterior ulnar veins, the common ulnar vein, the median basillic vein, the basillic vein, the median cephalic vein, the cephalic vein and the median vein.

What is the relation of the basillic vein to the brachial artery in the middle third?

The vein is placed to the inner side of the brachial artery, the median nerve to the outer side.

What is the relation of the femoral vein to the femoral artery?

In its upper third the vein lies to the inside; in the middle portion the vein lies behind or posterior to the artery, while in its lower portion the vein lies to the outside.

What veins form the superior vena cava?

The two innominate.

What veins form the innominate vein?

The subclavian and the internal jugular.

What is the longest vein in the human body?

The internal or long saphenous vein.

What are prominent veins of the lower extremities?

The internal and external saphenous veins, the popliteal and the femoral.

What is the shortest vein in the human body?

The superior vena cava.

Which is the largest in diameter, the superior or the inferior vena cava?

The superior vena cava.

Which contains most blood?

The inferior vena cava.

What forms the inferior vena cava?

The two common iliac veins.

Name some of the large veins that empty into the inferior vena cava.

The renal veins from the kidneys are the largest. There also empties into it the lumbar, the right spermatic, supra-renal, phrenic and the hepatic veins.

Has the inferior vena cava a valve?

It has the remains of a valve just at its opening into the heart (eustachian valve). This, however, does not prevent the regurgitation of blood.

What is the difference between the veins of the spinal column and the inside of the heart from those in soft tissues?

The veins of the spinal column and those on the inside of the heart have but one coat. The others have three coats.

What large veins are destitute of valves?

The superior and inferior vena cava, the innominate and the internal juglars.

What is the location of the torcular herophili, or wine press?

This is a depression on the internal surface of the occipital bone, and marks the junction of the longitudinal to the lateral sinuses.

Where is the blood during life?

In the arteries, capilliaries and veins.

What becomes of it after death?

It takes on putrefactive and chemical changes, passes from the arteries to the capillaries and into the veins, and, subsequently, to the dependent tissues of the body, seeking the points of least resistance.

How much blood would drain away from a body decapitated in life?

From a normal man weighing 153 pounds there would drain away from the divided arteries and veins of the neck from seven and one-half to eight and one-fourth pounds of blood.

How much blood would drain away from a body decapitated after death?

It depends altogether on what caused the death, the conditions of temperature, the weight of the subject, and how long after death the decapitation took place. (See chapter on blood coagulation.)

What will hasten the coagulation of blood after death?

First, a temperature above that of the body; second, diseases of the blood vessels themselves; third, admixture with more than twice its volume of water.

What chemicals have a tendency to prevent coagulation of the blood?

Sodium sulphate, sodium chloride, magnesium sulphate, nitrate of potash; and a temperature below 32 degrees F.

Between what ribs would you insert a trocar for the purpose of entering the right auricle of the heart?

Between the third and fourth ribs on the right side, one inch from the breast bone.

What cavity is found in the lower part of the abdomen?

The pelvic cavity.

What organs are contained in this cavity?

The bladder and the lower portion of the rectum, and in the female subject the uterus.

How many distinct circulations are there in the human body?

Five—systemic, pulmonary, portal, fœtal and capillary.

What is the function of the valves in the veins?

They prevent the regurgitation of the blood, permitting a flow only in one direction, towards the heart.

Where do the veins forming the portal circulation terminate?

In the substance of the liver.

What causes the blood to leave the arteries and escape into the ins after death?

The nervous system, which does not die immediately he cessation of circulation and respiration, reacts on the contents of the coats of the arteries, causing them to contract and completely empty the arterial system of blood. The capacity of the veins being three times that of the arteries, and the capillaries being distended, favors the flow of blood from the arteries to the veins during this contraction.

What are the venæ comities?

Venæ comities are the accompanying veins of the arteries.

What artery is oftentimes found out of its natural position?

The brachial.

If on cutting down for this artery and failing to find it, what would you do?

Make an incision higher up in the arm, just beneath the coraco brachialis muscle, and take up the axillary artery.

Bound Scarpas' triangle.

Scarpas' triangle is bounded on the outside by the sartorious muscle, on the inside by the adductor longus muscle, above by Poupart's ligament.

What important structures are found in this triangle?

The femoral artery, the femoral vein, the anterior crural nerve.

In the Barnes needle process, give the anatomy concerned in the operation.

The needle enters the muscular tissue at the back and side of the neck and is directed upwards and inwards between the atlas, the first bone of the spinal column, and the occipital bone. The needle entering the foramen magnum in the occipital bone, passes through the dura mater, the outer covering of the brain and cord, enters the medulla oblongata and extends to the corpus callosum.

How many lobes has the liver?

Five; the right and left lobes, the lobulus caudatas, the lobulus quadratus and the lobulus spigelii.

What is the difference in the structure of the fœtal heart from that of the adult heart? And how does the flow of blood in the fœtal heart differ from that of the adult?

In the fœtal heart there is an opening between the right and left auricles called the foramen ovale, and blood flows from the right auricle to the left auricle while the child is in utero. In the adult heart, or just as soon as the child is born, this opening closes and blood flows from the right auricle to the right ventricle.

What do you understand by an anomalous condition of an artery?

A deviation from the natural course of an arterial trunk.

What is a plexus?

A plexus is a conglomeration of arteries, veins or nerves.

What part of the intestines is found empty after death?

The jejunum.

What coat in an artery is usually divided when you ligate?

The middle and internal coats.

Where is the plantar arch?

In the bottom of the foot.

Where is the palmar arch?

In the palm of the hand.

ON EMBALMING.

How soon after death is it proper to embalm the body?

As soon as you are called and the presence of actual death is positively ascertained.

Give seven signs of death.

Absence of circulation, absence of respiration, the gradual cooling of the body, putrefaction, immobility of the pupil of the eye, change in color, loss of elasticity in the skin, and rigor mortis.

Does rigidity interfere with arterial embalming?

Yes.

If called upon to care for a body and you find the rigor mortis fully developed, would you proceed to embalm the body without breaking up the rigidity?

No. I would break up the rigidity by flexing and extending the head, neck and extremities, as that relieves pressure on the arteries and veins and insures a better circulation of the fluid.

Why do you inject the arteries instead of the veins?

Because the arteries are generally empty after death and they reach all parts of the system more direct. The veins are generally filled with blood, and if we inject the veins instead of the arteries we will force this blood to the face and neck and cause discoloration.

In injecting through the heart, which cavity would you select and where would you make the injection?

I would select the left ventricle of the heart, as it marks the beginning of the aorta. The trocar should be inserted either between the seventh and eighth ribs on the left side, or in the left hypochondriac space.

What are the principal arteries used in embalming?

The carotid, brachial, radial and femoral.

Define embalming.

Embalming is the injecting of a cadaver with preservative fluids.

Why do we embalm bodies?

To preserve the body from putrefaction and as a sanitary measure to kill all bacteria in the body so as to prevent contagion and infection.

What artery do you consider the best to use in embalming, and why do you so consider it?

The right common carotid, because it has alongside of it the right jugular vein, which is only a few inches from the right side of the heart, and blood can be removed better from this point than from any other. The arterial system can be injected more thoroughly than from any other, and the artery is always in position. Brachial second choice.

What artery is most preferred by the undertaking profession of the United States?

The brachial.

How do you raise the common carotid artery?

By either a transverse or vertical incision over the course of the vessel. The transverse incision should extend from the center of the breast bone to a point two and one-half inches to the right at the superior border of the clavicle (collar bone). The artery is placed deep in the tissues of the neck and lies between the sterno mastoid muscle and the trachea. It has to its outer side the internal jugular vein. (See questions on Anatomy.)

How do you raise the brachial?

By making an incision on the inner side of the arm between the biceps and triceps muscles in the middle third of the course of the artery. The vein is placed to the inside, the artery in the middle, and the median nerve slightly overlapping the outer side. Dissect the nerve from the artery and bring it into the wound by placing the handle of a scalpel beneath it, or a better instrument is the embalmer's helper, patented by Mr. C. W. Devore, of Monongahela City, Pa.

How do you open an artery?

With the scissors, by first cutting it transversely, and then longitudinally, making a |—— incision in the vessel.

In injecting the body, how should the arterial tube point when introduced into the artery?

Always toward the heart.

How do you raise the femoral artery?

By making an incision in Scarpas' triangle on an imaginary line drawn from the center of Poupart's ligament to the inner side of the knee. The incision is made in the middle third of the femoral artery. At this point the sartorious muscle slightly overlaps the sheath of the vessel. After cutting down upon the sheath, pull the sartorious muscle to the outside and bring the sheath into the wound. Open the sheath and dissect the artery from the vein which lies just back of it. Then open and inject as given in the answer above.

How do you raise the radial artery?

By making an incision about one inch above the ball of the thumb on the radial side of the arm between the tendons of the supinator longus and flexor carpi radialis muscles. This artery is the most superficial of all the arteries in the body and lies just beneath the skin. Bring the artery into the wound by the method above given.

Name the three recognized methods of embalming in this country.

The cavity, arterial and needle.

What method do you consider the best?

The arterial.

What method is the most scientific?

The Barnes needle process.

What is the eye process?

A process discovered by Dr. B. W. Richardson, of London, England, in 1884. It consists in injecting the cerebro spinal cavity by a needle introduced through the orbits into the brain, the needle passing through the sphenoidal fissure.

Give the linear guide for performing the Barnes needle process.

The head should be bent laterally upon the chest. A line should be drawn from the angle of the jaw to the back of the neck. A second line from the mastoid process of the temporal bone (prominence just back of the ear) to the center of the collar bone. The lines will cross just back of, and a little below, the lobe of the ear. The needle should be introduced at a point varying from a half inch to an inch back of the crossing of these lines, on the line drawn from the angle of the jaw to the back of the neck. The needle should be directed upwards and inwards towards the frontal eminence (prominence above the eyebrow) on the opposite side of the head.

In the Barnes process how does the fluid enter the circulation?

By first filling the cerebro spinal cavity and forcing the blood out of this cavity and the jugular veins down into the great veins of the chest. Then by force it percolates into the large venous sinuses on the interior of the cranium and passes out through the lateral sinus into the jugular veins. After once entering the sinuses, since there are no valves in the veins of the head, it passes through the capilliaries to the arteries, and the fluid enters both the arterial and venous system during an injection.

What is the most barbaric method of embalming introduced since the days of Gabrial Clauderus?

A method of taking a drill and boring a hole through the skull and introducing fluid into the brain with a trocar.

How many methods have we of removing blood?

Two; either opening the venous system at some part of its course, or tapping the right side of the heart with a hollow needle.

What causes purging from the mouth and nostrils?

Putrefaction either in the stomach or lungs, or in the -sues of the throat and nose, forming gas.

How do you prevent purging from the stomach?

By first relieving gas from this organ by puncturing with a trocar, or by means of a stomach tube, and afterwards filling the stomach with fluid, finally plugging the nose and throat with absorbent cotton.

How do you prevent purging from the lungs?

By introducing fluid directly into the bronchial tubes either by the nasal tube or by an incision into the trachea just above the collar bone, and afterwards surrounding the lungs with fluid by an injection between the first and second ribs in the pleural spaces.

If all of these methods have been employed and the purging still continues, what would you do?

Make an incision in the median line of the neck, cut down and tie off both the trachea and the œsophagus. A piece of tape should be used in this operation.

How do you inject the stomach?

Preferably with the stomach tube, or by puncturing the stomach in the epigastric space with a trocar and injecting fluid through it into the interior of the organ.

How do you remove gases from the intestines?

By puncturing them with a trocar which has been introduced just over the transverse colon in the left hypochondriac space immediately beneath the ribs, or by the use of the stomach tube.

If this fails what do you do?

Open the abdomen in the median line just above the umbilicus and take the scissors and cut the stomach, large and small intestines.

Name the different kinds of discolorations that appear on the dead body.

Post mortem staining, post mortem discoloration, venous congestion, and greenish discoloration of putrefaction.

What are the methods adopted for the removal of discolorations?

First, bleaching agents employed in the embalming fluid; second, bleaching agents applied externally; third, hot cloths and gentle massage in the natural course of the veins; fourth, removing the blood; fifth, the use of Barnes' needle process; sixth, the hypodermic injection of bleaching agents, such as chloride of zinc, alcohol, Formaldehyde, etc.

What causes discolorations?

Either the unskillful injection of fluid into an artery or mistaking an artery for a vein and injecting the vein, and the decomposition of blood in the tissues. Other discolorations, such as jaundice, spots of purpura, those caused by Addison's disease, etc., are caused by pigmentary changes in the true skin, and with our present knowledge cannot be removed.

Can you remove a spot which has been caused by a blow or a bruise, from the dead body?

Sometimes you can; more often it refuses to yield to treatment. The best method to remove such spots where there is only slight congestion of the vessels is to inject hypodermically into the part a bleaching solution, such as is recommended in the text of this book.

How could you tell whether a wound had been inflicted before death or after death?

Wounds made during life are always raised above the surface of the skin. Vessels are divided caused by the rupture of capillaries, and when incised with a scalpel the blood escapes. A microscopic examination reveals the presence of congested and ruptured capillaries. In a bruise on a dead body made after death, in addition to there being no elevation, there is no congestion of the capilaries, and when cut, no blood will flow. A microscopic examination shows the blood vessels to be in their normal condition. The discoloration in the part is either post mortem staining or post mortem discoloration caused by the decomposition of the blood. In the case of a blow before death the discoloration is caused by the congestion of blood in the part and the subsequent coagulation of that medium before death.

What amount of fluid is necessary to embalm a body of 150 pounds weight?

From three to four quarts.

What chemicals are usually employed in the manufacture of embalming fluids?

Arsenic, Formaldehyde, wood alcohol, grain alcohol, alum, bichloride of mercury, chloride of zinc, salts of potash and chloride of soda.

If your fluid is sold to you with the understanding that it is non-poisonous, what is your presumption of its contents?

I presume it contains formalin, an aqueous solution of formic aldehyde 40 per cent. strength.

If it is sold to you with the understanding that it is poisonous, what do you suppose it contains?

Arsenic, chloride of zinc, alum, bichloride of mercury, nitrate of potash, chloride of soda, wood alcohol and water.

Do you know of what chemicals your embalming fluid is composed, and in what proportion? Think about this and write me.

(?)

How would you remove blood from the brain cavity?

By the use of the Barnes needle introduced into the back of the neck through the foramen magnum in the occipital bone, directly into the brain.

Why is this method better than any other?

Because it reaches the cavity more direct, and being at the back and lowest portion of the brain, the drainage is more complete.

How do you remove blood from the veins?

By tapping the right auricle by means of a trocar introduced between the third and fourth ribs; by tapping the right ventricle from beneath, the trocar inserted in the epigastric space and extending through the diaphragm into the right ventricle, which rests upon this membrane, and by use of drainage tubes inserted into the large veins.

How do you wash the blood from the arteries and veins?

By opening a vein and then opening an artery, injecting the arterial system and allowing the blood to flow from the divided end of the vein. The injection of the artery should be continued until the clear fluid flows from the vein.

In what case is it necessary to drain the blood from the body?

In all those cases where there is an early tendency to take on decomposition, or where there is an excessive amount of blood in the body, and in those cases where discoloration is present when you are called to take care of the body.

What is the condition of the blood in a subject dead of asphyxia from illuminating gas?

The blood is a bright scarlet and does not coagulate; it resists slow combustion and putrefaction.

What is the condition of the blood in a case of tuberculosis (consumption)?

The blood is thin, of a light color, and has a decreased amount of fibrin, and does not coagulate very rapidly when exposed to the air, yet it decomposes very early after death.

What is the condition of the blood in a subject dead of Asiatic cholera?

The blood is thickened and coagulated, is dark, almost black, and of a tarry or syrupy consistence.

What is the condition of the blood in a body that has been immersed in water until the blood and tissues of the body have been saturated?

The blood is thickened and coagulated, is dark in color, and decomposes rapidly.

What is the condition of blood in a body dead from sunstroke?

The blood is found in all of the different organs of the body in a state of congestion. It is of a dark color, but is not so thickened and coagulated that it cannot be removed.

What is the condition of the blood in a body of one who has been frozen to death?

It is in a liquid condition, and of a bright red color.

What is the condition of blood in a body in case of poisoning by phosphorus?

It is dark in color and of a syrupy consistence.

What is the condition of the blood in poisoning by arsenic?

The color of the blood is not altered, and is generally in a fluid condition.

What is the condition of the blood in a case of pneumonia?

The blood is diminished in oxygen, is of a dark color and coagulates very early after death.

How do you treat a subject who has died of sunstroke?

Remove the blood as early as possible and inject the arterial system thoroughly on account of congested condition of the heart, lungs, liver, brain and intestines, don't fail to give a thorough cavity injection in all these parts.

How do you treat a subject who has died of apoplexy?

Remove the blood from the cavity of the brain by inserting a needle in the back of the neck (Barnes needle process), then inject the brain. Afterwards take up an artery and inject sufficient fluid to embalm the body, according to the weight of the subject. Cavity embalming is not always necessary in this case.

How do you treat a subject who has died of consumption?

If there is no discoloration it is not necessary to remove the blood. Inject the arteries and pay special attention to the lungs. Fill the thoracic cavity with as much fluid as it will hold.

What would you do in case you were injecting a subject through an artery and fluid began to escape from the mouth and nostrils?

It would indicate a leakage in either the pulmonary or the bronchial arteries. Continue the injection until the fluid escapes clear. Take up the carotid artery and inject downwards. Then inject the head and neck with the needle process. Afterwards fill the cavity and then plug the mouth and nostrils with cotton.

How do you prepare a body dead of a contagious or infectious disease that is to be transported a considerable distance?

First, wash the body with the embalming fluid and inject some into the mouth and nostrils; second, take up an artery and inject as much fluid as it is possible to inject without rupturing the circulation; third, inject all of the cavities of the body, the cranial, the thoracic and abdominal; fourth, close all orifices of the body with absorbent cotton, and wash the body with the disinfectant; fifth, wrap the body in a layer of absorbent cotton, not less than one inch thick, and bandage.

How would you prepare a body to ship to a foreign country that died of a non-contagious disease?

I would embalm the body the same as above and would wrap it in bandages made from cheese-cloth, the bandages having been immersed in the following solution:

Tannin	1	ounce.
Collodian	10	ounces.
Ethylic Alcohol, pure	12	"
Balsam tolu	2	"
Oil of Gaultheria	1	drachm.

To this mixture add gumbenzoin until it ceases to be dissolved.

How do you treat a subject who has died of drowning, if the body has been in the water only a few hours?

The same as any ordinary case, except that I would always remove the blood so as to prevent discoloration, and would use the needle process to drive the blood from the head.

How do you treat a subject who has died of drowning, if the body has been in the water several days or until the tissues have become saturated.

If the body has not been identified, inject the arteries with an embalming fluid made of Formaldehyde not less than thirty per cent. strength; wrap the body in a sheet which has been saturated with this mixture; then inject the cavities with the same solution and inject hypodermically with the same solution into the muscular parts of the head, neck, chest and extremities, and as soon as the body is identified insist on burying it immediately.

Can you remove blood from a body that has been in the water several days?

No, because admixture with water coagulates it.

How do you embalm a body where a post mortem has been held, all of the organs and tissues being subjected to an examination?

By removing all of the organs from their cavities and placing them in alcohol and Formaldehyde; then take sawdust and saturate it with Formaldehyde until it is thoroughly moistened. Sponge the cavities of the body dry and return the organs to their respective cavities and cover them with a mixture of sawdust and Formaldehyde. Take a layer of absorbent cotton not less than one inch thick and cover all of the organs, and finally bring the edges of the abdominal and thoracic incision together and close, using a close anatomical stitch. This is the method first advocated and used by Mr. James J. Morris, Assistant Demonstrator in the Chicago College of Embalming, and for twenty-five years more or less connected with the great morgues of Chicago.

What do you use to prevent mould?

Vaseline which has been saturated with arsenic, carbolic acid and corrosive sublimate; also solutions containing formalin.

What do you use to remove the mould when it has already appeared on the body?

First, harden the skin by laying over the parts containing the mould cotton containing a solution of formalin in alcohol, or if this is not at hand, a solution of alcohol, chloroform and ether in equal parts. This drives the moisture from the skin, hardens it, fastens the outer skin to the true skin, and enables you to remove the mould by carefully scratching over the part with the edge of a scalpel.

CAUTION.—Never take the fingers and try to rub mould off of the body. It rubs away the outer skin and leaves a brown yellow, horny discoloration when it dries.

How do you treat a case that has died of general dropsy?

Remove the water from the extremities by means of bandages. Remove the water from the abdominal cavity by tapping just above the pelvic bone; remove the blood by opening the venous system and injecting the arteries thoroughly. Use the needle process to drive the fluid and blood from the head and neck into the cavities of the chest, inject both arteries and cavities.

In the treatment of a dropsical case, what fluid do you consider the best?

Those fluids containing Formaldehyde.

What causes a body to decompose?

A low, moist temperature and the presence of micro-organisms.

In injecting a body with fluid what causes the nose and the finger tips to shrivel up and dessicate?

This is caused by the chemical changes of the fluid on the tissues, the combustion of the watery substances in the cellular parts, thus causing a shrinking or dessicating of the part.

What fluids have a tendency to cause this more than others?

Those fluids containing arsenic and chloride of zinc.

If in cutting down upon an artery to embalm the body, and opening it you find that it contains blood, what would you do?

Remove this blood from the arteries in the same manner that you would from the veins. Then proceed to inject. It is a safe procedure when blood is found in the arteries to always inject the right common carotid artery downwards, as what blood is left in them is driven towards the feet and extremities instead of towards the head and face, when the femoral and brachial are used.

Why does the skin of the arm or other parts of the body, while injecting the arteries, sometimes show blotches or a watery appearance, and in others, does not?

