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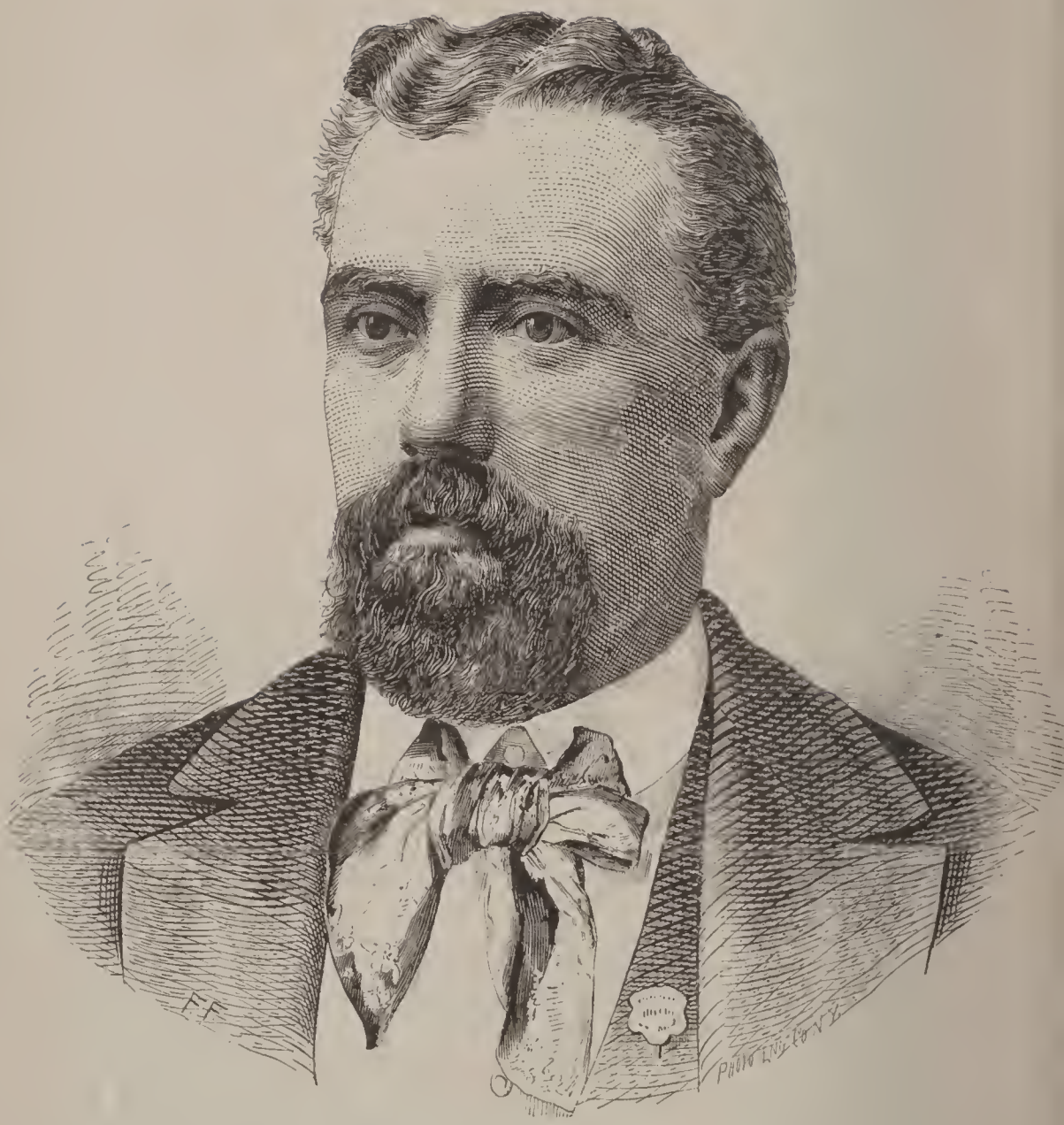

THE

UNDERTAKERS' MANUAL:

A TREATISE OF

USEFUL AND RELIABLE INFORMATION;

EMBRACING COMPLETE AND DETAILED INSTRUCTIONS FOR THE PRESERVATION OF BODIES.

ALSO, THE

MOST APPROVED EMBALMING METHODS;

WITH

HINTS ON THE PROFESSION OF UNDERTAKING.

BY AUGUSTE RENOUARD.

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INTRODUCTION.

THE AUTHOR of this book has labored diligently, and, as I think, with remarkable success, to occupy an original and unique field in American literature. Hitherto, a complete treatise on the important profession of Undertaking has been unknown. In fact, until the establishment of "THE CASKET" (to which Mr. RENOUARD has been a regular contributor from the beginning), there never had been published anything concerning the duties and amenities of the undertaker. There seemed to be a vague notion that there was nothing to write about, and so of course nothing had been written calculated to raise the profession to its proper dignity, and at the same time put it in the light in which a correct estimate of it could be obtained by the public. To be sure, there had been, and occasionally continues to be, diatribes in the secular and religious press on the "pomp," "extravagances," "oppression," etc., etc., of funerals, and plentiful rhetoric, couched in burlesque, sneer and satire, on the methods of the undertaker; but a volume of sound sense, practical

advice and valuable information for every one connected with the business never appeared important enough to command the serious thought and arduous labor of formulating into a Manual.

This work, however, has at last been accomplished by one of their number; a gentleman who, by education, industry and taste, is fully qualified for so important an undertaking. How successfully, the following pages amply testify. To occupy a great deal of space with complete instructions for the preservation of dead bodies was absolutely necessary, for without such instructions the book would fail of its mission and be absolutely valueless. To impart this important information, required the author to devote page after page to explaining Physiological Chemistry and Anatomy. to the profound study of which he has devoted the best years of his active life.

The more closely these pages are studied, the more satisfactory will be the knowledge gleaned by the student. Let no one, however, say that these chapters are burdened with unnecessary technical terms, for no scientific information can be imparted without employing the words and phrases which long usage by scientists has sanctioned. And if any individual supposes he can master the details without laborious study, and without commencing with the rudimentary

principles, he may as well stop before beginning, for he will spend his time in vain and his strength for naught. The study of the facts herein inculcated will, however, become, as the study of any important subject becomes to the earnest student, not only interesting, but really fascinating.

I therefore take especial pleasure in commending this Manual to all undertakers and their assistants, being fully persuaded that it will materially assist them in becoming more proficient in their profession. And as the years roll on, I am quite confident that the attainment of more accurate knowledge will be demanded, and more exacting duties required, of the undertaker; hence, he who acquires the valuable information which this book imparts will be *the successful undertaker* of the future.

THOMAS GLIDDON.

Rochester, N. Y., June 1, 1878.

TO THE PROFESSION.

IN presenting this book to the American undertakers, the object is to instruct, as well as to create interest in the profession, by developing scientific facts which are necessary to promote the avocation of an undertaker to the rank which it deservedly ought to occupy.

The several chapters, which may at first sight seem dry and superfluous, are nevertheless essential to a clear and thorough understanding of the several processes of embalming given in this book. Had these seemingly arid dissertations been left out altogether, the work of embalming and of preserving bodies would have proved a sore puzzle to many; and it was found necessary to elucidate the *modus operandi* of each process, by giving reasons for the use of the chemicals, their mode of action, and the results to be expected by a careful and discriminate use of them.

The names of the chemicals and the quantity to be used was not found sufficient in instructing undertakers; but, to satisfy the investigating propensities of all, and to make every one thoroughly conversant

with the means employed, the nature and properties of the different chemicals used have been explained at length.

As to the chapters devoted to anatomy, the arterial circulation and the different parts of the human structure, they will be found indispensable in this work, and, when thoroughly understood, will be found to greatly facilitate the work of the operator.

How can the embalmer find the point of injection, or go on with his work, if he be totally ignorant of the places of the different organs, the courses of the veins and arteries, their relations and relative positions? It is, then, an undeniable fact, that without this knowledge the embalmer will accomplish his task more or less well, and without knowing with any degree of certainty if the process of injecting is complete, or if the parts intended to be injected have been reached by the fluid.

Closely allied to this are the conditions of the body after death, as governed by circumstances which may affect it, and thereby modify the treatment thereof—admitting that different modes of treatment are required by different cases. How, then, is the undertaker to discriminate, if he be not warned beforehand, or if his knowledge does not teach him what course is the best to follow? And how is this knowledge to

be gained, if he has not made it a point to study at least that part of the human organism with which he may have to deal?

As the different processes given in this book for the preserving and embalming of bodies are founded upon practical experiments, based upon purely scientific principles, it becomes, then, necessary that these principles be fully explained, so as throw sufficient light on points which might otherwise remain obscure.

What has been said about anatomy applies equally well to the study of animal chemistry. The constituents of the human body, fluid and solid, have all more or less different properties, as also their composition varies to a great extent. It is, therefore, a point of material importance for undertakers to know and understand their formation, the causes which may accelerate their decay or putrefaction, and also the means which may be employed to the best advantage to counteract their tendency to disintegration.

All the points above mentioned being understood, it follows therefrom that the knowledge thus imparted will prove of great utility to the profession, although it may appear at first sight an unwarrantable waste of time and a mass of technicalities.

It may also be useful to repeat here certain injunctions as to the dangers to be encountered in the

handling of the dead, and also of the proper care to be exercised by undertakers in avoiding to rush heedlessly into danger and aggravate the perils of their calling.

The public at large have but a very imperfect idea of the dangerous, and even, in some cases, repulsive, character of our profession. The undertaker, and the perils attending in many instances the discharge of his duties, as a general thing, are very seldom thought of by those outside of the profession. To a great many the business of the undertaker has something dreadful and appalling about it; and without very well understanding themselves the nature of the feeling, it is always associated with the horrible.

This impression, which seems to have grown in the minds of the majority, is altogether an erroneous one, which ought to be eradicated from public sentiment. Undertakers, as a class, are men useful to society; their calling, far from being horrible and loathsome, as the ignorant and shallow minded are pleased to call it, is one which requires a great deal of self-denial, and which often brings to the surface the finest traits of human nature.

Granted that our profession is one fraught with dangers, it becomes incumbent upon professionals to protect themselves against them by all the means that

knowledge, experience and science may suggest. One great mistake, and one which has been repeated too often, is the false security some may place in the use of strong liquors to combat and render void the deadly effects of contagion. This has been a stumbling block to many; and without incurring the accusation of being a fanatic in regard to temperance, we may safely assert that a great many of our professionals have fallen victims to the effects of alcohol, which, being used at first as a sort of medical preventive, soon assumes full sway over the mind, and baffles their best efforts to resist it.

If we are to look anywhere for a preventive of contagion and infection, we must look to the directions and remedies which medical science holds in store; and also to the undisputable fact, that in the caution used and the care exercised in handling bodies, assisted by a discriminate judgment, lies our best pledge of safety.

As it has been remarked before, the different modes of preserving and embalming bodies given in this book are not mere speculations as to probabilities, nor are they simply mere recipes picked up at random; but they are the results of long practice and successful experiments, which have demonstrated, in a most satisfactory manner, that the advantages claimed for

these same processes are well founded and worthy of credit.

The long chapter on chemistry and physiology is, therefore, not only essential to the full understanding of the methods given, but it is also intended as a proof of the judicious selection of the chemicals that are employed in the operation of embalming, as also of the system upon which this operation is based.

It must not be supposed that all the known modes of embalming and preserving bodies are to be found in this book, nor was it ever intended to have it so; only those that are known to be reliable, and which have been found to give entire satisfaction, have been elucidated.

There are other methods, which are also said to be good; but, until they are found by actual and practical experiment to be worthy the merits claimed for them, they shall not be made public. However, should they prove to be equal, if not superior, in one way or another, to the methods herein illustrated, we will bring them out in the course of time to the notice of the profession.

UNDERTAKERS AND THEIR ASSISTANTS.

Among the many things important to undertakers to bear in mind is the discretion that must necessarily be employed in the choice of their help and assistants.

To a great number this caution will seem trivial and perhaps superfluous; but we hope those who may think so will change their opinion after reading attentively the following.

We have stated at the commencement of this work that every man cannot be an undertaker; it is equally true, also, that every man cannot fill with credit and satisfactorily the position of assistant to an undertaker. As a good, efficient assistant can, to a great extent, enhance the repute and promote the interests of his employer, so it is that a careless, inattentive, self-conceited man may and will cause harm in the same ratio.

A first-class assistant should consider the interests of his employer as closely his own as though they were so in fact, and perform his duties outside the store with as much promptitude, thoroughness and correctness of deportment as if he were under the immediate supervision of his employer.

A slovenly appearance in public should be guarded against: and a man who does not care for his personal appearance seldom possesses much regard for anything else; moreover, it is not beneficial to the establishment with which he may be connected.

Trustworthiness is also to be looked after in such parties, not only so far as immediate honesty is con-

cerned, but also in the punctual discharge of his duties. The profession of an undertaker is confining and exceptional in its nature, and requires constant attention. Pleasure and amusements are a secondary consideration; and any man accustomed to self-indulgence in the above to any extent should scrupulously keep out of the business, and select some other means of livelihood more congenial to his tastes. As an assistant may be called upon to exercise his functions at any hour of the day or night, he must be ready, and constantly so, to answer any call made upon his services.

An assistant should also enjoy sound health and a strong constitution, as the strain upon his physical powers may be placed to a severe test at times. He should be a man of some social standing, and be a thorough master of his profession, as he may at times be called upon to officiate instead of his employer, and any show of ignorance or neglect on his part will not only be a stigma upon himself, but will also reflect discredit upon the name of the party whom he may be serving.

An ill-mannered, boorish assistant is a plague to any establishment; so is also the self-conceited, foppish, ignorant one. The first is liable to give offence by the rudeness of his speech and manners; the last

will surely alienate the good will of patrons by his overbearing demeanor and shallow pretensions to a knowledge which he does not really possess.

A good assistant should know all that pertains to his business, not in superficial and light manner, but in thorough, complete fashion. He must be able to not only line a casket, but manufacture his own lining if necessary · to take charge of all the details of a funeral; assist physicians in a post mortem examination, if required so to do; or properly embalm a corpse. On the other hand, it must be conceded that such a man as I have described is a valuable one for an assistant, and ought to receive a generous remuneration, and also be made to feel that he is appreciated.

CONCLUSION.

My effort in this little volume has been to offer to my professional brethren the means employed by the most eminent chemists, both in this country and Europe, to preserve bodies, and the methods given are the best known to modern science. I have also tried to make them feel aware of the necessity of knowledge, and shall feel happy if by so doing I have helped to raise our profession to the standard it really deserves.

UNDERTAKING.

IT may not be amiss at the commencement of this work, to say a few words about the profession of an undertaker, and undertakers as a class. Among the many who have chosen

UNDERTAKING AS A PROFESSION,

and carried on the business for years, there exists a certain class who, although pecuniarily successful, do not have a very clear idea of the requisite qualities indispensable to the general make up of a first-class professional. Others seem to ignore the multitudinous duties, the performance of which will bring either credit, or blame, to themselves, according to the degree of tact or skill exhibited in the discharge thereof.

A great many have gone into the business simply because it is represented to them as a *money making* profession; others, because their fathers being undertakers have thought proper to train them to it, although their mercantile ideas may run in another direction. And again, some without capital will try and battle against competition, merely to make a living; but above all, there is that class of men who, entirely ignorant of the rudimentary knowledge of the business, having means, and regardless of the qualifi-

cations necessary to insure success, plunge right into it with the idea that it is a safe investment for surplus funds, a genteel employment, and one which, according to their notions, does not require any extraordinary amount of brains or labor.

Is it then a matter of astonishment if so many of our undertakers fail, or find themselves unable to cope with some more favored rival? To them it is a source of wonder, but to a discriminating public the cause is soon apparent.

It is safe to assert that every one cannot be an undertaker; in this profession, a man is more than in any other the architect of his own fortune; his success depends altogether upon his tact, skill, discrimination and untiring efforts to please those who may honor him with their trust. No small matter is it for an undertaker to perform his solemn duties with credit to himself and to the satisfaction of all present; sorrow has not so blunted all other feelings in relations and friends as to make them relax their lynx eyed vigilance of every motion of the undertaker while performing the delicate duties of his avocation.

He must be endowed with the soft touch of a woman in the handling of the dear remains; his work must be performed in silence, with soft tread and expedition; his presence in the house is a constant reminder to all of the irreparable loss which has bereft the family of one of its members.

He must be quick of perception and ready of expedients, as there is often no time left for reflection. To

hesitate at times would be taken for ignorance, and prompt action is the only means at hand to retrieve himself.

A clear head and a cool judgment are among the most necessary qualities. Urbane and affable in his manners; your first-class professional is an accomplished gentleman; his knowledge of the world and daily contact with people of all conditions allow him to assimilate himself with quiet dignity with persons of all rank in the social scale of life.

Well dressed, yet without ostentation, punctual in his engagements, without the flurry of general transactions, he will treat his more wealthy customers with deferential politeness without cringing, as also will he bring in his dealings with his more modest patrons none of the *hauteur* characteristic of a narrow mind and a lack of education.

Perfect equanimity of temper is a transcendent virtue in an undertaker. Mistakes and delays will happen in spite of the most careful preparations and the best laid plans; accidents, unforeseen and unthought of, will occur suddenly; it is then that a clear headed man will find some prompt means to remedy all before any one of those present has taken notice of anything amiss.

Good taste is also eminently one of the requisite attributes to be displayed in the easy, informal laying out of the remains, the attitude of repose devoid of the conventional rigidity of limbs; in the chaste trimmings of the casket, rich with elegance, but without

overloading with useless ornaments. How many so-called undertakers will calculate the beauty of a casket by the accumulation of silver ornaments promiscuously scattered on the top and sides; to such the profusion of flashy trimmings is the standard of elegance.

The floral decorations either in the house or the church must also be in accordance with the spirit of the scene. Good taste will likewise dictate to the undertaker that any attempt at a lachrymose or woe begone cast of countenance on his part, will not be regarded by his patrons as a criterion of his sympathies for the bereaved family, but rather as a hypocritical mask assumed for the occasion. A decorous, quiet bearing is by far better appreciated by friends and mourners.

The master head of a really good undertaker will show itself in every small detail and appointment of a funeral pageant; the carriages will quietly form without confusion, and either receive or deliver their occupants without orders being vociferously shouted from one end to the other of the line; everything will work without bluster or any noise which may grate harshly upon the ears of sorrow stricken friends or parents.

On the contrary, how is it with one who is not a proficient? His advent into the house of mourning is heralded by unusual bluster, and the often contradictory orders given to an assistant. Questions without number are asked from friends of the family or those present, about the time of the funeral, number of carriages required, etc., inquiries which are altogether out of place at the time, and ought to be postponed until

those having charge of the arrangements will make the wishes of the family known to the undertaker, at his office or place of business.

Nervousness is manifest with some as soon as they commence handling a corpse, and is apparent through all the details of a funeral. Let any incident take place and everything is immediately thrown into hopeless confusion, as the undertaker himself feels more at fault than any one else.

With others, again, a funeral is made a public display of their personal authority; it is to them an occasion to conspicuously show in an ostentatious manner that the job is theirs; the management of it in their hands; they intend to run it according to their notions, with the utmost disregard of anyone else's wishes in the matter. The undertaker is, however, but a public servant; a well-bred man will not try to coerce people into following his own ideas in regard to certain matters and utterly disregard their views of the same.

A direct conflict with the mourners in regard to some point of funeral etiquette will not place the undertaker in a very enviable position, whereas a sensible suggestion, deferentially offered to their better judgment, will win a ready assent and establish his reputation as a man thoroughly posted and well qualified for the business. Should the point be insisted upon by the family, and although it may be, in the undertaker's opinion, a breach of established rules or customs, it is his duty to quietly submit and

thereby show his moral sense of the solemnity of the occasion, which is ill-timed for a controversy of any kind.

Some undertakers have been known to extol the cheapness of their wares in the house of mourning, drawing aside some of those present and stating confidentially that such a casket never was sold so low, and were it not for the particular regard they entertain for the family, the regular price would have been charged. This mode of philanthropic advertising has seldom brought any trade to the one that had resorted to it. The best advertising medium for an undertaker consists in the manner his business is carried on, in the style and appointments of his livery, and above all in his own deportment in public, the integrity of his character, and his punctuality in meeting his business engagements.

As the assertion was made at the beginning of this chapter that every man cannot be an undertaker, the above enumerated qualities requisite to the make up of a first-class professional will prove conclusively that such is the case.

Before fully entering upon the text forming the subject of this book, I have thought it advisable as an introduction, to stimulate the zeal of undertakers in self-improvement by illustrating, in brief outlines, the necessary qualities of a popular sexton and exposing *per contra* the faults others are guilty of. Let not, therefore, the reader accuse me of severe criticism, for my aim has been only to try and elevate our profession above its common standard.

That the duties of an undertaker require a larger quota of delicacy, tact, and knowledge of human nature than generally falls to the lot of most men, no one will deny; but it is also a well known fact that, unless he be the busiest professional in one of the largest cities, an undertaker has ample time for SELF-IMPROVEMENT and CULTURE.

It is high time the business of undertaking be truly, and really, raised to the rank of a profession; let every undertaker be convinced that his calling is a solemn and responsible one, and our ranks will soon be free from the few interlopers who, so far, have impeded our progress toward a just recognition from the public for a class of men whose services are often very little short of self-sacrifice.

The physician has an office of great responsibility thrust upon him; into his hands we blindly confide the lives of relations and friends, hoping and expecting that his medical knowledge, his experience and skill, may save the existence of some one dear to us.

And after science has been baffled and death claims his victim, the undertaker is the one to whom we look to perform the last sad duties. To him we intrust the care of the beloved remains, relying entirely upon his experience and good judgment in such matters, to carry out in a manner becoming to this age of christian feeling, the ceremonial of sepulture with the deferential respect due to the dead.

EMBALMING.

IT has been a custom among ancient nations to preserve the bodies of the dead for a long period of time. Even to this day we find traces of it in the mummies of Egypt and the sarcophagi of Etruria. Their method of achieving this result may not have been strictly in accordance with the principles of modern science; certainly their success would hardly be satisfactory to the more refined taste of our generation. Still their discoveries in this art have been such that they have commanded the respect of modern savants. They also show conclusively that the sciences of chemistry and physiology, even at that remote period, had attained a certain degree of prominence among their scientific men. Many of their discoveries were no doubt accidental, still we must give them credit for the spirit of investigation which actuated their researches, and carried them on undaunted through the many disappointments they must certainly have encountered before they satisfactorily solved the problem.

The imagination is carried back to the time when the mysterious worship of Osiris and Isis was flourishing on the banks of the river Nile, when the Sphinx uttered, or was thought to utter, the sacred oracles of

Thormes, and before the pyramids had entombed a long generation of kings.

A great number of persons cannot revert to the science of embalming without placing it among the lost arts; to them a mummy is the contemporary of a mysterious past dimly perceived through the long vista of succeeding generations; a tangible proof of that much vaunted ancient civilization, which as they express regretfully will never be found again. A thorough elimination of the subject would convince those unsophisticated mourners that the loss is not quite an irreparable one. Let us divest a mummy of his bitumen-coated and fire-scorched bandages; we will then have before us a mass of blackened and hardened cement-like substance, shrunken and emaciated to almost a skeleton, and bearing semblance to the form of a human organism, only so far as the shape of the osseous frame has retained its symmetry. The lips have shrunk apart so far as to expose the row of white teeth, the sockets of the eyes are empty, the cheek bones are prominent, the whole covered with patches of the dark and almost petrified epidermis. Such is the picture a mummy presents to our view when denuded of its envelope

It is not to be wondered at, therefore, if some associate this repulsive image with the idea of modern embalming. Our present object in preparing bodies is two-fold: In the first place we desire to keep perfect for a certain length of time the remains of those who have been dear to us while living; but when des-

iccation has begun, when the roundness of the lines loses itself into the more angular shrinkage of the tissues, then we may take, and without any feeling of horror, a last look at the body, and consign it, not to slow, foul corruption, but to the gradual drying of the organic substances, without the horrible accessions of decay and putrefaction.

In view of all this, and with the help of modern chemistry, it is not singular that the art of embalming should have received a new impetus in this country and Europe, especially here, where it is customary to send back and over long distances the bodies of those that have died far from home. This usage has already brought about some astonishing results. The large majority of our first-class undertakers have taken the matter in hand; they vie with each other in trying to perfect themselves in an art which is daily growing into favor. Almost every day a new antiseptic is, if not discovered, at least brought to exercise its functions in the preservation of organic substances. Of late, new methods have been inaugurated on all sides, and among the number there are certainly some which are deserving all the merits claimed for them.

It behooves all professionals to exert their ingenuity to bring this science to a satisfactory issue. Many of the preparations sold under the name of preserving liquid are good; others are not. How then are undertakers to discriminate? By what means can the merits of the one, and the utter worthlessness of the other, be determined? There is but one way, and

that is an infallible one, of finding out the best method and preparation, and that is simply by experimenting, until the real means, which is the only true one, has been hit upon.

It may also be objected to, with reason that a certain process has been known to work effectually in some cases, whereas the same method employed in a similar manner has proved a signal failure in another instance. To this but one cause can be assigned, and that is the utter ignorance on the part of the operator of the properties, antiseptic and otherwise, of the materials he is employing, also of the different conditions, which will according to existing circumstances modify their action and govern their effect. To use a certain preparation simply because it is highly recommended by some, without knowing the constituents thereof, is very little short of foolhardiness. How is it possible for the operator to employ it with discrimination and judgment? Should he be successful, well and good; the end would be obtained without he being the wiser for it. Should it be otherwise, and the result prove unsatisfactory, how is he to account for the failure, and how to guard against a repetition of the same in the future?

A good embalmer, one that really understands his business, does not have recourse to ready-made preparations for preserving bodies; but he chooses the chemicals according to the properties each is known to possess. His experience of their relative actions teach him beforehand how they will work out the result he

anticipated. I do not mean that every undertaker and embalmer should be an Orfila in regard to Chemistry, nor is it expected that his knowledge of Anatomy should enable him to fill the chair of demonstrator in a dissecting room, but to achieve real, legitimate success, an embalmer ought to possess a thorough knowledge of the drugs he is manipulating, their individual effects, singly and collectively, and under different circumstances, upon subjects of different natures. A certain amount of the acquaintance with the anatomy of the human body is not only required, but strictly necessary; a gash of the knife upon some vessel of the arterial system might jeopardize the success of an otherwise satisfactory operation.

It is this rudimentary knowledge of Physiological Chemistry and Anatomy we shall endeavor to explain in this book, with complete instructions upon the best methods which have been heretofore and are now employed in the preservation of bodies.

THE LABORATORY.

BEFORE fully entering upon the subject of Embalming, it may not be out of place to make mention of the room devoted to that purpose.

As a general thing, undertakers will find it to their advantage to have set aside, either in the rear part of their store or at some other convenient point of the building, a room of moderate dimensions, exclusively for the purpose of preparing bodies. It may also be used either for the purpose of holding inquests, post mortem examinations, and as a morgue.

Although the purpose for which it is intended, be that of a laboratory or room where the embalming of bodies may be carried on, undisturbed by the traffic of the warerooms or the office, it will be found useful for the above named objects. Very often physicians, who may be wanting to investigate the immediate cause of death in some of their patients, and who cannot prosecute the necessary investigations either in their own office or at the house of the deceased, will avail themselves, with pleasure, of the opportunity thus offered to them. The advantages of this arrangement to the undertaker are obvious and require no explanation.

The room should be well ventilated and lighted, and everything so arranged as to be within reach; a sink with a water faucet should occupy a corner of the room; in the center an embalming board, with longitudinal grooves, on trestles, the head elevated about a foot higher than the feet, so as to allow all liquids to run down and be collected in a pail at the lower extremity, without unnecessarily soiling the floor; a closet or cupboard for chemicals, which, by the way, ought always to be kept locked up. It is also necessary to keep a certain amount of the preparation used in daily practice, already mixed for use at a moment's notice. The preceding recommendation will prevent mistakes, and do away with the confusion generally attendant upon a hasty call.

A very useful custom, and one that cannot be too highly praised, is that of keeping all needful articles for laying out and keeping a body, in a neat morocco satchel, which can be carried about in the hand without the least inconvenience. The contents should include all that is necessary to preserve bodies, say for five or six days, without the use of ice. The annexed list will furnish the explanation:

Two sponges for washing purposes. They can be, when dry, kept in a very small compass; these should be thoroughly cleaned after using, and immediately returned to their place.

A small post mortem case, containing a cartilage knife, two scalpels, one catheter, one pair scissors, chain and hooks, nippers, hook to raise arteries, and four crooked needles, assorted; also a skein of sur-

geon's silk. These instruments should be carefully cleaned before returning to the case.

Two pint bottles containing antiseptic solution for injecting stomach and bowels. I have here mentioned two pint bottles, in place of a quart bottle, for this reason: the two former are easier carried, less liable to break, and thus more convenient than the latter.

An eight-ounce vial, containing a concentrated solution for the complexion; it can be diluted to suit when using.

Some cotton for stopping air passages and rectum.

Two cups for collecting blood from the jugulars, should the veins be so congested as to require emptying of their contents.

An eight-ounce, black rubber syringe, for injecting either the stomach, lungs or bowels; this should be well cleansed after using, and also the leather forming the head of the plunger be saturated with glycerine; it will keep it moist and free from getting sticky, which generally happens when oil is used for that purpose.

A bottle of some pungent, aromatic, acidulated liquid, which will serve, not to absorb, but to disguise the smell, always more or less unpleasant, of a corpse.*

An eight-ounce bottle containing tannic acid to dust in cavities of the thorax or abdomen before closing the wounds.

* I have found by experience that vinaigre de bully, an imported toilet article, completely answers the purpose in this case, when slightly sprinkled over the clothes of a corpse.

And last, but not least, a one-ounce bottle of liquid muriate of ammonia, which is invaluable to cauterize any scratch, abrasion of the skin, or cut, on the hands of the operator while at work.

I would here advise that some adhesive plaster be also a part of the contents.

The following chapters on chemicals may be found, by some, dry and of no consequence; but to a sensible person, and a shrewd undertaker, it will be apparent that, unless possessed of some knowledge of physiological chemistry and morbid anatomy, it will be impossible for him to judge, with any degree of certainty, what means are to be employed to secure success in embalming. It will also be found, by the more enlightened mass of the profession, that a thorough examination of the causes of putrefaction and the means to counteract the same, are essential to a successful practice.

How, then, can such means be resorted to? How is it possible for an undertaker to prosecute the business of embalmer satisfactorily, if he has not in his hands all the information necessary to perform his labors, with credit to himself and satisfaction to his employers? The only resource he has consists in the complete knowledge acquired from study and experience, and the following chapters will pave the way to the desired result.

DRUGS AND CHEMICALS.

AS it is of the utmost importance for the operator to get familiar with the drugs or chemicals he is called upon to handle, the history and properties of each one will be detailed at length in the following chapters:

Acetic Acid.—The acid liquid distilled when charcoal is prepared from wood, in close cylinders without access of air, contains this valuable acid in a very impure state; by subjecting this to further distillation the liquid is collected which is known as wood vinegar, or pyroligneous acid. By saturating this acid with lime, acetate of lime is produced, which by decomposition with sulphate of soda, furnishes sulphate of lime and acetate of soda; the latter salt being crystallized in a state of purity yields, by distillation with sulphuric acid, pure hydrated acetic acid in solution in water.

Acetic acid is also produced by the oxydation of alcoholic liquids, especially cider and wine, and in this impure and diluted form is called vinegar. In chemical works it is generally classed among the derivatives of alcohol.

Camphorated Acetic Acid.—This is largely used as a pungent and refreshing perfume, to remove fetid odors from bodies. Take of

Camphor, - - -	half ounce,
Acetic Acid, - - -	6½ fluid ounces.

Pulverize the camphor by means of a few drops of alcohol and dissolve it in the acetic acid.

Aromatic Vinegar.—This is another pungent and reviving perfume, formerly deemed a preventive of contagion, and which will be found very useful in removing foul smells from the chamber of death. Take of

Camphor, - - -	2 ounces,
Alcohol, sufficient quantity to pulverize the Camphor,	
Oil of Cloves, - - -	1 fluid ounce,
Acetic Acid, very strong,	12 fluid ounces.

Acetone, or Pyroacetic Spirit, and Pyroxilic Spirit, or Wood Naptha.—These are products of the distillation of wood, which are separated from the acid liquors after they are saturated with lime by simple distillation and rectification.

Owing to its cheapness, pyroxilic spirit has been extensively used in England, as a substitute for alcohol in the arts and manufactures.

Uses of Crude Pyroligneous Acid.—This acid having been incidentally described as the source of the acetic acid of commerce, it may be proper in this place to notice its uses. It acts on the principle of an antisep-

tic and a stimulant; the former property being chiefly due to the presence of creasote.

Several cases in which it was successfully employed in the preservation of animal matter are reported by Dr. T. Y. Simmons, of Charleston, S. C. The crude acid has been so advantageously used for the above purpose that Mr. Wm. Ramsey was led to perform with it some very interesting experiments. Some fresh fish, simply dipped in the acid and afterwards dried in the shade, were effectually preserved, and when eaten, at the end of eight months, were found very agreeable to the taste. Fresh beef, dipped in the acid in summer for the space of a minute, was perfectly sweet the following spring.

Carbolic Acid, or Phenylic Acid.—It occurs in castor and the urine of many domestic animals.

Coal tar is distilled, the product between 300° and 400° is saturated with a strong solution of potassa, the oil is removed, the salt decomposed by muriatic acid; the carbolic acid washed with water, dried with chloride of calcium, rectified, cooled to about 12° F., the liquid decanted and the crystals quickly dried. It is in long colorless needles; not very soluble in cold water; more so in hot water; in all proportions in alcohol and ether; also soluble in concentrated acetic acid.

Commercial Creasote.—When obtained from coal tar is always contaminated with phenylic acid (carbolic acid.) Indeed, it is said that phenylic acid has been sold for creasote, which it closely resembles in properties.

How far these properties may be similar, deserves to be studied; for if they should prove to be the same, the fact would lead to its substitution as a substance to be easily obtained pure, for the variable creasote.

Of all the properties of creasote, the most remarkable is its power of preserving animal matter; this property has suggested its name, derived from two Greek words which mean flesh preserver. Dr. Christison finds that creasote water is as good a preservative of anatomical preparations as alcohol, with the advantage of not hardening the parts; it is probably to creasote that the antiseptic properties of pyroligneous acid are owing.

Tannic Acid.—Some powder of nut galls is macerated in a bottle, with just enough ether to moisten it, for 24 hours, and then expressed in a powerful press; and the process of maceration and expulsion is repeated in the same way until the powder is exhausted; the liquors are mixed, the ether distilled off, and the residue dried by means of a water bath.

Properties: Pure tannic acid is solid, uncrystallizable, white or slightly yellowish, inodorous; very soluble in water, and much less soluble in alcohol and ether, and insoluble in the fixed and volatile oils.

Tannic acid precipitates solutions of starch, albumen and gluten, and forms with gluten an insoluble compound which is the basis of leather.

Chromic Acid.—To 100 parts, by measure, of cold saturated solution of bichromate of potassa, 150 parts

of sulphuric acid are added and allowed to cool; the sulphuric acid unites with the potassa, and the chromic acid crystallized in deep red needles, very soluble and deliquescent.

It is a powerful oxydizing and bleaching agent. Small animals, as mice, etc., after being immersed in the acid were so completely dissolved after 20 minutes, that no traces were left of either their claws, hair, bones or teeth.

Sulphurous Acid.—It is prepared by exposing to heat a mixture of one part concentrated sulphuric acid with one part of mercury, or one-third part of copper filings, washing the gas by passing it through a little water, and condensing it in water which is well cooled. Professor Proctor directs the gas evolved from four ounces of copper turnings, and eight fluid ounces of sulphuric acid, to be condensed into four pints of water.

Sulphurous acid is a gas which dissolves largely in water and has a smell of burning sulphur.

Liquor Chlorinated Soda—Labarraque Disinfecting Solution.—It is prepared as follows:

Chloride of Lime, - -	1 pound,
Carbonate of Soda, - -	2 pounds,
Water, - - - -	1½ gallons.

Dissolve the carbonate of soda in 3 pints of water by the aid of heat; to the remainder of the water add, by small portions at a time, the chloride of lime, previously well triturated, stirring the mixture after each

addition; set the mixture by for several hours that the drugs may subside, then decant the clear liquid and mix it with the solution of carbonate of soda. Lastly, decant the clear liquor from the precipitated carbonate of lime, pass it through a linen cloth and keep it in bottles secluded from the light.

It is a colorless alkaline solution, having a faint odor of chlorine, and an alkaline taste; it owes its antiseptic properties to containing hypoclorous acid which is readily liberated by the addition of even a weak acid and, on exposure to the air, by the absorption of carbonic acid.

One of its principal uses is to purify the air in dissecting rooms and hospitals, in which case it acts by decomposing sulphurated hydrogen, against which gas when inhaled, it is also an antidote.

Nitrate of Lead.—Take of litharge $4\frac{1}{2}$ ounces; dilute nitric acid one pint. Dissolve the litharge to saturation by the aid of a gentle heat; filter, and set the liquor aside to crystallize; concentrate the residual liquid to obtain more crystals. This is a beautiful white salt, of a sweet astringent taste and soluble in $7\frac{1}{2}$ parts of water and in alcohol. It has recently been found useful in the correction of fetid odors, dependent upon the presence of sulphurated hydrogen or hydrosulphate of ammonia, which it decomposes.

It will not prevent the putrefaction of animal matter, but it will be found extremely useful, as a disinfectant of putrescent animal fluids.

Ledoyen's Disinfecting Fluid—Which is greatly esteemed abroad, is a solution of this salt in water, in the proportion of two ounces of salt to one pint of water.

Corrosive Sublimate.—By the action of boiling sulphuric acid on mercury, the hipersulphate is first formed. When this is heated with common salt mutual exchange takes place, and bichloride of mercury and sulphate of soda, the former of which sublimes are produced. Corrosive sublimate is in heavy, white crystalline masses, of a styptic and metallic taste, soluble in about 20 parts of cold water, much more so in alcohol. A solution of corrosive sublimate precipitates albumen and forms with it a definite insoluble compound, to which property its use as an antiseptic is due.

Corrosive sublimate has the property of retarding putrefaction. Animal matters immersed in its solution shrink, acquire firmness, assume a white color, and become imputrescible. On account of this property it is usefully employed in preserving anatomical preparations. We have seen a head prepared in this manner which had for seven years resisted the attacks of decay and insects, and been subjected to all changes of temperature.

Hyposulphite of Soda.—This salt may be economically prepared by the following process: 16 ounces finely powdered carbonate of soda are mixed with 5 ounces flowers of sulphur, and heated in a porcelain dish with constant agitation until it takes fire and

burns to sulphite of soda; this is dissolved in water and boiled with sulphur and thus forms hyposulphite acid; it is then evaporated to crystallization.

It is easily soluble in water; the solution gradually deposits sulphur; 1 to 4 ounces dissolved in the necessary quantity of water, and with the subsequent addition of 3 fluid ounces of sulphuric acid for each ounce of the salt, will liberate the hyposulphurous acid, which immediately decomposes into sulphur and sulphurous acid.

Solution of Chloride of Zinc—Made in the proportion of 1 ounce of chloride of zinc dissolved in 1 pint of water. It is a powerful deodorizing and disinfecting agent in neutralizing noxious effluvia and in arresting animal and vegetable decomposition.

The concurrent testimony of a number of observers shows that it acts as an excellent disinfectant for hospitals, dissecting rooms, etc. When injected into the blood vessels, it preserves bodies for dissection without injuring their texture. The advantage is claimed for it, that while it destroys putrid odors, it has no smell of its own.

Alumina.—Dissolve alum in six times its weight of boiling water, add solution of carbonate of soda in slight excess, agitate for a few minutes, filter, and wash the precipitate with distilled water; the product is hydrate of alumina.

Acetate of Alumina.—A solution of this salt is obtained by saturating acetic acid with hydrated alumina and cannot be evaporated without the loss of

acetic acid. It has a faint smell of acetic acid and a sweetish taste, and possesses strong antiseptic properties.

Sulphate of Alumina.—Saturate diluted sulphuric acid with hydrated alumina, evaporate and crystallize; it is in thin, flexible plates, of a pearly lustre, sweet and astringent taste; soluble in twice its weight of cold water, but not in alcohol. Its chief use is as an antiseptic; a solution of 1 pound to a quart of water is used to preserve dead bodies; as a lotion it may be used in a somewhat less concentrated form.

The salts of alumina have been ascertained by Mr. Gannal to be powerful preservatives of animal matter. Among these the sulphate is to be preferred on account of its easy preparation and moderate price. Its aqueous solution was found by Mr. Gannal to be very effectual in preserving bodies, when injected into the blood vessels; in the summer season bodies were preserved for thirty days or more; in the winter for *three* months.

For use in the winter, a quantity of the solution sufficient for injecting one body, may be made by adding a pound, avoirdupois, of the salt to a quart of water; for use in warm weather, the solution must be saturated.

POST MORTEM EXAMINATIONS.

BEFORE commencing the work of embalming, and even while laying out a corpse, it is always necessary to make an inspection of the surface of the body. The minuteness of this inspection will depend upon the character of the case, and, in a great measure, dictate the course of treatment to be followed so as to insure success. It also behooves the operator, for his own safety, to look for evidences of skin diseases, ulcers, abscesses, etc.; the glands, penis and prepuce are to be carefully examined for syphilitic cicatrices.

It is customary to find certain changes in the external appearance of the body, which are due to the cessation of vitality in the tissues and the commencement of decomposition. I speak now of bodies which have not yet been buried, and which have been kept in the ordinary way, partly covered by a shroud, and lying on the back, in a loosely covered coffin.

If the bodies have been left in their ordinary clothes, the appearances are just the same. In such bodies, one of the first noticeable changes is the paleness of the skin and its mottling with irregular livid patches.

After a short time the blood settles in the vessels of the more dependent portions of the body, and the skin which covers the back of the trunk and extremities becomes of a livid red color.

In many cases, if we cut through the skin, we find the tissues beneath congested and infiltrated with bloody scum; in bodies which have been kept for a number of days in cold weather, this red color is also seen on the anterior portions of the body, especially on the face and neck. In hot weather, the red color is very soon altered by decomposition; if the epidermis has been detached at any point, the skin beneath this is dry, hard and red. In warm weather, we may find, for a few hours after death, broad, bluish lines, corresponding to the cutaneous veins, ramifying in the skin of the neck and thorax. These lines are formed by the escape of the coloring matter of the blood from the vessels.

Within a few hours after death, even in cold weather, there is usually some escape of bloody froth and mucous from the mouth and nose. If the eyelids are not closed, the conjunctira and cornea soon become dry, brown and hard, the eyeballs also become flaccid. After a considerable time the skin of the abdomen becomes green; still later, decomposition fairly sets in. The entire body is of a dark green color; the tissues are infiltrated with serum, the abdomen is distended with gas, then the color changes from a green to a reddish brown; the epidermis is detached; the skin is covered with maggots; the entire body is

swollen from the formation of gases; the face can hardly be recognized; the nails drop off, and the scalp becomes detached.

When a body is in this condition it can hardly be determined whether a month or five months have elapsed since death occurred. After this all the soft parts change into a formless, pustulent mass. The cavities are open, the viscera are indistinguishable, and the bones are left bare.

The rapidity with which these changes take place, varies under the influence of a great number of conditions. The bodies of infants usually decompose more rapidly than those of adults; fat bodies putrefy quicker than lean ones; the bodies of persons who die suddenly from violence, decompose less rapidly than the average, unless the body be considerably mangled. Exhausting diseases, fevers, and the puerperal condition, are followed by rapid decomposition, as is also death from suffocating gases. Poisoning by alcohol, by arsenic, and by sulphuric acid, may preserve the bodies for an unusual length of time. Atmospheric air, moisture, and warmth, quicken decomposition. At the same temperature, a body which has been for one week in the air, one which has been two weeks in the water, and one which has been eight weeks buried in the usual way, will all exhibit the same degree of decomposition.

THE RIGOR MORTIS.

It is proper to notice whether or not the body is in the condition of post mortem rigidity. More attention has, perhaps, been given to this post mortem condition than it well deserved. According to Kühne, the rigor mortis is produced by a change in the muscular fibres; the fibres first lose their contractibility, then there is coagulation of the myosine and loss of elasticity. When this acidity has reached its height, muscle becomes softer, and the rigor mortis gradually disappears; finally, the acid condition is succeeded by an alkaline fermentation, and decomposition ensues.

The rigor mortis generally begins in the muscles of the lower jaw and back of the neck; it then extends to those of the face, neck, thorax, arms, and finally, the legs; it usually disappears in the same order; it generally begins in from eight to twenty hours after death, but often much sooner. The bodies of persons killed on the field of battle, and of those who have been drowned, sometimes seem to be overtaken by the rigor mortis at the very instant of death; the bodies retain the same position, and the face the same expression, which they had in the last moments of life. The rigor mortis may continue for from one to ten days, generally, but not always; death from narcotic poisons is followed by a short and feeble rigidity. While death by lightning is followed by rapid and intense rigidity, in young children, it is feeble and of short duration. The degree and duration of rigor

mortis after death from violence, from different diseases, etc., is stated so variedly and contradictorily by different observers, that no definite rules can be given concerning it.

The temperature of the normal living body is 98° to 99° F. In illness, the temperature may be increased several degrees. After death, the body generally cools to the same point as the surrounding air; this is said to take place in from fifteen to twenty hours.

Taylor, from the examination of one hundred bodies, states that the average heat of the skin of the abdomen, at a period of two to three hours after death, is 77°; at four to six hours, 74°; at six to eight hours, 70°; at twelve hours, 69°. The internal viscera retain their heat longer than the surface of the body.

It is said, that, after sudden death from accidents, apoplexy, acute disease and asphyxia, the body retains its heat for an unusually long period. It is both asserted and denied, that after death from hemorrhage the body cools rapidly; the body of an adult cools more slowly than that of a child or an old person; that of a fat person more slowly than that of a lean one.

In some cases there is an exceptional retention and even an increase of heat in the dead body. Dr. John Davy reports, that in case of death from rheumatism, after the viscera had been exposed for several minutes, the temperature of the left ventricle of the heart was 113°, and that of the liver 112°. In a second case, six hours after death, the temperature of the heart was

108°. It is stated that after death from yellow fever and cholera, the temperature increases for several hours after death. There are also recorded a number of instances in which the body retained its heat for several days, without known cause.

It will be seen from what has been said, that if we are called upon to pronounce upon the length of time that has elapsed since death, in a given case, this is only to be done approximately, and it is probably necessary to take into consideration the cause and manner of death, the condition of the individual, the state of the atmosphere, the manner in which the body has been kept after death; and even after making these allowances, we can only say that a person has probably been dead for such and such a time.

This chapter may prove tedious to some, but it is, however, an undeniable fact, that the preceding information (compiled from the Morbid Anatomy of F. Delafield, M. D.), is of the utmost importance to the professional undertaker. The external examination of the body, before handling, is a matter not to be neglected. Should any syphilitic sores or foul ulcers be present, the utmost caution must be used in handling the body, as the pus, which is a most virulent poison, might find its way into the system through some abrasion of the skin. The effects of this poison are such, that, should it not prove fatal, it will leave in the system traces that can never be completely eradicated. This chapter also contains information of such character as will be found needful to fully understand the subsequent chapters.

PRESERVATION OF BODIES.

THE following process is intended to preserve bodies without the use of ice, merely until the time of the funeral may arrive. Sometimes, this ceremonial may be delayed for three or four days, or until some member of the family, who may be at some distance, can arrive. It is also intended to take the place of the cumbrous refrigerator, and substitute for the labor of removing ice, carrying the box to and from the residence, the more simple and less laborious process of injecting the abdominal viscera.

The first step to be taken upon arrival in the chamber of death, is to create a current of fresh air, by lowering the upper part of a window, or of a couple of them, if there be no transom light over the door.

Next, remove the body from the bed and place it on a cooling board; this board ought to be elevated about one foot at the head; also, the head of the body should be raised at an angle of about forty-five degrees; this disposition of the body will allow the fluids contained in the circulatory system to go down of their own gravitation, and leave the face, neck, and upper part of the body uncongested, and therefore free from the purple spots that gradually discolor the face and neck.