Those fluids containing corrosive chemicals will do this on account of their affinity for water. In those cases where there is no mottling of the skin there is usually a diminished amount of fatty tissue in the body. It all depends on the fluid. Formaldehyde fluids have a greater action on the albuminous portion of the skin than any other, and it will be noticed more in the use of these fluids than in those containing metallic salts.

In case a person is shot through the head and you inject the fluid, and leakage occurs, what would you do?

The leakage shows a rupture of the arteries of the brain. Put your thumb over the bullet hole and inject, holding the fluid in the cavity. After you have injected sufficient fluid to embalm the body, stop injecting, and afterwards fill the opening in the skull with absorbent cotton for a basis and close with plaster of Paris.

What would you do in case the subject was covered with powder marks?

Use any white powder and cover them over.

Is the presence of blood in an artery a sign that life exists?

No, blood will be found in the arteries of all those who die suddenly from Coma, and in many other cases of sudden death.

ON DISINFECTION.

What is a disinfectant?

A disinfectant is anything that will kill micro-organisms.

What is an antiseptic?

An antiseptic is a drug, chemical or agent which restrains the action of putrefactive bacteria.

What is a deodorant?

Anything which destroys disagreeable odors.

What are the different forms of bacteria known as?

Micrococci, round-shaped organisms; baccilli, rod-like in form; streptococci, almost like a row of beads; staphylococci, like a bunch of grapes; spirilla, those that are curved or in the form of a corkscrew; diplo cocci, those found in pairs; tretrads, in fours, and sarcinae, in bales.

What is the greatest disinfectant of modern times?

Formaldehyde gas, used under pressure.

Name some of the other disinfectants recommended by boards of health?

Bichloride of mercury, sulphur, lime chloride, carbolic acid, Labaraques' solution (a solution of chlorinated soda), etc.

Why is Formaldehyde gas preferable to sulphurus acid gas?

It is non-poisonous, is a stronger disinfectant, is non-corrosive, and does not bleach or stain fabric.

What is the proper strength to use bichloride of mercury?

1: thousand.

What per cent. would you use carbolic acid as a disinfectant?

Four per cent. solution.

What is the best disinfectant to be used on clothing that has been around a dead body?

Destroying by fire. If this is objected to, boil or expose to the fumes of Formeldehyde gas for not less than five hours.

What is the best disinfectant to use for the discharges from the patient, of sewage matter, etc.?

A solution of chloride of lime; one ounce in a gallon of water, to which has also been added mercuric chloride and permanganate of potash.

According to the National Conference of State Boards of Health, what bodies cannot be shipped?

Those dead of small-pox, Asiatic cholera, yellow fever, typhus fever, and bubonic plague.

What is a contagious disease?

A contagious disease is one capable of being communicated from the sick to the well, either by atmospheric, diffusion, or by absolute contact with the germs.

What is an infectious disease?

An infectious disease is one that does not spread by atmospheric diffusion, and can only be communicated from the sick to the well by direct innoculation, or direct entrance into the system in water foods, etc.

How would you take care of yourself and family if called to handle some body dead of the most violent of contagious and infectious diseases?

By protecting my clothing with a rubber overcoat buttoned close about the neck, rubber boots on the feet, and the hands encased in rubber gloves. The air passage may be protected by means of any of the protectors sold by the instrument makers for this purpose. The face and hair should be washed in a solution of bichloride of mercury, 1: thousand.

Why is absorbent cotton used in wrapping a dead body?

Because no germs can pass through it.

Can a germ penetrate a rubber garment?

No.

What diseases are liable to be communicated by bed-clothes, etc.?

Scarlet fever, diphtheria, measles, small-pox, Asiatic cholera, etc.

What disease is usually communicated by means of drinking water?

Typhoid fever.

What is diphtheria?

Diphtheria is an acute, specific, epidemic, contagious disease, characterized by sore throat, in which membranes form on the throat tonsils, uvula, and back of the fauces.

What are the germs causing scarlatina and small-pox known as?

Neither of these germs has been discovered.

Name two effective deodorizers?

Chloride of lime and permanganate of potash.

What cases are especially liable to cause blood poisoning?

Syphylis, septicaemia, puerperal fever and bodies only dead a few days.

What precaution would you use in case you accidently cut yourself in making a dissection of a dead body which had not previously been disinfected.

Cauterize the part at once. Use either nitrate of silver or carbolic acid.

How would you disinfect a dead body?

By a thorough arterial and cavity injection with an embalming fluid containing a proved disinfectant. Wash the body with the same, plug all orifices with absorbent cotton and wrap in cotton one inch thick.

Do you consider an ordinary embalming fluid to be a disinfectant?

No, only those fluids containing bichloride of mercury in the proportion of 1:1000, or Formaldehyde, 10 per cent., are considered to be good disinfectants.

What is the difference between a disinfectant and a deodorizer?

Disinfectant kills micro-organisms; a deodorizer merely destroys offensive odors.

If a person should die during hot weather from suspected poisoning, and it was necessary to have the stomach analyzed, state how you would preserve the body until this could be accomplished?

By putting it in an ice-box or in cold storage, with the temperature below 32 degrees F.

What bodies are most likely to decompose rapidly, regardless of the time of year?

Plethoric subjects and those who have met death by drowning, or who have died from dropsy, or those dead from childbirth.

What instructions would you give a family in case of a death from one of the contagious diseases?

Advise them not to kiss the subject and to observe all the laws of sanitary science regarding the spread of contagious and infectious diseases; disinfect the apartment with Formaldehyde gas; insist on having a private funeral.

In case of syphilis, puerperal fever and blood poisoning. is it necessary to disinfect the atmosphere?

No.

How should the body of one dead of an infectious disease be disinfected?

By the same method as that laid down under treatment of contagions cases.

Is a private undertaker allowed to conduct a small-pox funeral?

No.

Would you make any distinction between bodies dead from diphtheria and those dead from membranous croup?

No.

What precaution would you take in transferring a body which had been dead one year from one cemetery to another?

First, only healthy and strong individuals should be employed; second, all bodies should be removed in a tight metellic case, and a free use of chloride of lime and corrosive sublimate should be employed.

What would you do with the clothes, bedding, etc., in case of death from diphtheria, scarlet fever. or anthrax, etc.

Burn them.

Describe some other mode of preserving bodies than that of embalming them.

Either by placing them in cold storage, with a temperature 32 degrees F.. or by immersion in preservative solutions, or by dissicating them by drying with hot air.

Name some of the contagious diseases.

Pneumonia, diptheria. measles, scarlet fever, typhus fever, small pox, etc.

Name some of the infectious diseases.

Syphilis, puerperal fever, blood poisoning, typhoid fever, etc.

What is necessary to prepare a body dead of a contagious or infectious disease so that it may be transported by rail.

See chapter on rules for transportation.

Self Pronouncing Dictionary

— of —

Medical and Scientific Terms.

A

Ab'domen or **Abdo'men**. One of the great visceral cavities of the body, bounded by the diaphragm above and the pelvis below.

Abdom'inal. Relating to the abdomen.

Abdom'inal Aorta. The aorta which is below the diaphragm.

Abdom'inal Cavity. The cavity which is within the peritoneum.

Abdom'inal Muscles. Internal and external obliques, transversalis, rectus, pyramidalis, and quadratus lumborum.

Abdom'inal Rings. The ring-like opening on each side of the abdomen, external and superior to the pubes, giving passage to spermatic cord in the male and round ligament in the female.

Abdom'inal Regions. The nine regions of the abdomen: Right and left hypochondriac, right and left lumbar, right and left inguinal, epigastric, umbilical and hypogastric.

Abduct'or. A muscle or nerve, the action of which moves certain parts by abduction.

Aber'rant Arteries. The long, slender vessels which are connected with the brachial or axillary artery.

Abla'tion. Removal of a part of the body, especially by a cutting operation.

Abnorm'al. Not conformable to the natural law or customary order.

Abnorm'ity. That which is abnormal, especially a malformation.

Abort'. To miscarry; to fail to fully develop.

Abor'tion. The expulsion of a fœtus before it is viable. (The termination of pregnancy by the expulsion of the ovum before the fœtus has quickened.)

Abs'cess. A pus formation in some cavity of the body which is the result of localized inflammation.

Absorb'ents. Organs or parts which absorb, withdraw or take up; a medicine or dressing absorbing liquids or gases; a substance which mechanically takes up excreted matter; a lymphatic or lacteal

ABSORP'TION. The process by which nourishment, medicines, morbid products of metamorphosis, etc., are taken up by the lymphatic and venous systems. (In general, the act of absorbing; the imbition of nutritive or other material by a living organism; the process of taking up waste or effete material into the general circulation.)

ACCIDENTAL HEMORRHAGE. A hemorrhage that occurs during pregnancy, or by accident.

ACETAB'ULUM. The cup-shaped cavity of the hip bone which receives the head of the femur.

AC'ETATE. Any salt composed of acetic acid.

ACET'IC ACID. An acid solution containing thirty-six parts of absolute acetic acid and sixty-four parts water (and having strong acid properties).

ACHIL'LES TENDON. The common tendon of the gastrocnemius and soleus muscles, being the thickest and strongest of the body.

ACT'IVE. A term applied to treatment the opposite of passive; that is, where the pathalocical conditions are acted upon directly rather than partly controlled.

ACUTE'. A term applied to diseases with a certain degree of severity, rapid progress and short duration; sharp and quick as opposed to chronic.

AD'AM'S AP'PLE. Name commonly applied to the prominence made externally by the upper and middle portion of thyroid cartilage.

AD'DISON'S DISEASE. A disease, the leading characteristics of which are dark-brown pigmentation of the skin, anaemia, gastric disturbances and general weakness. It is usually associated with tuberculosis or other destructive disease of the supra-renal capsules.

ADDUC'TION. Any movement by which parts are drawn toward the axis of the body.

ADDUC'TOR. A muscle that draws toward the median line of the body or limb.

ADENI'TIS. The inflammation of a gland.

ADHE'SION. The healing of a wound without granulation or suppuration; the healing of a wound by opposite granulating surfaces becoming united.

ADHE'SIVE. Having the property of, or causing adhesion.

AD'IPOSE. Relating to fat.

AD'IPOSE ARTERIES. Arterial branches which supply the renal fat.

ADULT'. One who is of legal age.

ADVENTI'TIA. Outer coat of blood vessels.

ADNAM'IC. Affected with weakness of vital powers.

AERA'TION. The act of supplying with fresh air or oxygen: change venous blood into arterial; ventilation.

AERO'BIA. Existence in an atmosphere which contains oxygen.

AERO'BIC. Term applied to organisms requiring air or oxygen in order to live.

AFFEC'TION. The manner in which mind or body is affected or modified; disease.

AF'FERENT. Conveying toward the center, as periphery to center.

AF'FLUX. Flow of blood or other liquid to some particular part.

AFFLU'SION. The action of pouring water upon a substance to cleanse it, or upon the body in fevers to reduce temperature and calm nervous prostration.

AF'TER-BIRTH. The placenta and membranes expelled after the birth of a child.

A'GENT. Any power that produces, or tends to produce, effect on the body. (A substance or force, which by its action, effects changes in the human body.)

AGGLOM'ERATE. Gathered together; appled to glands.

AGGLUTINA'TION. A gluing or joining together; applied to the healing of wounds.

AG'GREGATE. Grouped into a mass. A term applied to glands which are in clusters.

AGITA'TION. The act of putting into active or violent motion; mental disturbance.

AG'MINATED. Aggregated; clustered; applied to glands.

AG'ONY. Violent pain; extreme anguish; the death struggle.

A'GUE. Common name for intermittent fever.

AIR CELLS. Air sacs; air-vesciles of the pneumonic tissue.

A'LA. A name applied to parts which resemble a wing.

ALBU'MEN. The white of an egg.

ALBU'MIN. A proteid substance, the chief constituent of the body; or a peculiar constituent principle of essentially the same character as the albumen of an egg, found in the animal and vegetable kingdoms.

ALBU'MINATE. The compound of albumin and certain bases, as albuminate of iron, or of iron and potassium, mercury, etc.

ALBU'MINOID. Resembling albumen.

AL'COHOL. A liquid obtained by the distillation of fermented grain or starchy substance.

AL'COHOL, ABSOLUTE. The strongest alcohol which can be procured.

AL'DEHYDE. A colorless liquid of a suffocating odor and readily absorbing oxygen from the atmosphere.

ALIMENT'ARY. Pertaining to aliment; nourishing.

ALIMENT'ARY CANAL. The entire passage (from the mouth to the anus) through which the aliment or food passes.

ALIMENT'ARY DUCT. A name sometimes applied to the thoracic duct.

AL'KALI. A term applied to an important class of binary compounds which combine with acids to form salts, and with oil or fat to form soap, and have the power to change vegetable blues to green.

AL'KALI ALBU'MIN. A derived albumin; a proteid having been acted upon by dilute alkalies and yielding an alkaline reaction.

AL'KALOID. Resembling an alkali.

AL'UM or AL'UMEN. The sulphate of alumina and potassa, a double or sometimes a triple salt, consisting of sulphuric acid and alumina, with either potassa or ammonia, or frequently both.

ALU'MINA. The principal ingredient of clay and of many stones, earths and minerals.

ALVE'OLAR. Pertaining to the alveoli, or sockets of the teeth.

ALVE'OLAR STRUCTURE. A term applied to minute superficial cavities found in the mucous membrane of the stomach, œsophagus and small intestines, which are sometimes compared to the cells of honeycomb.

ALVE'OLUS. A little hollow; applied to the socket of a tooth, or other cavity.

AM'BULANCE. A vehicle for the transferance of the sick or wounded from one place to another.

AM'BULATORY. Relating to walking.

AMBUS'TION. A burn or scald.

AMŒ'BA. A colorless, single-celled, jelly-like protoplasmic organism found in sea and fresh waters, constantly undergoing changes of form and nourishing itself by surrounding objects.

AME'BOID. Resembling an amœba in form or in changes; white blood cells, etc.

AMMO'NIA. A volatile alkali. A transparent, colorless, pungent gas, formed by the union of nitrogen and hydrogen.

AMO'NIUM. The supposed metallic base of ammonia.

AM'NION. The soft, moist, internal membrane containing the waters which surround the foetus *in utero*.

AMORPH'OUS. Having no definite form; shapeless; uncrystallized.

AMPUTA'TION. The operation of cutting off a limb or a projecting part of the body.

AM'YLOID. Resembling starch.

ANAL'YSIS. The resolution of compound bodies into simple, or constituent parts.

ANASAR'CA. Dropsy in the integuments of the body. General dropsy as distinguished from dropsy of some particular part or membrane.

ANASTOMO'SIS. The communication of branches of vessels with one another.

ANAT'OMY. The dssection of organic bodies in order to study their structure, the situations and uses of their organs, etc.

ANAT'OMY COMPAR'ATIVE. The investigation and comparison of the anatomy of different orders of animals or of plants, one with another.

ANAT'OMY MORBID. A study of diseased structures.

ANAT'OMY REGIONAL. A study of limited parts or regions of the body, the divisions of which are collectively or peculiarly affected by disease, injury, operations, etc.

ANE'MIA, *an-e-me-ah*. Deficiency of blood and red corpuscles.

ANE'MIC. Pertaining to anenia.

ANERO'BIA. Faculty of living without oxygen.

ANERO'BIC. Living without oxygen, as bacteria.

ANESTHET'IC. A substance that produces insensibility to feeling or to acute pain, diminished muscular action and other phenomena.

AN'EURISM, *an'-u-rizm.* A tumor filled with blood from the rupture, wound, ulceration or simple dilation of an artery; also applied to dilation of the heart.

ANGI'NA ACU'TA. Simple sore throat.

ANGI'NA PEC'TORIS. Spasm of the chest; a disease attended by acute pain, sense of suffocation and syncope.

ANGIOG'RAPHY. A description of the vessels of the body.

AN'GULAR. Pertaining to an angle.

AN'GULAR AR'TERY. Terminal branch of the facial artery.

AN'ILINE. An oily liquid formed by the action of caustic potash on indigo, and also obtained from coal-tar and benzol. It is very poisonous.

AN'IMAL. An organic being having life and power of motion.

AN'IMAL HEAT. The normal temperature of the body; about 98.5 degrees F.

AN'IMAL TISSUE. A general name for any of the textures which form the elementary structures of the body.

ANIMAL'CULE, *an-i-mal'-kule.* An organism so small as to require the microscope for its examination.

AN'KLE. The joint between the tibia and fibula above and on the sides, and the astragalus below.

ANKYLO'SIS. Union of the bones forming a joint, resulting in a stiff joint.

AN'NULAR. Ring-like. (A number of ligaments of the joints are called annular, as those of the ankle, wrist, etc.)

ANOM'ALOUS. Irregular; not according to rule or system; contrary to the natural order; applied to diseases or symptoms out of the regular course.

ANOM'ALY. Irregularity; deviation from rule.

ANTAG'ONIST. A term applied to muscles whose function is opposed to that of others, as abductors and adductors, extensors and flexors, etc.

ANTEFLEX'ION. A bending forward.

ANTEVER'SION. A turning forward.

AN'THRAX. A carbuncle; a hard, circumscribed, inflammatory, dark red or purple tumor, accompanied by a sense of burning; resembling a boil, but having no central core.

AN'TIDOTE. An agent preventing or counteracting the action of a poison.

ANTIEMET'IC. Releiving nausea.

ANTISEP'TIC. A substance which prevents or retards putrefaction; that is, the decomposition of animal or vegetable bodies and evolution of offensive odors.

ANTITOXIC. Opposed to poison.

ANTIZYMOT'IC. Against fermentation or putrefaction.

AN'TRUM. A cavity in bone.

AOR'TA. Largest artery in the body.

BIOL'OGY. The science of life and living organisms.

BIS'TOURY, *bis'-too-rē.* A curved knife.

BLAD'DER. Membraneous sac receiving the urine.

BLAD'DER, GALL. Membranous sac on the under surface of right lobe of liver, receiving the bile.

BLEB. A blister.

BLIS'TER. Collection of serous fluid beneath the cuticle.

BLOOD. Red fluid circulating through the heart, arteries, capilliaries and veins.

BLOOD CELL. A blood corpuscle.

BLOOD COR'PUSCLES. Morphological constituents floating in the blood, including red and white corpuscles and discs.

BLOOD PLAS'MA. The liquor sanguinous.

BLOOD POI'SONING. Infectious disease of the blood.

BLOOD PRES'SURE. Pressure of the blood against the walls of the blood vessels.

BO'RIC AC'ID. White antiseptic powder (H_3BO_3) from Borax.

BOW'ELS. The intestines.

BRACH'IAL. Relating to the arm.

BRACH'IAL AR'TERY. Continuation of the axilary artery along inner side of arm to bend of elbow.

BRAIN. The entire nervous mass within the skull.

BRIGHT'S DISEASE. Kidney disease with albuminuria.

BRIM OF PEL'VIS. The edge of the inlet of the pelvis.

BROAD LIG'AMENT. A double layer of peritoneum, extending from the sides of the uterus to the sides of the pelvis.

BRON'CHI. Pleural of Bronchus; the lobes of the lung.

BRON'CHIAL, *brong'-ke-al.* Relating to bronchus.

BU'BO. An inflamed and swollen lymphatic gland, especially in the groin.

BUBON'IC, *bū-bon'-ik.* Pertaining to, or in the nature of bubo.

BUF'FY COAT. Yellowish coagulum on the surface of coagulated blood.

BULB. Any rounded swelling or part.

BULB, OLFAC'TORY. The olfactory nerves resting on the ethmoind bone.

BUL'LA, *bul'ah.* A large blister in under the cuticle.

BURN. A lesion caused by the application of heat.

BUR'SA, *ber'-sah.* A sac or pouch of any sort.

BUT'TOCKS. The rounded prominence formed by the gluteal muscles over the ischium.

C

CACHEX'IA, *kak-ex'-e-ah,* A depraved condition of health.

CADA'VER, *kad-a'-ver.* A dead human body.

CADAV'ERINE. Liquid Ptomaine ($C_5H_{14}N_2$) formed in putrefying flesh.

CALCA'NEUM, *kal-kā'nē-um.* The heel bone.

CALCA'REOUS. Containing lime.

CALCIFICA'TION, Changing into lime; deposit of lime salts.

CAL'CIS, Os. The largest bone of the foot, forming the heel.

CAL'CIUM, *kal'-sē-um.* Metalic element, the base of lime.

CAL'CULUS. A stone-like concretion in any part of the body.

CALF, *kaf.* Fleshy part at back of leg.

CAL'LOUS, *kal'-us.* Hardened.

CAL'LUS, *kal'-us.* Osseous matter deposited around a fractured bone.

CALOR'IC, *ka-lor'-ik.* Pertaining to heat

CALVA'RIA, CALVA'RIUM. The top of the skull.

CANAL'. Any tubular passage in the body.

CAN'CELLOUS. Resembling a grating in structure.

CANINE' TEETH. Third tooth from the front in each side.

CAN'KER, *kang'-ker.* An ulceration, especially about the mouth.

CAN'NULA, *kan'-ū-lah.* A hollow instrument for introduction into the body.

CAP'ILLARY. From *capillus*, relating to hair; one of the minute blood vessels forming a network between arteries and veins.

CAP'SULE, *kap'-sūl.* Membraneous sac enclosing a part.

CAP'SULE, SUPRA-RE'NAL. The fatty capsules over the superior border of the kidney.

CAP'UT. Head.

CARBOL'IC ACID. Colorless crystaline substance (C_6H_6O) from coal tar.

CAR'BON. Non-metalic element occurring in form of diamond, graphite, charcoal, etc.

CARBON'IC ACID. Effervescing liquid made by dissolving carbon dioxide in water.

CAR'BUNCLE, CARBUN'CULUS, *kar'-bung-kl, kar-bung'ku-lus.* Circumscribed inflammation of subcutaneous tissue, ending in suppuration.

CARCINO'MA, CHIM'NEY-SWEEP'ERS. See Epithelioma. Malignant tumor composed of epithelial cells.

CARCINO'MA, ENCEPH'ALOID. Brain like cancer

CARCINO'MA LENTIC'ULARE. Carcinoma of the lens.

CARCINO'MA, SCHIR'RUS. Hard, stone-like cancer.

CAR'DIA, *kar'-de-ah.* Cardinac orifice of the stomach.

CAR'DIAC, *kar'-de-ak.* Of, or relating to the heart.

CARDI'TIS, *kar-dī'-tis.* Inflammation of the heart.

CA'RIES, *kā'-ri-ēz.* Ulceration of bone.

CA'RIOUS, *kā'-re-us.* Having or affected with caries.

CARNIFICA'TION. Change of a tissue into flesh.

CAROT'ID. Pertaining to Carotid artery.

CARPHOL'OGY, *kar-fol'-ō-gē.* Plucking movements of the fingers in condition of extreme exhaustion.

CAR'PUS. The wrist: Pertaining to the eight bones of the wrist.

CAR'TILAGE. Grissel. White, elastic substance found at the articular surface of bone.

CA'SEOUS, *kā'-sē-us.* Oheese-like structure.

CATAB'OLISM. Passage of protoplasm from higher to lower form.

CAT'ALEPSY, *kat'-a-lep-se.* Nervous disease marked by attacks of suspension of sensibility and voluntary motion.

CATAME'NIA, *kat-a-mē'-nē-aih.* The monthly discharge from the Uterus.

CAT'ARACT, *kat'-a-rakt.* An opacity of the crystaline lens.

CATARRH', *kat-ar'.* Inflammation of mucous membrane, especially of the naso pharynx.

CAT'GUT. Substance from the intestines of sheep.

CATH'ETER, *kath'-e-ter.* Tubular instrument for introduction into some bodily canal.

CATH'ETERISM, *kath'-e-ter-ism.* Operation of introducing a catheter.

CAT'LING. A straight, sharp-pointed amputation knife.

CAU'DAD, *kaw'-dad.* Towards the tail.

CAU'DAL, *kaw'dal.* Of, or relating to the tail.

CAUS'TIC, *kaws'-tik.* Burning, eating into tissue.

CAUS'TIC, LU'NAR. Nitrate of silver.

CAU'TERY. An agent applied for destruction of tissue, either heat or some caustic substance.

CAV'A, *kav'ah.* The terminal veins ending in the right auricle of the heart.

CAV'ERNOUS, *kav'-er-nus.* Containing cells or caverns.

CAV'ITY, *kav'-i-te.* Any hollow space.

CE'CAL, *sē'-kal.* Of or relating to the cæcum.

CE'CUM, *se'-kum.* Dilated portion of ascending colon.

CE'LIAC, *sē'-le-ak.* Pertaining to celiac artery.

CE'LIAC AX'IS. The first large branch given off by the aorta after passing through the diaphragm.

CELL, *sel.* One of the minute masses of protoplasm composing organized tissue.

CELL'ULAR, *sel'-u-lar.* Composed of or containing cells.

CELL'ULAR TISSUE. Loose connective tissue having large inter-spaces.

CELLULI'TIS, *sel--lī'ū-tis.* Inflammation of cellular tissue.

CEN'TIGRADE THERMOM'ETER. A thermometer in which the scale contains 100 degrees between 0 degrees, the melting point of ice, and 100 degrees, the boiling point of water.

CEPHAL'IC, *sef-al'-ic.* Of and relating to the head.

CEPHAL'IC VEIN. Tributary of axillary vein.

CEPHALO'MA, *sef-al-ōm'-ah.* A soft tumor.

CE'RA, *sē'-rah.* Wax.

CEREBELLI'TIS, *serē--bel-ī'-tis.* Inflammation of cerebellum.

CEREBEL'LUM, *ser-e-bel'-um.* The portion of the brain behind the cerebrum.

CER'EBRAL, *ser'ē--bral.* Of or relating to the cerebrum.

CER'EBRO-SPI'NAL. Relating to the cerebrum and spinal cord.

CER'EBRO-SPI'NAL CAVITY. Cavity containing brain and spinal cord.

CER'EBRO-SPINAL FE'VER. (Meningitis.) Fever resulting from inflammation of brain and cord.

CER'EBRUM, *ser'-ē-brum.* The larger and upper portion of the brain.

CER'VICAL, *sir'-vē-kl.* Of, or relating to the neck.

CER'VIX, *sir'-viks.* The neck of the uterus (womb).

CESA'REAN OP'ERATION. Opening abdomen in median line for removal of child.

CHAM'BERS, *cham'-bers.* Anterior and posterior cavities of the eye.

CHANGE OF LIFE The menopause. The period at which menstruation ceases.

CHEST. Cavity of body containing heart and lungs.

CHICK'EN-POX (Varicella). An infectious febrile disease of childhood. accompanied by the formation of vesicles, which dry up, leaving slight pitting of the skin.

CHILD'BED. The puerperal state (time of confinement).

CHILD'BED FE'VER. Puerperal fever after child birth.

CHLO'RAL. An oily liquid.

CHLO'RAL HY'DRATE. Chloral combined with water.

CHLO'RIDE, *klō'-rīd.* Combination of chlorine with an element or radicle.

CHLORINE, *klō'-rēn.* Yellowish green gaseous element.

CHLO'ROFORM. Colorless volatile liquid—anaesthetic and spasmodic, used externally.

CHLORO'MA, *klo-ro'-mah.* Green malignant tumor of the periosteum covering the skull.

CHOLECYSTECT'OMY. Excision of the gall bladder.

CHOL'ERA, *kol'-e-rah.* Disease marked by purging, vomiting, griping spasms, etc.

CHOL'ERA, ASIAT'IC. An infectious and malignant form of cholera, usually fatal, caused by coma bacillus.

CHOL'ERA INFANT'UM. Cholera in children during summer.

CHOL'ERA MOR'BUS. Gastro enteritis, with vomiting, diarrhœa and cramps.

CHOLES'TERIC. Crystaline fatty substance from bile and nerve tissue.

CHON'DRIN, *kon'-drin.* Proteid substance from cartilage.

CHORE'A. St. Vitus dance. A nervous disease with irregular and involuntary movements of the limbs.

CHRON'IC, *kron'-ik.* Long continued, not acute.

CHYLE, *kīl.* The milky liquid formed in the lacteals after digestion.

CHYLOPOIET'IC, *ki-lo-poi-et'-ik.* Pertaining to the stomach, intestines, spleen and liver.

CICATRI'CIAL, *sik-a-trish'-al.* Of, or relating to cicatrix.

CICA'TRIX, *si-ka'-triks.* A scar of a wound.

CIL'IA, *sil'-e-ah.* The eye lashes.

CIL'IARY AR'TERIES. Relating to arteries of the ciliary body.

CIR'CLE OF WIL'LIS. Circle of arteries formed by the branches of the internal carotids and the basilar on the base of the brain.

CIRCULA'TION, A moving in a circle as of the blood.

CIRCUMDUC'TION. Circular movement of a limb.

CIR'CUMFLEX. Winding around.

CIR'CUMSCRIBED. Limited, confined to a definite space.

CIRCUMVAL'LATE. Large papialiae on dorsem of tongue.

CIRRHO'SIS. Interstitial inflammation of any organ, especially the liver.

CLAV'ICLE. The collar bone.

CLIMAC'TERIC, *kli-mak'-te-rik*. Critical period of life, especially the menopause.

CLIN'IC, *klin-'ik*. Instruction at the bed-side.

CLIN'ICAL, *klin'-ik-al*. Relating to clinic.

COAGULA'TION, *kō-ag-ū-lā'-shun*. Process of changing into a clot.

COAG'ULUM. Same as clot.

CO'CAINE. Colorless alkaloid; from cocoa; local anæsthetic and stimulant.

COCCYG'EAL, *kok-sij'-ē-al*. Pertaining to the coccyx.

COCCYGODYN'IA, *kok-si-gō-din'-e-ah*. Pain in the coccyx.

COC'CYX, *kok'-siks*. Small triangular bone at end of the sacrum.

COHE'SION, *kō-hē'-shun*. The force holding together the particles of a body.

COLI'TIS, *kō-lī'-tis*. Inflammation of mucous coats of colon.

COLLAPSE'. A falling in. 2. State of extreme prostration.

COLLAT'ERAL. Circulation through lateral or secondary channels.

COLLO'DION. Solution of pyroxylin in ether and alcohol applied locally to burns, wounds, etc.

COL'LOID. Glue-like. 2. A non-crystalloid.

CO'LON, *kō'-lon*. Large intestine from cæcum to rectum.

COLUM'NAE CAR'NEAE, *kol-um'-nē kar'-nē-ē*. Muscle columns of carnea in the heart.

CO'MO STU'POR. State of lethargy from severe nervous disturbance.

CO'MATOSE, *kō'-ma-tōs*. Relating to or affected with coma.

COMBUS'TION, *kom-bus'-chun*. Burning.

COM'MA BACIL'LUS. The spirillum of Asiatic cholera.

COMMINU'TION. Act of breaking into fragments.

COMPLICA'TION. A disease occurring with another and intensifying its character.

COMPOSI'TION. The act of forming a whole of various dissimilar parts.

COM'POUND FRAC'TURE. Fracture with external wound into the bone.

COM'PRESS, *kom-press*. Folded cloth or other material for applying pressure.

COMPRESSION OF BRAIN. Pressure upon brain by tumors, effusions, fractures, etc.

CON'CAVE, *kon'-kave*. Presenting a hollow or depressed surface.

CONCA'VO-CON'CAVE. Having two concave faces.

CONCENTRA'TION. The state of being brought to a point.

CONCEP'TION, *kon-sep'-shun*. Act of being impregnated.

CONCUS'SION OF BRAIN. Diseased state produced by violent blows on the head.

CONDUC'TOR. (1) Body which permits conduction. (2) Grooved instrument for grinding knife.

CON'DYLE, *kon'-dīl.* Round eminence at articular end of bone.
CON'DYLOID, *kon'di-loid.* Resembling or relating to a condyle.
CONFINE'MENT, *kon-fīn'-ment.* Childbirth, or period of childbirth.
CON'FLUENT, *kon'-flūent.* Flowing, or running together.
CONGEN'ITAL, *kon-jen'-i-tal.* Existing from birth.
CONGES'TION, *kon-jes'-chun.* Excessive accumulation of blood in a part.
CONGES'TION OF THE LUNGS. Excessive accumulation of blood in the lungs.
CONGES'TIVE FEVER. Malarial fever.
CONGLOM'ERATE. To collect into a round mass.
CONJUNCTI'VA, *kon-jungk-tī'-vah.* Delicate mucous membrane lining eyelids and covering eyeballs.
CONJUNCTIVI'TIS, *kon-jungk-ti-vī'-tis.* Inflammation of conjunctiva.
CONNEC'TIVE TISSUE. The tissue which supports and binds together the structures of the body.
CONSTIPA'TION, *kon-sti-pā'-shun.* Infrequent or incomplete evacuation of bowels.
CONSTITU'TIONAL DISEAS'ES. Disease affecting the whole body.
CONSTRIC'TOR. Muscle which contracts an opening.
CONSUMP'TION, *kon-sump'-shun.* Any wasting of body, particularly pulmonary phthisis.
CONTA'GION. (1) Communication of disease through contact or proximity. (2) Contagium.
CONTA'GIOUS, *kon-tā'-jus.* Communicable by contagion.
CONTA'GIUM. The agent by which a disease is transmitted.
CONTIGU'ITY, *kon-ti-gū-i-te.* Contact.
CONTIN'UED FE'VER. Fever without intermission of symptoms.
CONTINU'ITY, *kon-ti-nū'-i-te.* State of being continuous.
CONTINU'ITY, SOLUTION OF. Fracture.
CONTRAC'TION. A drawing together or shortening.
CONTU'SION. (1) A bruising. (2) A bruise.
CONVALES'CENCE. Period of recovery from disease.
CONVER'GENT, *kon-ver'-jent.* Tending to the same point from different places.
CON'VEX, *kon'-veks.* Having an elevated rounded surface.
CONVUL'SION. An involuntary contraction of voluntary muscles.
CONVUL'SION, PUER'PERAL. Convulsions during parturition.
CONVUL'SION, URE'MIC. Convulsions due to uremic poison.
CO-ORDINA'TION. Harmonious working, especially of muscles.
COP'PERAS. Ferrous sulphate ($Fe\ So_4+7H_20$).
COR'ACOID, *kor'-a-koid.* Resembling a crow's beak.
CORD, UMBIL'ICAL. Cord connecting child in utero to the placenta (after birth).
CO'RIUM, *kō'-re-um.* The true skin beneath the epidermis.
COR'NEA, *kor'-ne-ah.* The transparent anterior part of the eyeball.
COR'ONARY, *kor'-ō-nā-re.* Encircling.

COR'ONER. Officer who holds inquests over mysterous deaths.
CORPSE, *korps*. Dead body of a human being.
COR'PULENCY. Obesity, fatness.
COR'PUS CALLO'SUM. The mass of white substance joining cerebra hemispheres.
COR'PUSCLE, *kor'-pus-l* A small body. A cell.
COR'PUSCLES OF BLOOD. Red and white blood cells.
CORRO'SIVE, *ko-rō-siv*. Destroying or eating away.
CORRO'SIVE SUB'LIMATE. Mercuric chloride.
COR'REGATOR, *kor'-ū-gā-tor*. A muscle producing wrinkling.
COR'TEX. Bark, or external layer.
COR'TICAL. *kor'-te-kal.* Pertaining to the cortex.
COS'MOLINE, *koz'-mō-lin* Vaseline.
COS'TAL. Of or relating to the ribs.
CRAMP. Painful spasmodic contraction of muscles.
CRA'NIAL, *krā'-ne-al*. Of or relating to cranium.
CRA'NIUM, *krā'-ne-um*. The skull.
CREMA'TION, *krē-mā'-shun*. Burning of dead bodies.
CRICOID CAR'TILAGE. Ring-like cartilage at lower part of larynx.
CROUP, *kroop*. Disease of the larynx with dysponea, stridulous breathing, and dry, harsh cough.
CRU'RAL ARCH. Same as femoral arch.
CUL'-DE-SAC, *kool'-de-sak*. Tube or cavity closed at one end.
CUL'-DE-SAC, DOUGLAS'S. Pouch at posterior part of uterus.
CUL'TURE. Cultivation.
CURETTE', *kū-ret'*. Instrument for removing granulations and growth by scraping.
CURRIC'ULUM. *kur-ik'-ū-lum*. A prescribed course of study at college.
CUTA'NEOUS, *kū tā'-nē-us*. Of or relating to skin.
CU'TICLE, *kū'-ti-kl*. The epidermis or outer layer of skin.
CU'TIS, *kū'-tis*. The skin, especially the true skin.
CYANO'SIS. Blueness of skin from deficient oxygenation of blood.
CYANOT'IC, *sī an-ot'-ik*. Affected with cyanosis.
CYST, *sist*. Any membraneous sac containing liquid.
CYS'TIC, *sis'-tik*. Relating to or having cysts.
CYSTI'TIS, *sist-ī'-tis*. Inflammation of the bladder.
CYST'OCELE, *sist'-ō-sēl*. Hernia of the bladder.
CYSTOT'OMY, *sist-ot'-ō-me*. Operation of cutting into the bladder.

D

DEATH, *deth*. Extinction of life. Absolute and permanent cessation of vital function.
DEATH'-RATE. The proportion of persons dying to those surviving.
DEATH'-RAT'TLE. The rattling sound in the throat of a dying person.
DECALCIFICA'TION. Removal of calcareous matter from tissues.

DECAPITA'TION. Removal of head of foetus in labor. (2) Cutting off the head of an animal.

DECID'UA, *dē-sid'-ū-ah.* Membraneous structure produced during gestation and thrown off after parturition consisting Decidua vera lining, the interior of the uterus.

DECOMPOSI'TION. Putrefactive decay caused by micro organisms.

DECUS'SATE, *dē-kus'āt.* To cross like the letter X.

DEFECA'TION, *def-ē-kā'-shun.* The act of discharging the fæces.

DEFORM'ITY, *dē-for-mi-te.* A malformation. This may involve the whole body, as in dwarfs, of whom there have been some remarkable peripatetic specimens.

DEGENERA'TION. Change of tissue from a higher to a lower form.

DEGENERA'TION, CALCA'REOUS. Degeneration with deposit of calcium carbonate.

DEGENERA'TION, COL'LOID. Change of tissue into a jelly-like substance.

DEGENERA'TION, FATTY. Change of tissue into fats. (b) Amyloid degeneration.

DEGENERA'TION, MU'COID. Change of semi-solid tissue to mucous.

DEGREE', *dē-grē'.* A step; a space in progression.

DEHYDRA'TION, *dē-hī-drā'-shun.* Removal of water from a compound.

DELIR'IUM, *dē-lir'-e-um.* Derangement of the mind marked by excitement, incoherent speech and illusions.

DELIR'IUM TRE'MENS. Delirum from excessive alcoholism.

DELIV'ERY, *dē-liv'-e-re.* Extraction of the child in parturition.

DEMEN'TIA, *de-men'-she-ah.* Insanity marked by weakness of intellect.

DEN'SITY, *den'-si-te.* The degree of compactness.

DEO'DORANT, *de-o'-do-rant.* Destroying odor or an agent so acting.

DEODORI'ZER, *de-o-do-ri-zer.* An agent that destroys odors.

DEPIL'ATORY, *de pil-a-to-re.* Removing hair, or an agent so acting.

DEPLE'TION. Removal of fluid, especially blood, from the body.

DEPOS'IT. 1. Sediment. 2. Inorganic material collected in tissues.

DEPRAVA'TION, *dep-ra-va'-shun.* Change for the worse; deterioration.

DEPRES'SANT. A medicine which retards any function.

DESSICA'TION, *des-i-ka'-shun.* The act of making dry.

DES'ICCATIVE. Lessening the moisture of a wound.

DESQUAMA'TION, *des-qwa-ma'-shun.* Separation of scales from the skin.

DEVEL'OPMENT, *de-vel'-op-ment.* Detection. To originate.

DEVIA'TION. A turning to one side.

DIABE'TES, INSIP'IDUS. Abnormal flow of urine.

DIABE'TES MEL'LITUS. Urine contains much sugar.

DIABET'IC, *dī-a-bet-ik.* Relating to diabetes.

DIABET'IC GAN'GRENE. Same as sphaceloderma.

DIAGNO'SIS. Determination of disease by examination.

DIAPEDE'SIS, *dī-a-pē-dē'-sis.* Passage of corpuscles through the walls of blood vessels.

DI'APHRAGM, *dī'-a-fram.* Muscular partition between thorax and abdomen.

DIAS'TOLE, *dī-as'-tō-lē.* The dilation of the heart by which it becomes filled with blood.

DIFFERENTIA'TION. Specialization of tissue or of function.

DIFFUSE'. Widely spread.

DIGAS'TRIC, *dī-gas'-trik.* Having two bellies.

DIGES'TION, *dī-jes'-te-on.* The process by which food is converted into matter fit for assimilation.

DILITA,TION, *dil-a-tā'-shun,* Enlargement or expansion of an organ.

DIPHTHE'RIA, *dif-thē'-re-ah* Infectious febrile disease, marked by formation of false membranes on mucous surfaces, especially the throat.

DIPLOCOC'CUS, *dip-lō-kok'-us.* Micro-organism consisting of cocci joined in twos.

DISEASE', *di-zēz.* Any definite departure from health.

DISINFEC'TANT, *dis-in-fek'-tant.* Destroying infection; anything which destroys micro-organisms.

DISSEC'TION. Cutting up of the body for study.

DISSEMINA'TION. Scattered in separate patches.

DISSOLU'TION, *dis-ō-lū'-shun.* Separation or dissolving; especially death.

DISSOL'VENT, *diz-ol'-vent.* A resolvent.

DIS'TAL. Remote from the center or the median line.

DOR'SAL. Relating to the back.

DOR'SUM. (1) The back. (2) The superior surface of a part.

DRACHM, *dram.* A weight of 60 grains.

DRAIN'AGE. Drawing off of discharges from wounds, abscesses, etc.

DRES'SING. Application of a remedy, or bandage to a wound.

DROP'SY. Accumulation of fluid in subcutaneous tissue or in a cavity.

DUCT, *dukt.* A canal in the body for conveying fluid.

DUODE'NAL, *dū-ō-dē'-nal.* Relating to the duodenum.

DUODENI'TIS, *dū-ō-dēn-ī-tis.* Inflammation of the duodenum.

DUODE'NUM, *dū-ō-dē'-num.* The first portion of the small intestine.

DU'RA MA'TER. The tough external membrane of the brain and spinal cord.

DYSENTERY. Inflammation of large intestine with frequent and bloody evacuations.

DYSMENORRHE'A, *dis-men-ō-rē'ah.* Difficult and painful menstruation.

DYSPEP'SIA, *dis-pep'-se-ah.* Impairment of digestion.

E

ECCHYMO'SIS. Extravasation of blood, or a patch caused thereby.

ECLAMP'SIA, *ek-lamp'-se-ah.* An attack of convulsions.

ECTOP'IC GESTA'TION. Out of normal place.

EDE'MA, *ē-dē'-ma.* Swollen, congested, puffed.

EF'FERENT. Conveying away from the center.

EFFLORES'CENCE, *ef-lōr-es'-ens.* State of being efflorescent.

EFFU'SION. Escape of a fluid into part.

EMPYE'MA, *em-pi-ē'-mah.* Collection of pus in a cavity, especially the chest.

ENAM'EL. Hard, white substance investing crown of a tooth.

ENCEPH'ALOID, *en-sef-a-loid,* Resembling brain.