The head is raised on the cooling board at the proper elevation as directed above, by means of a head rest attached to the cooling board, and provided with a catch resting on a cog scale, which allows the rest to be raised or lowered at will.

The mouth must next be firmly closed by means of a ligature, tied firmly round the head and passed under the apex of the chin; this ligature should be kept in place until the rigor mortis has firmly set the jaws together.

A great improvement for the above purpose upon the old way of tying a cloth or a handkerchief round the head, is to use a band of some wide, elastic fabric, of which several sizes must be kept on hand, as when this ligature presses too tightly it leaves upon the face, especially on fat persons, unsightly wrinkles.

The eyes must next be attended to; the lids must be brought together firmly, avoiding at the same time interference with the lashes or the creation of wrinkles of the skin on the corners; then fold up neatly some small pieces of linen, well saturated in the following solution, which is also to be used to moisten the face with:

Alum, 8 ounces; Corrosive Sublimate, 2 ounces; Water, 1 gallon.

The linen pads should not exceed the size of a quarter dollar, and thoroughly saturated in the above solution before applying to the eyes. The face, after washing with soap and water, should be well moistened with the same solution, and a cloth laid carefully and

evenly over the features, so as to come into direct contact with every part of them; this cloth must be kept moist with the above solution, and remain over the face until such time as the body is placed in the coffin, when the cloth may be removed previous to the lid being closed. This solution should be diluted with one-half water for use on children or persons whose skin is very fine. It must also be kept from a very strong light, in a glass bottle, and should, when used, never be mixed in a metallic vessel, but in a bowl, cup, or some dish of queens-ware or china.

The next step to be taken consists in preventing frothing or purging from the mouth and nostrils; also keeping down generation of gases, and swelling of the stomach and bowels.

For this purpose an incision about 4 or 5 inches in length is made in the abdomen, above the transverse arch of the colon; this incision will reveal the colon and upper part of the large intestines, also the stomach, a little to the left.

If the bowels are distended with gas, puncture first the colon and some of the smaller intestines, and, after expelling the air by firmly pressing on the abdomen, inject into the bowels about eight ounces of the following solution: Dissolve in one gallon of water as much alum as the water will take up, shaking at intervals; then pour off the clear liquor, and add to it two ounces chloride of zinc and two ounces corrosive sublimate. Keep this injecting solution in a cool, dark place.

The bowels being injected, the stomach must be emptied of its contents by puncturing its walls, and by pressing gently upon its outer surface in a downward direction; the matter contained in it will be forced out into the pleural cavity, and can then be either sponged or scooped out; the stomach is then to be injected in a similar manner as the bowels; some of the injecting fluid may be then poured between the interstices of the bowels, about (6 or 8 ounces), and some cotton batting be laid evenly over the bowels; this cotton should be well saturated with the solution after it is properly laid in its place. The lips of the wound may then be neatly brought together and sewed up.

It will be readily understood by the above described operation, that no gases can be generated in either the bowels or the stomach, as the injecting fluid in those parts of the viscera will effectually prevent their formation; and this being the case, the purging at the mouth and nostrils, which is the result of the escape of gas driving out the contents of the stomach, is avoided. The expansion of the abdominal viscera, or the bowels, is also prevented by the same cause.

In some instances, when the body is that of a stout, fleshy person, or especially when some length of time has elapsed from the time of death until the undertaker has been called in, and particularly if the body has been reclining in a horizontal position, the face, neck and shoulders, will be found highly congested

with blood; the face, in fact, may be swelled and of a purple appearance, owing to the extravasation of blood into the capillary vessels under the skin.

In such cases, and after the body has been removed and placed into a proper position on the cooling board, if the blood is not carried to some lower part of the body by its own gravitation, it may be found necessary to cut into the jugular veins on either side of the neck, an incision about one quarter of an inch in length; through this opening the congested blood may be let out, and the face will soon recover its original color. This process, which occupies about twenty minutes, will be found preferable to the use of ice, especially when the corpse is at some distance from the undertaker's place of business; or when it would be almost impracticable to carry a large and cumbrous ice box, besides the labor and bustle occasioned in the house of mourning by the carrying in and out of the box, ice, etc.

It is also well understood that this process can not be applied where the corpse is that of a person who has died of some contagious or infectious disease. Besides the danger to the operator in this case, it is not customary to retain for any length of time the remains of those who may have died from the effects of an epidemic.

To the solution for injecting, as given above, must be added one ounce of creosote to the gallon of liquid, when the preparation is to be used in warm weather.

STATE OF BODY AFTER DEATH.

AS the object of this book is to give, not only the best modes of preserving and embalming bodies, but also to make comprehensive to our professionals the *modus operandi*, it is a most important matter to them that the different conditions of a body, as influenced by the cause of death, should be made a study of, and fully understood, before proceeding any farther. These different circumstances may so influence the state of the body, that the process of embalming, as given hereafter and as usually practiced, may not be successful.

I repeat an assertion already made, that one body having been treated successfully in a certain manner, yet the same method may fail in another case. Although the same chemicals may have been used in both instances, and given full satisfaction in the first, they failed to accomplish their object in the last.

It is a well known fact that the arterial system must be intact and without lesions, if the injecting fluid is to be carried in a thorough manner, and by the natural channels through the body—therefore any rupture in the arteries may cause the fluid to escape at that point, and fill the neighboring cavities. The result

would certainly not in that case be satisfactory to the operator; for as the fluid would thus be arrested in its course, and fail to permeate the tissues through the arteries, veins and smaller vessels, the corpse would soon putrefy in consequence.

Destructive inflammation of the surrounding tissues may invade and destroy the walls of an artery. Thus, ulceration of the brachia, bronchial glands, and œsophagus, may perforate the aorta; gangrene of the lungs, the pulmonary arteries, ulcer of the stomach, the gastric arteries, etc.

Let us suppose that the operator chooses the femoral artery as a point of injection. The injecting fluid will fill the arteries of the abdomen and the thorax until it reaches a point where the walls of the arteries are ruptured, and then will lose itself into the surrounding cavities, thereby failing to reach the upper portion of the body. It will of course, in an instance of this kind, be found necessary to inject again at some other point situate in a higher part of the body, as for instance, the axillary artery. It is, therefore, easily understood that—

1st. The cause of death may so affect the arterial system that the point selected for injecting may not be the proper one.

2d. That it may be necessary to inject the body at different points.

3d. That, in many cases, the cause of failure does not lay in the lack of antiseptic properties of the chemicals used, but in the need of discrimination on

the part of the embalmer, in choosing the proper place for injecting, and also in his ignorance of where that place should be.

It is, therefore, patent, that should the course of the arteries and veins be not readily understood by the operator, it will be a rather hard matter for him to discover the cause of his failure. This want, we will try to supply in the following chapters, by giving in detail the course of the blood vessels, also of the different positions of the several parts of the viscera, which it is necessary for the embalmer to be acquainted with, and which it is absolutely indispensable to know, so as to fully comprehend the instructions given further on in this book.

DEATH FROM POISONING.

BY *Sulphuric Acid.*—There does not seem to be any lesions of the arteries after death, as the stomach is the only part which might be perforated, as also the adjoining viscera might be blackened and softened by the action of the acid. The blood is thickened, sirupy acid, and the body may be partially preserved from decomposition.

Nitric Acia.—In this case the stomach will be found to contain a viscous, sanguinolent yellow or greenish fluid, which must be got rid of before injecting. The lungs will also be found highly congested, and the blood must therefore be emptied out. The acid, Nitrate of Mercury, and Muriatic Acid, produce about the same changes after death as those of Nitric Acid.

Oxalic Acid.—The stomach will be found to contain a dark, brown, mucous fluid, but in some cases of death from this poison there are no well marked lesions.

Oxalate of Potash produces the same changes.

Potash-Soda.—These alkalies and their carbonates are rarely used as poisons. Cicatrices and strictures of the œsophagus and stomach may be produced.

Ammonia.—The vapor of strong ammonia may cause death from inflammation of the larynx and air passages. But the strong solution of Ammonia produces corrosion of the mouth, œsophagus and stomach.

Nitrate of Potash.—In some cases, there is intense congestion of the stomach, and sometimes perforation of that organ.

Phosphorus.—The post mortem appearances vary with the length of time which lapses before death. If death takes place in a few hours, the only lesions are those produced by the direct action of the poison. The contents of the stomach, which must be evacuated, are often mixed with blood, and may have the peculiar smell of phosphorus. It is said that the mucous membrane of the stomach may emit a phosphorescent light in the dark. If death does not ensue until after several days, the lesions are more marked; the body is usually jaundiced, and there may be found a congestion of the liver, or there may be a small hemorrhage in the liver tissue.

Arsenic.—The stomach may be empty, or contain mucous mixed with blood, and the intestines contain a white, rice-water fluid, which must be emptied out.

Corrosive Sublimate.—The stomach is usually contracted; there are inflamed and congested, sometimes *gangrenous, patches* of the mucous coat. The intestines may appear normal, or there may be patches of congestion. In both preceding cases it must be borne in mind that the poison may be absorbed by the skin,

therefore the operator should use great care in manipulating the stomach and bowels.

Vegetable Irritants.—Aloes, colocynth, jalap, gamboge, scammony, savin, croton oil, colchicum, veratria, turpentine; all these drugs produce congestion and inflammation of the stomach and bowels.

Sulphate of Copper—Verdigris.—The post mortem appearances have only been observed in a moderate number of cases; the stomach may be unchanged, or there may be patches of gangrene and inflammation, and even perforation.

Tartar Emetic.—In this instance the lesions are not constant, but the lungs may be engorged with blood.

Opium.—The post mortem appearances of persons who have been killed by the preparations of opium, are negative. Intense congestion of the brain and lungs are spoken of by most authors, but they seem to depend chiefly on the way in which the patient dies, rather than on any specific action of the drug.

Prussic Acid.—The skin is usually livid, and the muscles contracted; the stomach is congested, and the veinous system unusually full of blood. The most characteristic condition, when this acid is present, is the odor of bitter almonds exhaled from the stomach and tissues.

Alcohol.—The different preparations of alcohol may, when taken in large quantities, produce sudden coma and death. The bodies are said to resist decomposition for an unusual length of time. There is conges-

tion, and sometimes extravasation of the blood in the brain; the veins everywhere are full of blood, and the bladder distended with urine. Chronic alcoholic poisoning is of a different nature; in this latter case the brain appears normal, but the lungs are usually congested.

Strychnia—Nux Vomica.—In cases of poisoning from these, the cramping and contraction of the muscles relax after death, but the brain is always congested with blood.

Corium, *Aconite*, *Belladona*, *Lobelia*, *Digitalis*, *Stramonium*, *Veratrum.*—All these poisons produce congestion of the brain, lungs and stomach.

Carbonic Oxide.—This gas is produced from burning charcoal, and forms the poisonous ingredient of illuminating gas. For post mortem appearances, see death from suffocation.

Carbolic Acid.—A number of deaths from this poison have been reported in the last few years. In this case, the stomach, lungs and intestines are intensely congested.

From Lightning.—In persons killed by lightning the internal viscera may be so lacerated and disorganized that the injection of the embalming fluid may be rendered impossible.

Drowning.—Persons who have been drowned usually die from asphyxia. The lungs are generally congested, the stomach contains some of the fluid in which the person may have been drowned, and must be emptied.

The abdominal viscera may also be congested, but the blood generally remains fluid throughout the body, and is easily removed.

Strangulation.—In this instance the carotid arteries are generally ruptured; the heart, the lungs and the viscera, are usually congested. In death from suffocation the same symptoms are present. In cases of sunstroke, decomposition sets in very rapidly, and requires an immediate check; the lungs will frequently be found congested.

Epidemic, Cerebro-Spinal Meningitis.—In many cases the skin of the body and face may show purpuric patches. The rigor mortis is pronounced and long continued, but decomposition sets in early. The intestines may be swollen, and even ulcerated, and the lungs congested.

The character of the disease almost precluded the idea of preserving the body after death. However, should the request be insisted upon, too many precautions cannot be taken, for the disease is of a virulent character.

EMBALMING BODIES.

THE board generally employed to lay the body on while the operation of embalming is being performed resembles any ordinary cooling board with an adjustable head-rest, but it is also provided with a rim, extending all around, and raised about one inch above the level of the board; this rim stops at the foot, where the board remains open in all its width. There are also longitudinal grooves running the full length of the board.

The usefulness of this arrangement is obvious, as the liquids which are used during the washing and embalming of the body run down the grooves—the board being raised at the head about one foot during the operation—and can easily be collected in a pail placed under the foot of the board. This will do away with soiling the floor or carpet, as is often the case with the common board in use. The rim around the board will also prevent any liquid from dripping over the sides, and will save a great deal of annoyance and trouble.

The greatest precaution must be used by the operator. All useless and unnecessary talk must be avoided while at work; the mind must be concentrated upon

the work in hand. The knives, needles and other instruments must be carefully laid away on a stand within easy reach of the operator, and not be left laying about the board, under sponges, towels, etc.; these might be grasped thoughtlessly, and in doing so a gash might be inflicted, which, if not fatal, at all events would certainly prove very serious.

Before commencing the operation, and after the body has been thoroughly cleansed with soap and water, let the operator anoint and rub his hands with either lard or sweet oil; not so much so as to soil any article used, but let a vigorous rubbing force the oil into the pores of the skin until the hands are almost dry.

The eyes and the mouth being carefully closed by the usual means, let the body be well saturated with the following solution:

Sulphate alumina, - - -	2 lbs.
Corrosive sublimate, - -	2 ounces.
Water, - - - - -	1 gallon.

A cloth moistened with this solution may be laid on the face, and remain while the operation is being performed. This solution should not be wiped off, but it should be allowed to dry on the body; the water will evaporate and leave behind it a thin coating of the salts, which by penetrating the pores of the skin will render it imputrescible.

Next, an incision about five or six inches in length is cut transversely from right to left in the abdominal

region, over the stomach, about one inch in a line below the curvature of the lower ribs. Through this opening is revealed the stomach on the right, the liver and gall bladder on the left, the transverse arch of the colon in front, and below the smaller intestines.

If the stomach is distended with food or gas, it must in all cases be emptied of its contents and injected. For this purpose, puncture the walls of the stomach on the side exposed to view, and passing the left hand gently between that organ and the ribs, press down, so as to force the contents out and through the opening made. Then, after the stomach is completely emptied, inject with the following solution, which we shall designate, for the sake of avoiding mistakes, by the name of

EMBALMING FLUID.

Corrosive sublimate, - - -	2 ounces.
Chloride of zinc, - - -	4 "
Creasote, - - - - -	4 "
Alcohol, - - - -	1 gallon.

The chloride of zinc and corrosive sublimate must be first dissolved in the alcohol, and the creasote then added.

The small intestines must then be gently and carefully drawn out, and allowed to lay on the right side of the abdomen; this will reveal in the abdominal region a cavity, which may or may not be filled with serum, according to circumstances. At any rate,

should there be any liquid, it must be carefully pumped out or sponged off until perfectly dry.

The cavity is then to be sprinkled heavily with tannic acid. The small intestines must then, and before being replaced, be next attended to. If inflated with nothing but gas, a simple puncture at different points, so as to favor the escape of the gas, and a moderate injection through the aperture, will suffice.

If, however, the intestine should be found congested with blood, or some other substance, the contents must be emptied by the following method: Seize firmly, between the two forefingers of the left hand, the intestine, at the lowest point you can reach, and with the right hand draw the intestine through the fingers of the left; this will have the effect of forcing the contents of the intestine forward in front of the fingers of the left hand. After the matter has so accumulated that the progress is impeded, the intestine must be cut, the matter extracted, the part which has thus been emptied, injected with the embalming fluid, and then tied up. This operation must be repeated until the whole of the intestines, small and large, have been emptied and injected, and then the whole is to be replaced into the cavity.

About four ounces of the embalming fluid must be poured over the intestines, and the wound neatly sewed together.

It may be found necessary before closing the opening to lay a thickness of cotton batting over the bowels and under the walls of the abdomen.

Should the lungs be congested with blood, they must be emptied. This object may be attained either by pressing upon the lower part of the thorax, which will have the effect of forcing the blood out through the nostrils and mouth; or else the diaphragm separating the thoracic cavity from the abdomen may be cut through, and the extravasated blood can therefore be got out through the opening. The injection of the thoracic cavity can also be performed through the same opening. The utmost caution must be used in perforating the diaphragm, as some of the arteries might be wounded by a careless use of the knife.

The above operation may be performed before closing the wound in the abdomen or replacing the intestine into the cavity, as it will then leave more room to collect the fluid which may escape from the lungs.

The lungs should in all cases be well injected, either through the trachea or by the process given above. The air passages must be carefully stopped with cotton. The mouth being closed, the nostrils are about the only air passages which require the attention of the operator. The eyes, after a few days, are liable to sink in the sockets, which gives the body an unnatural appearance. Mr. John C. Rulon, of Philadelphia, has invented a wax shell, which, after being introduced under the eyelids, prevents the sinking of the eyes.

The arterial system is to be injected, and next requires attention. Before commencing to inject the

arteries, the jugular vein on the left side of the neck must be punctured so as to allow the blood to escape. In some subjects, the flow of blood will be very copious, in which instance the jugular veins must be opened on both sides of the neck; at other times the flow of blood will be very limited, and even the opening of the veins has sometimes been found quite unnecessary.

The femoral artery is the vessel generally chosen for injecting, at a point below the arch about eight inches from and below Poupart's Ligament. After the artery has been raised, a small incision is punctured into the coat of the artery, large enough to admit the nozzle of the injector, and the canula is carefully pushed upwards into it as far as its length will allow; the artery is then safely and firmly fastened around it, and everything is then ready for injecting.

On the mode of injecting depends, in a great measure, the success of the operation. With some of the instruments now employed, the pressure of the injecting fluid is so strong and sudden as in some instances to rupture the walls of the arteries at some weak point, and fill the cavaties of the thorax and abdomen; sometimes even the liquid has been forced in with such force and in such quantities as to burst the arteries, and, after filling the chest, to pour out in a stream from the mouth and nostrils.

In the above instances, it stands to reason that neither the arterial nor venous systems have been properly injected.

The injection should be performed in a slow, regular manner. After a quart of the embalming fluid (the composition of which has been given above) has been injected, the operation should be suspended for about ten minutes, after which it should be renewed in the same manner, until a gallon and a half or two gallons have been injected. Sometimes the quantity injected need not be so great, as for instance in the case of a person much emaciated by long illness, or if the subject be a child.

The jugular veins must be kept open so long as the flow of blood continues, but they must be closed as soon as the embalming fluid makes its appearance. The best manner of closing the veins is by introducing into the jugulars a small pad of cotton, and neatly sewing up the opening.

It should be remembered that the cloth moistened with the solution for the face should be kept on, well saturated, while this operation is being performed, and even for a few hours after the body has been dressed.

A body prepared in this manner has been kept, in a wooden coffin, in a dark and moderately cool place, for the space of nine months without any perceptible change. After that time the shrinking of the tissues took place, and the body was slowly drying up and being desiccated without in the least decaying or putrefying.

THE ARTERIAL SYSTEM.

TO understand thoroughly the process of embalming as described in the preceding chapter, it will be necessary to give here a brief explanation of the circulatory system; also to explain the position of the different parts of the viscera, to which reference has been made.

The arteries commence from the great arterial trunk, called the aorta, and their branches are distributed to all parts of the system; they are dense in structure, and preserve for the most part their cylindrical form when emptied of their blood, which is their condition after death.

The aorta arises from the left ventricule, at the middle of the root of the heart; it ascends at first forwards and to the right, then curves backwards and to the left, and descends on the left side of the vertebral column, to the fourth lumbar vertebra; here it is divided into the arch and descending aorta.

It should be here remembered that most of the branches, which spring from the great artery and vein, are double, that is, each right branch has a corresponding one on the left side—so that there are, for instance,

the right and left carotid arteries, the right and left jugular veins, etc. From the arch of the aorta are sent off those arteries which are distributed to the head and arms; the principal ones among these are named as follows:

The carotid artery, which ascends in the side of the neck and divides into the temporal artery which is distributed in the temple. and the facial artery which supplies the face, and also sends a branch called the *internal carotid* to the parts within the skull. The sub-clavian artery, lying beneath the clavicle, or collar bone—that part of the continuation of this artery which passes through the axilla or arm-pit, is called the axillary artery; its continuation in the upper part of the arm, the brachial artery; and in the fore-arm it divides into the radial and ulnar arteries, which are distributed to the hands and fingers.

The principal branches of the descending aorta are as follows:

The iliac artery, which on passing into the thigh becomes the femoral artery, and, in the leg divides into the tibial and peroneal arteries, which form numerous branches for the supply of the leg and foot.

Before dividing into the iliac arteries the descending aorta gives off several important branches, as the cœliac artery, from which the stomach and liver are supplied; the renal artery, which goes to the kidneys, and the mesenteric artery to the intestines; besides many other sub-divisions in various parts of its course.

THE VEINS.

The veins are the vessels which return the blood to the heart, after it has been circulated by the arteries through the different tissues of the body; they are much thinner in structure than the arteries, so that when emptied of their blood they become flattened and collapsed.

The veins of the trunk may be divided into, the superior vena cava, with its formative branches, and the inferior vena cava with its formative branches.

The superior vena cava is formed by the junction of the right and left vena innominata; it is a short trunk about three inches in length; it descends perpendicularly on the right side of the arch of the aorta, and terminates in the upper part of the right auricle of the heart. The right vena innominata receives the veins of the neck, which return the blood from the head as follows: The internal, external and anterior jugular veins—the external jugular vein being the one which is ordinarily open to let out the extravasated blood from the head—it will not be amiss to describe its course; it descends the neck in the direction of a line drawn from the angle of the lower jaw to the middle of the clavicle or collar bone, and terminates into the sub-clavian vein; it is variable in size, and replaced by two veins. The sub-clavian vein becomes the axillary vein near the arm-pit, and opens into the brachial veins down to the bend of the elbow, where it is divided into several branches which supply the fore-arm and the hand.

The inferior vena cava is formed by the union of the two common iliac veins; it ascends along the front of the vertebral column or back bone, and, passing through the fissure in the posterior border of the liver, terminates into the inferior part of the right auricle of the heart. Its branches are the lumbar veins, three or four in number, which collect the blood from the muscles and integuments of the loins and spinal veins; the renal veins, which return the blood from the kidneys, and the hepatic veins in the liver.

The common iliac veins, which, by their union form the inferior vena cava, are in turn formed by the union of the internal and external iliac veins; the external iliac vein passing into the thigh becomes the femoral vein, and is found in the same sheath with the femoral artery; further below it becomes the popliteal vein; about one inch and a half below Poupart's ligament in the upper part of the thigh, the femoral vein receives the internal saphenous vein, which commences at the inner side of the foot and great toe; it ascends in front of the inner ankle and along the inner side of the leg; it then passes behind, and along the inner side of the thigh to the saphenous opening, where it pierces the sheath of the femoral vessels and terminates as above stated, in the femoral vein.

The above explanation of the circulatory blood vessels is given only for one side of the body—the right side. The other vessels branching off from the two great trunks, the aorta and the vena cava, on the left side are the same, with very slight modifications.

DIGESTIVE ORGANS.

The œsophagus is a slightly flexuous canal, inclining to the left in the neck, to the right in the upper part of the thorax; it commences at the termination of the pharynx, which is a musculo-membranous sac, about four inches in length, and communicating with the cavity of the nose and mouth; the œsophagus then passes behind the arch of the aorta to the œsophagal opening in the diaphragm, where it enters the abdomen, and terminates into the stomach.

The stomach in man is an oblong, membranous bag, placed obliquely across the abdomen and just below the diaphragm; its average capacity in the adult is about one quart; it has two openings, one towards the heart called the *cardiac orifice*, which receives the food from the œsophagus, and the other at the right or small end of the stomach, called the pyloric orifice, for the transmission of food to the small intestines.

The small intestines, about twenty-five feet in length, are coiled in various directions, and terminate into the large intestine, called the colon, which is about five feet in length, and resembles in appearance a long sac divided into numerous pouches.

The pancreas is a long narrow gland, situated partly behind the right side of the stomach, and within the first curve of the small intestine.

The liver is the largest gland in the body; it is situated on the right side, below, and in contact with

the diaphragm, and is divided into several lobes. At its lower side is the gall bladder, into which the bile is poured after being secreted. Its duct opens into a duct leading direct from the liver, and forms with it the common bile duct, through which the bile is poured into the small intestine, at the same point with the duct from the pancreas, until, at length, it is carried with the food into the larger intestine or colon, from whence it is excreted from the system, through the rectum.