ENCEPH'ALON, *en-sef-al-on.* The brain.

ENDARTERI'TIS, *end-ar-ter-ī'-tis.* Inflammation of internal coat of an artery.

ENDEM'IC, *en-dem'-ik.* Occurring naturally in a certain district.

ENDOCAR'DIAL. *en-do-kar'-de-al.* Produced within the heart.

ENDOCAR'DIUM. Lining membranes of heart cavities.

ENDOSMO'SIS. Passage of a liquid from outside to inside through a porous diaphragm.

ENGORGE'MENT, *en-gorj'ment.* State of vascular congestion.

EN'SIFORM APPEN'DIX. The lower most piece of the sternum.

ENTER'TIC. Pertaining to the intestine.

ENTER'IC FE'VER. Typhoid fever.

ENTERI'TIS, *en-ter-ī-tis.* Inflammation of the intestine.

ENTERO-COLI'TIS. Inflammation of small and large intestine.

ENTERO-GASTRI'TIS. Combined enteritis and gastritis.

ENTEROT'OMY. Formation of an opening into intestines.

EN'TRAILS, *en'-trālz.* The bowels or intestines.

ENUCLEA'TION, *ē-nūk-lēa'-shun.* Removal of a tumor or organ from its envolopes.

ENVI'RONMENT. The external influences or surroundings.

EN'ZYMES, *en'-zims.* Unorganized ferments formed within the body.

EPICAR'DIUM, *ep-i-kar'-de-um.* Innermost layer of pericardium.

EPICRA'NIUM. Structure covering the cranium.

EPIDEM'IC. Attacking many people at the same time.

EPIDER'MIS. The outer layer of the skin; cuticle.

EPIGAS'TRIC, *ep-i-gas'-trik.* Pertaining to epigastrium.

EPIGAS'TRIUM, *ep-i-gas'-tre-um.* Portion of abdomen over stomach.

EPIGLOT'TIS. Petal-like cartilage covering aperture of larynx.

EPILEP'TIC, *ep-i-lep'-tik.* Pertaining to epilepsy.

EPISTAX'IS, *ep-is-tak'-sis.* Nose-bleed.

EPITHELIO'MA, *ep-i-thē-le-ō-mah.* Cancer composed of epithelium cells.

EPITHE'LIUM, *ep-i-thē'-le-um.* The cellular covering of skin and mucous membarnes.

EQUIV'ALENCE. State of being equivalent.

ERO'SION, *ē-rō'-shun.* Eating away of tissue.

ERUP'TION, *ē-rup'-shun.* A breaking out of discoloration or pimples on skin.

ERUP'TIVE, *erup'-tiv.* Bursting forth.

ERYSIP'ELAS, *er-i-sip'-e-las.* Contagious febrile disease marked by peculiar redness and inflammation of skin and mucus membrane.

ERYSIPEL'ATOUS, *er-i-si-pel'-a-tus.* Of the nature of erysipelas.

ERYTHE'MA, *er-i-thē'-mah.* Redness of the skin from superficial inflammation.

ES'CHAR, *es'-kar·* Slough produced by burning.

ESCHAROT'IC, *es-kar-ot'-ik.* Causing a slough.

ESOPHAG'EAL, *ē-sof-aj'-ē-al.* Pertaining to the œsophagus or gullet.

ESOPHAGI'TIS, *ē-sof-aj-ī'-tis.* Inflammation of œsophagus.

ES'SENCE, *es'ens.* The inherent principle of anything.

ESSEN'TIAL, *es-en'-shal.* Constituting the essence of anything.

ETIOL'OGE, *ē-te-ol'-ō-je.* Science of the causes of diseases.

EVAC'UANT, *ē-vak'-ū-ant.* Emptying; especially emptying the bowels.

EVACUA'TION, *ē-vak-ū-ā'-shun.* Discharge of contents of bowles.

EVOLU'TION, *ev-ō-lū-shun.* Development by which anything becomes more complex.

EXANTHEM'ATOUS, *eks-an-them-ā-tus.* Marked by eruption.

EXCIS'ION, *ek-sizh'-un.* Act of cutting out or off.

EX'CORIA'TION, *eks kō-re-a-shun.* Removal, partial or complete, of the skin.

EXCREMENT, *eks'-krē-ment.* Anything excreted.

EXCREMENTI'TIOUS, *eks-krē-men-tish'-us.* Of or relating to excrement.

EXCRES'CENCE, *eks-kres'-ens.* Any outgrowth or projection.

EXCRE'TA, *eks-krēk'-tah.* The excretions of the body.

EXCRE'TION, *eks krē'-shun.* The process of excreting.

EX'CRETORY, *eks'-krē tō-re.* Of or relating to excretions.

EXFOLIA'TION, *eks-fō-le-ā--shun* Separation of dead portions of bone or of skin in the form of scales.

EXHALA'TION, *eks hā-lā'-shun.* The throwing off of vapor from the lungs.

EXHAUS'TION, *eg-zaws'-tyon.* Withdrawal of force.

EXPECT'ORANT. Causing excretion and ejection of mucous from the lungs.

EXPECTORA'TION. Coughing up of matter from the chest.

EX'PERT, *eks'-pert.* One skilled in any branch.

EXPIRA'TION. *eks'-pī-rā-shun.* Act of breathing out from the chest.

EXTEN'SOR, *eks-ten'-sor.* A muscle which extends a part.

EXTIRPA'TION, *eks-tir-pā'-shun.* Complete removal or destruction of a part.

EXTRAVASA'TION. Escape of any bodily fluid from its normal place into the surrounding tissue.

EXTREM'ITY, *eks-trem'-i-te.* The arms and legs; the limbs.

EXUDA'TION, *eks-ū-dā'-tion.* Oozing out of adventitious matter or tissue.

EYE'-BALL. The globe of the eye.

EYE'BROW. Fold of skin covered with hair above the eye.

F

FA'CIAL, *fā' shal.* Relating to the face.

FAC'ULTY. The staff or professors of a college.

FAHR'ENHEIT'S THERMOMETER. One in which the boiling point of water is 212 degrees and the melting point of ice 32 degrees.

FALLO'PIAN LIG'AMENT. The round ligament of the uterus.
FALLO'PIAN TUBES. Same as oviducts; tubes connected to uterus.
FALSE MEM'BRANE. Membraneous deposit due to inflammation.
FALSE RIBS. The ribs not connected with the sternum.
FALX CEREBEL'LI. Portion of dura mater between lobes of cerebellum.
FALX CE'REBRI. Sickle-shaped portion of dura mater between the cerebral hemispheres.
FARAD'IC, *fār-ad'-ic.* Induced electricity. Faradization.
FAS'CIA, *fash'-e-ah.* A layer of connective tissue covering muscles.
FAS'CIA LA'TA. Broad fascia covering the thigh.
FAT. The whitish. oily substance of animal connective tissue.
FAU'CES, *faw'-sēz.* The passage between the throat and the pharynx.
FE'BRILE, *fē'-bril.* Relating to fever.
FE'CAL, *fē'-kal.* Relating to or containing fecæs.
FEC'UNDATE, *fek'-un-dāt.* To impregnate.
FEM'ORAL, *fem'-ō-ral.* Relating to the anterior portion of the thigh.
FEM'ORAL CANAL. Canal extending from femoral ring to upper part of saphenous opening.
FEM'ORAL RING. Abdominal end of femoral canal.
FE'MUR, *fē' mer.* Thigh bone; long bone articulating with the knee below and the pelvis above.
FERMENTA'TION. Decomposition produced by a ferment.
FER'TILE, *fer'til.* Able to produce offspring; capable of originating.
FES'TER. A superation of superficial structures.
FE'TAL. Relating to the child in utero.
FETA'TION, *fē-tā'-shun.* Production and developement of the fœtus.
FE'TICIDE, *fē'-ti-sīd.* To take the life of the fœtus in utero.
FE'TID. Possessing a disagreeable smell.
FŒ'TUS. Child in utero.
FE'VER. Rise of temperature above 99° Fahrenheit.
FI'BER. An elongated structure entering into the composition of animal and vegetable tissue.
FI'BRIN. A white coagulating constituent of the blood.
FI'BRO-CAR'TILAGE. Cartilage having fibrous structures.
FI'BROID. Resembling fibre.
FIL'AMENT. A delicate thread-like structure.
FIL'IFORM. Thread-like in shape.
FIL'TER. An apparatus for separating impurities from liquids.
FILTRA'TION, *fil-trā'-shun.* The operation of filtering.
FI'LUM TERMINA'LE. The slender inferior end of the spinal cord.
FIS'SURE, *fish'-ūr.* A narrow cleft or depression.
FIS'TULA, *fis'-tū-la.* An ulcer with an opening leading from the surface to some internal cavity.
FIXA'TION, *fiks-ā'-shun.* The act of holding in a fixed position.
FLAC'CID, *flaks'-id.* Weak and soft.
FLAT'ULENCE. Undue generation of gases in the stomach or bowels.
FLA'TUS, *flā'-tus.* Gas in the stomach or bowels.

FLEX'IBLE, *fleks'-ĭ-bl.* Easily bent without breaking.

FLEX'ION, *flek'-shun.* The act of bending, or in a state of flexion.

FLEX'OR, *fleks'-or.* A muscle which bends a part.

FLOATING RIBS. Ribs not attached at both ends; the last two pairs of ribs.

FLOOD'ING, *flud'-ing.* Profuse hemorrhage from the uterus.

FLOOR OF PEL'VIS. Lower part of abdominal cavity formed by muscles connecting sacrum and ischium.

FLOW, *flō.* To menstruate. To have escape of blood or liquids.

FLUCTUA'TION, *fluc-tū-ā'-shun.* Wave-like motion, as of a fluid in the body under percussion.

FLUX, *fluks.* Dysentery. Any excessive discharge from the bowels.

FOL'LICLE, *fol'-i-kl.* A very small tubular gland.

FOLLIC'ULAR, *fŏl-lik'-ū-lar.* Relating to or resembling a follicle.

FORA'MEN. An opening.

FORA'MEN MAGNUM. Large opening in occipital bone.

FORA'MEN OVA'LE. Oval opening between right and left auricle of fœtal heart.

FORA'MEN OF WINS'LOW. Opening between greater and lesser sac of peritoneum.

FOR'CEPS. An instrument used in grasping a part. A two-armed instrument.

FORE'ARM. Portion of the arm between wrist and the elbow.

FOR'EIGN BOD'Y. A substance in a part to which it does not belong.

FOREN'SIC, *for-ĕn'-sik.* Legal medicine.

FOR'MULA, *for-mū-lah.* Combination of symbols expressing a chemical compound.

FOS'SA, *fos-ah.* A pit or depression.

FRAC'TURE, *frak-tūr.* A breaking of bone.

FRAGMENTA'TION, *frag-men-tā'-shun.* A splitting into fragments.

FRIC'TION, *frik'shun.* Rubbing.

FRONTAL. Relating to the forehead.

FUMIGA'TION. Disinfection of an apartment by exposure to fumes.

FUNC'TION, *funk'-shun.* The special office or action of an organ.

FUNC'TIONAL, *funk'-shun-al.* Relating to or affecting a function.

FUNC'TIONAL DISEASE'. Disease affecting the function, but not the structure of an organ.

FUN'GUS. One of a class of plants including moulds, etc.

G

GALAC'TOSE, *gal-ak'-tōs.* A sugar derived from lactose.

GALL *gawl.* The bile; secretion bythe liver.

GALL BLAD'DER. The reservoir for the bile.

GALL CYST, *gawl sist.* A cyst of the gall ducts or gall bladder.

GALL DUCTS. Ducts leading from the liver and gall bladder into the duodenum.

GAL'LON, *gal-on.* Measure equal to four quarts.

GALL STONES. Calculus in gall bladder or gall ducts.

GAL'VANISM. Electricity produced by chemical action.

GALVANO-CAU'TERY. A cauterization by wire heated by galvanic current.

GANG'LION, *gang'-le-on.* Mass of gray nervous matter serving as a center of nervous power.

GAN'GRENE, *gang'-grēn.* Mortification or death of a part. Local death.

GAN'GRENE, DRY. Due to lack of blood supply; found in old people, usually called senile.

GAN'GRENE, HOS'PITAL. A contagious ulceration of wounds in hospitals.

GAN'GRENE, MOIST. Humid, containing fluid; a serous, swollen gangrenous ulceration of a part.

GAN'GRENE, SENILE. Gangrene of old age; dry.

GAN'GRENOUS, *gang'-grē'nus.* Resembling or affected with gangrene.

GAS. An æriform elastic fluid.

GAS'EOUS, *gas'-e-us.* Pertaining to gas; of the nature of gas.

GASTRAL'GIA, *gas-tral'-je-ah.* Pain in the stomach.

GAS'TRIC, *gas'trik.* Of, or pertaining to the stomach.

GAS'TRIC JUICE. Clear liquid secreted by the stomach.

GAS'TRIC FE'VER. Fever resulting from a diseased condition of the stomach.

GASTRI'TIS, *gas-trī'-tis.* Inflammation of stomach and intestines.

GASTRO-ENTERI'TIS. Inflammation of stomach and intestines.

GASTROT'OMY, *gas-trot'-ō-me.* Cutting operation on the stomach.

GATH'ERING. A collection of pus in a part.

GAULTHE'RIA, *gawl-thē'-rē-ah.* Winter green.

GAUZE, *gawz.* A light, open fabric used in surgery.

GEL'ATIN, *jel'-a-tin.* Albuminoid substance from connective tissue.

GEL'ATIN CUL'TURE. A bacterial culture in which gelatin is the medium.

GEN'ERATE, *jen'-e-rāt.* To originate. To develop.

GENERA'TION, *jen-er-ā'-shun.* The act of reproducing.

GEN'ESIS, *jen'-e-sis.* Production and reproduction.

GEN'ITAL, *jĕn'-i-tal.* Pertaining to generation or to genitals.

GERM, *jerm.* First principal of a living organism.

GER'MAN MEA'SLES. An infectious disease in which the eruption begins at the onset of the disease; slight catarrhal symptoms.

GERM DISEASE'. A disease due to a micro-organism.

GER'MICIDE, *jer'-mi-sīd.* Agent which kills microbes.

GER'MINAL, *jĕr'-mi-nal.* Relating to a germ.

GER'MINATION, *jer-mi-nā'-shun.* Sprouting of a plant; the embryo.

GESTA'TION, *jes-tā'-shun.* Pregnancy; being with child.

GLAND. An organ which separates particles or fluids from the blood.

GLAN'DERS. Contagious disease of horses, transmissable to man.

GLAN'DULAR, *glan'-du-lar.* Of, or relating to a gland.

GLAU'BER'S SALT. Sulphate of soda.

GLAUCO'MA, *glaw-kō'-mah.* Hardening and bulging of the eye ball.

GLIS'SON'S CAP'SULE. Connective tissue sheath covering liver, entering portal fissure, where it surrounds the vessels and nerves.

GLOBE OF THE EYE. The whole of the eye ball.

GLOB'ULAR, *glob'-u-lar.* Resembling a globe; spherical.

GLOB'ULE, *glob'-ūl.* A spherical particle of matter.

GLOM'ERATE, *glom'-er-āt.* Clustered together in a ball.

GLOM'ERULE, GLOMER'ULUS. A cluster of arteries and veins within the malpigian body of the kidneys.

GLŪTE'AL, *glu-tē'-al.* Of, or relating to the buttocks.

GLȲC'ERINE. Colorlesss syrupy liquid, having the chemical formula of ($C_3H_8O_3$) obtained from decomposition of fats and fixed oils.

GLȲ'COGEN. A starch obtained from animal tissues.

GOI'TRE, *goi'-ter.* An enlargement of the Thyroid gland causing a swelling in front of throat.

GONOCOC'CUS, *gon-o-kok'-us.* Germ causing gonorrhœa.

GOUT. Disease marked by painful inflammation of the joints, accompanied with deposits of sodium.

GRAIN. The twentieth part of a scruple.

GRAMME. Unit of weight in metric system.

GRAV'ID. Pregnant.

GRAY MATTER. Portion of the brain and central nervous system having a gray color.

GROIN. The lower lateral part of the abdomen above the thigh, extending along Poupart's ligament.

GUT. Intestines.

H

HAB'IT. (1) A regular practice. (2) Disposition of bodily temperament. Chorea, spasm, spasmodic movements of voluntary muscles occuring habitually.

HAB'ITAT. Region in which an animal or plant lives naturally.

HAIR-FOL'LICLE. Flask-shaped depression in skin containing hair root.

HA'LO, *hā'-lō.* A ring around anything.

HAM'STRINGS. Either of two tendons forming inner and outer boundaries of popliteal space.

HANG'NAIL. Splitting of epidermis at side of nail.

HARTS'HORN. Linumentum ammonia carbonate.

HAVER'SIAN CANAL OR TUBE. Intercommunicating canals running through bone.

HEART. Hollow muscular organ which drives blood through the arteries.

HEAT'-STROKE. Overwhelmed by excessive heat; sunstroke.

HEC'TIC FE'VER. Slow fever with irregular exacerbations in phthisis.

HE'LIX, *hē'-liks*. Rounded outer edge of external ear.

HEMASTAT'IC. Agent used to arrest hemorrhage.

HEMATOG'ENOUS, *hem-at-oj'-e-nus*. Containing or relating to blood.

HEMATO'MA, *hem-at-ō'-mah*. A blood tumor.

HEMIPLE'GIA, *hem-i-plē'-je-ah*. Paralysis of one side of body.

HEM'ISPHERE, *hem'-is-fēr*. Either lateral half of cerebrum.

HEM'ORRHOIDS. A pile, vascular tumor in rectal mucous membrane.

HEMOTHO'RAX, *hem-ō-thō'-raks*. Hemorrhage in the thorax.

HEPAT'IC, *hēp-at'-ic*. Of or relating to the liver.

HEPAT'IC LOBES. Lobes of the liver.

HEPATI'TIS, *hep-at-ī'-tis*. Inflammation of the liver.

HEPATIZA'TION. Conversion of tissue into liver-like substance.

HEP'ATOCELE, *hep'-at-ō-sēl*. Hernia of liver.

HERED'ITARY, *her-ed'-i-ta-re*. Transmitted from parent to offspring.

HERMET'IC, *her-met'-ik*. Sealed. To exclude all atmospheric air.

HER'NIA. Displacement of an organ or a tissue through an abnormal opening.

HERO'IC, *hē-rō'-ik*. Bold, severe.

HER'PES, *her'-pēz*. Inflammation of skin, marked by cluster of little vessicles.

HIC'COUGH, *hic'-kup*. Quick inspiratory sound from spasm of diaphragm and glottis.

HIDRO'SIS, *hī-drō'-sis*. Excessive sweating.

HI'LUM. Depression in the edge or border of an organ.

HIP. Region between body and thigh.

HIPPOCRAT'IC FACE. The peculiar expression of the face immediately before death.

HIS'TIOID, *his'-te-oid*. Formed from a single tissue.

HISTOCHEM'ISTRY, *his-tō-kem'-is-tre*. Chemistry of organic tissues.

HISTOL'OGY. Science treating of minute structure and composition of tissue.

HIVES, *hīvs*. Urticaria, or any vesicular skin eruption.

HOMEOP'ATHY. System of treatment professing to cure by infinitesimal doses of medicines which will cause in healthy tissue diseases similar to the one to be cured.

HOMOGE'NEOUS, *ho-mo-jē'-ne-us* Of same quality throughout.

HOMOGEN'ESIS, *ho-mō-jen'-ē-sis*. Reproduction in the same way in all generations.

HOOK. Instrument with curved end for making traction.

HOS'PITAL, *hos'-pit-l*. A building for the treatment of the sick.

HU'MERUS, *hū'-mer-us*. The bone of the upper arm.

HUMID'ITY, *hū-mid'-i-te*. Moisture; particularly, degree of moisture of atmosphere.

HU'MOR, *hū' mor*. Any fluid of the body.

HU'MORAL. Pertaining to the humorous, arm bone.

HUN'TER'S CANAL'. Triangular space between adductor longus and adductor magnus and vastus internus muscles.

HY'ALINE, *hī'-al-in.* Glassy.

HYDRARGYR'IA, *hi-drar-jĕr'-e-ah.* Chronic mercury poisoning.

HYDRAR'GYRUM. Latin for mercury.

HYDRAR'GYSM, *hī-drar'-jism.* Chronic mercury poisoning.

HY'DRATE, *hī'-drat.* (1) Compound of a radical with hydroxyl. (2) Compound of a substance with water.

HYDRE'MIA, *hī-drē'-me-ah.* Watery condition or the blood.

HYDROCAR'BON. Compound of carbon with hydrogen.

HY'DROCELE, *hī'-drō-cēl.* A collection of watery fluid, especially about the testicle.

HYDROCEPH'ALUS, *hī-drō-sef'-al-us.* Accumulation of fluid within the cranium.

HYDROCHLO'RIC AC'ID. Colorless gas. Also aqueous solution.

HYDRO'GEN. Colorless gas, the lightest element known.

HYDROM'ETER. Instrument for measuring specific gravity of liquids.

HY'DROPS, *hī'-drops.* Dropsy.

HY'GIENE, *hī'-jē-ēn.* Department of medicine treating of health and its preservation.

HYGROSCOP'IC. Absorbing moisture readily.

HYGLOS'SUS. Cormea of hyoid. Side of tongue.

HY'OID BONE. U-shaped bone at base of tongue.

HYPERPYREX'IA, *hī-per-pī-reks'-e-ah.* Unusually high fever.

HYPERSECRE'TION, *hi-per-se-kre'-shun.* Excessive secretion.

HYPERTROPH'IC, *hī-per-trof'-ik.* Relating to or marked by hypertrophy.

HYPER'TROPHY. Abnormal enlargement of a part or an organ.

HYPHIDRO'SIS. Deficient perspiration.

HYPINO'SIS, *hip-in-ō'-sis.* Production of sleep or of hypnotism.

HYPNOT'IC, *hip-not'-ik.* Inducing sleep.

HY'POBLAST, *hī'-pō-blast.* The most internal of the layers of the primitive embryo.

HYPOCHONDRI'ASIS, *hī-pō-kon-drī'-a-sis.* Mental disorder with unnecessary anxiety concerning the health.

HYPOCHRO'MIA, *hī-pō-krō'-me-ah.* Deficiency in color.

HYPODERMAT'IC, *hi-pō-der-mat'-ik* Situated or applied beneath the skin.

HYPODER'MIC. The same as hypodermatic.

HYPOGAS'TRIC, *hī-pō-gas'-trik.* Pertaining to the hypogastrium.

HYPOGAS'TRIUM. The lower middle region of the abdomen.

HYPOGLOS'SAL, *hī-pō-glos'-sal.* Situated beneath the tongue.

HYPOGLOT'TIS, *hī-pō-glot'-is.* Ranula.

HYS'TERIA, *his'-te-re-ah.* Functional disease, especially of women, marked by lack of self-control over actions and emotions.

HYSTEREC'TOMY, *his-ter-ek'-tō-me.* Excision of the uterus.

I

IC'TERIC, *ik'-tĕr-ik.* Relating to or affected with jaundice.

IC'TERUS, *ik'-ter-us.* Same as jaundice.

IC'TUS, *ik'-tus.* A stroke; a sudden attack.

ID'IOCY, *id'-i-ō-se.* Extreme dementia.

IDIOPATH'IC. Self-originated, independent.

IDIOSYN'CRASY, *id-i-o-sin'-krā-se.* A disposition of mind or body peculiar to an individual.

ID'IOT, *id'-i-ot.* One who is without understanding.

ILEO-CE'CAL VALVE. Fold of mucous membrane between ileum and cæcum.

ILEO-COLI'TIS. Inflammation of ileum and colon.

IL'EUM, *il'-ē-um.* Last portion of small intestine ending in cæcum.

IL'EUS, *il'-ē-us.* State of severe pain with vomiting and prostration, from intestinal obstruction.

IL'IAC, *il'-e-ak.* Of or relating to the ilium.

IL'IAC CREST. Upper free edge of ilium.

IL'IUM, *il'-e-um.* The flat upper portion of the innominate bone.

IMME'DIATE, *im-ē'-di-āt.* With nothing intervening.

IMMER'SION, *im-er'-shun.* Act of plunging into a fluid.

IMMOBIL'ITY, *im-ō-bil'-i-te.* Stationary, not capable of being moved.

IMMUNE', *im-ūn'.* Protected against disease, as by innoculation.

IMMU'NITY. State of being immune.

IMPAC'TED, *im-pak'-ted.* Driven in; firmly fixed in anything.

IMPAC'TION. Condition of being packed.

IMPER'MEABLE. Not affording a passage through.

IMPER'VIOUS, *im-per'-ve-us.* Not penetrable.

IMPREGNA'TION, *im-preg-nā'-shun.* Act of being pregnant.

IMPRES'SION, *im-presh'-un.* A depression or indentation.

IM'PULSE OF THE HEART. Heart sounds.

IMPU'RITY, *im-pū'-ri-te.* Not pure, unhealthful.

INAN'IMATE, *in-an'-i-māt.* Lifeless.

INANI'TION. Exhaustion from lack of food.

INASSIM'IABLE, *in-as-im'-i-a-bl.* Not capable of being assimilated.

INCINERA'TION. Act of reducing to ashes.

INCISED', *in-sizd'.* Cut; laid open.

INCIS'ION, *in-sizh'-un.* The act of cutting.

INCOMPAT'IBLE. Not suitable for simultaneous administration.

INCORPORA'TION. Mixing of a substance with another.

INCUBA'TION, *in-kū-bā'-shun.* Period between implanting of a disease and its development.

INDENTA'TION, *in-den-tā'-shun.* A pit or depression.

IN'DEX, *in'-deks.* (a) The first finger. (b) Ratio of measurement of any part with a fixed standard.

INDISPOSI'TION, *in-dis-pō-si' shun.* State of being ill.

IN'DOL. Crystalline compound from indigo.

IN'DOLENT, *in'-dō-lent.* Without pain. Sluggish.

IN'DURATED, *in'-dū-rā-ted.* Hardened.

INDURA'TION, *in-dū-rā'-shun.* State of hardness or hardening.

INER'TIA. Inactivity.

INFAN'TICIDE, *in-fan'-tis-id*. Act of killing an infant.

INFECT', *in-fekt'*. The act of infecting, as by germs, or innoculation, contact, etc.

INFECTION, *in-fek'-shun*. Communication of disease from one to another.

INFEC'TIOUS. Communicable by infection by direct and indirect contact, but not through the medium of the atmosphere.

INFE'RIOR, *in-fē'-re-or*. Beneath; smaller.

INFIL'TRATE. Material deposited in tissue by infiltration.

INFLAMMA'TION, *in-flam-ā'-shun*. Condition of tissue marked by redness, pain, heat and swelling.

INFLUEN'ZA, *in-flū-en'-zah*. Epidemic disease with general depression, heaviness over eyes and distressing fever.

IN'GUINAL, *in'-gwin-al*. Of or relating to the groin.

INHALA'TION. Drawing of air into the lungs. A medicine to be inhaled.

INHIB'IT. Prevent.

INHIBI'TION. Arrest or suspension of any process.

INHIB'ATORY, *in-hib'-it-o-re*. Producing inhibition.

INHUMA'TION. Put in the ground: the sepulture of the dead.

INJEC'TED, *in-jek'-ted*. Filled by injection; filled with blood or fluid.

INJEC'TION. Act of throwing liquid into a part, especially the rectum and blood vessels.

INNOMINA'TA, *in-om-in-ā-tah*. Pertaining to arteries, veins, bones, etc., nameless.

INNOMINA'TUM, *in-om-in-ā'-tum*. Large flat bone forming sides of the pelvis.

INOCULA'TION. Insertion of virus into body to cause disease.

INORGAN'IC, *in-or-gan'-ik*. Not organic.

IN'QUEST, *in'-kwest*. Judicial inquiry into manner of death.

INSAN'ITARY, *in-san-it-ā're*. Not sanitary.

INSEC'TICIDES. Substances for killing insects.

INSEN'SIBLE, *in-sen'-si-bl* Devoid of sensibility.

INSER'TION, *in-ser'-shun*. Attachment of a muscle to the bone which it moves.

INSID'IOUS, *in-sid'-e-us*. Treacherous, stealthy.

INSOLA'TION, *in-sō-lā'-shun*. Overwhelming by excessive heat; sunstroke.

INSOL'UBLE, *in-sol'-ū-bl*. Not soluble.

INSPEC'TION, *in-spek'-shun*. Examination by the eye.

INSUFFIC'IENCY. Lack of capacity for normal action.

INSUFFLA'TION, *in-suf-flā-shun*. Act of blowing into a cavity.

INTEG'UMENT. The covering of the body; the skin.

INTERARTIC'ULAR. Between articulating surfaces.

INTERCOS'TAL, *in-ter'kos'-tal*. Between ribs.

INTER'MENT. (*In* and *terra*, earth.) Buried in earth.

INTERMIT'TENT. Having periods of interruption.

INTER'NAL. That which is placed on the inside.

INTEROS'EOUS, *in-ter-os-ē-ous*. Between bones.

INTER'STICES, *in-ter-stis-ēs*. Intervals between organs or parts.

IN'TERVAL. Space between two things.

INTES'TINAL. Of or pertaining to the intestines.

INTES'TINE. Membraneous tube from the stomach to the anus.

INTUSSUSCEP'TION. Invagination of a portion of intestine into an adjacent portion.

INVA'SION, *in-vā'-zhun*. The onset or attack of a disease.

INVER'SION, *in ver'-shun*. Act of turning inward or upside down.

INVOL'UNTARY, *in-vol'-un-tā-re*. Performed without the will.

IRI'TIS, *ī-rī'-tis*. Inflammation of the iris.

IRREG'ULAR, *ir-reg ū-lar*. Not regular.

IR'RITANT. Causing irritation.

ISCHIAT'IC, *is ki at'-ik* Relating to the ischium.

IS'OLATE, *is'-ō-lāte*. To separate one from the other.

IS'SUE, *ish'-ū*. A suppurating ulcer formed and kept open by the insertion of an irritant body.

ISTH'MUS, *ist-mus*. Narrow band of tissue connecting two larger parts.

ITCH'ING. Pruritis.

J

JAUN'DICE, *jawn'-dis*. Yellowness of skin, eyes and tissues from impregnation with bile pigment.

JEJU'NUM, *je-jū-num*. Portion of the small intestine between duodenum and ileum.

JOINT. Joinéd; articulated; apposition of two opposing surfaces.

JU'GULAR VEINS. The large veins of the neck, comprising internal, external, anterior and posterior.

JUICE. The expressed fluid of muscle.

K

KERATI'TIS, *ker-at-ī'-tis*. Inflammation of the cornea.

KID'NEY. One of two glandular bodies in the lumbar region concerned in secreting urine.

KIL'OGRAMME, KIL'OLITRE, KIL'OMETRE. One thousand grammes, litres or metres.

KNEE, *nē*. Region of articulation of leg and thigh.

KNIT'TING, *nit'-ing*. Union of fractured bone.

KOCH'S LYMPH, *kōk's limf*. Glycerine extract of culture of bacillus tuberculosis.

KYPHO'SIS. Humpback.

KYSTHI'TIS, *kis-thī'-tis*. Vaginitis.

L

LAB'ARRAQUE'S SOLU'TION, *lab'-ar-ak's.* Solution of chlorinated soda.

LA'BIA, *lā'-be-ah.* Plural of labium.

LA'BIA MAJO'RA. Larger of the two vaginal lips.

LA'BIA MINO'RA. Smaller of the two vaginal labia.

LA'BIAL, *lā'-be-al.* Relating to the lips, or to a labium.

LA'BOR, *lā'-bor.* The act of bringing forth a child.

LAB'ORATORY. A room fitted for experimental work.

LACERA'TION. A tearing; a torn wound.

LACH'RYMAL, *lak'-re-mal.* Relating to tears.

LACH'RYMAL DUCTS. Ducts conveying tears into the nose.

LAC'TATE, *lak'-tāt.* A salt of lactic acid.

LAC'TEAL, *lak'-te-al.* Relating to milk.

LAC'TEALS. Chyliferous vessels; vessels absorbing chyle, lymph, etc.

LAC'TEOUS, *lak'-tē-ous.* Lactic.

LAC'TIC, *lak'-tik.* Pertaining to or resembling milk.

LAC'TIC AC'ID. Syrupy liquid occurring in four varieties.

LACU'NA, *la-ku-'nah.* A small depression or pit.

LACU'NÆ, *lā-kū' nē.* Certain dark spots in bone with thread-like lines running from them, seen in bone under magnification.

LAMBDOI'DAL, *lam-doi'-dal.* Pertaining to junction of occipital and parietal bones.

LAMEL'LA, *lam-el'-ah.* A thin plate, as of bone.

LAM'INA, *lam'-in-ah.* A thin plate or layer.

LAN'CET, *lan'-set.* Two-edged, pointed knife for making small incisions.

LAN'CINATING, *lan'-sin-ā-ting.* Sharp, acute.

LAP'ARO-CYSTOT'OMY, *lap'-ar-ō-sist-ot'-ō-me.* Colostomy through abdomen.

LAPAROT'OMY, *lap-ar-ot'-o-me.* Operation of cutting through abdominal wall.

LARDA'CEOUS, *lār-dā'-se-us.* Resembling lard.

LARYN'GEAL, *lar-in'-jē-al.* Relating to the larynx.

LARYNGI'TIS, *lar in-jī'-tis.* Inflammation of the larynx.

LARYNGOT'OMY, *lar-ing-got'-ō-me.* Act of cutting into larynx.

LAR'YNX, *lar'-ingks.* Portion of air-passages between base of tongue and trachea.

LA'TENT, *lā'-tent.* Concealed, hidden.

LAT'ERAL. Relating to or situated upon the side.

LAT'ERAL SI'NUSES. Veins of dura mater diverging from occipital protuberance.

LATIS'SIMUS DOR'SI. Muscle connected to the spines of six lower dorsal and lumbar and sacral vertebræ, crest of ileum, and three or four lower ribs.

LAU'DANUM, *law'-dan-um.* Tincture of opium.

LAUGH'ING GAS. Nitrous oxide gas.

LAX'ATIVE, *laks'-ā-tive.* Mildly purgative.

LAXA'TOR, *laks-ā'-tor.* A muscle which relaxes a part.

LEG. Part of lower extremity between knee and ankle.

LENS, *lenz.* The transparent lens in the eye behind the pupil.

LENTIC'ULAR, *len-tik'-ū-lar.* Shaped like a lens or lentil.

LEP'ER. Person affected with leprosy.

LEP'ROSY, *lep'-rō-se,* A chronic, infectious skin disease, with swellings, redness and infiltration of skin.

LEP'ROUS, *lep'-rus.* Relating to or affected with leprosy.

LEPTOCEPH'ALUS. Monster with very small head.

LEP'TOTHRIX, *lep'-tō-thriks.* Genus of bacteria from tarter of teeth.

LE'SION, *lē'-zhun.* A hurt, a wound or disease of a part.

LE'THAL, *lē'-thal.* Fatal.

LETH'ARGY, *leth'-ar-je.* State of drowsiness or stupor.

LEUCHE'MIA, *lū-kē'-me-ah.* Usually fatal disease, with abnormal increase in number of white blood corpuscles.

LEU'COCYTE, *lū'-kō-sīt.* White blood corpuscle.

LEU'COMAINES, *lū'-kō-mah-ēns.* Albuminous constituent of putrefying material.

LEUCORRHE'A, *lū-kor-ē'-ah.* Whitish discharge from female genitals.

LEVA'TOR, *lev-ā'-tor.* A muscle which lifts a part.

LIG'AMENT. A fibrous band connecting ends of movable bones.

LIGA'TION, *lī-gā'-tion.* Act of applying a ligature.

LIG'ATURE, *lig-ā'-tūr.* Thread for tying about a part.

LIMB, *lim.* One of the extremities of the body.

LINE, *līn.* One-twelfth of an inch.

LIN'EAR, *lin'-ē-ar.* Relating to or resembling a line.

LINT. Soft, absorbent dressing made by picking to pieces linen cloth.

LIPE'MIA, *lī-pē'-me-ah.* Presence of fat in the blood.

LIPO'MA, *lī-pō'-mah.* Fatty tumor.

LIQUEFAC'TION, *lik-wē-fak'-shun.* Change into liquid.

LI'QUOR, *lī'-kwor.* A liquid.

LI'QUOR AM'NII, *lī'-kwor am'-ne-ī.* The fluid within the amnion.

LIS'TERISM, *lis'-ter-izm.* Principle of antiseptic and aseptic surgery.

LI'TER, *lē'-ter.* A measure of 1,000 cubic centimetres.

LIT'MUS. Blue pigment from lichens, turned red by acid.

LIV'ER. Largest glandular organ of body, secreting bile.

LIV'ID. Purple.

LO'BAR, *lō'-bar.* Relating to or affecting a lobe.

LO'BATE, *lō'-bāt.* Having lobes.

LOBE, *lōb.* Rounded prominent part.

LOB'ULAR, *lob'-ū-lar.* Relating to or affecting a lobule.

LOB'ULE, *lob'-ūl.* A small lobe.

LO'BUS, *lō'-bus.* A lobe.

LO'CAL, *lō'-kal.* Limited to a particular part.

LOCK'JAW. Tetanic spasm of jaw muscles.

LOCOMO'TION, *lō-kō-mō'-shun.* Act of moving from place to place.
LOINS, *loinz.* Portion of back between ribs and pelvis.
LONGEV'ITY, *lon-jev'-it-e.* Long life.
LUMAB'GO, *lum-bā'-gō.* Pain in the loins.
LUM'BAR. Relating to the loins.
LU'MEN, *lū'-men.* Empty spaces between the walls of a tube.
LU'NAR CAUS'TIC, *lū'-nar kaws'-tik.* Silver nitrate.
LUNGS. The organs of respiration filling either side of the chest.
LY'ING-IN, *lī'-ing-in.* The puerperal state.
LYMPH, *limf.* The clear fluid circulating in the lymphatics.
LYMPHADENI'TIS, *limf-ad-en-ī'-tis.* Inflammation of the lymphatic gland.
LYMPHADENO'MA, *limf-ad-en-ō'-mah.* A tumor of lymphoid tissue.

M

MACERA'TION, *mas-er-ā'-shūn.* Breaking up of a solid by soaking in liquid.
MA'CIES, *mā'-sē-ēz.* Wasting.
MACROSCOP'IC, *mak-rō-skop'-ik.* Visible to the naked eye.
MAC'ULA, *mak'-ū-lah.* A spot or stain.
MAC'ULATE, *mak'-ū-lāt.* Spotted.
MALA'CIA. Morbid softness of a part.
MALACO'MA, *mal-ak-ō'-mah.* Same as malacia.
MAL'ADY. *mal'-ad-ē.* A sickness or disease.
MALAISE', *mal-āz'.* Uneasiness in disposition.
MA'LAR, *mā'-lar.* Of or relating to cheek.
MALFORMA'TION, *mal-for-mā'-shun.* Defective formation.
MALIG'NANT, *mā-lig'-nant.* Virulent, very fatal.
MALIN'GERER, *mal-in'-jer-er.* One who feigns disease.
MALLE'OLUS, *mal-ē'-ō-lus.* Either of the projections on tibia and fibula forming part of ankle joint.
MALPRAC'TICE, *mal-prak'-tis.* Wrong or negligent treatment.
MAM'MA, *mam'-ah.* The breast; the mammary gland.
MAM'MARY, *mam'-a-re.* Relating to breast.
MANGANESE', *man-gan-ez'.* Gray, hard, metalic element.
MA'NIA, *mā'-ne-ah.* Insanity with excessive mental activity.
MAN'IKIN. A model for teaching anatomy.
MANU'BRIUM, *man-ū-bre-um.* Uppermost part of sternum.
MARSH'S TEST. A test for arsenous acid.
MASS. A collection or lump of matter.
MASSAGE', *mas-ahzh'.* Theraputic use of systematic rubbing, kneading and stroking of the body.
MASTICA'TION, *mas-tik-ā'-shun.* Act of chewing the food.
MASTI'TIS, *mas-tī'-tis.* Inflammation of female breast.
MAS'TOID. Shaped like a teat.
MAS'TOID BONE. Process of temporal bone.

MATRIC'ULATE, *mā-trik'-ū-'lāt.* To enroll one's name on the register of a college.

MA'TRIX, *mā'-triks.* The womb.

MATURA'TION, *mat-ū-rā'-shun.* State of ripening.

MAXIL'LA, *maks-il'-ah.* A jaw bone especially the upper.

MAX'ILLARY BONES. Same as maxilla.

MEA'SLES, *mē'-zlz.* A contagious, eruptive fever, with catarrh of eyes, ears and air passages.

MEA'TUS, *mē-ā'-tus.* A passage.

ME'DIAN, *mē'-de-an.* In the middle.

MEDIASTINI'TIS. Inflammation of mediastinum.

MEDIASTI'NUM, *mē-de-as-tī'-num.* Space in middle of chest between pleuræ of the two sides.

MEDUL'LA OBLONGATA, *med-ul-ah ob-long-gā'-tah.* The prolongation of the spinal cord into the brain.

MED'ULLARY, *med'-ul-ā-re.* Relating to marrow or to the medulla oblongata.

MED'ULLARY CANAL'. Canal in back of embryo forming the rudiments of nervous system.

MELANCHO'LIA. Form of insanity with great mental depression,

MELANE'MIA. Presence of black pigment masses in the blood.

MELANODER'MA, *mel-an-ō-der'-mah.* Black discoloration of the skin.

MELANO'SIS, *mel-an-ō'-sis.* Same as melanism.

MELITU'RIA, *mel it-ū'-re-ah.* Diabetes mellitus.

MEM'BRANE, *mem'-brān.* A thin tissue covering some surface or organ.

MEM'BRANEOUS, *mem'-bran-us.* Composed of or relating to membrane.

MENIN'GES, *men-in-jēs.* The plural of meninx; membranes of a part.

MENINGI'TIS, *men-in-jī'-tis.* Inflammation of the membranes of the brain or spinal cord.

MEN'OPAUSE, *men'-o-pawz.* The period at which menstruation ceases.

MEN'SES, *men'-sēz.* The monthly discharge from the uterus.

MEN'STRUAL, *men'-strū-al.* Relating to the menses.

MENSTRUA'TION. The occurrence of the menses.

MEN'STRUUM, *men'-strū-um.* A solvent.

MEN'TAL. Pertaining to the mind or to the chin.

MEN'THOL. A stearoptene from oil of peppermint.

MERCU'RIAL, *mer-kū'-re-al.* Pertaining to mercury.

MERCU'RIALISM. Chronic mercurial poisoning.

MER'CURY. Silver-white metallic element.

MESENTER'IC, *mes-en-ter'-ik.* Of or pertaining to the mesentery.

MESENTERI'TIS, *mes-en-ter-ī'-tis.* Inflammation of mesentery.

MES'ENTERY. A fold of peritoneum attaching intestine to abdominal wall.

METABOL'IC, *met-a-bol'-ik.* Relating to metabolism.

METAB'OLISM, *met-ab'-ō-lizm.* Change, transformation.

METACAR'PUS, *met-ah-kar'-pus.* Pertaining to bones of the hand, the metacarpus.