ORGANS OF RESPIRATION.

The lungs are supplied with air through the larynx and the trachea.

The larynx is an irregular cartilaginous tube, forming the upper part of the windpipe, as the whole tube is commonly called.

The larynx is situated immediately below the root of the tongue, and forms the protuberance in the front part of the neck, called Adam's apple.

The trachea, which is a continuation of the larynx, is composed of about eighteen cartilaginous rings, connected together so as to form a tube, which is capable of maintaining a uniform size. On entering the chest, the trachea divides into two trunks, called bronchi, one of which goes to the right, and the other to the left, lung. As soon as the bronchi enters the lungs they branch off into numerous divisions and sub-divisions; their ultimate extremities terminate in air cells.

The lungs occupy the greater part of the chest, the heart being the only organ of much volume, which it includes in it.

The chest, or thorax, is a cavity closed on all sides from the entrance of air, and its bony walls afford an admirable protection to the delicate organs included within it. The walls of the thorax are formed by the breast-bone in front, by the ribs and spine on the sides and back, and by the diaphragm below.

The diaphragm, as has been stated in a previous part of this chapter, is a large muscular partition, which separates the chest from the abdomen.

The explanations given in this chapter upon the arterial and venous circulation, also upon the names, places and relations of the abdominal and thoracic viscera, will be found of the utmost importance, to understand fully the process of embalming already given, and also the other methods which will be stated hereafter.

Although briefly enunciated, this review of the anatomy of the parts of the human body, which the embalmer must be conversant with, will be found quite sufficient for the purpose.

It will be seen, that even after the arterial and venous systems have been properly injected, there still remains a prolific source of putrefaction in the liquids contained in the intestines, and the thoracic viscera; for instance, the fecal matter contained in the intestines, and the undigested food in the stomach at the

time of death, must all be evacuated, and the organs containing them properly cleaned and injected, and unless this be done fermentation will set in, and be followed by rapid decay of the surrounding tissues. It is true the arteries and veins extend their branches to all parts, and to every organ of the body, but it is also an undeniable fact that the contents of those organs which are prone to putrefy will carry the infection to the vessels containing them.

The stomach and bowels are emptied of their contents for the mere reason that these same contents are already undergoing a process of fermentation, which will generate into rapid decay and the emission of noxious gases.

In certain cases of consumption, the lungs are gangrenous and decayed long before death takes place; it will then be found necessary to introduce through the trachea some antiseptic fluid which will stop the progress of decay.

It is also necessary that the names of the different organs mentioned in this work should be explained, so as to make the use of technical words comprehensive to every undertaker who is not supposed to be familiar with the terms of the dissecting room or the human organism in general.

Besides the knowledge of the information given in the preceding pages will enable the embalmer to follow the workings of the embalming process in all its details, and enable him to discover the causes of failure in certain cases; also to use the proper means in the achievement of success.

ANIMAL MATTER.

PRESERVATION AND PUTREFACTION.

FROM the great complexity of the composition of animal substances, their decomposition is more rapid and its products more diverse than in the case of organic bodies of vegetable origin. While the carbon, hydrogen and oxygen give origin to the various kinds of ulmine and other substances of the same class, the nitrogen is generally valued as ammonia, and the sulphur as sulphurated hydrogen. It is the presence of these bodies that give to the putrefying substances the disagreeable odors by which that process is distinguished from mere mouldering and rotting.

Even during life, the constituent particles of the body are in a continual state of change, being absorbed and thrown out of the system, while others are assimilated in their place. Any part of our constituents, liquid or solid, which become unfitted for this vital function, is thereby killed, and must, if not got rid of, induce the death of the individual.

Hence, precisely the same means which give to the

animal substances the fixity of constitution which belongs to true chemical compounds, and thus preserve them from decomposition by the disturbing action of their own elements (as when we coagulate albumen by an acid, by corrosive sublimate, or by sulphate of copper), produce if applied to the living body the death of the part or the whole being by depriving the blood or the tissue of the mutability of constitution, which is required for the functions of the animal frame.

It is thus that the generality of metallic poisons act in producing death. Being absorbed into the system, they unite with the albumen and fibrine of the blood, and converting them into the insoluble compounds which we form in the laboratory, unfit them for the continual absorption and secretive offices, which, as organs, while they live they must fulfill. If the injury be local and limited in extent, the part so coagulated may be thrown off, and after a certain time the functions return to their proper order. If the mass, or the importance of the affected parts be greater, the system cannot so get rid of the portions which have thus been removed from the agency of life, to submit to merely chemical laws; on the contrary, the vital powers of the remaining portions of the animal are so much weakened in the effort that general death is caused.

For putrefaction it is thus necessary: 1st. That the force of vitality which governs so completely the mere chemical tendencies of the elements of our tissues be removed.

2d. That there shall not be present any powerful chemical reagent with which the organized material matter may enter into combination and thus the divellent tendencies of the affinities of its elements be overcome.

3d. That water be present in order to give the necessary mobility.

4th. That oxygen be present, or at least some other gas, into the space occupied by which the gaseous products may be diffused; and lastly, that the temperature shall be within moderate limits, putrefaction being impossible below 32° or above 182°.

The agency of the first of these preventive powers need not be further noticed. The second is extensively employed for embalming purposes, and in the preparation of bodies for anatomical studies, by baths, or injections into the arteries of solutions of corrosive sublimate, acetate of alumina, sulphate of iron, tannin, wood vinegar, and creasote; this last body, however, does not appear to act by direct combination, but by the complete (catalytic) coagulation it produces in all the tissues of the body that have protein for their base.

The necessity for the presence of water is shown by the fact that by drying the animal substances they are completely preserved. It is thus that the bodies of those perishing in the Arabian deserts are recovered years subsequently, dried, but completely fresh.

Alcohol and common salt both act in the preservation of bodies by their affinity for water. If a piece of flesh is covered with salt, the water gradually passes from the pores of the flesh, and dissolving the salt forms a brine, which does not wet the flesh, but trickles off its surface ; the water necessary for putrefaction is thus removed

Fourth, by excluding oxygen, the putrefactive process is retarded, precisely as the fermentative action of the gluten in grape juice cannot begin until a certain quantity of oxygen be absorbed. It is thus that meat that is sealed up in close vessels and then boiled for a moment is preserved ; the small quantity of oxygen of the air remaining then in the vessel is absorbed, and the produce of that minute change being coagulated by heat it cannot proceed farther.

A high temperature stops putrefaction by coagulating the azotized materials ; a temperature below 32° by freezing the water acts as if the tissues had been dried ; in both cases putrefaction is arrested.

During putrefaction, at a stage prior to any fetid gas being evolved, a peculiar organic substance is generated, *possessed of intensely poisonous properties, and the blood of persons who have died from its effects is found to be quite disorganized and irritating when applied to wounds.*

This and the blood of over-driven cattle are found to produce effects similar to those of venomous reptiles, and the wounds received in dissection are sometimes followed by similar fatal consequences.

The communication of disease in this way has recently been very ingeniously ascribed by Liebig to the general principle of the communication of decomposition by contact.

The small quantity of diseased organic matter originally introduced into the system by absorption, acts as a ferment and reproduces itself in the mass of the blood, until this becomes unfitted for the performance of its functions and the animal is killed; the active principle being thus copiously present, is exuded from the skin and lungs and gives a contagious character to the disease, or it remains only in the blood, or is secreted in *pustules*, constituting infection, by which the disease may be communicated to some other person.

This brief enumeration of the process of putrefaction will, to a certain extent, elucidate the process of embalming given in this book; it shows that the different methods herein explained, fulfill the conditions necessary to stop the progress of decomposition.

A most important point, and one which ought not to be passed upon without serious consideration is, the communication of disease by contact and absorption.

In a former part of this work, it has been suggested that too much care cannot be used in handling the bodies of persons who have died of certain diseases, especially when their bodies are to be subjected to the embalming process, which operation is rendered extremely dangerous to the embalmer from the fact

that the hands must, perforce, come into direct contact with the denuded tissues, the blood, or some vitiated secretion of the body.

We shall, in the following chapter, find instances when the decomposition of certain parts of the body has taken place even before death. It is obvious that in such cases the utmost caution is necessary to avoid serious results.

THROMBOSIS AND EMBOLISM.

SOMETIMES during life, some portion of the body is in a condition of gangrene, that is, the tissues are not only dead, but decomposing. With the evolution of gases, the softening and liquefaction of the solid parts, and the development of minute organisms, either animal or vegetable.

The bodies of persons who have died from such causes, *decompose with unusual rapidity.* The inner coats of the vessels are often stained with the coloring matter of the blood. The viscera are soft and flabby, the stomach may be swollen, and the kidneys congested and degenerated.

People who have suppurating wounds or abscesses may, without much change in the wounds or abscesses, be seized with rigors followed by fever, become jaundiced and die.

In such persons after death, the same tendency to rapid decomposition, and all the symptoms of the preceding cases are to be found.

There is no way of accounting for the rapid decay in the preceding cases, except by supposing that the pus from the original wound or abscess in some way infects the system, and renders the tissues prone to putrefy.

There is another modified condition of the body very different from the two preceding. Either in consequence of wounds, injuries, inflammations, abnormal conditions of the system, or changes in the venous walls, the blood may become coagulated during life and form thrombi in the veins.

These thrombi may become organized, or they may soften, break down, and their fragments be carried into the circulation; by their mechanical action in obstructing the vessels, they produce extravasation of blood.

By the irritative character of the thrombi themselves, they excite inflammatory action in the adjoining tissues; in this way are produced multiple abscesses. Therefore, we find in persons who die under such conditions, abscesses in the brain, heart, lungs, kidneys and intestines; further we may find purulent inflammation and abscesses in the connective tissues.

It is now necessary to explain the nature and composition of both the thrombus and embolus, and how, through their mechanical agency, the process of embalming may become seriously impaired, if not altogether arrested. A thrombus is a clot, composed principally of the fibrine of the blood, formed during life in the cavities of the heart, the arteries, the veins, or the capillaries.

An embolus is a solid body, usually a portion of a thrombus, carried by the blood current into some artery or capillary, and becomes fixed there. A

thrombus may entirely fill the cavity of a vessel, or it may only form a layer on its wall, or it may project from a smaller vessel into a larger one.

An embolus may completely or only partly plug up a vessel; it may remain alone or a thrombus may be formed around it.

A thrombus may merely become harder and whiter in time, or it may become organized, or it may degenerate, soften, and change into a mass of puriform fluid and *gangrenous looking fibrine*, or it may calcify.

The production of thrombi is due to various causes.

(1.) Spontaneous thrombi are produced by any cause which seriously weakens the whole system, as old age and chronic exhaustive diseases. They are usually formed in the veins of the lower limbs and pelvis, and in the sinuses of the dura mater.

(2.) Compression of the vessels by ligatures, tumors, dislocated bones, and inflammatory exudation. *Pneumonia* may produce *thrombosis* of the *pulmonary veins*. *Phthisis* may produce *thrombosis* of the *pulmonary arteries*.

(3.) Thrombi may form into capillaries or small veins, and increase until they project into larger veins.

(4.) It may also form when there is inflammation, especially of a gangrenous and suppurative nature, in the parts around a vessel.

The causes of embolism are also various.

(1.) Fragments of thrombi in the veins are the most frequent material of emboli.

(2.) Thrombi of the heart, vegetations on the valves and on the walls of the aorta.

(3.) Portions of the inner-coat of the aorta may become detached and form an embolus; also portions of tumors which project in the veins, and fat may form emboli.

In a considerable number of cases, it is impossible to find any source for embolus. It must be remembered, however, in emboli, in connection with wounds, that not only the veins of the wounded region are to be examined, but also those of the pelvis.

The consequences of thrombosis vary with the situation of the clot; thrombi in the arteries produce either a lack of circulation in the region supplied by the artery, or else intense congestion from the collateral circulation. Later there may be inflammatory changes, softening, or gangrene. Thrombi in the veins produce inflammation in and around the vein, thickening of the skin and connective tissue, gangrene and hemorrhage.

The consequences of embolism vary with the character of the embolus and its situation. A simple plug of fibrine in a vessel only produces changes in the circulation, but a plug from a gangrenous thrombus has a tendency to excite suppurative inflammation wherever it lodges.

The size of the artery thus obstructed, and the character of its collateral circulation also lead to a variety of results. If a large artery is stopped, the part becomes empty; if a small one the part may become

extravasated with blood from the collateral circulation. Thus, if the large arteries supplying the extremities are obstructed, paralysis of the muscles, and finally dry gangrene, ensue.

Emboli of the pulmonary arteries produce sudden death; of the coronary arteries, sudden death; of the cerebral arteries, softening of the brain; of the retina, sudden blindness; of the mesenteric arteries, congestion and gangrene of the intestines.

Abscesses are also produced. This takes place when the embolus is of an irritative and gangrenous nature. Large abscesses are only found in the lungs and liver, therefore the mechanical results of an embolus produce the following condition of affairs: A set of vessels are first emptied of their blood, and the nutrition of their walls thus impaired; after a time these vessels are filled up from the veins, their abnormal walls can no longer resist the blood pressure, and hemorrhage takes place.

After an hemorrhagic infraction is formed, the subsequent changes are of a degenerative character. The blood loses its coloring matter and breaks down into a mass of granules, forming a dry, yellow, wedge-shaped mass, or it may break down and form into a puriform fluid, or it may be surrounded by a zone of inflammation or of gangrene.

The above condition of the system will explain why and under the circumstances enumerated, the injection of a blood vessel may be brought to a sudden stop without any apparent cause, and the injecting fluid flow back towards the injecting point.

The various causes for such a result have been clearly demonstrated, but with the knowledge of these causes as previous stated, the remedy can be applied without much trouble. It can be estimated by the amount of fluid injected, about to what extent the vessel has been filled, and by following its course the point where the obstruction is, can be easily ascertained.

By reopening the vessel at a point above, the injection may still be carried on successfully, or the corresponding vessel on the other side of the body may be used for that purpose.

It is then that even a limited amount of knowledge of anatomy of the human body will be found of immense advantage to the operator, inasmuch as it will trace the cause of action, to be followed in this case, and will enable him to do so with success.

If, on the other hand, too great a pressure is brought to bear, so as to remove the obstruction by the mere weight of the fluid injected, the walls of the vessel may not be able to resist the strain, and the injecting fluid loses itself in the surrounding tissue and cavities, thereby failing to accomplish its mission.

PROCESS OF EMBALMING.

THE following process is more laborious and requires more time than the one already given, but at the same time it is more complete and lasting, and when the operation is skillfully and properly performed, the body may be said to be embalmed for an indefinite period of time.

But to carry out this process to a successful issue, it will be found strictly necessary to study well, and bear in mind, all the details of the operation.

It would be impossible to omit any part of the process and still expect the same results, for, after repeated experiments and trials under favorable and adverse circumstances, the result has always proved to be the same. Still, this process is regulated by the same laws and governed by the same conditions which affect a body under all circumstances. An explanation of these conditions has already been given, and it will be found that a thorough knowledge of these will materially assist the operator in his work.

Let us suppose, for one moment, that a man entirely unaquainted with the causes which may affect the morbid conditions of the veins and arteries, goes recklessly on, and commences to inject some part of the circulating system ; if that system is in a normal con-

dition the injection will prove successful; if not, the worst consequences may follow. How is he then to remedy his mistake? His very limited knowledge, if he has any, will be of no avail to him. It is in the lack of a sufficient understanding of the human organism that the cause of many failures is to be found. When the proper antiseptics are used, the fault does not lie in the inefficiency, but in the manner in which they have been employed.

It is unnecessary to repeat here what we have before stated, that in order to understand thoroughly the process of embalming, the operator must make himself familiar with the explanations already given, and also with those which shall be found hereafter.

It will be seen in the following pages that the mode of treatment to which the body is subjected in this process, is entirely different from that which has already been given.

The completeness of this process will be readily understood after a careful study of its details, and if strictly followed in every particular, will be found not only satisfactory in its results, but also lasting for an indefinite period of time.

It is well enough to say here, that a metallic casket is not required to assist in keeping the body after it has been treated according to the following method. Quite the reverse, a wooden casket will answer the purpose much better, as the body is rendered perfectly inaccessible to the attacks of the ambient atmosphere by the external covering which encases the body, in its trans-

parent and elastic coating, impervious alike to air and moisture.

The body should be placed on a table about four feet high, and elevated nearly six inches at the head; it must be here borne in mind that, to perform the following operation successfully, the operator should be left alone to his work, in a room free from intrusion, where idle questioning from standers by, or the talk of the usual routine of business, will not disturb him. And as it may require some time to complete the work, it were better that the remains were brought to the undertaker's establishment, where there is generally, or ought to be, a room set apart for this branch of the business.

The body is first washed clean with soap and tepid water, so as to remove every particle of fat or greasy substance which might obstruct the pores of the skin, and thereby prevent the salts contained in the bathing lotion to penetrate the tissues and produce the desired effect.

The body must then be thoroughly dried by means of clean towels, and be well saturated with the following lotion :

Acetate of Alumina, - - -	1 pound.
Sulphate of Iron, - - - -	4 ounces.
Corrosive Sublimate, - - -	2 ounces.
Water, - - - - - -	1 gallon.

The body is to be kept constantly moist with the aforesaid solution, and as soon as evaporation has

dried up the surface of the skin, a new application of the solution becomes necessary; in fact, the process should come as near complete immersion as possible. The eyes must be well closed. To avoid the sinking, which after a certain time must inevitably take place, and which will disfigure the best prepared corpse, I would here suggest the use of the wax shells, to be inserted under the eye-lids—these shells, as stated in a previous chapter, are manufactured by JOHN C. RULON, of Philadelphia, and can be had by the quantity on very moderate terms—to keep the eye-lids in their place; the outside of the shell must be coated with white gum shellac, dissolved in alcohol.

After the insertion of the shells thus coated, the lids are brought together and held in place by the fingers. Shelac dries quick, and in about five minutes' time it will be found that the gum has acquired enough of consistency to hold the lids together. As a matter of course it will get harder in time and prevent the lids from starting apart.

The operator will then cut a straight line through the skin with a scalpel, the line to extend from the superior part of the sternum to the umbilical region.

Another incision of the skin is to be made at right angles from the first, about six inches in length, and one inch below the lower bend of the last rib.

Then, with the thumb and forefinger of the left hand, seize the skin firmly at a point where the two lines intersect each other, and with the scalpel held in the right hand, carefully separate the skin from the

fascia underneath. This operation is repeated on the four sides, and the flaps of the skin turned over the sides of the body. This will leave exposed to view a diamond shaped opening of the epidermis, with its apex reaching above to the superior portions of the sternum, and the lowest angle reaching to within two inches of the navel; the two lateral points extend on both sides of the body from the region of the stomach to the liver, and almost immediately above the transverse arch of the colon.

To cut through the abdominal fascia, carefully puncture it above the stomach, so the opening will be large enough to admit the fore-finger of the right hand being introduced through the opening; then holding the scalpel with its edge upwards, the back resting along the extended forefinger, introduce both into the opening, and cut from downward upwards into the the fascia of the abdomen in a straight line across from the stomach to the liver in a similar way to that above described for cutting through the skin. This last incision is to follow the same course as the one cut in the epidermis, and will extend from one to the other lateral angles of the diamond shaped opening in the skin. This opening will reveal the stomach on the left, the liver on the right, and the transverse arch of the colon immediately beneath.

Then another cleaving of the fascia is to be performed, downwards and in a similar manner, from the middle of the transverse opening to within two inches of the navel; this last opening exposes the small intestines.

The reason why the cutting of the fascia of the abdomen should be performed in this manner, that is, with the scalpel being held edge upwards along the extended forefinger, is obvious ; the forefinger in this case acts as a guide to the scalpel in dividing the tissues, and also protects the viscera from being wounded by the sharp point of the knife.

The abdominal viscera being thus exposed, the lungs, heart and other parts of the thoracic viscera must also be uncovered. For this purpose, and with the cartilage knife separate the ribs from the sternum about two inches on either side of the latter ; commencing from the second rib down to the last one, and extending to the transverse opening made in the abdomen, it will be found that the ribs at that distance from the sternum are attached to it by a cartilage, which it is very easy to cut in children, harder in adults, and it may sometimes be indispensable to use a saw on old persons. This cutting through the ribs must be carefully performed, for fear of wounding some of the organs which lay immediately beneath and against the ribs.

The sternum being thus freed from the ribs, it can be turned back over and against the face, and will reveal through the opening thus made, the lungs, the heart, the arch of the aorta, etc.

The operator should use extreme caution whilst performing this operation, as the jagged and sharp edges of the ribs might cut through the skin and inflict a wound, should the hand be suddenly brought

in contact with them. It is also necessary to enjoin again forcibly, the recommendation made before, of keeping the body well saturated with the lotion while the work is progressing.

The bowels must then be carefully displaced, and all fluid or serum found between or under the intestines be completely sponged out; the intestines must also be emptied of their contents by the process which has already been given in the first method of embalming; also the stomach, the gall bladder, all the organs, in fact, which contain foreign elements prone to putrefy. The bladder can be emptied of the urine by means of a catheter, introduced into the urinary canal.

All the organs which shall have been emptied of their contents, as also the intestines, the bladder, and the others, must be injected with the following solution, or embalming liquid:

Corrosive Sublimate, - - -	2 ounces.
Chloride of Zinc, - - - -	3 ounces.
Alcohol, - - - - -	½ gallon.

Dissolve the corrosive sublimate and the chloride of zinc into the alcohol; then after the salts are completely dissolved, add

Pyroligneous Acid, - - -	½ gallon.
Creasote, - - - - -	4 ounces.

Stir briskly with either a glass or wooden rod and the liquid is ready for use. The above solution, which ought always to be prepared in advance and

kept on hand, must be enclosed in green glass bottles, well stoppered, and kept in a dark and cool place. Metallic vessels should never be used to hold the embalming liquid; neither the solution employed to bathe the body. A glass or china vessel must be used in either case.

As to puncturing the different organs for the purpose of emptying their contents, the manner for doing so has clearly been given in the first process for embalming bodies, but great care must always be used so as not to perforate any of the vessels of the circulatory system.

The next step is to inject the arterial system. For this purpose a different point for injecting the system is selected from the one pointed out in the former process. By removing the small intestines out, and on the right side of the body the descending branch of the aorta is exposed to view. In its course downwards, the aorta lies on the vertebral column to the left of the middle line, and terminates on the fourth lumbar vertebra, by dividing into the two common iliac arteries. The descending branch of the aorta is then punctured so as to admit the nozzle of the injector; this is introduced into the opening in an upward direction, and the walls of the artery are then tied firmly, but not so as to cut through, around the nozzle. After the artery has been thus prepared, and before injecting, the vena cava must be perforated at a point corresponding with the incision practiced in the descending portion of the aorta where the nozzle of the injector is inserted.

The inferior vena cava ascends *along the front of the vertebral column*, and to the right of the abdominal aorta. The object of severing this vein is to give the blood in the upper portions of the body a means of escape, as the fluid is forced through and up the arteries of that part and returning through the veins forces the blood through the opening.

After the upper portion of the body has been injected with about half a gallon of the embalming liquid, the nozzle of the injector must be reversed and the lower parts injected in a similar manner with about the same amount of liquid; the injection must then be stopped for the space of about three hours, and all the blood which may have escaped from the opening made in the vena cava into the cavity of the intestines must be sponged out as it fills up the space left.

The mode of injecting is also of extreme importance. The injection should be done slowly and steadily, as a strong, sudden forcing up of the liquid into the arteries might occasion a rupture of their walls should some point be weakened from some cause arising from previous sickness, or from lesions as described in a previous chapter.

The injection may then be renewed and more liquid be injected, until a sufficient quantity has been used. As there are no rules laid down for the amount of liquid to be injected, it is left altogether to the discrimination and good judgment of the operator.

The bodies of children and old persons will require less liquid than adults up to the age of forty. The bodies of persons killed by accident or some sudden cause, will require a larger amount of liquid than those of persons who are emaciated by long illness, as, for instance, consumption.

After the arterial and venous system have been thus completely injected, the intestines must be replaced in the abdominal cavity.

The brains must next be removed, and this operation is one which requires extreme caution, as will be seen by the following explanation of the process.