METAMOR'PHOSIS. Change of form or structure.
ME'TEORISM, *mē'-tē-o-rizm.* Tympanites.
MET'ER. A measure of length equal to 39.371 inches.
ME'TRA, *mē'-trah.* The uterus.
METRI'TIS, *mē-trī'-tis.* Inflammation of the uterus.
METORRHAG'IA. Hemorrhage from the uterus.
MI'CROBE, *mī'-krōb.* Any living micro-organism.
MICRO'BIC, *mī-krō'-bik.* Relating to or resembling microbes.
MICRO'BICIDE, *mī-krō'-bis-īd.* A medicine destructive to microbes.
MICROBIOL'OGY, *mī krō-bī ol'-ō-je.* The study of microbes.
MI'CROBLAST, *mī'-krō-blast.* Any unusually small blood corpuscle.
MICROCHEM'ISTRY, *mī-krō-kem'-is-tre.* Chemistry in which the manipulations are carried on with the aid of the microscope.
MICROCOC'US, *mī-krō-kok'-us.* Genus of bacteria or schizomycetes.
MICRO-OR'GANISM, *mī-krō-or'-gan-ism.* An organism of microscopic size.
MICROPATH'OLOGY. Pathology treating of diseases caused by microbes.
MI'CROSCOPE. Instrument for examining minute objects.
MICROS'COPY, *mī-kros'-kō-pe.* The art of using microscopes.
MI'CROTOME Instrument for cutting thin slices of tissue for microscopical study.
MICTURI'TION, *mik-tū-rish-un.* Act of passing water.
MID'RIFF. The diaphragm.
MID'WIFE. A woman who delivers women with child.
MILIA'RIA, *mil-ē-ā'-re-ah.* Prickly heat.
MIL'IARY, *mil'-ē-ā-re.* Resembling a millet seed.
MILK'-LEG. Phlebitis of the femoral vein in women after delivery, with swelling of the leg.
MIN'ERAL. An inorganic crystalline substance found in the earth.
MIN'IM. The sixtieth part of a fluidrachm.
MISCAR'RIAGE, *mis-kar'-āg.* Expulsion of a non-viable fœtus.
MISTU'RA, *mis tū'-rah.* A mixture.
MI'TRAL, *mī'-tral.* Shaped like a mitre.
MOBIL'ITY, *mō-bil'-i-te.* State of being readily moved.
MOLE, *mōl.* A small brownish spot on the skin.
MOLEC'ULAR, *mō-lek'-ū-lar.* Relating to or consisting of molecules.
MOL'ECULE, *mol'-ē-kūl.* A small particle of matter.
MOLLUS'CUM. One of two skin diseases.
MONOCOC'CUS, *mon-ō-kok-us.* A micrococcus in which the cocci remain distinct.
MON'OSPASM. Spasm of some one part.
MON'SEL'S SOLU'TION. Styptic solution of ferrus sulphate.
MONSTROS'ITY, *mon-stros'-it-e.* Deviation from the normal form.
MONS VEN'ERIS. Part above the pubic bone, covered with hair in the adult.
MOR'BID. Diseased. Relating to a disease.
MORBID'ITY, *mor-bid'-it-e.* State of being diseased.
MORBIF'IC, *mor-bif'-ik.* Causing disease.

Mor'bus. A disease.

Morgue, *morg.* Place where unknown dead bodies are kept for recognition.

Mor'ibund, Dying; about to die.

Morphol'ogy, *mor-fol'-ō-je.* The science of structure and form of organisms.

Mors, *morz.* Death.

Mor'tal. Subject to death. Causing death.

Mortal'ity. Death rate.

Mortifica'tion, *mor-tif-ik-ā'-shun.* Gangrene.

Mor'tuary. Of or relating to death,

Mo'tile, *mō'-til.* Capable of moving spontaneously.

Mo'tor, *mo-tor.* A mover. Relating to motion.

Mu'cilage, *mū-sil-āg.* An aqueous solution of gum.

Mu'cin, *mū'-sin.* The essential constituent of mucous.

Myco'sis, *mī-kō'-sis.* Disease caused by vegetable microbes.

Mydri'asis, *mid-rī'-a-sis.* Preternatural dilatation of pupil.

Mydriat'ic, *mid-ri at'-ik.* Causing mydriasis.

Myeli'tis, *mī-el-ī'-tis.* Inflammation of the spinal cord.

My'eloid, *mī'-el-oid.* Resembling marrow.

Myi'tis, *mī-ī'-tis.* Inflammation of muscle.

Myocardi'tis. Inflammation of myocardium.

Myocar'dium, *mī ō kar'-de-um.* Muscular substance of the heart.

Myomala'cia, *mī-ō-mal-ā'-se-ah.* Softening of the muscles.

Myop'athy, *mī-op'-a the.* A disease of a muscle.

Myo'pia, *mī-ō'-pe ah* Near-sightedness.

My'osin, *mī ō'-sin.* A proteid from coagulum of muscle plasma.

Myosi'tis, *mī-ō sī'-tis.* Imflammation of a muscle.

My'ospasm, *mī'-ō-spazm.* Muscular spasm.

Myrrh, *mer.* Stimulant, tonic.

Myxo'mah. *mīks-ō'-mah.* A tumor of mucous tissue.

Myxo-sarco'ma. Sarcoma containing mucous tissue.

N

Nape, *nāp.* The back part of the neck.

Nar'cose, *nar'kōs.* Somewhat narcotic.

Narco'sis, *nar-kō'sis.* Same as narcotism.

Narcot'ic, *nar-kot'-ik.* Producing narcotism or artificial sleep.

Nar'cotism. State of unconsciousness produced by a drug.

Naso-phar'ynx. Nasal passages and pharynx taken together.

Na'tes, *nā'-tēz.* The buttocks.

Nau'sea, *naw'-se-ah.* Sickness at the stomach.

Na'vel, *nā'-vel.* The pit in center of abdomen.

Nebula, *neb'-ū lah.* A cloudy appearance in the cornea or in the urine.

Neck, *nek.* The part between the head and thorax.

NECROBIO'SIS, *ne-krō-bī ō'-sis.* Progressive degeneration and atrophy of a part.

NECROS'COPY, *nē-kros'-kō-pe.* Examination of a dead body.

NECRO'SIS, *ne-krō'-sis.* Death of an organ or tissue, especially the bone.

NECROT'OMY, *ne-krot'-ō-me.* Dissection of a dead body.

NEE'DLE. Slender, pointed instrument for puncturing and sewing.

NEPHRIT'IC, *nef-rit'-ik.* Relating to nephritis.

NEPHRI'TIS, *nef-rī'-tis.* Inflammation of the kidneys.

NERVE. A long, cord-like structure conveying sensation and impulse from one part of the body to the other.

NERVE CELLS. Any cell of the nervous system, especially a ganglion cell.

NER'VOUS, *ner'-rus.* Relating to or composed of nerves.

NEU'RAL, *nū'-ral.* Pertaining to nerves.

NEURAL'GIA, *nū-ral' je-ah.* Paryoxysmal pain in a nerve.

NEUREC'TOMY, *nū-rek'-tō-me.* Excision of a portion of a nerve.

NEURI'TIS, *nū-rī'-tis.* Inflammation of a nerve.

NEURO'SIS, *nū-rō'-sis.* Nervous disease. Pertaining to a nervous origin.

NEU'TRAL. Neither acid nor basic.

NEU'TRALIZE, *nū'-tral-īz.* To render neutral.

NEU'TRAL MIX'TURE. Liquor potassi citratis.

NI'DUS. A nest.

NIP'PLE. The conical projection in the center of the breast.

NI'TRATE, *nī'-trāt* A salt of nitric acid.

NI'TRIC AC'ID. Colorless liquid, strong caustic.

NI'TROGEN, *nī'-trō jen.* A gaseous element, the main constituent of the air.

NODE, *nōd.* A swelling or protuberance.

NOD'ULE, *nod'-ūl.* A small protuberance.

NOR'MAL. According to rule. Regular.

NOSOL'OGY. The science of the classification of disease.

NOS'TRILS, *nos'-trilz.* The anterior nares.

NOTCH. An indentation on the edge of a bone or other organ.

NOX'IOUS, *nok'-shus.* Hurtful, unwholesome.

NUCLE'OLUS. Nucleus-like body within a cell nucleus.

NU'CLEUS. A spherical body within a cell, being its essential part in reproduction.

NUT'MEG LIVER. A liver presenting when cut a mottled appearance.

NU'TRIENT. Nutritious, nourishing.

NUTRI'TION, *nū trish'-un.* The assimilation of nutritive matter.

O

OBES'ITY, *ō-bēs'-it-e.* Corpulence.

OBLONGA'TA, *ob-long-gā'-tah.* The medulla oblongata.

OBSTET'RICS, *ob- stet'-riks.* The art of management of pregnancy and labor.

OBSTRUC'TION, *ob-struk'-shun.* The act of blocking up, or state of being blocked up.

OBTUN'DENT. A soothing, demulcent medicine.

OB'TURATOR FORA'MEN. Large opening through forward part of innominate bone.

OCCIP'ITAL, *ok-sip'-it-al.* Pertaining to the occiput.

OC'CIPUT, *ok'-si-pūt.* The back part of the head.

OCCLU'SION, *ok-lū'-shun.* The act of closing.

OC'ULAR, *ok'-ū-lar.* Of or relating to the eye.

ODON'TOID, *ō-don'-toid.* Resembling a tooth.

OFFIC'INAL, *of-is'-in-al.* Regularly kept on hand in drug stores.

OIL. A greasy, inflammable liquid from animal, vegetable and mineral substances.

OLEAG'IONUS, *ō-lē-aj'-in-us.* Oily.

O'LEATE, *ō'-lē-āt.* A salt of oleic acid.

OLEF'IANT GAS. Ethylene.

O'LEUM, *ō'-lē-um.* Latin for oil.

OLFAC'TORY, *ol-fak'-tō-re.* Of or relating to the sense of smell.

OMEN'TAL, *ō-men'-tal.* Of or relating to the omentum.

OMENTI'TIS, *ō-men-tī'-tis.* Inflammation of the omentum.

OMEN'TUM, *ō-men'-tum.* A fold of peritoneum from the stomach to adjacent organs.

OPAC'ITY, *ō-pas'-it-ē.* State of being opaque.

OMOHY'OID, *ō-mō-hī'-ōid.* Upper border of scapula; name of muscle.

OPAQUE', *ō-pāk'.* Impervious to rays of light.

OPERA'TION, *op-er-ā'-shun.* An act done with instruments or the hands for the relief of injury or disease.

OPTHAL'MIA, PU'RULENT. Inflammation of the eye, especially of the ocular conjunctiva.

OPTHAL'MIC, *off-thal'-mik.* Of or relating to the eye.

OPHTHALMOS'COPY. Examination of the eye with the ophthalmoscope.

O'PIATE, *ō'-pi-āt.* A medicine containing opium.

OPISTHOT'ONOS, *ō-pis thot'-on-os.* Tetanic spasm in which the body is bent backward.

O'PIUM, *ō'-pi-um* The concrete juice of papaver somniferum.

OP'TIC, *op'-tik.* Pertaining to the eye.

O'RAL, *ō'-ral.* Of or relating to the mouth.

ORBIC'ULAR, *or-bik'-ū-lar.* Circular.

ORBICULA'RIS, *or-bik-ū lā'-ris.* A circular muscle.

OR'BIT. The bony cavity in which the eye-ball is situated.

OR'GAN. A part of the body having some special function to perform.

ORGAN'IC, *or-gan'-ik.* Of or relating to organs.

OR'GANISM, *or'-gan izm.* An organized body with a separate existence.

OR'IFICE, *or'-if-is.* The entrance to any bodily cavity.

OR'IGIN, *or'-ij-in.* That point of attachment of a muscle which remains fixed during contraction of the muscle.

Os. Chemical symbol for osmium; neck of uterus.

Oscula'tion, *os-kū-lā'-shun.* Making a diagnosis by listening to sounds.

Osmo'sis. The passage of a liquid through a porous partition.

Osmot'ic, *os-mot'-ik.* Of or relating to osmosis.

Os'seus, *os'-ē-us.* Composed of bone; bony.

Ossifica'tion, *os-if-ik-ā'-shun.* The formation of bone.

Ostei'tis, *os-tē-ī'-tis.* Inflammation of bone.

Osteo-arthri'tis. Painful chronic inflammation of joints and bones.

Osteomyeli'tis. Inflammation of the marrow of a bone.

Osteonecro'sis, *os-tē-ō-nē-krō'-sis.* Necrosis of bone.

Os'teotome, *os'-tē-ō-tōm.* An instrument for cutting bone.

Osteot'omy, *os-tē-ot'-ō-me* The cutting of bone, or of relief of deformity.

Otol'ogy, *ō tol'-ō-je.* The study of the ear and its diseases.

Otorrha'gia, *ō-tōr-ā'-je-ah.* Discharge of blood from the ear.

Ounce. A measure of weight.

O'val, *ō'-val.* Egg-shaped.

Ova'rian, *ō-vā'-ri-an.* Of or relating to the ovary.

Ova'riocele, *ō-vā'-ri-ō-cēl.* Hernia of the ovary.

Ovariot'omy, *ō-vā-ri-ot'-ō-me.* Excision of the ovary.

O'vary. The sexual gland of the female in which the ova are developed.

Oxal'ic Acid. White, crystalline, poisonous substance,

Oxida'tion, *oks-id-ā'-shun.* The formation of an oxide.

Ox'ide, *oks'-id.* Compound of oxygen with an element or a radical.

Oxy'gen, *oks'-ē-jen.* A gaseous, non-metallic element forming over 20 per cent. of atmosphere.

Oxygena'tion, *oks-ē-jen-ā'-shun.* Saturation with oxygen.

O'zone, *ō'-zōn.* A form of oxygen whose molecule consists of three atoms instead of two.

P

Pab'ulum, *pab'-ū-lum* Latin for food.

Pal'ate, *pal'-at.* The roof of the mouth, consisting of the hard palate in front, the soft palate behind.

Pal'atine, *pal'-at-in.* Of or relating to the palate.

Pale, *pāl.* Colorless.

Pal'iative, *pal'-i-ā-tiv.* Relieving but not curing.

Pal'lor. Paleness, loss of color.

Palm. The hollow surface of the hand.

Pal'mar. Of or relating to palm of hand.

Palpa'tion, *pal-pā'-shun.* Examination by touch and pressure of the hand.

Palpita'tion, *pal-pit-ā'-shun.* Rapid throbbing.

Pan'creas. Long, flat gland in the epigastric region below the stomach.

PANCREAT'IC, *pan-krē-at-ik.* Of or relating to the pancreas.

PAN'CREATIN, *pan'-krē-at-in.* A ferment obtained from the pancreas.

PANDEM'IC, *pan-dĕm'-ik.* Epidemic over a wide region.

PAPIL'LA, *pap-il'-ah.* A small nipple-like eminence.

PAP'ULE, *pap-ūl.* A small elevation of the skin.

PARACENTE'SIS, *par-as-en-tē'-sis.* Puncturing of a cavity to draw off fluid or gas.

PAR'AFFIN. White, waxy substance from petroleum; wood tar.

PARAGLOB'ULIN. A proteid from blood-serum and other bodily tissues.

PARAL'BUMIN, *par-al'-bū-min.* A proteid found in ovarian cysts.

PARAL'YSIS, *par-al'-is-is.* Loss of sensation.

PARALYT'IC, *par-al-it'-ik.* Of or relating to paralysis.

PARAPLE'GIA, *par-ah-plē'-je-ah.* Paralysis of lower half of body and lower extremities.

PAR'ASITE, *par'-as-īt.* An animal or a plant living on others.

PARASIT'IC, *par-as-it'-ik.* Having the characters or caused by parasites.

PARASIT'ICIDE, *par-as-it'-is- īd.* A remedy destructive to parasites.

PAREN'CHYMA, *par-en'-kim-ah.* The essential elements of a tissue.

PARENCHYMATI'TIS. Inflammation of the parenchyma.

PARENCHYM'ATOUS, *par-en-kim'-at-us.* Pertaining to the parenchyma.

PAR'ESIS. Incomplete motor paralysis.

PARTU'RIENT, *par-tū'-ri-ent.* Bringing forth.

PARTURI'TION, *par-tū-rish'-un.* The act of child-bearing.

PAS'SION, *pash'-un.* A painful affection.

PAS'SIVE. Not active.

PASTEURIZA'TION, *pas-toor-iz-ā'-shun.* The checking of fermentation by heating.

PATCH. An area of surface differentiated from the surface around it.

PATHET'IC, *path-et'-ik.* Pertaining to the feelings.

PATHOGEN'IC, *path-ō-jen'-ik.* Producing disease.

PATHOGNOMON'IC, *path-og-nō-mon'-ik.* Indicative of the nature of a disease.

PATHOLOG'ICAL, *path-ō-loj'-ik-al.* Of or relating to pathology.

PATHOL'OGY, *path-ol'-ō-je.* Branch of medicine treating of diseases.

PAT'ULOUS, *pat'-ū-lus* Spread open.

PAUNCH, *pawnch.* The stomach.

PECTINE'US. Iliopectineal line and pubes.

PEC'TORAL, *pek'-to-ral.* Pertaining to chest.

PE'DAL, *pe'-dal.* Pertaining to the feet.

PED'ICLE, *ped'-ik-l.* The stump or stalk of a tumor.

PEL'VIC, *pel'-vik.* Of or relating to the pelvis.

PEL'VIS. The bony basin formed by the innominate bone, the sacrum and the coccyx.

PEN'DULOUS AB'DOMEN. Relapsed state of abdominal walls.

PEN'ETRATING, *pen'-ē-trā-ting.* Piercing.

PEP'SIN. A ferment of the gastric juice.

PEP'TIC, *pep'-tik.* Of or relating to digestion or to pepsin.

PEP'TONE. A proteid formed from another by action of pepsin.

PERCEP'TION. The act of appreciating by the senses.

PERCOLA'TION, *per-cō-lā'-shun.* Extinction of soluble portion of powdered drug by allowing a liquid to pass through it.

PERCUS'SION. Act of striking a part to ascertain its condition by the sound obtained.

PER'FORANS, *per'-fō-ranz.* A nerve or muscle perforating a part.

PERICARDI'TIS, *per-ē-kar-dī'-tis.* Inflammation of the pericardium.

PERICAR'DIUM, *per-ē-kar'-de-um.* The membraneous bag enveloping the heart.

PERICRA'NIUM, *per-ē-krā'-ne-um.* The periosteum of the cranium.

PERIMYS'IUM, *per-ē-mis'-i-um.* The sheath around muscle, fasciculus.

PERINE'UM. The space between the anus and the genitals.

PE'RIOD, *pē'-ri-od.* A division or interval of time.

PERIOS'TEUM, *per-ē-os'-tē-um.* The tough, fibrous membrane investing a bone.

PERIOSTI'TIS, *per-ē-os-tī'tis.* Inflammation of the periosteum.

PERISTAL'SIS. The peculiar movement, like that of a worm, by which the intestines and other tubular organs propel their contents.

PERISYS'TOLE. The interval of time between diastole and systole.

PERITONE'AL, *per-it-on-ē'-al.* Of or relating to the peritoneum.

PERITONE'UM, *per-it-on-ē'-um.* The strong serous membrane investing parietes of the abdomen.

PERITONI'TIS, *per-it-on-ī'-tis.* Inflammation of the peritoneum.

PERYTYPHLI'TIS, *per-it-if-lī'-tis.* Inflammation of the tissue about the cæcum.

PEROX'IDE. An oxide with more oxygen than the normal oxide.

PERSPIRA'TION, *per-spir-ā'-shun.* Sweat.

PESTIF'EROUS. Pestilential.

PES'TILENCE. Any contagious epidemic disease.

PETE'CHIA, *pē-tē'-ke-ah.* A small spot due to infusion of blood.

PETRO'LEUM. Coal oil.

PEY'ER'S GLANDS, *pī'-er's glanz.* Whitish patches of lymph follicles in mucous or sub-mucous layers of small intestine,

PHAGEDE'NA, *faj-ed-ē'-nah.* Malignant, rapidly spreading ulceration.

PHAG'OCYTE, *fag'-ō-sit.* A cell which destroys pathogenic microbes or other harmful cells.

PHALAN'GES, *fā-lan'-jēs.* The plural of phalanx.

PHAN'TOM, *fan'-tum.* A ghost.

PHAN'TOM TU'MOR. Swelling resembling a tumor caused by puffing out of the abdomen.

PHAR'YNX, *far'-inks.* The muscular membraneous sac at the back of the mouth and nose.

PHE'NOL, *fē'-nol.* Carbolic acid.

PHEN'YL, *fen'-il,* The radical of carbolic acid.

PHLEBEC'TASIS, *flē-bek'-tas-is.* Dilatation of a vein.

PHLEBI'TIS, *flē-bī'-tis.* Inflammation of a vein.

PHLEBOT'OMY, *fleb ot'-ō-me.* Opening of a vein for letting blood.

PHLEGM, *flem.* One of the formerly supposed humors of the body; mucous.

PHLEGMA'SIA AL'BA DO'LENS. Phlebitis of the femoral vein in women after delivery.

PHLEGMAT'IC, *fleg-mat'-ik.* Abounding in phlegm.

PHOS'PHATE. *fos'-fāt.* A salt of phosphoric acid.

PHOS'PHORUS, *fos'-for-us.* A non-metallic element, colorless, translucent, and of a waxy consistence.

PHTHI'SIS, *tī'-sis.* A wasting away.

PHYS'ICAL, *fiz'-ik-al.* Of or relating to nature.

PHYS'ICAL EXAM'INATION. Examination of the body to ascertain its condition.

PHYS'ICAL SIGNS. Any sign of disease by examination.

PHYSIOL'OGY, *fiz-i-ol'-ō-je.* The science of the functions of living bodies and organs.

PI'A MA'TER, *pī'-ah mā'-ter.* The most internal of the membranes of the brain and cord.

PIG'MENT. A dye-stuff or coloring matter.

PIL'LAR. Any supporting structure.