The body is turned on the right side, and, by means of a trephine, a round hole is cut into the back of the skull, about two inches above the cerebellum; the piece of bone thus taken out is preserved so as to be replaced into the opening after the operation is finished. Previous to cutting through the skull, a small incision in the shape of a cross, about two inches in length, each way, must be cut in the skin. The object of this is to leave the bone denuded after the skin has been detached from the bone, and also to bring the parts together by sewing, after the brain has been removed.

Through the opening thus made in the skull, the brain, or the portion of it which can be reached, is easily removed by means of a small, slender spoon, with a long handle, made for the purpose. The cavity thus made in the head is to be filled with the following:

Take two gallons or more of water, and saturate

with alum, as much as it will dissolve; then mix with plaster of paris to the consistency of *very thin paste*, and fill the cavity of the brain; some cotton may then be introduced to keep the mixture inside; the round piece of bone cut from the skull is then replaced, the flaps of the cut in the skin brought together and neatly sewed up; if this operation is carefully performed, the cuts thus made cannot be perceived under the hair.

Great caution should be exercised while removing the brain, in not wounding any of the veins and arteries which are inside that part of the skull, and with a little care this can be easily avoided.

The body is then turned again on the back, in the former position, and all the cavities in the thorax and the abdomen, between and under the intestines, the liver, the lungs and the heart, must be well cleaned and dried with a sponge of all liquid or serum that might be found; pulverize some tannic acid into fine powder, and sprinkle heavily around and between the organs of the thorax and the abdomen; the sternum is then replaced over the thoracic opening, the flaps of the skin temporarily brought back over the abdomen, and the body, being enveloped in a sheet or some linen cloth, well saturated with the *lotion for the face* as given in the first part of this chapter.

The face, hands, feet, in fact every inch of the surface of the body, above and under, is to be covered with the cloth, tightly wrapped around it and well saturated as above directed.

The body must be kept in this condition for about twelve hours, when the cloth is to be removed; the sternum is then raised again and the skin over the abdomen thrown back; a mixture of plaster of paris and alum, prepared as described above, is then poured over the whole of the thoracic and abdominal viscera, being careful to fill completely all the interstices existing between and under the different organs and the intestines.

This composition, or cement, must be brought up to a level with the ribs in the thorax, and cover the viscera in the abdomen; after the cement is set, or nearly so, sprinkle a plentiful quantity of powdered tannic acid on the top of it.

Then bring the sternum down to its proper place between the ribs, and also the internal fascia of the abdomen over the viscera; and last, the flaps of the skin are brought together and neatly sewed up, taking a stitch alternately under and above the skin. Should the mouth have a tendency to remain open, or the lips be too far apart, sew the lips together with surgeon silk, passing the needle up inside of the lip, near the gums, also through the nether lip in a similar manner, from one corner of the mouth to the other, where the last stitch can be tied up in a slip knot.

Before the mouth is sewed up it is always necessary to fill the inside of the mouth with cotton, well saturated with embalming fluid. In case a great number or all the back teeth be missing, which might cause a sinking of the cheeks, and thereby to a great extent

disfigure the body, introduce some cotton, prepared as above, between the gums and the cheeks; it will give the body an appearance more natural, and less emaciated. This rule ought to be applied not only in embalming, but also at ordinary times. When laying out a corpse, the mourners and friends of the family will always appreciate anything of the kind, which tends to beautify the remains and divest death of its hideousness.

The nostrils must also be filled with the same composition of alum and plaster of paris; let the cement be thin enough in this case, so it may be injected into the *nasal fossea* by means of an India rubber syringe, until the nostrils are completely full; then hold it in place with some cotton wads saturated with embalming fluid.

After the body has been so far prepared, it remains to encase it into a transparent and elastic covering, which will prevent the attacks from the atmosphere, and, at the same time, render the body impervious to moisture. For this purpose, procure from some first-class druggist some Canada balsam (it must be fresh and perfectly colorless, as it is prone to grow thick and yellow in time); then procure a vessel—a glass jar with large mouth should be preferred; this jar should be large enough to hold twice the amount of Canada Balsam on hand; bring the jar near the fire, if it is in winter, and submit the balsam to a gentle heat until it is liquefied; so soon as the balsam has attained the consistency of thin honey, add to it the

same amount of the best spirits of turpentine that can be obtained, and stir with a glass rod until the balsam and turpentine have been thoroughly mixed; then apply the mixture on the body by means of a camels-hair brush, very wide, and similar in shape to the brushes generally employed for moistening the paper used in copying letters.

A single thin layer of this mixture is quite sufficient, and should be evenly applied to any part of the body, where the growth of hair is not sufficient to exclude the approach of the atmosphere.

It will require but a very short time for this varnish to dry, and then the body will be ready for either burial in a crypt, easy of access, or for transportation to some foreign country.

In the course of time the organic tissues will dry and desiccate, the bony prominent parts of the joints may become more angulous, the skin may assume a slightly yellow tinge, but the features will always be natural and recognizable; the skin will never shrivel up and shrink back, exposing the teeth, as is generally the case with the Egyptian mummies; and, above all, putrefaction with all its repulsive hideous accessories, will never take place; nor will noxious gases or offensive odors be emitted.

A wooden casket will also be found preferable to a metallic one, as the free admission of air will favor the drying up of the tissues and the absorption of whatever little moisture which might find its way out of the only opening not hermetically sealed—the mouth.

Undertakers will find this process to be, without any exception, the best method of embalming ever employed; bodies prepared as above can be shipped to the most distant points across the seas; or, can be preserved for an indefinite period of time in some family vault, where the surviving members can at any time obtain a vision of the body without having their sensibilities shocked by the horrible picture of slowly decomposing animal matter.

It must not be forgotten, that, if the above process is slow, long and tedious, requiring a good deal of labor and delicate handling, the results obtained are equally important, and the compensation commensurate with the magnitude of the undertaking.

EXPLANATION OF TERMS.

STERNUM.—One of the bones of the thorax; is situated in the middle line in the front of the chest, and is oblique in direction, the superior end lying within a few inches of the vertebral column, the inferior being projected forward so as to be placed at a considerable distance from the spine. The bone is flat or slightly concave in front, and marked by five transverse lines, which indicate its original sub-division into six pieces. It is convex behind, broad and thick above, where it presents a concave border, and narrow at its junction with the middle piece. It is divided into the superior piece or manubrium, the middle piece or body, and the inferior piece, which is the smallest of the three, and varies in appearance, being sometimes pointed, at other times broad and thin, and again, at other times, perforated by a round hole. The seven true ribs are attached at each side of the sternum by means of the costal cartilage.

Abdominal Region.—The abdomen is the inferior cavity of the trunk of the body; it is bounded in front and at the sides by the lower ribs and abdominal muscles, above by the diaphragm, and below by the pelvis, and contains the alimentary canal, the organs

subservient to digestion, viz: the liver, pancreas and spleen, and the organs of excretion, the kidneys and the supra-renal capsules.

The abdomen may be divided into three regions; in the upper region will be seen the liver, extending across from the right to the left side, the stomach and spleen on the left, and the pancreas and duodenum behind; in the middle region is the transverse part of the colon, with the upper part of the ascending and descending colon, omentum, small intestines, messentery, and behind, the kidneys and supra-renal capsules; in the inferior region is the lower part of the omentum and small intestines, ascending and descending colon, and ureters.

Fascia (from fascia, a bandage) is the name assigned to laminæ of various extent and thickness, which are distributed through different regions of the body for the purpose of investing or protecting the softer or more delicate organs. From a consideration of their structure, these fasciæ may be arranged into two groups: areolo-fibrous fascia, and aponeurotic fascia.

The areolo-fibrous fascia is best illustrated by the common subcutaneous investment of the entire body, the superficial fascia. This structure is situated immediately beneath the integument over every part of the frame, and is the medium of connexion between that layer and the deeper parts; it is composed of areolar and elastic tissues, and contains an abundance of adipose cells. The fat, being a bad conductor of caloric, serves to retain the warmth of the body, while

it forms at the same time a yielding tissue, through which minute vessels and nerves pass to the skin without incurring the risk of obstruction from injury or pressure.

The aponeurotic fascia is the strongest kind of investing membrane; it is composed of tendinous fibres running parallel with each other and connected by other fibres of the same kind passing in different directions, together with areolar tissue and fine elastic fibres. In the limbs, it constitutes the deep fascia, inclosing and forming distinct sheaths to all the muscles and tendons. It is thick on the outer and least protected side of the limb, and thinner at its inner side.

The *Skin* is the exterior investment of the body, which it serves to cover and protect. It is continuous at the aperture of the internal cavities with the lining membrane of those cavities, the internal skin or mucous membrane, and is composed essentially of two layers—derma and epidermis. The derma or cutis is chiefly composed of areola-fibrous tissues, besides which it has entering in its structure elastic tissues and smooth muscular fibre, together with blood vessels and nerves. The epidermis or cuticle (scarf-skin) is a product of the derma, which it serves to envelop and defend. That surface of the epidermis which is exposed to the influence of the atmosphere and exterior sources of injury is hard and horny in texture, while that which lies in contact with the under layer is soft and cellular.

Viscera.—The viscera of the human body are situated in the three great cavities—cranio-spinal, thorax and abdomen. The viscera of the cranio-spinal cavity are the brain, with the spinal cord, and the principal organs of sense. The viscera of the chest are, the central organs of circulation, the heart, the organs of respiration, the lungs. The abdominal viscera admit of a sub-division into those which properly belong to that cavity, viz: the alimentary canal, the liver, pancreas, spleen and kidneys; and those of the pelvis, the bladder and the internal organs of generation.

Cartilage.—In the structure of joints, cartilages serve the double purpose of a connecting and separating medium; in the former capacity possessing great strength; in the latter, smoothness and elasticity. For instance, the costal cartilages unite the ribs with the sternum and form the point of separation by the knife, when it is desired to raise the sternum, as in the preceding process of embalming.

Gall Bladder is the reservoir of the bile; it is a sac situated in a fosse on the under surface of the right lobe of the liver.

Pancreas.—It is a long, flattened, conglomerate gland; it is about six inches in length, and is situated transversely across the posterior wall of the abdomen and behind the stomach.

Supra-Renal Capsules are two small, yellowish and flattened bodies surmounting the kidneys, and inclining inwards and towards the vertebral column.

Kidneys are the secreting organs of the urine; they are situated in the lumbar region, and at each side of the vertebral column.

Pelvis.—The cavity of the pelvis is that portion of the great abdominal cavity which is included between the bones of the pelvis. The viscera of the pelvis in the male are the urinary bladder, prostrate gland and rectum.

Bladder.—It is a hollow, membranous viscus, triangular and flattened against the pubes when empty, ovoid when distended, and in front of and upon the rectum.

Circle of Willis.—The communications established between the anterior cerebral arteries in front and the internal cavities and posterior cerebral arteries behind, by the communicating arteries, constitute the remarkable vascular communication at the base of the brain called the circle of Willis.

OF ANIMAL CHEMISTRY.

SECTION ONE.

THE purpose of the present chapter, so far as our knowledge extends, is to describe the chemical history of those bodies which are characterized as being rather organized than organic; as constituting not merely a product of the vital operations of the being, but the mechanism itself by which these vital operations are carried on; as making part of the tissues essential to its proper organization and life; and as being, while in connection with the animal and participating in its life, protected from the truly chemical reactions of their proper elements, which after the death of the animal, especially when in contact with air or water, rapidly assume simpler forms of union, and breaking up the complex animal tissue into a crowd of binary compounds, under the change well known as putrefaction.

In connection with these substances which form the basis of the organs and tissues of the animal frame, will be brought under survey the processes by which, from the atmosphere or from the materials of our food, the substance of our organs is continually renewed, their growth provided for, and the condi-

tions necessary for the continuance of life and health maintained. The following elucidation of the materials which enter into the composition of the human body is of extreme importance, as it will help to demonstrate why the chemicals employed in the former processes of embalming have been selected in preference to others.

Of Fibrine.—This substance constitutes the basis of the muscular tissue, and forms an important constituent of the blood. In the latter it exists dissolved during life, but separates after death or extraction from the body, producing, with the coloring material, the phenomenon of coagulation. In the muscles the fibrine is arranged in a truly organized and living condition, constituting the contractile fibres, in which it is so interwoven with nervous and vascular filaments as to render its isolation impossible. To obtain pure fibrine, therefore, we have recourse to blood, which, if immediately on being drawn it be briskly agitated with a little bundle of twigs, does not coagulate, but the fibrine is deposited on the twigs in soft, tenacious masses, which, being washed to remove any adhering coloring matter, and digested in alcohol and ether to remove any traces of fatty substances which may adhere to it, constitute pure fibrine; which may be dried by a gentle heat, and appears then as a yellowish, opaque mass, hard, tasteless and inodorous. If it be at all transparent, this results from traces of adhering fat. It is insoluble in water, alcohol and ether; it absorbs, however, so much water as to treble

its weight, and thereby recovers the volume, softness and flexibility it possessed before being dried.

If sulphate of soda or nitrate of potash be added to newly drawn blood, its coagulation is prevented; and if fibrine be digested in a strong solution of nitre, it dissolves, forming a thick liquid, which is coagulated by heat, by alcohol, by acids, and is precipitated by the *salts of mercury*, *lead* and *copper*, and by yellow prussiate of potash. This property of fibrine will again come under our notice.

Of Albumen.—This substance is even more extensively distributed through the animal frame than fibrine. Like fibrine, it exists in two conditions, one soluble and one insoluble in water; but whereas the fibrine becomes insoluble almost instantly on being withdrawn from the body, albumen may retain that state for an indefinite time, and its history is therefore more complete. In its soluble form it exists in the blood, in the serous secretions, in the humours of the eye; in the soluble or coagulated form it constitutes a portion of most of the solid tissues.

Soluble Albumen.—This is obtained in the solid form by evaporating to dryness, at a temperature which does not exceed 120°, the serum of blood; the dry mass is yellow, transparent, hard, tough, and contains, besides the albumen, the salts and some other constituents of the blood in minute quantities; these are extracted by digestion in alcohol and ether, which leave the albumen pure. When thus completely dry it may be heated beyond 212° without passing into

the coagulated condition; if digested in cold water it gradually swells up and finally dissolves. This solution, when heated to a temperature between 140° and 150°, coagulates; if dilute, the solution may even be heated to 165° without coagulating, and when present in very small quantity the albumen may not separate until the water boils.

When once coagulated in this manner, albumen is totally insoluble in water; it is then changed into its second form. The solution of albumen is precipitated by *alcohol*, by *acids* and *metallic salts*, exactly as the solution of fibrine in saltpetre; the only distinction that can be drawn between the two is that the saline solution of fibrine is partially decomposed by the addition of a large quantity of water.

The precipitates yielded by a solution of albumen with metallic salts are mixture of two distinct substances, one a compound of albumen with the acid, the other a compound of albumen with the metallic oxide; the former is generally somewhat soluble, the latter insoluble, and hence results the application of albumen as an antidote to mineral poisons, as corrosive sublimate and blue stone.

Albumen is also coagulated by many organic bodies, as tannic acid and creosote, which acts catalytically, as a very minute quantity of it coagulates a large quantity of albumen, without entering into combination with it.

Of the Gelatinous Constituents of the Tissues.—When the skin, cellular or serous, tissues, tendons, and some

forms of cartilage, as that of bones, are boiled in water, they dissolve in great part and form a solution which gelatinizes on cooling. Some of these tissues, as the skin, dissolve easily and almost completely; others dissolve but partly, and leave behind a quantity of coagulated albumen. In most kinds of cartilage a very prolonged boiling is necessary to extract a sensible quantity of gelatine. These various tissues are thus found to consist of albumen and gelatine, united in various proportions, and each presenting various degrees of condensation of texture; but by boiling they may be completely separated from each other.

Gelatine is insoluble in alcohol and ether. When a solution of gelatine is long exposed to the air, it undergoes a commencement of putrefaction, and loses its property of gelatinizing.

The action of reagents on gelatine is in some cases of high interest, it is not precipitated by solutions of either ordinary or basic alum, but if a solution of common salt be also mixed, the gelatine falls down, combined with alumina, as it decomposes the muriate of ammonia which is then formed. On this principle is founded the manufacture of white leather, by a kind of tanning with alum.

The most important compound of gelatine is that with tannic acid, which constitutes ordinary leather; this reaction is so distinct that one part of gelatine in five thousand of water is at once detected by the infusion of galls.

Many chemists consider that gelatine is merely a

product of the decomposition of albumen and fibrine by boiling water, and not a true constituent of the tissues; but this idea is thought to be incorrect, on the following grounds: First, pure fibrine or albumen gives no gelatine by boiling; second, in the process of tanning, the tannic acid combines with gelatine in a skin which has never been boiled; and third, that we can easily understand why some tissues give more gelatine than others by the different degrees of condensation of their structure. But it is rather considered that gelatine bears the same relation to the tissues of the skin or cellular membrane that proteine does to the fibrine of the blood, being really a product of its death and decomposition, *though the only representative of it which we can have.*

Of the Fatty Constituents of the Tissues.—The fatty bodies, although contributing essentially to the support of the animal frame, are mere secretions, and do not form any portion of its organized tissues. The substances properly included under the present head are the constituents of the nervous tissue, such as it is found in the brain, the spinal cord and the nerves.

In the composition of the brain, it is easy to distinguish three, perhaps five, distinct substances of a fatty nature; the most characteristic and important is called cerebrote; in composition it resembles albumen, containing a large quantity of nitrogen.

Saline, and Extractive Constituents of the Tissues.—We find in all the animal tissues small quantities of a

great variety of salts, the same as those which will be hereafter noticed as existing in the blood, to the presence of which in the substance of the tissues they are probably due. In the tissue of the bones and teeth, however, these saline matters are deposited in much greater quantities, and in disease and old age bony deposits occur in all those tissues, which yield true gelatine on boiling. The composition of the bones will be hereafter noticed.

Of the Composition of the Tissues and of the Secretions in Health and Disease.—Having described thus individually the constituents of the tissues, we shall now present such results as have been hitherto obtained as to the quantitive composition of the organized tissues formed by their reunion, their secretory products and morbid alterations.

The skin of animals is a congeries of finely constructed organs, sensitive and secretory, imbedded in a peculiar tissue, which is one of those most yielding gelatine, whence the process of tanning skins. On the surface of the skin there is secreted a substance, which, though varying in anatomical structure and appearance exceedingly, as it forms the fine epidermis, the nails, the hair, etc., is yet throughout all their shapes identical in chemical character, and may be described as the same substance. The principal mass of hair is composed of the same substance as horn, but the color is due to an oil which may be extracted by ether. If by virtue of the sulphur contained in hair a solution of litharge in some limestone water

blackens it, a solution of nitrate of silver will also blacken the hair, but by a deposition of the metal.

The perspiration from the skin varies in nature according to the part of the body; it is generally acid, contains traces of albumen, fatty matter and the salts of the blood; it often contains, also, an odoriferous, volatile principle, characteristic of the animal by which it is secreted.

Cellular and Serous Tissues.—These tissues are constituted of gelatinous materials similar to that in the skin, and hence dissolve by boiling water, being converted into gelatine. In the natural condition of these membranes their surface is moistened by a watery liquid, which, accumulating in excessive quantity, gives rise to the dropsies of the cavities, or of the cellular tissues. This serum of the cavities is clear and colorless. The cells of the cellular tissues, in which fat is usually deposited, are often filled up by an albuminous material having considerable analogy with casein; it is thus that the diffused hardening of the cellular tissue and the local white tumors have their origin.

Of the Muscular Tissue.—From what has been already said of fibrine, it is evidently the essential element of the muscular tissues, and forms with water almost the whole of their parts.

Of the Bones.—In vertebrated animals with osseous skeletons the earthy material, in all cases, consists principally of phosphate of lime, with phosphate of

magnesia, carbonate of lime and soda. By digesting a bone in dilute muriatic acid, all of these inorganic salts are removed, and the cartilage remains, preserving perfectly the form of the bone.

The teeth present, in their combinations, the greatest analogy to bone; the principal and organized substance of the teeth is indeed true bone, containing indeed less cartilage and more phosphate of lime than other bones. The enamel, which is an inorganic secretion from the surface of the long tooth, is almost destitute of any animal matter.

Of the Composition of the Blood.—Blood is, in the higher classes of animals, an opaque, thick, red fluid; it has a salty and nauseous taste, and a peculiar smell, resembling that of the animal whence it has been derived.

When the blood of any red blooded animal is allowed to rest, it gradually forms a soft jelly, from which, after some time, a thin yellowish fluid (serum) separates, while the red jelly or coagulum contracts in volume and acquires great consistence. If this coagulation of the blood takes place slowly, the upper portion of the coagulum becomes white or pale yellow; forming thus, the buffy coat. There is no doubt that the blood, while in connection with the animal, participates in its life, and the phenomena of coagulation are to be referred to a new arrangement of its materials consequent on the loss of that vitality.

The serum of the blood, when coagulation has been perfect, is of a yellowish, sometimes greenish,

color; its taste is dull and salty; it is thick fluid, like olive oil; when heated to 140° it coagulates.

If we examine under the microscope the appearance presented by blood, we find that it consists of a great number of red particles swimming in a nearly colorless liquor. These red particles are flattened disks; in man they are round. Their size is variable, being in man from one four-thousandth to one eight-thousandth of an inch in diameter, but larger in other animals.

The blood contains a large quantity of *albumen*, partly dissolved and remaining in the serum after coagulation, partly in a solid state, forming the great mass of the globules.

In the living body the blood also contains fibrine in solution, but this separates soon after extraction from the body; it assumes a solid form, and investing, as a sponge, the red globules, forms with them the coagulum.

The fibrine is thus the element active in the coagulation of the blood, the globules being but passively engaged in it. In addition to this essential organic element, the blood contains a variety of salts, as common salt, phosphate of magnesia, ammonia and lime, lactates of soda and magnesia. The best analyses of the blood are those of Lecanu, and the results for blood and serum are that they contain, in the human subject of each sex:

Water,	75.00
Albumen,	5.00
Globules,	7.14
Fibrine,	.20

The fatty substance of the blood is a mixture of cholesterine with stearic and oleic acid and a peculiar fatty substance termed seroline, the history of which is yet incomplete. None of the fats of the brain, however, seem to exist in the blood.

The chemical history of fibrine and albumen having been already given, it remains only to describe the peculiar coloring matter, for the most accurate knowledge we possess concerning which, we are indebted to Lecanu's elaborate researches on the blood.

Pure hematosine or coloring matter, when it is coagulated, is a dark brown mass, tasteless and inodorous; when heated it does not smell, but swells up and evolves ammoniacal products; it is insoluble in water, alcohol and ether; *it forms, with the mineral acids, compounds which are insoluble in water but soluble in alcohol.*

By caustic alkalies it is dissolved with a red-blood color, and these combinations are soluble in water, alcohol and ether. Hematosine contains neither phosphorus nor sulphur, but iron in large quantities. The state in which iron exists in hematosine has been, up to the present day, an object of much discussion among chemists; but with the knowledge we now possess of hematosine in its pure form, we must consider the iron to be an integral part of its organic constitution, as sulphur in albumen, or arsenic in alkarsine, and the opinion of its being oxydized and combined with the true organic element as a kind of salt can no longer be supported. If a solution of

hematosine be acted on by chlorine gas, a white, flocculent precipitate is produced, and the solution contains chloride of iron.

Although hematosine is the coloring principle of the globules of the blood, it is present but in very small quantity; one hundred parts of dried globules containing but four to five parts of hematosine; in the blood globule the hematosine exists in its uncoagulated state, and possesses properties somewhat different from those of its coagulated form.

A solution of the colored blood globules in water, when exposed to the air, becomes of a brighter red color, being thus partially arterialized; it is *coagulated also by alcohol and by acids;* the hematosine then passes into the condition of insolubility, already described.

The colorless ingredient in the blood globules has already been spoken of as being albumen, with which, indeed it is identical in properties, but differ in some points. It has been termed globuline. In its uncoagulated condition it can not be separated from hematosine, and is there distinguishable from albumen, principally by being insoluble in even a very dilute saline solution, which dissolves albumen readily. It is, hence, that the globules of the blood swim unaltered in the serum, but are readily dissolved by pure water.