PIPETTE', *pip-et'.* A tube for withdrawing or adding small quantities of liquid.

PIS'IFORM BONE. Small round bone on ulnar side of proximal row of the carpus.

PIT OF STOM'ACH. The epigastrium.

PIT'TING. The formation of pits in the skin.

PLACEN'TA, *plā-sen'-tah.* The flat, circular, vascular structure in the uterus forming a medium of communication between mother and child.

PLAGUE, *plāg.* A disease resembling typhus spreading in epidemics over Africa, Asia, Europe and America.

PLAN'TAR. Of or relating to the sole of the foot.

PLAN'TAR ARCH. Arch of arteries in the sole of the foot.

PLANTA'RIS, *plan-tā'-ris.* An extensor muscle of the foot.

PLAS'MA, *plaz'-mah.* The fluid portion of blood containing the corpuscles.

PLAS'TIC. Building up tissue.

PLATYS'MA MYOI'DES. Broad, thin muscle on side of neck.

PLED'GET, *pled'-jet.* A small compress.

PLETH'ORA. Condition marked by fullness of blood vessels.

PLETH'ORIC. Relating to or marked by plethora.

PLEU'RA, *plū'-rah.* The serous membrane lining thorax and investing lungs.

PLEU'RISY, PLEURI'TIS, *plū'-ris-e, plū-rī'-tis.* Inflammation of pleura with exudation into its cavity.

PLEURO-PNEUMO'NIA. Pneumonia combined with pleurisy.

PLEX'US. An interlacing network of nerves or veins.

PNEUMOCOC'CUS, *nū-mō-kok'-us*. The diplococcus pneumonia.

PNEUMON'IC, *nū-mon'-ik*. Relating to or affected with pneumonia.

PNEUMONI'TIS, *nū-mon-ī'-tis*. Pneumonia.

POI'SON. A substance which when applied to the body causes injury or derangement.

POL'LEX. The thumb.

POLLU'TION, *pol-ū'-shun*. Emission of semen without coitus; contamination.

POLYCLIN'IC, *pol-ē-klin'-ik*. Clinic or hospital for treating all kinds of diseases.

POL'YPOID, *pol'-ip-oid*. Relating to or resembling a polypus.

POL'YPUS, *pol'-ip-us*. Smooth, pedunclated tumor from a mucous surface.

PO'MUM ADA'MI, *pō'-mum ad-ā'-mī*. Projection on fore part of neck caused by anterior part of thyroid cartilage.

PONS, *ponz*. A bridge.

PONS VARO'LII. Square portion of medullary matter connecting cerebrum, cerebellum and medulla oblongata.

POPLITE'AL, *pop-lit-ē'-al*. Of or relating to the ham.

POPLITE'AL SPACE. Lozenge-shaped area back of knee.

PO'ROUS, *pō'-rus*. Filled with pores.

POR'TAL. Of or relating to the porta hepatis.

POST'-CAVA, *pōst'-kav-ah*. The inferior or ascending vena cava.

POSTE'RIOR, *pōs-tē'-rē-or*. Situated towards the rear.

POST-MOR'TEM. After death: examination of a dead body.

POUCH. A pocket-like cavity.

POU'PART'S LIG'AMENT, *poo'-partz*. Lower border of aponeurosis of external oblique between anterior spine of ilium and spine of pubis.

PRE'-CAVA, *prē'-kav-ah*. The descending or superior vena cava.

PRECIP'ITANT, *prē-sip'-it-ant*. A substance which causes precipitation.

PRECIP'ITATE, *prē-sip'-it-āt*. To cause a substance in solution to settle down as a deposit.

PRECOR'DIA, *prē-kor'-de-ah*. The epigastric region.

PREDISPOSI'TION, *prē-dis-pō-zish-un*. Condition of the system disposing to a disease.

PREG'NANCY. Being with child.

PREG'NANT. With child.

PREMON'ITORY, *prē-mon'-it-ō-re*. Giving warning.

PRO'CESS, *prō'-ses*. Projecting point or eminence of bone.

PROCREA'TION, *prō-krē-ā'-shun*. Act of generating or begetting.

PROGNO'SIS, *prog-nō'-sis*. Prediction of progress and termination of disease.

PROGNOS'TIC, *prog-nos'-tik*. Giving an indication of progress of disease.

PROLAPSE' PROLAP'SUS. A falling or sinking of a part, such as prolapsus uteri.

PROLIF'IC, *prō-lif'-ik.* Productive, fruitful, fertile.

PROM'INENCE. An eminence.

PRONA'TION, *prō-nā'-shun.* Act of turning palm of hand downward.

PROPHYLAC'TIC, *prō fil-ak'-tik.* Warding off disease.

PROPHYLAX'IS, *prō-fil-aks-is.* Prevention of disease.

PROSEC'TOR, *prō-sek'-tor.* One who prepares a cadaver for demonstration.

PROS'TATE GLAND. Large gland below neck of bladder in the male.

PROTEC'TIVE, *prō-tek'-tiv.* A water-proof material used in surgical dressings.

PRO'TEIDS, *prō'-tīdz.* One of a class of albuminoid compounds forming constituents of the bodily solids and fluids.

PRO'TOPLASM. Physical basis of life. Constituent of cells.

PRO'TOPLAST, *prō'-tō-plast.* A cell without a cell wall.

PROX'IMAL, PROX'IMATE, *proks'-im-al, proks'-im-āt.* End nearest the trunk of the body.

PSEU'DO-CROUP, *sū'-dō-kroop.* Larngismus stidulus. False croup.

PSEU'DO-CYE'SIS, *sū'-dō-sī-ē'-sis.* False or spurious pregnancy.

PSO'AS, *sō'-as.* One of the two muscles of the loins.

PTO'MAINES, *tō'-mā-ins.* Alkaloidal substance formed during putrefaction.

PTO'SIS, *tō' sis.* Dropping of the upper eyelid from paralysis.

PU'BERTY, *pū'-ber-te.* Age at which generative organs become active.

PU'BES, *pū'-bēz.* The bones forming the symphysis, the anterior part of the pelvis.

PU'BIC, *pu'-bik.* Pertaining to the pubes.

PU'DIC, *pū'-dik.* Relating to the pudendum.

PU'ERILE, *pū'-er-il* Childish.

PUER'PERA, *pū-er'-per-ah.* A woman in child-birth.

PUER'PERAL, *pū-er'-per-al.* Of or pertaining to child-birth.

PUER'PERAL CONVUL'SIONS (Eclampsia). Convulsions preceding delivery, or after the birth of a child.

PUER'PERAL FEVER. Fever caused by infection during child-birth, accompanied by peritonitis, cellulitis, septicæmia, etc.

PUL'MONARY, PULMON'IC. Of or relating to the lungs.

PULMONI'TIS, *pul-mon-ī'-tis.* Inflammation of the lungs.

PULSA'TION, *puls-ā'-shun.* A beating or throbbing of a vessel or part.

PULSE. The regular expansion of an artery felt by the finger.

PUNC'TURE, *punk'-tūr.* To penetrate; act of pricking.

PUN'GENT, *pun'-jent.* Sharp, penetrating.

PU'PIL, *pū'-pil.* The round opening in the center of the iris.

PU'RIFORM, *pū'-re-form.* Resembling pus.

PU'RULENT, *pū'-rū-lent.* Quality of being purulent. Containing pus

PUS. A thick, cream-like fluid resulting from inflammation.

PUS'TULE, *pus'-tūl.* A small elevation of the cuticle containing fluid.

PUTREFAC'TION, *pū-trē-fak'-shun.* Decomposition of animal matter caused by the action of putrefactive micro-organisms.

PUTRES'ENCE, *pū-tres'-ens.* Undergoing decomposition.

PU'TRESCINE. *pū'-tres-in.* Liquid ptomaine from putrefying matter.

PU'TRID, *pū'-trid.* In a high state of decomposition.

PU'TRID FEVER. Typhoid typhus.

PYE'MIA, *pī-ē'-me-ah.* Septic infection caused by absorption of germs of suppuration, and marked by abscesses, accompanied by chills, fever and perspiration.

PYLOR'IC, *pī-lor'-ik.* Of or relating to the pyloris or lesser end of the stomach.

PYLO'RUS, *pī-lō'-rus.* The smaller opening in the stomach leading into the duodenum.

PYR'AMID. A cone-shaped eminence of an organ.

PYRAM'IDAL. Shaped like a pyramid.

PYRET'IC, *pī-ret'-ik.* Of or relating to or marked by fever.

PYREX'IA, *pī-reks'-e-ah.* A rise of temperature above 99.

Q

QUADRAN'GULAR, *kwod-rang'-gū-lar.* Having four sides; square-shaped.

QUADRA'TUS, *kwod-rā'-tus.* An oblong muscle.

QUAL'ITATIVE, *kwol'-it-ā tiv.* Pertaining to the quality.

QUAN'TITATIVE, *kwon'-tit-ā-tiv.* Pertaining to the quantity.

QUANTIV'ALENCE, *kwon tiv'-al-ens.* The combining power of an element or radical.

QUAR'ANTINE, *kwor'-an-tēn.* The period during which vessels, cars, carriers or people from an infected part are prohibited from entering a healthy one.

QUICK'ENING. The first perceptible feeling of the movements of the child in utero.

QUIN'SY. Tonsilitis; inflammation of the tonsils.

QUIZ, *kwiz.* Instruction by questions and answers.

R

RAC'EMOSE, *ras'-ē-mōs.* Resembling a bunch of grapes.

RA'DIAL, *rā'-de-al.* Of or pertaining to the radius.

RAD'ICAL. Thorough, directed to the cause.

RA'DIUS, *rā'-de-us.* The long bone on the thumb side of the forearm.

RAMIFICA'TION, *ram-if-ik-ā'-shun.* Division into branches.

RA'MUS, *rā'-mus.* A branch, especially of an artery, vein or nerve; when applied to bone means a division.

RASH. An eruption on the skin.

REAC'TION, *rē-ak'-shun.* Counter-action or opposite action.

RECEPTAC'ULUM CHY'LI, *rē-sep-tak'-ū-lum kī'-lī.* The lower expanded portion of the thoracic duct.

REC'TAL, *rek'-tal.* Of or pertaining to the rectum.

REC'TUM, *rek'-tum.* The last portion of the large intestine, about nine inches in length.

REC'TUS, *rek'-tus.* Straight muscle.

REFLEC'TION, *rē-flek'-shun.* A turning back, a bending.

RE'GION, *rē'-jun.* A particular portion of the body.

RE'GIONAL, *rē'-jun-al.* Of or pertaining to a region.

REG'ULAR, *reg'-ū-lar.* According to rule, normal.

REGURGITA'TION, *rē-ger-jit-ā'-shun.* A casting up of food; a flowing backward of fluid.

REINFEC'TION, *rē-in-fek'-shun.* Infected a second time.

REINOCULA'TION, *rē-in-ok-ū-lā'-shun* Inoculated a second time.

RELAXA'TION, *rē-laks-ā'-shun.* A loosening.

REME'DIAL, *rem-ē'-di-al.* Acting as a remedy.

REMIS'SION, *rē-mish'-un.* An abatement or diminution of the symptoms of a disease.

REMIT'TENT, *rē-mit'-ent.* Abating at intervals.

REMIT'TENT FEVER. Malarial fever with remissions.

RE'NAL, *rē'-nal.* Of or pertaining to the kidneys.

RESID'UAL, *rē-zid'-ū al.* Remaining portion, left behind.

RESPIRA'TION. Breathing, act of taking air into and expelling it from the lungs.

RESPIR'ATORY, *res-pīr'-ā-tō-re.* Of or pertaining to respiration.

RESUSCITA'TION. Act of restoring to life one in a state of suspended animation.

RET'INA. The internal nervous coat of the eye, formed by the expansion of the optic nerve.

RETRAC'TOR. Instrument for drawing aside the edges of an incision.

RHEUM'ATISM, *rūm'-at-izm.* Constitutional disease in which the joints and muscles are inflamed and painful.

RHEUM'ATOID, *rūm'-at-oid.* Chronic inflammatory condition of joints.

RI'GOR, *rī'-gor.* A chill, a stiffening.

RI'GOR MOR'TIS. State of rigidity after death, due to nervous contraction and coagulation of muscle plasma.

RIGID'ITY, *rij-id'-it-e.* A stiffening of a part.

ROTA'TOR, *rō-tā'-tor.* A muscle which rotates a part.

RUBE'OLA. False or German measles, an infectious disease resembling measles.

RUDIMEN'TARY, *rū-dim-en'-tā-re.* Imperfectly or incompletely developed.

RUP'TURE, *rup'-tūr.* Breaking or bursting of a part; a protrusion of a part from its containing cavity.

S

SAC, *sak.* Membrane enclosing fluids.

SAC'CULATED, *sak'-ū-lā-ted.* Composed of saccules.

SA'CRAL, *sā'-kral.* Of or relating to the sacrum.

SA'CRUM, *sā'krum.* The triangular bone above the coccyx.

SAG'ITTAL, *saj'-it-al.* Shaped like an arrow.

SA'GO SPLEEN. A spleen in which the malpigian corpuscles are degenerated, forming white patches like sago grain.

SALICYL'IC ACID, *sal-is-il'-ik.* A crystalline substance, highly antiseptic, found in plants, also obtained from carbolic acid.

SA'LINE, *sā'-līn.* Salty.

SALI'VA, *sā-lī'-vah.* The fluid secreted by the salivary glands.

SAL'IVARY, *sal'-iv-ā-re.* Of or relating to the saliva.

SALT. Sodium chloride.

SALTPE'TER, *sawlt-pē'-ter.* Potassium nitrate.

SALTS, *sawltz.* Magnesium sulphate.

SAN'ITARY, *san'-it-ā-re.* Pertaining to or promoting health.

SAPHE'NA, *saf-ē'-nah.* The saphenous veins.

SAPONIFICA'TION, *sap-on-if-ik-ā'-shun.* Conversion into soap.

SAPRE'MIA, *sap-rē'-me-ah.* Blood poison caused by the entrance of septic products into the blood.

SAP'RINE. A ptomaine from decaying flesh.

SARCI'NA, *sar-sī'-nah.* A genus of microbe.

SARCOLEM'MA A membraneous sheath enclosing a fiber of voluntary muscles.

SAR'COMA. A tumor of embryonic connective tissue cells.

SARCO'MATOUS, *sar-kō'-mat-us.* Pertaining to a sarcoma.

SATURA'TION. The state of a solvent, which has dissolved as much of a body as it can contain.

SCAB, *skab.* A crust formed on the cuticle, over a wound or ulcer.

SCA'BIES, *skā'-bi-ēz.* Itch, a contagious skin disease.

SCALD, *skawld.* A burn caused by hot liquid.

SCALP'EL, *skal'-pel.* A small straight knife with a convex edge.

SCAPH'OID AB'DOMEN. Boat shaped.

SCAP'ULA, *skap'-ū-lah.* Flat triangular bone of the shoulder, shoulder blade.

SCARF'SKIN, *skarf'-skin.* The cuticle or epidermis.

SCARIFICA'TION, *skar-if-ik-ā'-shun.* Act of making small superficial incisions on the skin.

SCARLATI'NA, *skar-lat-ē'-nah.* Scarlet fever, an acute contagious disease.

SCAR'LET FE'VER, *skar'-let fē-ver.* Same as scarlatina.

SCAR'PA'S TRIANGLE, *skar'-paz trī'-ang-gl.* Triangle at upper anterior portion of thigh, bounded above by Poupart's ligament, on the outside by sartorious muscle, on the inside by the adductor longus.

SCIR'RHUS, SCIR'RUS, *skir'-us.* Hard, stone-like in texture.

SCLEROT'IC *sklē-rot'-ik.* The outer coat of the eye.

SCROF'ULOUS, *skrof-ū-lus.* Having or of the nature of scrofula; tuberculous swelling of glands.

SCRO'TAL, *scrō'-tal.* Of or pertaining to the scrotum.

SCRO'TUM, *scrō'-tum.* Pouch containing the testes and spermatic cord.

SCULL-CAP. The top of the head.

SCUR'VY. A disease produced by improper food; a variety of purpura.

SEBA'CEOUS, *sē-bā'-she-us.* Of or relating to a gland secreting sebum.

SEC'ONDARY, *sek'-on-dā-re.* Second in order, following something else.

SECRE'TION. Function of the body by which various substances are separated from the blood, tissues, etc.: the substance thus separated.

SECRE'TORY, *sē-krē'-tō-re.* Of or pertaining to secretion.

SEC'TION, *sek'-shun.* A cut, or cut surface. The act of cutting.

SED'ENTARY, *sed'-en-tā-re.* Sitting, requiring a sitting position.

SED'IMENT. A spontaneously formed precipitate.

SEG'MENT. A portion separated from a part.

SELF-INFEC'TION. Infected by a poison generated within the body.

SEMI-LU'NAR VALVES. Valves shaped like a half moon.

SEMI-MEMBRANO'SIS, *sem-ē-mem-brān-ō'-sis.* Half membranous.

SENI'LIS, *sē-nī-lis.* Arcus. Ring formed around the cornea in old age.

SENIL'ITY, *sē-nil'-it-e.* Old age.

SENSA'TION, *sen-sā'-shun.* A feeling; an impression made on the organs of sense by an outward influence.

SEN'SORY, *sen'-sō-re.* Pertaining to sensation.

SEP'SINE, *sep'-sin.* Poisonous ptomaine from decaying yeast and animal matter in a state of putrefaction.

SEP'SIS, *sep'sis.* Poisoning by putrefactive matter.

SEPTE'MIA, SEPTICE'MIA, *sep-tē'-me-ah, sep tis-ē'-me-ah.* State of disease in which putrefactive bacteria are found in the blood.

SEP'TIC, *sep'-tik.* Pertaining to, or due to putrefaction.

SE'ROUS, *sē'-rus.* Of or pertaining to, or resembling serum.

SER'RATED, *ser'-ā-ted.* Indented like teeth of a saw.

SE'RUM, *sē'-rum.* A thin fluid of a serous nature, secreted by the serous coverings of the viscera.

SHEATH, *shēth.* Covering of a nerve, the neurelema; covering of arteries and vessels, usually derived from the deep fascia.

SHIP FEVER. Same as typhus fever, due to overcrowding in ships.

SHOCK. A depressed condition of the system due to sudden mental emotion or injury.

SIGHT, *sīt.* The act or power of seeing.

SIG'MOID. Shaped like the letter S.

SIMULA'TION, *sim-ū-la'-shun.* Counterfeiting or pretending disease.

SKEL'ETON. The bony framework of the body of an animal.

SKIAG'RAPHY, *skī-ag'-ra-fe* (See X-rays). Act of producing a skiagraph.

SKULL. Bony framework of head and face.

SLOUGH, *sluf.* A portion of dead tissue debris in a living part.

SMALL-POX. (See Variola.)

SOFT'ENING. Act of becoming soft.

SOLE, *sōl.* Bottom of the foot.

SOLE'US, *sō-lē'-us.* Large muscle entering into formation of the calf of leg.

SOL'UBLE, *sol'-ū-bl.* Susceptible of solution.

SOLU'TION, *sō-lū'-shun*. A liquid containing solids which have been dissolved.

SOMAT'IC, *sō-mat'-ik*. Death of the whole body.

SOMNIF'EROUS. Pertaining to sleep.

SOM'NOLENT, *som'-nō-lent*. A state of incomplete sleep.

SPASM, *spazm*. A sudden involuntary contraction of muscles.

SPECIF'IC. A specific remedy; relating to a species.

SPECIF'IC GRAV'ITY. Weight of a body compared with an equal volume of another.

SPERMAT'IC CORD. Cord leading from the testes.

SPHINC'TER, *sfingk'-ter*. A ring-shaped muscle.

SPI'NAL, *spī'-nal*. Of or pertaining to the spine.

SPI'NAL CANAL. Canal extending through the spinal column, and containing the spinal cord.

SPI'NAL COL'UMN. The back-bone.

SPI'NAL CORD. Cord leading from medulla oblongata to sacrum.

SPI'RAL, *spī'-ral*. In the shape of a coil.

SPIRIL'LUM, *spī-ril'-um*. A genus of microbe, spiral in shape.

SPLANCH'NIC, *splangk'-nik*. Pertaining to the viscera.

SPLEEN. A purple-colored organ situated in left hypochondriac space, near great end of the stomach.

SPLEEN'-PULP, *splēn'-pulp*. The proper pulp or tissue of the skin.

SPON'GIFORM, *spun'-je-form*. Having the appearance of a sponge.

SPONTA'NEOUS, *spon-ta'-ne-us*. Voluntary. Occurring without external influence.

SPORAD'IC, *spor-ad-ik*. Occurring in places not widely diffused.

SPORE, *spor*. A reproductive cell, found in some of the vegetable micro-organisms.

SPOT'TED FE'VER. Cerebro spinal fever.

SPU'TUM, *spu'-tum*. Matter spit out of the mouth.

SQUA'MA, *skwā'-mah*. A scale.

SQUA'MOUS, *skwa'-mus*. Of or relating to a scale.

STA'SIS, *stā'-sis*. A stoppage, especially of the circulation.

STATIS'TICS, *stā-tis'-tiks*. Records of cases.

STE'ARIN, *stē'-ar-in*. A white crystalline powder.

STE'NO'S OR STEN'SON'S DUCT. The duct leading from the parotid gland.

STENO'SIS, *stē-nō'-sis*. Contraction or narrowing of a canal or part.

STER'ILE. Not containing micro-organisms. Barren, not producing young.

STERILIZA'TION, *ster-il-iz-ā'-tion*. Process of rendering objects aseptic.

STER'NAL. Of or pertaining to the sternum.

STER'NUM. The breast bone.

STER'TOR. Sonorous breathing; snoring.

STETH'OSCOPE. Instrument for recording condition of the lungs and heart.

STILL'-BORN. Born without life.

STOMATI'TIS, *stō-mat-i'-sis*. Inflammation of the mouth.

STOOL. A movement of the bowels.

STRANG'ULATED HER'NIA. An irreducible hernia.

STRANGULA'TION, *stran-gu-lā'-shun.* Of or affected with strangulation.

STRA'TUM, *strā'-tum.* A layer of tissue.

STRIC'TURE, *strik'-tūr.* A narrowing in a canal, tube or duct.

STROKE, *strōk.* A sudden attack of disease.

STRUC'TURE, *struk'-tūr.* Pertaining to the structure or tissue of a part.

STRU'MOUS, *strū'-mus.* Scrofulous.

STU'POR, *stū'-por.* A state of unconsciousness.

SUBACUTE', *sub-ak-ūt'.* Moderately acute; between acute and chronic.

SUBARACH'NOID, *sub-ar-ak'-noid.* Beneath the arachnoid membrane.

SUBCLAV'IAN, *sub-klā'-vi-an.* Beneath the clavicle.

SUBCLAVIC'ULAR, *sub-klā-vik'-ū-lar.* Beneath the clavicle.

SUBCUTA'NEOUS, *sub-kū-tā'-nē-us.* Beneath the skin.

SUB'JECT. A cadaver. (*b*) A living person upon whom experiments are being performed.

SUBJEC'TIVE. A symptom perceived by the patient only.

SUB'LIMATE, *sub'-lim-āt.* The substance obtained by sublimation.

SUB'LIMATE, CORRO'SIVE. Bichloride of mercury.

SUBLIMA'TION, *sub-lim-ā'-shun.* The act of causing a solid substance to vaporize without undergoing fusion.

SUFFOCA'TION, *suf-ō-kā'-shun.* Stoppage of respiration.

SUFFU'SION, *suf-ū' zhun.* Superficial extravasation of blood.

SUGGILLA'TION, *suj-il-ā'-shun.* A bruise or an ecchymoses.

SUL'CATED, *sul'-kā-ted.* Marked by sulci; furrowed, grooved.

SUL'PHATE, *sul'-fāt.* A combination of sulphur with a base.

SUL'PHUR, *sul'-fer.* A non-metallic agent used in fumigation of apartments.

SULPHU'RIC ACID. Colorless caustic liquid (H_2SO_4).

SUNSTROKE. Overcome by excessive heat. (See insolation.)

SUPERFIC'IAL, *sū-per-fish'-al.* Upon or near the surface.

SUPE'RIOR, *sū-pē'-ri-or.* Higher, situated above.

SUPINA'TION, *sū-pin-ā'-shun.* Act of turning the palm of the hand upward.

SU'PINATOR, *sū'-pin-ā-tor.* A muscle causing supination.

SUPPRES'SION. A complete stoppage of a secretion or an excretion.

SUPPURA'TION, *sup-ū-rā'-shun.* The formation or discharge of pus.

SUSPEN'DED ANIMA'TION. Condition simulating death.

SWEL'LING. An enlargement of a part.

SYMPATHET'IC. Pertaining to sympathy.

SYMP'TOM, *simp'tum.* An evidence of disease or a patient's condition.

SYMTOMAT'IC, *sim-tō-mat'-ik.* Pertaining to symptoms.

SYN'COPE, *sin'-kō-pe.* Fainting or swooning.

SYNO'VIA, *sin ō'-ve-ah.* The viscid fluid of the cavities of joints.

SYNOVI'TIS, *sin-ō-vī'tis.* Inflammation of a synovial membrane.

SYN'THESIS. Formation of a chemical compound by union of its elements.

SYNTHET'IC. Pertaining to or formed by synthesis.

SYPH'ILIDE, *sif'il-id.* A cutaneous manifestation of syphilis.

SYPH'ILIS, *sif'il-is.* A chronic, infectious venereal disease, with cutaneous and other structural lesions; three stages—primary, secondary and tertiary.

SYR'INGE, *sir-inj.* Instrument for injecting liquids.

SYS'TEM. The entire body.

SYSTEMAT'IC. According to a system, methodical.

SYSTEM'IC. Pertaining to the whole organism.

SYS'TOLE, *sis'-tō-lē.* The period of contraction of the heart.

SYSTOL'IC. Pertaining to the systole.

T

TABEFAC'TION, *tab-ē-fak'-shun.* Emaciation.

TA'BES, *tā'-bēz.* Wasting away; tuberculosis in lymphatic glands of children.

TA'BLE, *tā'-bl.* A flat plate of bone.

TAC'TILE, *tak'-til.* Pertaining to touch.

TAL'IPES, *tal'-ip-ēz.* Club feet.

TAM'PON. A cotton plug.

TAN'NIC ACID. Astringent and hæmostatic powder of a yellowish color ($C_{14}H_{10}O_8$).

TAN'NIN. Same as above.

TAP'PING. Puncturing a cavity to draw off fluid or gas.

TAR'SAL. Pertaining to the tarsus.

TAR'SUS. The bones forming the instep, seven in number.

TARTAR'IC ACID. White powder from tartar and plants ($C_4H_6O_6$).

TEM'PERAMENT. The peculiar disposition of an individual.

TEM'PERATURE. The degree of heat eliminated by a body.

TEM'PORAL, *tem'-pō-ral.* Pertaining to the temple. Region over frontal bone.

TENAC'ULUM, *ten-ak'-ū-lum.* A sharp, hook-like instrument for holding a tissue.

TEN'DINOUS. Of or relating to tendon.

TEN'DON. A white, fibrous cord attaching a muscle to a bone.

TENES'MUS. Painful, ineffectual straining to evacuate the bowels.

TEN'OTOME, *ten'-ō-tōm.* Instrument for dividing a tendon.

TEN'SION. State of being stretched.

TEN'SOR. A muscle that stretches.

TER'TIARY, *ter-she-ā'-re.* The third stage of a disease.

TER'TIARY SYPH'ILIS. Third stage of syphilis.

TEST. An examination. A trial.

TEST'ES, *test'-ēz* Plural for testicle.

TEST-PAPER. Paper used to test for alkalies and acid; litmus paper

TETAN'IC, *tē-tan'-ik.* Pertaining to or resembling tetanus.

TET'ANINE. Ptomaine made from cultures of bacillus of tetanus.

TET'ANUS. A disease with persistent spasmodic contraction of voluntary muscles (lock-jaw).

THER'MIC. Insolation.

THER'MIC FEVER. Sunstroke.

THIGH, *thī*. Part of leg above the knee.

THIGH BONE. The femur.

THORAC'IC, *thō-ras'-ik*. Of or pertaining to the thorax.

THORAC'IC DUCT. Chief duct for collecting the lymph of the body.

THO'RAX, *thō'-racks*. Part of body above the diphragm, extending to the root of the neck and containing the heart, lungs and great vessels.

THROMBO'SIS, *throm-bō'-sis*. The development of a thrombus.

THROM'BUS. A plug in a vessel formed where found.

THY'MIC, *thī'-mik*. Pertaining to the thymus gland.

THY'MOL, *tī'-mol*. Colorless, antiseptic substance of a crystalline nature ($C_{10}H_{14}O$).

THY'MUS, *thī'-mus*. A bi-lobed organ in the neck of children.

THY'ROID, *thī'-roid*. Pertaining to the thyroid structure.

THY'ROID CAR'TILAGE. Cartilage found in the larynx, being the largest of the laryngeal cartilages.

THY'ROID GLAND. Reddish organ in front of and on either side of the trachea.

TIB'IA, *tib'-e-ah*. The inner and larger bone of the leg.

TIB'IAL, *tib'-e-al*. Of or pertaining to the tibia.

TIS'SUE, *tish'-ū*. A collection of cells or fibres forming a structure.

TOL'ERANCE. Power of endurance

TONE. A state of normal tension and vigor.

TON'IC. An agent increasing bodily tone or vigor.

TON'IC-SPASM. A spasm continuing without exacerbation.

TONIC'ITY. Condition of being in health and vigor.

TON'SIL. Small ovoid organ between the anterior and posterior pillars of the fauces.

TONSILI'TIS, *ton-sil-ī'-tis*. Inflammation of the tonsils.

TOPOG'RAPHY, *tō-pog'-ra-fe*. A description of places or regions.

TOR'CULAR HEROPH'ILI, *tor'-ku-lar her-off'-il-i*. Depression in occipital bone, formed by confluence of the lateral and longitudinal sinuses.

TOR'PID. Sluggish; not acting in a healthy condition.

TOR'SION, *tor'-shun*. A twisting.

TOXAL'BUMINS, *toks-al'-bū-minz*. A poisonous albumin, the product of bacteria.

TOXE'MIA, *toks-ē'-me-ah*. Blood poisoning.

TOX'IC. Pertaining to or caused by poison.

TOXICOGEN'IC, *toks-ik-ō-jen'-ik*. Producing poisons.

TOXICOL'OGY, *toks-ik-ol'-ō-je*. The science of poisons.

TOXIF'EROUS. Producing or conveying poison.

TOX'INE, *toks'-in*. A poisonous ptomaine.

TRA'CHEA, *trā'-kē-ah.* The windpipe or tube between larynx and the bronchi.

TRA'CHEAL, *trā'-kē-al.* Pertaining to the trachea.

TRACHEOT'OMY, *trā-kē-ot'-ō-me.* Operation of cutting into the trachea.

TRAC'TION. Act of pulling or drawing.

TRANCE, *trans.* A profound, unnatural sleep.

TRANSFORMA'TION, *trans-for-mā'-shun.* Degeneration; a retrograde metamorphosis.

TRANSFU'SION, *trans-fu'-shun.* Introduction of saline material, or blood of one person into the veins of another.

TRANSLU'CID, *trans-lū'-sid.* Transparent.

TRANSUDA'TION. A passing through a part.

TRANS'VERSE. Lying crosswise; from side to side.

TRAU'MA, *traw'-mah.* A wound.

TRAUMAT'IC, *traw-mat'-ik.* Pertaining to or caused by an injury.

TRAU'MATISM, *traw'-mat-izm.* A wound.

TREAT'MENT, *trīt'-ment.* The management and care of a subject.

TRI'CEPS, *trī'-seps.* Three-headed muscle of upper arm.

TRICHI'NA SPIRA'LIS, *trik-ī'-nah spī-rā'-lis.* Worm found in muscles of the hog.

TRICHINO'SIS. Disease produced by eating pork infected with trichinia.

TRICUS'PID, *trī-kus'-pid.* Having three cusps.

TRITURA'TION, *tret-ū-rā'-shun.* Reduced to powder by rubbing.

TRO'CAR, *trō'-kar.* An embalming needle.

TROCH'LEA, *trok'-lē-ah.* A pulley-like surface or structure.

TRUN'CATED, *trun'-kā-ted.* Cut off abruptly.

TRUNK. The body without head and limbs.

TU'BERCLE, *tū'-ber-kl.* A small eminence or nodule.

TUBER'CULAR, *tū-ber'-kū-lar.* Of or pertaining to tubercles.

TUBERCULO'SIS, *tū-ber-kū-lō'-sis.* Specific infectious contagious disease, (consumption) caused by bacillus tuberculosis.

TUBEROS'ITY, *tū-ber-os'-it-e.* A broad eminence upon a bone.

TUMEFAC'TION, *tū-mē-fak'-shun.* Swelling of a part.

TU'MOR, *tu'-mor.* A swelling: a morbid growth of new tissue.

TU'NICA, *tū'-nik-ah.* A coat of the surface of the eye: external coat of artery.

TUNIC. A coat or lining membrane.

TURGES'CENCE, *ter-ges'-ens.* Swelling or turgescence of a part.

TUR'GID, *ter'-jid.* Swollen; congested.

TYMPANI'TES, *tim-pan-ī'-tēz.* Distension of intestines and abdomen by gas.

TYMPANIT'IC, *tim-pan-it'-ik.* Pertaining to or caused by tympanites.

TYPE, *tīp.* Special form of a disease.

TYPHLI'TIS, *tif-lī-tis.* Inflammation of the cæcum.

TY'PHOID, *tī'-foid.* Of or pertaining to typhus.

TY'PHOID FEVER, *tī'-foid fēver.* A specific eruptive fever caused by bacillus typhois, followed by great depression, delirium and inaction.

TYPHOTOX'IN, *ti-fo-toks'-in.* A poisonous ptomaine resulting from the action of bacillus typhosis.

TY'PHUS FEVER, *ti'-fus fever.* A specific, infectious, contagious fever, (ship fever, jail fever) without lesion.

TYP'ICAL, *tip'-ik-al.* Genuine, well-marked case.

TYRO'SINE, *ti'ro-sine.* White crystalline substance from decomposition of proteids.

TYROTOX'ICON. Ptomaine from poisonous cheese, ice cream, milk, etc.

U

ULCERA'TION, *ul-ser-a'-shun.* Formation of an ulcer.

UL'NA, *ul'-nah.* The larger and inner bone of the fore-arm.

UL'NAR. Pertaining to the ulna.

UMBIL'ICAL, *um-bil'-ik-al.* Pertaining to the navel (umbilicus).

UMBIL'ICAL CORD. The cord connecting placenta of mother to the umbilicus of the child.

UMBIL'ICUS, *um-bil'-ik-us.* The navel; the depression in the center of the abdomen.

UNCON'SCIOUSNESS. Comatose: unable to appreciate external sensations.

UNC'TION, *ungk'-shun.* An ointment.

UN'GUENT, UNGUENT'UM, *un'-gwent, un-gwent'-um.* An ointment or salve.

UNILAT'ERAL, *ū ne-lat'-er-al.* Affecting only one side.

U'NION, *ūn'-yun.* Healing; a joining together.

U'RATE, *ū'-rāt.* A salt of uric acid.

U'REA, *ū'-rē-ah.* White crystalline constituent of urine.

URE'MIA. Caused by absorbtion of ural uræmic.

URE'TER, *ū-rē'-ter.* Tube leading from the pelvis of the kidneys to the bladder.

URETH'RA, *ū-rēth'-rah.* The canal through which the urine passes from the bladder.

U'RIC ACID. Crystalline substance found in urine and certain organs.

U'RINARY, *ū'-rin-ā-re.* Pertaining to the urinary organs.

U'RINE, *ū'-rin.* The fluid secreted by the kidneys and evacuated by the bladder.

URINE'MIA, *ū-rin-ē'-me-ah.* Same as uræmia.

URINIF'EROUS, *ū-rin-if'-er-us.* Conveying urine.

U'TERINE, *ū-ter-in.* Of or pertaining to the uterus.

UTERI'TIS, *ū-ter-i-'-tis.* Inflammation of the uterus.

UTERO-GESTA'TION, *ū-ter-ō-jes tā'-shun.* Pregnancy where the child is in the womb, or normal.

U'TERUS, *ū'-ter-us.* The womb; the hollow organ for the reception and development of the fœtus.

U'VULA. Small fleshy body hanging from soft palate above root of tongue.

V

VACCINA'TION, *vak-sin-ā'-shun.* Act of vaccinating.

VAC'CINE, *vak'sēn.* Virus used in vaccination.

VAC'UOLE, *vak'-ū-ol.* A cavity in cell protoplasm.

VAC'UUM, *vak'-ū-um.* A portion of space devoid of air or gas.

VAGI-NA, *vā-jī'-nah.* The curved canal from the vulva to the uterus.

VAG'INAL, *vaj'-in-al.* Pertaining to the vagina.

VALVE. A fold across a tube or canal preventing reflux of its contents.

VA'POR, *vā'-por.* A gas which at an ordinary temperature is a liquid.

VARIA'TION, *vā'-re-ā-shun.* A deviation from the normal.

VARICEL'LA. Chicken Pox; an infectious febrile disease of childhood.

VAR'ICOSE, *var'-ik-ōs.* Resembling varix; extremely dilated.

VARI'OLA, *vā-rī'-ō-lah.* Small Pox; acute infectious fever with eruption, which is successively papular, vesicular and pustular.

VA'RIOLOID, *vā'-ri-ō-loid.* A mild, modified form of small pox.

VARI'OLOUS, *vā-rī'-ō-lus.* Pertaining to or resembling small pox

VARO'LII, PONS, *ponz vā-rō'-le-ah.* The lower portion of the brain connecting the medulla oblongata.

VAS. A vessel. A blind tube connected with the epidermis.

VAS'A VASO'RUM. Minute arteries and veins in the walls of the blood vessels.

VAS'CULAR, *vas'-kū-lar.* Pertaining to vessels full of vessels; full of blood.

VAS'ELINE, *vas'-el-in.* A proprietary petroleum product.

VEGETA'TION, *vej-et-ā'-shun.* A fungoid growth.

VEIN, *vān.* A vessel returning blood to the heart.

VE'NA, *vē'-nah.* A vein.

VENESEC'TION, *vē-nē-sek'-shun.* Opening a vein.

VEN'OM. Poison secreted by animals.

VE'NOUS, *vē'-nus.* Pertaining to the veins.

VENTILA'TION. Act of furnishing with fresh air.

VEN'TRAL. Pertaining to the belly; abdominal.

VEN'TRICLE. Any cavity: more especially the lower cavities of the heart.

VERMIC'ULAR, *ver-mik'-ū-lar.* Worm-like.

VER-MIFORM, *ver'-mif-orm* Worm shaped.

VER'MIFORM APPENDIX. Worm-like tubular attachment found at the posterior portion of the cæcum, at the junction of the small and large intestines.

VER'TEBRA, *ver'-te-brah.* One of the thirty-two bones forming the spinal column

VER'TEBRAL, *ver'-te-bral.* Pertaining to the vertebræ; back bone.

VER'TEBRAL COL'UMN. The spinal column.

VER'TEX, *ver'-teks*. The top or sumit; crown of the head.
VER'TIGO, *ver'-tig-ō*. Dizziness, swooning.
VES'ICA, *ves'-ik-ah*. A bladder.
VES'ICANT, *ves'-ik-ant*. An agent to produce a blister.
VESICA'TION, *ves-ik-ā'-shun*. Act of blistering.
VES'ICLE, *ves'-ik-l*. A bilster.
VESIC'ULAR, *ves-ik'-ū-lar*. Of or pertaining to a blister.
VES'SEL, *ves'el*. A vascular tube.
VES'TIBULE, *ves'-tib-ūl*. Elliptical cavity of the internal ear behind the cochlea.
VIB'RIO, *vib'-re-ō*. A genus of microbe.
VICA'RIOUS, *vi-kā'-re-us*. Taking the place of another.
VIL'LI. Plural of villus, one of the minute projections from mucous membrane of the intestines.
VIR'ULENCE, *vir'-ū-lens*. State of being virulent.
VIR'ULENT, *vir'-ū-lent*. Malignant, poisonous.
VI'RUS, *vi'-rus*. A poison.
VIS'CERA Pleural of viscus, an organ of the body.
VIS'CERAL. Of or pertaining to the v scera.
VIS'CID. Sticky, gluey.
VIS'COUS, *vis'-kus*. Glutinous, sticky.
VIS'CUS, *vis'-kus*. An organ.
VI'TAL, *vi'-tal*. Pertaining to life.
VITAL'ITY, *vi-tal'-i-te*. State of health.
VI'TALS, *vi'-talz*. Usually referred to the heart, brain or lungs.
VIT'REOUS, *vit'-re-us*. Glossy.
VIT'REUS HU'MOR. Transparent gelatinous substance found in the posterior chamber of the eye.
VIVISEC'TION. Experimental dissection on living animals.
VOL'ATILE, *vol'-at-il*. Tending to evaporate spontaneously.
VOL'UNTARY, *vol'-un-tā-re*. Performed by means of the will.
VOL'VULUS, *vol'-vū-lus*. A twisting or knitting of the intestines.
VOMITO-NI'GRO. Yellow fever.
VUL'VA. External genital of the female.

W

WEN. A sebaceous cyst.
WET-PACK. A wrapping of the patient in wet sheets to lower temperature.
WIL'LIS, CIRCLE OF. Circle of arteries at the base of the brain, formed by the branches of the internal carotids and the basilar.
WINDPIPE. The trachea.
WIN'SLOW, FORA'MEN OF. Foramen connecting cavity of great omentum with the peritoneal cavity.
WIN'TERGREEN. Gaultheria.
WOMB, *woom*. The uterus.

WOUND, *woond*. An injury in which an opening is made in the body.

WRIST, *rist*. Part connecting the forearm and hand.

X

XAN'THIC, *zan-thik*. Yellow.

XANTHODAR'MA, *zan-thō-der'-mah*. Yellow discoloration of the skin.

XI'PHOID, *zī'-foid*. Resembling a sword.

XI'PHOID APPEN'DIX. The ensiform cartilage or end of breast bone.

Y

YELK. See yolk.

YEL'LOW FEVER. An infectious fever of tropical America, marked by chills, headache, pain in back an limbs, nausea and vomiting.

YEL'LOW-SPOT, *yel'-ō-spot*. Spot on retina of eye, the macula, lutea, center of vision.

Y-LIG'AMENT. The ileo femoral ligament.

YOLK. The nutritive part of an ovum.

YOUTH, *ūth*. Age between puberty and lawful age.

Z

ZE'RO, *zē'-rō*. A unit.

ZOOGEN'OUS, *zō-ō-jen'-ous*. Developed or acquired from animals.

ZOOL'OGY, *zō-ol'-ō-je*. The science of animals.

ZYGO'MA, *zī-gō'-ma*. Arch formed by junction of zygomatic process of the temporal with the malar bone.

ZYGOMAT'IC, *zī-gō-mat'-ik*. Of or pertaining to the zygoma.

ZYMOL'YSIS, *zī-mol'-is-is*. Digestion by means of an enzyme.

ZYMOT'IC, *zī-mōt'-ik*. Pertaining to or caused by zymosis. Infectious.

ZYMOT'IC DISEASES. Infectious diseases produced by some morbic agent acting in the nature of a ferment.

THE END.