If the blood, when extracted from the vein, is received into a vessel containing a solution of glauber's salt, coagulation is prevented, as the fibrine remains dissolved, and by filtering the liquor so obtained, the

serum and water pass off and the globules remain, mixed only with little of the salt. The globuline cannot, however, be separated from hematosine, except by acids, which, as described in the preparation of hematosine, then combine with the globuline.

Alteration of the Blood in disease.—The examination of the state of the blood in disease, although presenting important relations to pathology and to practice, has been conducted in a manner too disconnected and superficial to produce any satisfactory results. This branch of chemical pathology has, however, been taken up by the illustrious Andral and Gavaret, who have published the result of the analysis of the blood in three hundred and sixty cases of disease.

Their researches have enabled them to recognize four classes of diseases, in which the composition of the blood is essentially altered, though in different ways.

The first class presents as a constant alteration, an increase in the quantity of fibrine; it includes diseases remarkably different in their locality and form, but all belonging to the class of acute inflammations in some cases of morbid deposition, as in tubercle and cancer, a similar increase in the quantity of fibrine is found, but it may be doubted whether it be due to abnormal growth or to the inflammatory action which accompanies it.

In the second class the fibrine remains stationary, or even diminishes in quantity, while the globules in-

crease in proportion to the fibrine. The diseases which belong to this class, are, continued fevers without local inflammation, and some form of cerebral hemorrhages.

Cerebral Hemorrhages.—In the third class, the fibrine remaining unchanged, there is a remarkable diminution in the quantity of globules; of these diseases, chlorosis may be taken as an example, and in the fourth class it is no longer the fibrine or the globules which are the subject of the morbid change, but the quantity of the albumen in the serum is diminished; of this class of affections is Bright's disease.

It has been observed, that in cholera the blood becomes so thick as to arrest the circulation, and contains from thirty to forty-five per cent. of solid matter; it is then, also, less strongly alkaline than healthy blood; this is connected probably with the matters vomited and evacuated, which are strongly alkaline, and contain a quantity of albumen.

The blood has been found, occasionally, in cases of Diabetes Mellitus, to contain traces of sugar. The great discordance of the results obtained, may result, perhaps, from the sugar contained in the blood only for a short time after meals, and then being rapidly evacuated by the kidneys. In the jaundice the green coloring matter of the bile has been found mixed with the blood.

Other observations of morbid constituents of the blood are too indefinite to justify me in occupying space with them.

Color of the Blood.—In the living body, the blood in the veins and arteries is well known to differ essentially in color; in the former being of a dark purple-red, in the latter of a bright vermilion color. The change from the venal to the arterial state occurs during the passage of the blood through the capillary vessels of the lungs, where it is exposed to the action of an extensive surface of atmospheric air; while the arterial blood, in traveling the general capillary system of the body, assumes the red, dark condition in which it is carried back to the heart by the veins. Yet, although the vital properties of the blood depend essentially upon this change of color, we are not able to connect it with any alteration in the composition of the constituents of the blood, or even in their relative proportions.

Arterial and venous blood contains sensibly the same quantity of water, fibrine, globules, albumen and salts; and, by analysis, the composition of those bodies is found to be identical, no matter what kind of blood they may be derived from. To trace the difference of nature between arterial and venous blood, it is therefore necessary to study it under different points of view than its approximate or elementary composition. So far as we have yet explained it, the air which has been employed in respiration, is found to have undergone an important change of constitution; its volume is but slightly, if at all, altered; but a quantity of oxygen has disappeared, and is replaced by carbonic acid, in generally equal volume.

Air which has been once respired is found to contain from three to four per cent. of carbonic acid, and if the same quantity of air be continually breathed, the animal dies with all the symptoms of narcotic poisoning. When the carbonic acid has accumulated to from eight to ten per cent., the action of the air in expiration is therefore to remove carbon from the blood. The quantity so taken from the system in twenty-four hours is very large, and makes up the principal portion of that element which we take in with our food; yet, such is the activity with which its assimilation provides, that no perceptible change in the solid elements of the blood can be perceived.

It was, at one time, a much disputed point, whether the carbon so separated from the system was directly excreted from the lungs, and carried off as it were, by contact with the oxygen of the air, or whether the oxygen was first absorbed by the blood and carried by the circulation to every portion of the body, where it combined with the carbon, which was there present in excess, and the carbonic acid so produced, being dissolved by the venous blood, was thrown off on arriving at the surface of the atmosphere, in the lungs. The progress of science has, however, finally decreed in favor of the latter view, to which the fullest confirmation has been given by the careful and elaborate researches of Magnus.

Gases in the Blood.—It was found that both arterial and venous blood contain dissolved quantities of gases, oxygen, nitrogen and carbonic acid, which

amount to from one-tenth to one-twentieth the volume of the blood; the proportions of these two gases to each other are different in arterial and venous blood; the oxygen in arterial blood being about one-half of the carbonic acid, while in the venous blood it seldom amounts to more than one-fifth; the difference is greatest in young persons, and probably is proportional to their activity of nutrition.

The quantity of nitrogen appears to be the same in both kinds of blood, making from one-fifth to one-tenth of the gaseous mixture.

The physico-chemical conditions of respiration are simply explicable upon these results, by the principle of gaseous diffusion, the fine lining pulmonary membrane being permeable to gases. When the venous blood arrives at the surface of the lungs, a portion of the carbonic acid which it contains is evolved, and a quantity of oxygen gas absorbed in place of it; these two quantities are not necessarily equal at each moment, though ultimately they become so, and hence the volume of oxygen absorbed is generally, though not universally, equal to that of the carbonic acid given out. There appears, from the presence of nitrogen in equal quantity in both kinds of blood, to be an absorption and evolution of that gas, simply from physical laws, and independent of any application of it to the nutrition of the animal; hence the volume of nitrogen in air is sometimes increased, and at others diminished, by respiration, and a man evolves much nitrogen when respiring an atmosphere of oxygen and

hydrogen, while it has been shown that the rate of nutrition of a man is proportionate to the quantity of nitrogen it receives as food, and that none of that principle is really assimilated from the air.

It is still by no means easy to decide upon the changes of color which occur in the blood during respiration; for this should appear connected, not merely with the presence of certain gases in the blood, but upon a true change in the composition of hematosine, which analysis cannot direct.

Stevens first attracted the attention upon the influence which saline bodies have upon the color of the blood. If dark, venous blood is put in contact with a solution of common salt, glauber salt, nitre, or carbonate of soda, it becomes as vermilion colored as if it had been truly arterialized; on the contrary, the presence of carbonic acid impedes this action, and gives to blood, so reddened by a salt, not in excess, the dark tint of venous blood.

If we consider, therefore, the arterial tint to be due to the material combination of the coloring matter with the saline constituents of the serum, this will be darkened, when, by passing through the capillary system, the blood takes up an excess of carbonic acid; and again, in the lungs, when the carbonic acid is replaced by oxygen, the vermilion color is restored, not by any active agency of the oxygen, but by the natural tint of saline hematosine becoming evident.

Although this theory of the change of color is by no means free from objection, it still appears to be better founded than any other that has been proposed.

Animal Heat.—The phenomena of respiration consisting mainly in the conversion of carbon into carbonic acid by union with oxygen, the heat which is developed in the body of all red blooded animals has been naturally referred to that source; and as we know that the change from the arterial to the venous condition of the blood occurs at every point of the system, the almost complete equality of temperature throughout the body in health is explained. That the great source of heat is the respiratory process, is abundantly proved by the temperature being highest in those animals, and in the same animal, at those periods when the circulation is most rapid and the quantity of air consumed the greatest. But it has been calculated that the heat evolved by the combustion of the quantity of carbon thrown off from the body in twenty-four hours is no more than eight-tenths of the quantity generated in the body during that time, and the origin of the remainder must be found in the action of the muscles and the nervous power, which appears of itself to be a distinct source of animal heat.

ANIMAL CHEMISTRY.

SECTION TWO.

Composition of the Digestive Organs and of their Secretions—Chemical Phenomena of Digestion.

MUCUS.—The living membrane of the alimentary canal is moistened with a liquid possessing many of the characteristics of vegetable mucus, but containing nitrogen. It is a thick, tenacious substance, which contains, dissolved in the water through which it is diffused, the ordinary salts of the serum of the blood; it swells up with water to a considerable mass, but without dissolving; it dissolves in alkaline liquors, and is precipitated therefrom on the addition of an acid and the tincture of galls; the mucus from different parts of the mucus membrane is, however, by no means identical in properties.

The liquid secreted by the internal surface of the stomach—the gastric juice—which exercises an important influence on digestion, differs essentially in its character from mucus. When the stomach is empty and contracted, it contains ordinary mucus; but if even indigestible substances are introduced, and still more, after taking proper food, a liquid is abundantly

poured out, which is colorless or pale yellow, and contains a very small quantity of solid matter (two per cent.), which consists principally of inorganic salts (common salts and sal ammoniac, with a trace of a salt of iron); it is specially characterized by the presence of a notable quantity of free muriatic acid, the proportions of which vary with the activity of the digestive powers at the time. This gastric juice possesses the remarkable property of softening down and dissolving fibrine and albumen, and thus converts the masses of food into the uniform pulp (chyme), from which the absorbing vessels of the small intestines take up the nutritious elements.

If we form an artificial gastric juice by mixing together the muriatic acid and salts in the right proportions, it is found to be totally incapable of dissolving the materials of the food, and, indeed to be quite inactive towards digestion. The organic material of the gastric juice, although its quantity be so minute, is, therefore, essential to its powers, and these may be perfectly conferred upon the previously inactive, artificial juice, by the addition of a little of the mucus of the stomach or by steeping in the acid liquor, for a short time, a small portion of a mucous membrane, and filtering the liquor; for this purpose it is not even necessary to use the mucous membrane of the stomach, for that of the bladder has been found to answer equally well. The substance which is dissolved out of the membrane in these cases has been termed pepsine. It has not been obtained in a truly isolated or

pure form, but its properties are very remarkable. For its full activity it requires the presence of a free acid, as the artificial gastric juice becomes much less active in dissolving food when neutralized by an alkali, though it retains other properties, as that of coagulating milk-like rennet. If the artificial juice be precipitated by nitrate of lead, the precipitate washed, and then decomposed by sulphuret of hydrogen; the solution thus obtained possesses all the digestive powers of the juice. Hence, the pepsine and muriatic acid act together, by combining with oxide of lead.

Pepsine appears to be completely decomposed by contact with alcohol or boiling water; its powers are also destroyed by deodorizing substances; the solution of albumen and fibrine in gastric juice differs essentially from their solution in muriatic acid, as in the former case the quantity of acid is very minute, in relation to the quantity of material dissolved, and after solution the acid remains quite uncombined.

The action of the stomach in digestion, appears, therefore, so far as our actual knowledge extends, a purely catalytic fermentative action; one in which the active excitant is an organic substance (pepsine), secreted by the mucous surface, and whose properties are developed by the presence of muriatic acid, which is secreted at the same time. The new products into which the food, fibrine, albumen, gluten, starch, oils, sugar, etc., are converted, and which collectively constitute the white uniform pulp, termed by physiologists

chyme, have not been made the subject of accurate chemical researches.

In the mouth the mass of nutritive material is acted on by a liquid which is secreted by the salivary glands, the saliva. It is alkaline, and holds in solution not one per cent. of solid matter, which contains some carbonate of soda and common salt, admixed mucous, and a peculiar organic body, termed salivary matter.

This last substance is soluble in water; its solution is not coagulated by heat, nor precipitated by tincture of galls, corrosive sublimate, acetate of lead, nor by acids. The pancreas, so similar in structure to the salivary glands, has a different secretion; it contains no salivary matter, but albumen and some salts; it is generally slightly acid.

Composition of the Bile.—The precise part which this remarkable secretion performs in the animal economy is not yet fully known; it has been the subject of repeated and accurate chemical examination, although, from the facility with which its elements are transferred into other bodies, by the action of the reagents employed, every succeeding analysis has led to different results.

The Coloring matter of the Bile—is present during health but in small quantity, but in disease it sometimes accumulates so as to form solid masses. When pure, it is a reddish-yellow powder, which is scarcely soluble in water or in alcohol, but dissolves easily in a solution of caustic potash. This solution is of a

clear yellow color, but when exposed to the air it becomes deep green, absorbing oxygen. This change is remarkably produced by nitric acid, and it is indeed the reaction by which the presence of the bile in the serum of the blood, in the skin, in the urine, and eyes, etc., may be shown in cases of jaundice.

Chyle and Lymph—The nutritive materials extracted from the food by the absorbing vessels of the intestines, is thrown into the thoracic duct, where it meets with another fluid, which is transmitted to the same vessel from all parts of the body by the colorless veins or lymphatics. The fluid from the intestines is termed chyle; that from the body is generally termed lymph. It is the mixture of these that has alone been examined, for the vessels which carry either separately are too minute to allow of the extraction of their contents in a pure form.

When taken from the thoracic duct, a few hours after a meal, when, probably, the chylous element prevails, it is whitish, opaque, liquid, like milk, with generally a reddish shade; a short time after separation from the body, it coagulates· the clot is at first pale, but it soon becomes light crimson red; the milkiness of the serum is due to the presence of oil; it contains albumen, and coagulates by heat; except that it is more dilute, and that the hematosine is for the most part absent, the chyle and lymph have the same composition as the blood. It appears to vary, however, with the nature of the food, as Dr. Prout found the chyle of persons fed on vegetables to con-

tain a much smaller quantity of albumen than when they had had animal food.

Dr. Prout also indicates in chyle the presence of a substance which he terms incipient albumen, which is not coagulated by heat, except after the addition of acetic acid; the properties of this form of albumen, however, are not fully known.

Constitution of the Urine in Health and Disease.—The nature of this secretion has at all times been an object of considerable interest to the chemist, from the indications which changes in its composition give of diseases of important organs and from the number and interest of the different organic substances it contains. As in almost all other branches of animal chemistry, Burzelius first determined its composition, and lately Lecaner has ascertained with great care the limits to which the proportions of its ingredients may vary in health, and this established a correct basis of comparison for urine in the various conditions of diseases.

Of the Urine in Disease and after Death—Urinary Calculi.—To the chemist, the indications of disease of the urinary and digestive organs, formed by changes in the composition of urine, are most valuable. The majority of the substances which are taken into the circulation, but are incapable of assimilation to our organs, are thrown off by this secretion, and hence a variety of medicinal substances may be traced to it after having been ingested, sometimes quite unaltered,

at others modified in their natures. Thus if alkaline salts of organic acids be taken into the stomach, the organic material is oxidized, probably during the action of respiration, while the alkali passes into the urine in the state of carbonate. If, however, the organic acid be taken uncombined, it escapes decomposition, and, passing into the urine, produces an abundant precipitate of salts of lime. In the case of the tartaric acid and oxalic acids, some organic bodies, as aspharagine and the oil of turpentine, are decomposed, and the products which they form are execreted, giving to the urine peculiar odors; in the latter case like that of violets.

The majority of coloring matters are thrown out of the system by this secretion, while others are not so given off.

The mineral acids—alcohol, camphor and most metallic salts—do not pass into the urine to any sensible degree.

Urine in Diabetes.—The most remarkable change in the nature of urine occurs in Diabetes Mellitus, it is voided in great quantity; it is found to contain a great quantity of grape, sugar, and very little urea.

It was supposed that in this disease urea ceased to be formed by the system, and was replaced by sugar; but it has been shown that, although the quantity of urea is very small in any one specimen of urine, yet the total quantity is so much increased that in twenty-four hours the natural quantity of urea is secreted; the secretion of sugar being an act of faulty digestion,

and totally unconnected with the urea. These results have been fully confirmed by experience.

The diabetic urine sometimes contains albumen, which arises from complications of other forms of disease.

All that has been said in the former chapter about the solid and fluid constituents of the human body may, at first sight, and to a great many, seem to be superfluous and out of place in a work of this kind. It is true that the different modes of preserving bodies, as explained in this book, do not require this long dissertation on animal chemistry in order to be understood; still, when we consider that the chemicals used in these different processes have an object to accomplish, it must be granted that a thorough knowledge of the constituents of the body, their composition and chemical proportion, will, to a great extent, explain the reason why these same chemicals are used in preference to others.

The secondary object, which is not less important, consists in the fact that a thorough knowledge of the animal chemistry of the human organism is most necessary to understand the different changes which take place in the formation of the different juices and tissues of the body, when they enter into combination with the chemicals, the object of which is to render them imputrescible.

However, the study of these combinations affords a simple and clear explanation of the means resorted to in order to preserve bodies.

GANNAL'S PROCESS OF EMBALMING.

WITH MODIFICATIONS.

THIS process, which has been successfully employed in Europe for a long time, for the purpose of embalming bodies and for the preservation of anatomical preparations, is still practised extensively, owing to the cheapness of the materials used and to the simplicity of the modus operandi.

The embalming fluid in this instance is composed as follows, viz:

Sulphate of alumina, - -	4 pounds.
Arsenious acid, - - -	4 ounces.
Creasote, - - - -	4 ounces.
Water, - - - - -	1 gallon.

To prepare this fluid, an explanation of its constituents is required.

There are two different kinds of arsenious acid, the opaque and the transparent. This latter variety (the transparent) should be selected in preference to the other, on account of its greater solubility; the acid must also be procured in crystals, and not in powder, as it will, in the first place, dissolve quicker, and will not be liable to be adulterated. The water must

then be heated to 55°, and the acid dissolved in it. The sulphate of alumina is then to be added, and, after being completely dissolved, let the solution cool off to the usual temperature; then add the creasote, and, after stirring gently, the solution is ready for use.

Lay the body on an inclined board, as described in a former chapter, and, after thoroughly cleansing with water and soap, saturate well with a concentrated solution of alum; the body should be kept well moistened with the solution, as prescribed in the processes of embalming already given, until the operation is completed.

Through an opening made in the skin of the abdomen, and immediately over the transverse part of the colon, the bowels and the stomach will then be revealed, which must be emptied of their contents and properly cleaned, and injected with the above preparation.

After the contents of the abdomen have thus been treated, the whole abdominal viscera is to be heavily sprinkled over with tannic acid, until the acid forms a layer about one-half inch in thickness between the bowels and the skin of the abdomen; the flaps of the skin are then brought together and neatly sewed up.

The femoral vein is then opened. The femoral vein ascends the thigh in the sheath of the femoral artery, and, entering the pelvis beneath Poupart's ligament, becomes the external iliac vein. In the lower part of its course, it is situated on the outer

side of the artery; it then becomes placed behind that vessel, and at Poupart's ligament lies to the inner side. It receives the muscular veins and propenda, and, through the saphenous opening, the internal saphenous vein.

The blood, in some cases, will issue very freely, and the flow of it must continue until the embalming fluid makes its appearance.

To inject the circulatory system, extend the left arm at a right angle with the body, and open the axilliary artery about three inches from the arm-pit. The axilliary artery is a continuation of the subclavian artery; it passes through the axilla or arm-pit into the arm, and is called the axilliary artery; that part of its continuation into the upper arm is called the brachial artery, and in the fore arm it divides into the radial and ulnar arteries, which are distributed to the hand and fingers.

Through the opening thus made in the axilliary artery two gallons of embalming fluid may be injected, or such quantity as may be found necessary to completely fill the arterial and venous systems.

After the blood has ceased to flow from the opening in the femoral vein, the wounds must be sewed up, and the body, anointed with the solution, left to dry in a cool, well ventilated place.

The surface of the body and also the face may be mottled in some places with white spots, but the skin will soon assume a uniform color, and the blotches will disappear.

After the solution on the body has become sufficiently dry and has penetrated the pores of the skin, the excess of moisture must be wiped off with a clean towel.

The nostrils should be hermetically sealed, by introducing into them some cotton, well saturated with gum shellac dissolved in alcohol.

The eyes must be well closed, and, if no other means at hand, the lids must be sown together with a small circular needle, and some silk, saturated in spirits of turpentine.

The body is then saturated with a thin coating of turpentine; and after the turpentine is dry, the clothing can be put on, and the body is then ready for interment.

As shown by the preceding, this process is very simple, and has given satisfactory results in all cases, although the amount of embalming liquid and the composition thereof vary in all cases, and according to the temperature of the season and country.

For instance, if the body to be embalmed is that of a very fleshy person, and it be in the summer season, when animal substances are more prone to putrefy than at other seasons, the embalming fluid must be altered as follows, in its quantitive composition:

Sulphate of alumina, - -	6 pounds.
Arsenious acid, transparent, -	4 ounces.
Creasote, - - - -	6 ounces.
Water, - - - - -	1 gallon.

For the minor parts of this process, as, for instance, the closing of the eyes, mouth, etc., the reader is referred to previous processes already given in former chapters.

The most reliable composition yet found for embalming purposes, and the one which has given the most satisfactory results, is the following:

Alcohol, one gallon; dissolve into it eight ounces of corrosive sublimate, and, after complete solution, add two pounds of creasote. This solution, for injecting purposes, has never failed to accomplish the purpose, and has given the most astonishing results. The only objection to its use, but one which does not in reality carry any weight with it, is the fact that the solution will produce a white scar on the skin of the body wherever it may be dropped; but a very moderate amount of care in the use of it will preclude the possibility of such an accident.

The embalming of bodies by injection has so far occupied our attention. We will hereafter pass briefly in review the process of maceration employed in the preservation of bodies.

EMBALMING BY MACERATION.

THE process of embalming bodies, as at first practised, was founded on the principle of complete immersion of the body into some bath composed of antiseptics, which, by being absorbed by the system, rendered the tissues imputrescible, much in the same way as we now preserve anatomical preparations by immersing in alcohol.

At the commencement of this century a process of embalming was brought out in Europe, and succeeded very well for some time; but after a certain period, Mr. Gannal and others inaugurated a new system of preserving the dead, and the process of maceration was abandoned, and has not since been revived to any extent. The following is the manner of treatment to which a body was subjected in the above process:

The body was washed thoroughly with soap and water; then the abdomen was opened and the sternum raised; the thoracic as well as the abdominal viscera was then removed altogether, as also the brain.

The body was then immersed for one week in a strong solution of alum and nitrate of potash; the body was then taken out and the cavities filled with tow and powdered arsenic; the bowels, lungs, liver, etc., in fact all the viscera, were buried separately.

The body was then completely buried in dry sand for the space of ten days, to absorb all the moisture contained in the tissues, and was then dressed in the funeral habiliments and placed in a leaden coffin, hermetically sealed; a small, thick glass, immediately over the face, allowed the friends to obtain a view of the features.

This process has been found objectionable for a good many reasons; in the first place, the eviscerating of the body is a repulsive feature of it, and not to be had recourse to when less barbarous means are at hand; secondly, the skin of the body assumes a yellow and wrinkled appearance, which, if it does not entirely destroy the cast of the features, alters the general appearance so much as to render them very different from the natural appearance.

At any rate, the method of preserving bodies by the above means has entirely fallen into disuse, and as, with our perfected improvements in this branch of the undertaking business, we are able to do away with the most repugnant features of it, this system has been superseded by the less objectionable and more effective arterial injections.

LAWS OF HEALTH.

UNDERTAKERS, like physicians and all those who may be called at any time of the day or night to make use of their physical and mental faculties, whose duties compel them to breathe the foul effluvia of the sick chamber, or the noxious gases generated by the dead, even to come into direct contact with every variety of contagious or epidemic disease—such professionals find it to their interest and physical welfare to observe certain rules of living in accordance with the requirements of their calling.

It is a matter of great importance that their diet, clothing and habits be regulated by certain laws, which will, to a great extent, reduce the dangers to which they are exposed in the discharge of their duties.

DIET.

Man is less uniform in his diet, and suffers more in consequence of it, than any other animal. All other animals are directed by instinct to select only those substances which are best adapted to their wants. Man is endowed with reason to enable him, by the exercise of thought and reflection, to make his choice of food. He should, therefore, select his daily food

with as much forethought and care as he would select the materials for his dwelling. He should consider, not what will gratify his taste, but what will build up and strengthen his bodily structure, and secure most perfectly the highest and most permanent enjoyment of all his faculties.

The kind of food which each individual should select is by no means uniform; the climate, the season of the year, the occupation, the temperament, the age, the habits of life, and various other circumstances which might be mentioned, demand modifications of diet.

MODIFICATIONS OF AGE.

The constituent elements of the body are not found in the same relative proportions at different periods of life, or in different individuals of the same age. In middle life the muscular system predominates, and the body is remarkable for the compactness of its fibres, its strength, and its power of endurance.

In the child there is an excess of fluids, which renders the body more plump and round and the form beautiful, though more frail and delicate than at a later period. In advanced age, the soft tissues become greatly diminished, and the form wrinkled and wasted.

CLIMATE.

The inhabitants of cold climates require those articles of food which produce the largest amount of

animal heat, such as oil, tallow and fat meats, which contain from sixty-six to eighty per cent. of carbon. The natives of the arctic regions consume enormous quantities of fat and oil, and seem to relish them as great luxuries; the inhabitants of tropical regions subsist mainly on rice, fruits, vegetables and lean meats. It would be impossible to live in Greenland on the plaintain and rice of the Hindoo, or in Hindostan on the seal fat and whale oil of the Greenlander.

In temperate climates we require different kinds of food at different seasons of the year. In winter we consume larger quantities of fat meat and carbonaceous food, and in summer more fruit and vegetables. Were we to indulge in the summer in the same diet which we might find highly conducive to health in the winter, the system would soon become burdened with an excess of carbonaceous matter, and induce congestion and inflammatory diseases. It is therefore highly important that each person should possess some knowledge of the properties of different articles of diet, and select from time to time those which he may think most suitable to his own organization.

Different substances are nutritious in proportion as they yield, when digested, those elements which are found to exist in the different tissues of the body. Animals do not possess the power of forming new elements, or of converting one element into another, and it necessarily follows that the elements of their growth and nutrition must be derived from the food which they take.

The largest part of nearly all the substances which make up the human body are composed of oxygen, hydrogen, nitrogen and carbon, and different substances are regarded as nutritious in proportion as they furnish these essential elements of our organization. In general, those substances may be regarded as the most important articles of diet which furnish, with the greatest facility of digestion, the largest amount of these elements.

Milk is regarded, perhaps correctly, as the plainest and simplest kind of food. Cow's milk is composed of:

Casein,	4.48
Butter,	3.13
Sugar of milk,	4.77
Various salts,	.60
Water,	87.00

Milk, being furnished by nature as the only food for the young of the mammalia during a certain period of their existence, contains all the elements necessary to the nutrition and the growth of the body. Out of the casein are formed the albumen and fibrin of the blood. The butter serves for the formation of fat, and contributes, with the sugar, to the support of animal heat, by yielding carbon and hydrogen to be burnt in the lungs. The earthy salts (phosphate of lime, etc.) are necessary for the development of the bones, the iron required for the blood, corpuscles and the hair.

In this country, meat constitutes an important part of the diet of almost every family. As a general rule, animal food is more easily digested, contains a greater amount of nutriment, and is more stimulating than any of the varieties of vegetable food.

As minuteness of division and tenderness of fibre facilitate digestion, young meats are more tender than old; thus, roasted pig is more speedily digested than broiled pork; steak and boiled lamb sooner than boiled mutton. Still, there are some exceptions to the digestibility of young meats, veal, and with some persons lamb, are slower of digestion than beef or mutton.

The vegetable kingdom greatly exceeds the animal in the number and variety of the aliments which it furnishes to man. It is well known that the four essential elements, carbon, oxygen, hydrogen and nitrogen, which form an important part of all animal compounds, are also to be found in great abundance in all vegetable compounds; it is owing to this fact that different animals are nourished equally well on an exclusive diet of either. The lion, tiger and other animals which live exclusively on animal food, give no evidence of being better nourished than the deer, the ox, and animals which subsist wholly on vegetable food; but the apparatus for digestion in each class is constructed with an evident adaptation to the kind of diet on which the different animals subsist.

In man the digestive apparatus is more extensive than in flesh-eating animals, but is less complicated

than in those which are confined to vegetable food alone. Man is therefore omnivorous, both in his structure and in his habits.

But the universal tendency of mankind gives preference to a mixed diet. The most perfect development and the greatest individual vigor are to be found among those races in which a mixed diet is the prevalent habit.

During the warm season vegetables and fruits may be made the means of great mischief or of great good. Perfectly ripe fruits or vegetables are highly useful and well adapted to the wants of the system at that season of the year; yet they may become, and often are, a prolific source of disease. So frequently is this kind of food a cause of bowel complaint that city physicians discard it wholly from the diet of children not under their immediate supervision.

Vegetables and early fruits that have been long exposed, in a malarious or filthy market, or in transportation, are unquestionably dangerous articles of food for all persons. But the injurious consequences which follow the use of ripe and wholesome vegetables and fruit are, in almost all cases, the results of imprudence. They are either in an improper condition to be used as food, or the quantity is too great, or they are taken at improper hours.

In either case there is a great change in the usual diet. Instead of a lack of refrigerant food, there is now an excess of it. Active fermentation takes place in the process of digestion, and results in serious

derangement in the alimentary canal, which leads to cholera morbus, diarrhœa or dysentery.

During warm weather vegetables and fruit are to be regarded as safe only when used as an accompaniment to other food; they are not adapted to meet all the wants of the system, and therefore should not constitute a full meal at any time. In the country, where this kind of food is enjoyed daily in a proper condition to be eaten, injurious consequences are quite rare, and then they are the result of an excess, or of an indulgence of an appetite at irregular hours.

Much care is also requisite to prevent imperfect mastication of this kind of food. Orange peel and the skins and stones of cherries, plums and grapes are wholly indigestible, and often cause serious mischief when swallowed. Cucumbers, green potatoes, green fruit of all kinds should be wholly discarded from the diet.

DRINKS.

Water in some form is more essential to our existence than any of the solid aliments we have yet considered, and is next in importance, in the performance of the vital process, to the air we breathe. Water enters into the formation of all the various tissues of the body, and constitutes a very large proportion of the human system. The blood contains about eighty per cent., the flesh about seventy-six per cent., of water; and of the entire human body, at least seventy-five per cent., or three-fourths

of its weight, is water. The most important purposes in the animal economy are accomplished through this medium.

In the blood, the solid vital elements are transported by the medium of water from one part of the body to another, in a form and condition to promote the vital changes which are constantly taking place.

In exhalation, secretion and absorption, the presence of water is indispensable. It acts as a solvent of various alimentary substances, and thus assists the stomach in the act of digestion; though when taken in large quantities immediately after eating it dilutes the gastric juice and hinders digestion.

Water enters more or less largely into the composition of all alimentary substances, and is taken into the stomach in a pure state, or forms the principal part of the various kinds of drinks in use.

Water is unquestionably the natural drink of adults, and meets the wants of the body more perfectly than any of the artificial liquids which are regarded as improvements on water. Whenever a man is left to the cravings of instinct, unbiased by a viscious appetite, he invariably resorts to water as the natural means to quench his thirst, cool his system, and invigorate his wasting strength.

When we say that water is the only fitting drink for man's daily and habitual use, we are sustained by the facts of the case. Water is the only liquid which is necessary to the formation, development and support of his frame; it is equal to all the exigencies of

thirst, for the relief of present inconvenience, and of dilution, by mixing with his blood and other fluids, to prevent further sufferings and disease.

DIGESTIBILITY OF ALIMENTARY SUBSTANCES.

The facility with which alimentary substances are digested, depends on a variety of circumstances. Some kinds of food are naturally more difficult of digestion than others. This is especially the case with oily and fatty substances, which contain a large amount of nutritive matter in a concentrated form. Tenderness of fibre renders the digestive process more easy; and, therefore, all those circumstances which affect the texture of flesh have an influence on its digestibility. Violent muscular exertion previous to the death of the animal renders the flesh more easy of digestion. The flesh of young animals, though more tender than the flesh of adult animals, is frequently not so easily digested. Of adult animals, the youngest will be found more tender and digestible than old animals. Vegetables are generally more slowly digested than meat. Minute division facilitates digestion; hence, if food is properly masticated, the process of digestion will be more rapid than otherwise.

Some variety of food is unquestionably more agreeable and more conducive to health than a diet limited to one or a few simple articles. Accordingly, we find

that, whenever the condition of men will admit of it, they universally make use of more or less variety of alimentary substances, and that variety increases very much in proportion to the wealth and ability which exists to gratify the desires of the palate.

Too great a variety of alimentary substances is always injurious when it becomes a temptation to excess. Thus, a much larger amount of food is taken than the wants of the body require, and more than the digestive organs have the capacity to dispose of.

It is impossible to point out to each individual the kind of diet which will suit best. This, to some extent, must be a matter of personal observation and experience. Peculiarities of constitution, habits of life, age, sex, etc., require modifications of diet in accordance with the natural wants of each individual.

Abstinence from all that is found or suspected to be injurious, uniform hours and temperate indulgence should be observed by all who value lasting health more than the mere temporary gratification of the palate.

CLOTHING.

Dress does not make the man, but it is often indicative of his character. Some men dress in such a manner as to indicate that they estimate themselves by the cost per yard of the garments they wear; others dress so as to carry an impression of perfect indifference to the feelings and sentiments of those

around them. Both are wrong. Our personal appearance, which depends to a great extent on dress, is a matter of some consequence; and the man who wholly disregards the customs and habits of others in this respect will be very likely to be indifferent to the sentiments and feelings of society in other particulars, and at least may be in danger of passing for less than his true worth. But the fop, whose only accomplishment is the dress he wears, is usually despised as thoughtless and vain.

The style of dress which is most to be commended is that which will not draw attention either for its gaudiness or its plainness. The external appearance of our clothing should always be regarded as less important than its practical uses, inasmuch as bodily health is infinitely more important than personal appearance.

During the warm season we require clothing which will protect the body without retaining too large an amount of heat. For this purpose we prefer, in summer, materials which are good conductors of heat. Cotton and worsted, though not as good conductors as linen, are usually found sufficiently cool for the temperature of the Northern States, where the climate is so changeable that there are but few days in the season when linen can be worn with safety.

Winter clothing should correspond somewhat with the exposure, both in quality and amount. The object to be sought in winter clothing is, not to produce heat, but to retain the heat which the body is constantly evolving.

Woolen is one of our best non-conductors of heat, and all garments formed from this material are regarded as warm clothing. All kinds of furs are good non-conductors, but they are liable to two serious objections: First, furs are too warm for ordinary exposure, and cause too great a change of temperature when they are removed; second, they prevent the escape of perspiration, and confine it within the garments usually worn inside of the fur.

The amount of clothing should depend on the constitutional vigor and the exposure of each individual. In doors we require less than during an out doors exposure; less when taking active exercise than when inactive. The amount of clothing, therefore, should be sufficient to insure a constant and uniform protection against sudden changes.

It is especially injurious to bundle up the face and neck with fur collars and shawls, which are so warm that colds will be induced when they are removed.

In a changeable climate, the constant wearing of flannel under garments next to the skin should be recommended. Flannel absorbs the perspiration and preserves a uniform temperature of the surface of the body, and prevents that sense of chilliness which we are liable to experience without flannels.

EMBALMING PROCESS

OF WORTH AND DURAND.

THIS process, often employed in Europe, has given very satisfactory results, and seems to deserve a good deal of attention. The mode of proceeding differs in some particulars from the methods already given; also the preparations used in this process are very different from the others, although the principles upon which it is founded are the same.

The solution employed as an injecting fluid in this process is as follows:

Arsenious acid, - - - -	3 ounces.
Carbonate of soda, - -	4 ounces
Water, - - - - -	3 quarts.

Dissolve the arsenious acid and soda in hot water, in a glass or porcelain vessel, and, after solution, let the liquor cool off; then add enough of water to make up a gallon of the mixture. In the making and using of this preparation a great amount of care should be exercised, as it must be borne in mind that arsenious acid is a violent poison.

The stomach is then opened, as described in former chapters, and emptied of its contents; the bowels, also, must be subjected to the same process. The trachea is punctured, and the bronchial tubes completely filled with the solution through the opening thus made. The stomach and intestines should also be injected with the solution, and also the surrounding parts.

The main point of injection is the common carotid artery. Before injecting the stomach and bowels, and before replacing the intestines into the abdominal cavity, the inferior vena cava is punctured a little below the renal vein, and the flow of blood allowed to take place in the cavity, from whence it may be either sponged or pumped out.

The right carotid artery is selected as the point of injection, instead of the left, for the following reasons: The right common carotid artery is shorter than the left; it is also more anterior, and, in consequence of proceeding from a branch instead of from the main trunk, is larger than its fellow.

The common carotid artery in the neck is inclosed in a fibrous sheath, which also contains the internal jugular vein lying to the outer side of the artery, and the pneumogastric nerve, which lies between and behind both; the sheath rests on the vertebral column. To the inner side of the carotid is the trachea and larynx; to its outer side, and inclosed in its sheath, the jugular vein. It may be inferred from the above that the jugular vein in the neck is in close proximity

with the carotid artery, and great care must be exercised in puncturing the artery not to injure the vein lying at its side.

After the injection has proceeded upwards, until the arteries of the head and neck are filled, a very small puncture may be cut into the jugular vein, and the blood allowed to escape at that point and for a few minutes, until the flow decreases, when the vein may be tied up.

The nozzle of the injector is then turned in a downward direction, and the injection continued until a sufficient quantity of the liquid has been injected.

The artery is then tied up, and the wound neatly brought together and sewed up. The blood which may have escaped from the vena cava is taken out of the abdominal cavity, and the stomach and bowels injected with the solution. Some of the same solution may also be poured around the bowels before and after their being replaced in their former position, and the opening in the abdomen is then closed.

Another preparation, which has been employed with some success, was as follows :

Hyposulphate of soda, - -	12 ounces.
Sulphuric acid, - - -	6 ounces.
Water, - - - - -	1 gallon.

The sulphuric acid liberates the hyposulphurous acid, which immediately decomposes into sulphur and sulphurous acid. It is to the antiseptic properties of the sulphurous acid that this preparation owes its preserving qualities.

A strong solution of bichromate of potash has also been used several times for an injection, but the result has not always proved satisfactory, as the liquid, when concentrated, is too much of an oxydizing agent.

MISCELLANEOUS.

WHEN the services of the undertaker are required, the party or parties—generally some friend of the deceased—who may have charge of the arrangements will, in a few words, make the undertaker acquainted with the nature of the case and the particular duties he is expected to perform.

Sometimes they will there and then select the style of case or casket, order the carriages, and arrange all the other details of the funeral. At other times, again, these particular points are to be decided upon only after consulting the wishes of the family in this respect.

In either case it is the undertaker's most imperative duty to hasten to the house of mourning with all the implements necessary for washing, laying out, dressing, and if necessary preserving the body. That is, where the party has died at his own house; for, in many cases, where death has taken place either at a hotel, boarding house, or any other place of a like public character, the proprietor thereof may wish the remains removed, at as short notice as convenient, to the rooms of the undertaker, where the remains may be properly cared for without any annoyance or discomfort to the other inmates.

Before the undertaker brings in any of the appliances necessary to the laying out of the corpse, it will be well for him to make his entrance unincumbered, and be introduced to the persons present. He must also view the remains, and make such arrangements or alteration in the furniture of the room as may be necessary to facilitate the operation of laying out, washing, etc.

The assistant may then be called in, and he shall dispose of the funeral implements according to the directions given by the undertaker. After the preliminaries have thus been disposed of, none but the intimate friends or relatives of the deceased are allowed to remain while the work of dressing the corpse is being performed. This is subservient to the wish and good judgment of the undertaker, who is supposed to be vested with powers of expelling those whose presence is not justifiable, or retaining others who may have claim to the privilege.

It should be here borne in mind that the work must be done as silently and noiselessly as the nature of the case admits of; and that any subject of discourse between the undertaker and his assistant, not immediately connected with the matter in hand, is very much out of place, and will be regarded by the persons present as a lack of good manners, not to say a disrespectful behavior.

Let it be also remembered that a mortuary chamber is not the place fitly chosen to consummate the ulterior arrangements of the funeral, but some other

apartment in the house, or even the undertaker's own office, are the proper places to perfect subsequent proceedings.

The laying out and dressing of the body being completed, the assistant may retire, after having carefully removed whatever articles may have been used in the process; while the undertaker, who may have some directions to give about the proper care of the body until the time of burial, or some instructions to receive from the persons in charge of the funeral, will wait until every point is settled; or sóme other time and place may be selected for the purpose.

It is not the sphere of the undertaker, especially at such time, to press with questions the parties whom he may chance to serve; but he will abide his time and accept their decisions with becoming respect, unless some imperative object should make it incumbent upon him to hasten the proceedings, as, for instance, the danger of contagion from some infectious disease, or some other equally important reason.

In the matter of dressing the body, especially if it be that of a lady, this duty is usually performed by some lady attached to the establishment, or by some lady friend of the deceased, although the undertaker is often called to perform this office himself. It is at such a time that good taste and refinement will show conspicuous in the professional undertaker.

The same may be said about the floral decorations and the ornamenting of the casket; a certain amount of good sound common sense and discrimination should be used in both cases.

Some parties will consider it a mark of good taste to have but a few elegant and well chosen gold or silver trimmings, while others would consider a superfluity of these as needful to the complete decoration of the casket. This part of the business must be well understood by the undertaker, and it requires a certain amount of tact to pamper successfully to the taste of the different parties he may be called upon to serve.

The remains, after being placed in the coffin a few hours previous to the time of the funeral, do not require much of his attention, but he is expected to be on hand at the specified time. As the hearse and carriages arrive at the house of mourning and take the places allotted to them without confusion or unnecessary noise, the undertaker will see that each carriage driver has his place assigned in the *cortège* and observes the directions given him.

The assistant stands ready to receive the casket and help the pall bearers in placing it properly in the hearse; he will also see that each carriage approaches in time and receives the occupants, as his employer may direct. Should the religious ceremonies be performed in the house of the deceased, his duties will end there until the cemetery is reached; should, however, the services be performed at some public place of worship, it will be his duty to precede the arrival of the procession, to see that everything is in readiness, to give timely warning to the sexton, and to assist in removing the casket from the hearse; also in

preserving order in the loading and unloading of carriages; while the undertaker takes the lead in the carrying of the remains into the church, and will see that the casket is laid up with proper care at the place appointed.

The undertaker is expected to occupy a position not far remote from the officiating clergyman, so as to be within hearing of the latter should it be necessary for him to request some service or make some inquiries.

The funeral services over, the undertaker is expected to lead the march out of the church, preceding the casket bearers, but following the minister, who, in many instances, will walk at the head as far as the door.

The assistant will be found ready to assist in placing the casket in the hearse, as before mentioned, and will also have the carriages move up in the right order, open and close the carriage doors, while the undertaker ushers the occupants into the vehicles.

The undertaker may also require the services of an assistant at the grave, but this will depend in great measure upon the nature of the funeral itself, whether it be of a certain magnitude, or if it be one of less importance.

This brief elucidation of the duties of an undertaker in the discharge of his functions is not given as a general rule to be strictly adhered to without any exception, but merely as a ground plan to work upon, and to be subject to different modifications, as circumstances may require.

One undisputable fact is, that in the general management of a funeral pageant, and for the better and more systematic working of the details, especially if the funeral is one on a large scale, the services of a well trained assistant will be found almost indispensable to the undertaker, and will be conducive of the happiest results in securing perfect system, dispatch; and also in preventing delays and mistakes, which might otherwise happen where the responsibility and the smooth working of the whole rests upon one man.

The laying out, washing, dressing, etc., of a corpse, under any and every circumstance, ought to be so systematized and arranged, that either the undertaker or his assistant may be able to perform these duties alone and singly, with ease and promptness, should circumstances so require.

As the undertaker is supposed to understand the wants required by different cases, it will be his duty, so soon as he is acquainted with the nature of the cause of death, to take such steps as his experience will suggest, as regards the safety of those who may trust him with the care of properly disposing of the remains.

Should the disease be of a contagious or infectious character, it will be incumbent upon the undertaker to see that perfect ventilation be established in the chamber where the body lies; that all cloths which are removed from the corpse be disposed of in a cautious manner; that the bed-clothes be either carried immediately out of the room and exposed outside

to the light and heat of the sun, or be burned up, if the character of the disease be so dangerous as to require it.

He will see that proper means of disinfecting the house be used, so as to a great extent neutralize, if not completely destroy, the germ of the epidemic.

A good preparation to combat noxious and poisonous miasma, besides the other disinfecting liquids which have been enumerated in previous chapters, consists of the following:

Nitrate of potash (saltpetre), -	6 ounces.
Water, - - - - -	2 quarts.
Sulphuric acid, - - - -	4 ounces.

Dissolve the nitrate of potash in the water. If the water be moderately warm it will dissolve quicker. For this purpose use a large *china* wash bowl (no metallic vessel), which must hold at least twice the amount of the solution, or about one gallon. When the solution is completed, gradually pour into it the sulphuric acid; it will effervesce, and care must be taken not to let any of it fall on the carpet, as it will not only destroy the color but also the texture of the fabric; the effervescence will, however, soon subside, and the foul effluvia of the room will soon lose its offensive odor.

This fumigation has been successfully employed in Southern cities, in times of severe epidemics.

Although it may be questioned by some whether or no these measures come within the sphere of the

undertaker's duties, it is by no means a reason why they should be discarded by our professionals, or why undertakers should not be familiar with all the means that will tend to enhance the success of the profession, as well as to promote the comfort and safety of those whom they may be called upon to serve; besides the credit they will receive from the family for their well directed efforts in securing their approval.

CHLORIDE OF LEAD AS A DEODORIZER AND DISINFECTANT.

Dr. R. H. Goolden calls attention in the *Lancet* to the value of chloride of lead, which he says is the most powerful deodorizer and disinfectant. To prepare it for use, he directs to take half a drachm of nitrate of lead, dissolve in a pint or more of boiling water; then dissolve two drachms of common salt in a bucket of water, and mix the two solutions together; allow the sediment to subside.

The clear supernatant fluid will be a solution of chloride of lead. A cloth dipped in this solution and hung up in a room will sweeten a fetid atmosphere instantaneously; or if the solution be sprinkled over the bed-clothes or clothing of a fast decomposing body, it will produce a like result.

Even the tarnishing of gold and silver ornaments may be prevented, by a rag dipped in the solution being hung up in the room or window where they are exposed.

He relates some striking instances of the instantaneous and efficient action of this preparation.

DANGERS OF ABSORPTION OF CARBOLIC ACID.

Undertakers and others using carbolic acid to some extent should always use extreme caution in the handling of it.

The carelessness with which certain papers take up some popular recipe is not always without its dangers. For instance, there appeared lately in some public print an article upon the poison of vipers, which is very similar to that of the virus from a putrefying corpse; the article recommended that carbolic acid should be immediately introduced into the wound, the acid to be mixed with alcohol in the proportion of two to one. Observe the off-hand manner with which a toxic agent is spoken of, as if it were the most inoffensive thing in the world.

In order to try the experiment, a cat was selected, upon whose skin, denuded of hair alone, a saturated solution of carbolic acid in alcohol, with an equal quantity of water, was rubbed; this produced no effect; but when the same solution was rubbed into a scratch upon the end of the nose two or three times, the animal fell immediately into convulsions and very shortly succumbed. Prussic acid could not have acted more promptly. The moral of this experiment is obvious.

DISINFECTANTS.

Dr. Baxter has executed a great number of very careful experiments, with a view to testing the different disinfecting properties of the so-called disinfectants commonly used. Evidence was adduced to show that carbolic acid, sulphur, permanganate of potash and chlorine are all endowed with true disinfectant properties, though in very varying degrees. The effectual disinfectant operation of chlorine and permanganate of potash appeared to depend far more on the nature of the medium through which the particles of infective matter are distributed than on the specific character of the particles themselves.

A virulent liquid cannot be regarded as certainly and completely disinfected by sulphur, unless it has been rendered permanently and thoroughly acid. No virulent liquid can be considered disinfected by carbolic acid, unless it contains at least two per cent., by weight, of the pure acid.

When disinfectants are mixed with a liquid, it is very important to make sure that they are thoroughly incorporated with it, and that no solid matters capable of shielding contagion from immediate contact with its destroyer be overlooked.

Aerial disinfection, as commonly practised in the sick room, is either useless or positively objectionable, owing to the false sense of security it is calculated to produce.

To make the air of a room smell strongly of carbolic acid, by scattering carbolic powder about the

floor, or of chlorine, by placing a tray of chloride of lime in a corner, is, so far as the specific destruction of contagion is concerned, an utterly futile proceeding.

The practical result of these experiments goes to prove, first, that dry heat, when it can be applied, is probably the most perfect of all disinfectants; second, that the old plan of stopping up crevices and fumigating with sulphur and charcoal is more efficacious than any other proceeding with more modern disinfectants; third, that the use of carbolic vapor for disinfecting purposes should be abandoned, owing to the relative feebleness and uncertainty of its action.

A RELIABLE SIGN OF DEATH.

This sign consists in the absence of contraction of the pupil, after puncture of the cornea and evacuation of the aqueous humor. When the pupil contracts, life is still present; when it remains immovable, it is a certain sign of death. The puncture of the cornea may be made with a cataract knife, or even an ordinary lancet. It is a harmless operation.

RAPID DECAY OF THE HUMAN STRUCTURE.

UNDER this heading, we will present to our readers an essay upon the causes of the dissolution of the human body. The writer, Mr. W. W. Ball, of Bangor, Michigan, who published the following in The Casket of March, 1877, has kindly allowed us to republish it, for the benefit of those who have not read it, and also as a proof that the theories advanced in this volume cannot be refuted. We give the article at length. The statements advanced in the essay, also the course of treatment adopted in the preservation of bodies, will be found to possess great similarity with the different methods herein given.

By W. W. Ball.

As soon as the vital action ceases, decomposition ensues in the substances which were before the very elements of life, viz: blood, lymph, chyme, chyle and gastric juice, become active agents in its destruction.

In the blood, the most important agent during life, as soon as life ceases it becomes one of the first to produce that blackened, putrid and sloughing condition we find shortly after death. The blood being

left in every part of the body, it breaks up and forms new compounds, of which only a general outline is attainable, for want of definite chemical analysis or microscopical observation. The fibrine and serum separate; the former, which contains most of the red corpuscles, albumen, saline and fatty substances, glutinates or coagulates on the sides of the vessels themselves, while the serum permeates the surrounding tissues, uniting with oxygen carried off from the pulmonary structure during life, and these, having an affinity for the tissues, form those compounds termed sulphuretted and carburetted hydrogen gases, giving rise to that effluvium which characterize deceased bodies.

CONDITION OF THE BLOOD.

After death the blood is found in two forms. This is owing to certain diseases and circumstances. The first is encountered when death has ensued after a long stage of sickness. The vital fluids become exhausted by disease, and the organs of circulation become too weak to perform their office of circulating the fluid they contain; hence, dissolution takes place in the blood from want of constant and rapid action. Thus the fibrine becomes lodged and coagulated in the veins and capillary system. The fibrine and serum separate, leaving the fibrine coagulated or clotted, and the serum, a transparent, fatty or oily liquid, permeates the tissues of the flesh. Usually the arteries are found without any blood remaining in

them. In instances of this kind there will be no difficulty encountered from the corpse turning black, as the gases cannot force the blood to the surface into the capillary system, because the fibrine is lodged elsewhere, but the flesh may turn brown or saffron color to some extent.

DIFFICULT CASES.

The second condition of the blood is found when death resulted from accident or short duration of sickness. In these instances there is usually a large abundance of fluids remaining in the system. These foster fermentation in every structure, and evolve the gases so rapidly as to cause the cavities of the thorax and abdomen to become extended to their utmost capacity with gases that induce the blood to leave the vessels in the thorax and appear at the surface in the capillary system. In this instance the fibrine and serum of the blood remain together in an inky or eccymosed condition.

Thus it is observed that the gases are so rapidly evolved by the destructive fluids, that before the fibrine coagulates it is forced from the vessels of the thorax (especially the superior vena cava), and caused to appear above the surface into the neck and face. The great pressure of the gases depresses the vessels of th thorax in the same manner that it does the stomach when purging takes place, which occurs invariably whenever the stomach contains any movable matter. The lymph, chyle and chyme, which are the same or

similar, as soon as death ensues take on new molecular changes; the lymph especially, which is retained in all the glands and vessels of the lymphatic system, enters into the process of decomposition, fostering putrefaction in the whole structure; while the gastric juice, a peculiar fluid so subservient to digestion, which affects the food only during life, immediately attacks the substances of the stomach when life is extinct, in the same or similar manner as it affected the food during life, corroding and completely destroying everything with which it comes in contact, as there is no vitality to resist its action. Elements having other affinities, and the organism generally, hurry back to their primeval state. Nature knows no delays. The work to be done is to disorganize the body and destroy its form. This is the work of heat, moisture, air and germs in unison, causing the fluids and tissues of the body to decay rapidly, while the albumenoid matters are decomposed into fetid gases escaping into the air, which in a short time accomplish the work of dissolution, leaving the body a mass of corruption and the receptacle of myriads of germs of microscopic beings. The corpse is their natural aliment, and death their chosen laboratory.

The products of putrefying animal matter are carbonic acid, water, ammonia and carburetted hydrogen gases, which are generally mixed with various portions of phosphuretted and sulphuretted hydrogen gases. The blackened or mortified appearance in those instances is usually caused by the eccymosed or dark

blood from the vessels of the thorax (especially the superior vena cava). The great pressure of the gases in the abdomen and thorax prevents the liquid from gravitating to the regions of the heart and large vessels, producing the black and livid appearance of the face and neck by its retention in the capillary system of the epidermis. Man has been facetiously described as twelve pounds of solid matter wet up with six pails of water; hence, the great abundance of water in the human structure gives the necessary mobility for putrefaction. This is proven by this fact: that by drying the animal substances they are completely preserved. It is thus that the bodies of those perishing in the Arabian deserts are recovered years subsequently, dried, but otherwise fresh and life-like. This fact also proves that the atmosphere and climate in Asia is far more favorable for the preservation of animal substances than in this country, and the writer thinks it has far more to do in preserving the many thousand mummies of the ancient Egyptians than any art or untold science. If it were not for want of space, I would dwell more upon this subject; but as the public generally have no desire to be wafted into untold centuries, I shall confine this writing to further the progress of science in this direction, if possible. Having no secret nostrum to impose upon the public, I will offer a few hints which I hope will prove to be of importance to the profession generally.

EMBALMING PROCESSES.

For chemical embalming, it is well known to those having experience as undertakers and embalmers, that in order to successfully perform this kind of work, it requires knowledge as well as experience. The various circumstances encountered necessarily govern the work. In the writer's experience, he finds that when difficult and obstinate cases are to be retained for some length of time (especially in warm weather), it will be necessary to complete the work with care. A very important matter in this work is to renovate the stomach thoroughly; then, with simple instruments, similar to an aspirator needle or trocar, give vent to the gases and thus expel them from the cavities of the system. Then, with pump, draw off or force out the fluids and gases from the organs of circulation, and in this manner disinfect the body as far as possible. Elevate the head and shoulders for the purpose of letting the inky fluid gravitate from the capillary system of the face to the large vessels of the thorax. This will renew the life's characteristics in a remarkable and satisfactory manner, if the gases be properly removed.

A simple method of disposing of the gastric juice of the stomach is to inject into the nose or mouth one or two ounces of an aqueous solution of any powerful antiseptic, similar to those mentioned in this article, and after a few moments carry the head off the bed, and, by gently pressing the stomach, empty its contents. This will prevent further difficulty from purg-

ing, if refilled with the solution and carefully sealed. Insert an instrument into the trachea, and thus give vent to the gases in the lungs, and inject full of the solution. In the same manner dispose of the gases from the thorax, and fill with solution. Also, the abdominal cavities, by completing thus, will preserve the viscera. The reagents or coagulants spoken of render the albumenoids or azotized material incapable of putrefaction, by the impervious nature of the compounds it forms of all substances that have proteïn for their base, as the tissues readily absorb the preserving solutions after being prepared as mentioned above. This unites the antiseptic and deodorizing agent with the very substances that it is necessary to render inactive in order to successfully retain the remains of deceased persons.

DEODORIZING AGENTS.

The following are very good antiseptics and deodorizing agents: Chloride of zinc, corrosive sublimate, hyposulphite, oxymuriate of mercury, carbolic acid, bicarbonate of potassa, aqueous solution of alumina. The two latter may be rendered more subservient by combining them with the higher oxides. The metallic salts are much the best for chemical embalming, if properly used. The remains of drowned persons may be prepared in the manner as above, with no small degree of success, as giving vent to the gases and freely applying antiseptics and deodorizing agents

will readily correct, to a great extent, the difficulties thus encountered by this process. We have removed the most destructive fluids, or effected a combination with them, thus preventing the fermenting process and dispersing the gases, rendering the body absolutely free from those disagreeable and noxious odors which are termed phosphuretted and sulphuretted hydrogen gases, as well as low types or germs of disease, while the life's characteristics in this state of preservation invariably present a most pleasant appearance, allaying all natural repugnance to the dead, as they seem so natural and life-like, and remain in this state of preservation for a great length of time, either in transit or various changes of atmosphere, while this manner of operation is simple and without complication, affording appropriate means that undertakers may apply successfully and save themselves annoyance, time, labor and expense, by a little practice and observing closely the directions herein given.

The enlightenment of the public demands more attention to these important matters, as there is no necessity for the untimely and indecent burial of the loved but unfortunate victims of mortality, when due observance is given to the progress of art in modern science. To successfully retain the dead for such a period of time as will enable the bereaved friends to make such arrangements for burial as the occasion may require, without the necessity of mutilating or eviscerating in the horrible manner that has been practised in many instances, has been the design of

the writer, who has devoted much time in the work, and hopes, with the aid of others, in the no distant future, to make such additional suggestions and contributions as will practically apply to the wants of the profession, as well as meet the approbation of a grateful public.

Scientific research has defined and established those fixed laws of nature with that precision whereby organic matters may be traced to their simple elements. We will herein endeavor to very briefly trace, as far as possible, the chemical changes that are observed in dead animal matter. We assert that in the majority of cases (with a given temperature maintained), the first described subject will be the first to become an uncontrollable mass from the agents of putrefaction ; first, simply by the abundance of those fluids contained in subjects that immediately become active agents of dissolution, while such agents have been completely exhausted by the disease of the second.

The apparent healthy condition of the flesh after death is produced by the favorable temperature that is maintained, dryness of the atmosphere, etc., together with the general favorable conditions of the subject, which will render the preservation of such remains quite perfect, in some instances for a surprisingly long time. It is shown that disease of long standing completely exhausts the vital fluids before death, especially when the functions of the body have failed to produce the necessary nutrition. Thus it will be observed that the process of decomposition is

very different than when the system is full of albumenoids and watery fluids, notwithstanding the tissues may have been seized upon by putridity before death. With consumptives, the disease reduces the flesh to dry parchment, or nearly so, leaving but a very small portion of water in the system. Hence, as putrefaction is impossible in the absence of moisture, and the active agent, albumen, equally reduced, decomposition of such substances that remain ensues only by a process of decay, slow combustion or oxidation, the slowly uniting of oxygen with the substance. In this the constituent parts of the animal tissues break up into simpler compounds by the chemical changes that nature produces, and differs from other forms of putrefaction only by the length of time employed. In cases like typhoid fever, the flesh, after death, assumes more of a putrid and sloughing condition, as the fluids are not so completely exhausted as in the former disease, thus leaving more of the active agents in the body for its immediate destruction.

When death is the result of a putrid malady, putrefaction begins almost immediately when the body grows cold; its effects are noticeable much sooner when the atmosphere is warm. In general, in our climate, the work of decomposition becomes evident after from thirty-five to forty hours. Its first effects are noticeable on the skin of the stomach; this takes on a greenish discoloration, which soon spreads and covers the whole surface of the body; at the same

time everything is seized upon by what is termed putridity; the moist parts soften and decay; little by little the flesh sinks and grows watery, and is thus carried away or burned up by the air's oxygen.

And now, dear reader, we would impress your mind with the fact that the moment of the appearance of putrefaction absolutely varies with the degree of outward temperature, the causes of death, and the general condition of the remains, and just in accordance to the quantity of fluids remaining in the system. The degree of difficulty in retaining the life's characteristics are encountered, first, because of the albumenoids, the active agents of putrefaction; second, the large per cent. of water they contain; hence we have the necessary mobility of putrefaction, and the very substances that are most prone to the active ferments, united with the agents of disorganization, vibrois and bacteria, or rather the germs of those thread-like corpuscles which penetrate the skin and wind their way through the ducts into the vessels of circulation, which seem to conduct the rabid element to every structure. The living germs that collect on the surface of the body and in the digestive canal, develope, multiply, pierce into all the points of the organism, and produce in it a complete separation of all the tissues and humors.

When persons have been killed suddenly, there being no disease to tamper with the functions of the body, the process of nutrition would be complete until the very moment the vitality is removed; hence

the supply of fuel for this fire of dissolution. The corruption of these animal matters is not more possible than the fermentive action of gluten in grape juice, and precisely the same. When these animal matters maintain a high temperature, the products formed are said to be destructive distillation.

Many cases are recorded of similar stages of decomposition, which is an apparent spontaneous combustion, renewing the normal temperature of life, many times giving flushness to the cheeks, and thus appearing to have life renewed, notwithstanding the body had been cold for many hours previous to this phenomenon taking place, the result of a peculiar chemical action. But these instances seldom or never occur, while the difficulty encountered is in completely reducing the heat from the bodies of those persons killed by accident, which fact renders the successful preservation of such remains for any length of time utterly impossible, as the fetid gases are evolved in such great abundance as to literally cook the flesh and escape into the air. Developed in the cadaverous odor, a pungent and ammoniacal stench, except there be prompt application of some powerful chemical reagent, with which the organized material may enter into combination and thus overcome the delivellant tendencies of the affinities of its elements. If ice is used and the temperature of the body reduced below 32°, the water in the system is frozen, which acts as if the tissues had been dried, and putrefaction is thus arrested for such time as the proper temperature is maintained.

PRACTICES WHICH MUST BE ABOLISHED.

SOME usages which seem to be sanctioned by long practice, but not by any remarkable amount of good judgment, ought to be discountenanced and done away with, simply upon the ground that these acts conflict directly with all sanitary laws, and to a great extent endanger the lives of the persons who may be present. Still, these repeated transgressions upon the common precautionary measures against contagion are not the result of a desire to do wrong, neither do they always arise from sheer ignorance, but they are almost always caused by an utter disregard of even the simplest prudence.

For instance, how often, where a child has succumbed to the attack of some infectious disease, like scarlet fever, diphtheria, etc., how often will parents, regardless of the contagious character of the disease, insist upon kissing the pallid lips of the corpse, and, moreover, invite other children to follow the same dangerous practice.

And again, another prolific source of disease lies in the fact that funeral services will be conducted in a close, warm, ill ventilated room, crowded with a sym-

pathizing audience, in close proximity to a corpse emitting foul and infectious effluvia, and inhaling these into the system. It is true that these same noxious gases may not always be detected by the smell, as the floral ornamentations, the crowded state of the room, etc., all tend to disguise any unpleasant odors; but the germ of contagion is still there and actively at work.

It is a fact, patent and undeniable, that carelessness in the keeping and disposing of bodies is an act of guilty neglect, and the sooner the community be made acquainted with the danger attending such practices as those above spoken of, the better it will be for the enforcement of those sanitary measures which are necessary in every well regulated city or town.

We have already spoken of dangers to be encountered in the handling of bodies, but the subject is of so much importance to undertakers, and concerns the profession so closely, that it may not be amiss here to renew our former cautions, also to add a few more suggestions, so as to modify the danger thereof, even if it cannot be completely eradicated.

DANGERS ARISING FROM HANDLING THE DEAD.

To those who, like physicians, students and nurses, are almost constantly thrown into direct contact with every form of epidemic, contagious and infectious

diseases, the dangers arising therefrom are considerable. But undertakers are exposed to a still greater risk, namely: that of handling the remains of those who have died from the effects of those same diseases. Not only do they have to guard against the infectious character of the contagion, but they have also to protect themselves against the malignant effluvia which emanates from the victims of the contagion after disintegration of the body has taken place, the nauseous and sickening gases which are generated by decay, and the deadly virus which may be innoculated into the system, either through some puncture or abrasion of the skin; the virulent effects of the poison may be carried carelessly to the mouth, the nose or the eyes by a thoughtless action. Too much care cannot be exercised by undertakers in handling a corpse, especially if the subject is known to be afflicted with some infectious or malignant complaint.

Still, the precautions generally in use among undertakers, and the different preparations that are commonly recommended as preventives, are useless in most cases, as there are conditions of the system which will increase the danger, and in some instances leave it open to the insidious attacks of disease and contagion. Too much importance has been attached, so far, by undertakers, to the artificial means devised by some, under the names of preservatives, antidotes, etc., etc. The reliance placed on them, in a great many cases, has proved futile, and although some possess real and undisputed merit, they proved inef-

fectual when the system has been influenced by the following

CONDITIONS OF THE SYSTEM,

which will increase the danger of contagion:

Fear.—Almost in every case, if a person is brought in sudden contact with the remains of one who has died of either cholera, small pox, yellow fever, or any of those terrible epidemic and contagious diseases which will in a few weeks decimate a populous city, the feeling will be one of repulsive horror; in some this feeling will amount to absolute fear, which will show itself in the dilated pupil, the bleached countenance, and the momentous forebodings which assail the mind and predispose the system to the attacks of the disease. In this case, the mind influences the body to such an extent that the disease has already fastened itself upon the system, before the first symptoms are felt.

Another and potent cause of danger is that which proceeds from a debilitated condition of the system, the causes of which are numerous: over-exertion of either the body or the mind; labor carried on incessantly without due regard to relaxation; imperfect nutrition, or long fast, are all causes which will tend to render the system more vulnerable to the aggressions of sickness.

But the most pernicious and fatal of all mistakes, is that of using stimulants to ward off the effects of contagion. How many of our professionals and their

assistants have given way to the use of ardent spirits, under the delusion that it was absolutely necessary, to avoid the noxious effects of infectious diseases. It is a well authenticated fact, and one worthy of notice, that persons who generally indulge in the use of spirituous liquors, even in a moderate quantity, are those who are first attacked by epidemic or contagious diseases, and who almost always fall victims to it. Take, for instance, the case of a surgeon about to perform a dangerous operation. His first inquiry will be about the habits of the patient; he knows well enough that a man addicted to drink will not bear up under the trial.

The only means we have to protect ourselves from the dangers of infection from dead bodies are, first, a perfect ventilation of the room where the remains lie, so as to obviate the bad tendency which the air of the death-chamber might have upon the system. Attention must also be paid to the diet; the food eaten should be generous and nutritious, and it is proper to take a *small quantity* of wine at a time when the body and mind are debilitated by long and exhaustive manipulation of the dead, but avoid all excess of fluids or solids. *Temperance is strictly necessary.*

Wounds received while handling a corpse should not be neglected; if a simple abrasion, it should be covered; if pricked, the liquid muriate of ammonia or caustic potass are recommended to be applied as cauteries. These are the early measures to be pursued; but after absorption has taken place, a different

course must be practised, and a good physician consulted without delay. The garments ordinarily worn should never be brought into direct contact with the remains of a person tainted with some infectious disease.

But it is to the hands we must pay particular attention. Gangrenous or syphilitic sores may be found on a subject, in which case extreme caution must be exerted; the hands should be first well rubbed with lard or sweet oil mixed with carbolate of camphor, and thoroughly washed after the handling of the body is over; then the hands should be well soaked in chlorinated soda (Labarraque solution), as the disinfecting properties of chlorine will be found here particularly useful.

If the above suggestions are faithfully followed, they will be found to greatly diminish the dangers attending the handling of the dead—dangers which can never be entirely avoided.

MANAGEMENT AND DISCIPLINE

OF AN UNDERTAKING ESTABLISHMENT.

MUCH of the success of an undertaking establishment will be dependent, not only upon the head of the firm himself, but also upon the discipline maintained among those to whom the details of the business are entrusted; and the difficulties surrounding proper management will increase as it extends and involves the employment of more numerous operatives, unless the general duties of all are specifically laid down, and the particular duties of each well defined and insisted upon.

The rules which follow were prepared by a gentleman of considerable experience and unusual success in business; they were designed for a store employing three assistants.

Although, of course, they require modifications to suit the circumstances of different establishments, their general tenor is adapted to all, and the high tone of professional and moral aptitude they require renders them worthy the acceptance of every assistant who would deserve the approval of his employer, and of every employer who desires the best interests of his assistants.

SPECIFIC DUTIES OF THE FIRST ASSISTANT.

1st.—To see that the specific duties of the other assistants are promptly and well performed.

2d.—To attend to mail orders from dealers in the country; select the goods to be packed up and sent out; to wait on customers, etc., that the two other assistants may not be hindered in the performance of their duties.

3d.—He is to attend to the laying out of bodies; and in the absence of the proprietor, or if the pressure of business should require it, he is to take charge of the funerals, with the assistance of the second assistant.

4th.—In case of the absence of either of his juniors, to take the place of the second assistant.

5th.—He is to take charge of the books, collections, etc., should the proprietor wish him to do so.

6th.—He is to take knowledge of and properly note any articles that may be needed for the store, including goods to be purchased and work to be attended to.

7th.—To see that the stock of goods is well supplied with those items which are generally kept by the quantity. Should the place of business be remote from any manufacturing firm of undertakers' goods, such as coffins, hardware, caskets, etc., he is to keep a faithful and strict account of the sizes, styles and grades of caskets and coffins on hand, as also of the

needful requirements in that line; he should also call the attention of the proprietor to the quality, style, etc., of the goods needed, and place in the hands of his employer a list of the goods to be ordered, or likely to be called for.

8th.—To keep a note book of what is necessary to be done in the ordinary business of the store, and to designate employment for the other assistants.

9th.—He is to superintend, and if need be to help, in the lining and trimming of coffins, and, in the absence of the proprietor, to attend to the embalming and preserving of bodies.

10th.—In short, he must, during the absence of the proprietor, take entire charge of the store, and be alone responsible for its business.

SPECIFIC DUTIES OF THE SECOND ASSISTANT.

1st.—It will be his duty to dust the cases, desks, etc., thoroughly every morning. This service must be performed before breakfast, and as often repeated through the day as necessary.

2d.—In the absence of the third assistant, he is to perform his duties.

3d.—He shall assist the proprietor, or the first assistant, in the laying out, washing and dressing of bodies; and also at funerals, in the management of the hearse and carriages.

4th.—He is to trim caskets according to the directions of the first assistant, and follow the instructions

given him as to the choice of materials used in their ornamentation.

5th.—He shall see that a sample of each size, style and grade of coffin and casket be always on hand in the show room, and ready to be turned out in the shortest space of time possible.

6th.—He is to keep an exact record, in the book devoted to that purpose, of the name, residence, cause of death, age and place of burial, of all parties which may have been interred by the firm. This register must always be posted up to date.

7th.—It will be his duty to clean the show cases, work room, and the stock in general, once a week, and oftener if necessary.

SPECIFIC DUTIES OF THE THIRD ASSISTANT.

1st.—He is to open the store in the morning; make the fire, and attend to it through the day; sweep out the store; wash the windows; and see that all tools and implements are in their proper place and ready for instant use.

2d.—It shall be his duty to keep cooling boards clean and tidy; to have palls, stools and pedestals dusted and in shape.

3d.—It shall be his duty to pack goods and make boxes when required.

4th.—It will be required of him to do such errands as the business of the store may demand, and also to close the store at night.

GENERAL REGULATIONS OF THE STORE.

1st.—Business hours will include the time between breakfast and six o'clock, P. M., except when special duty may require it otherwise.

2d.—During business hours, all hands must be employed at some regular store duty.

3d.—As waiting on customers is a duty which requires most knowledge and experience, the first assistant must always serve when there is one customer; the other assistants may help if need be.

4th.—The first assistant must always take that part of the duty which requires most knowledge and skill. This order of duty must never be deviated from, if circumstances will admit of it.

5th.—All other duty must give way to that of waiting on customers.

6th.—Every person entering the store, whether pauper or president, infant or adult, white or colored, must be treated with courtesy and kindness.

7th.—Boisterous mirth and a sullen temper are to be equally avoided, as productive of neither business nor business character. The acquisition of a uniformly cheerful temperament is an attainment worth far beyond the price it usually costs.

8th.—There are to be no masters and no servants. Each one is to feel conscious of the fact that the performance of the duties assigned to him is just as necessary and as important as what pertains to any other hand in the store. All useful employment is honorable; indolence is a disgrace.

9th.—An afternoon of every week will be devoted to the cleaning of the store, in which all must share as occasion offers.

10th.—As neatness, order and cleanliness are necessary, and not mere accomplishments, in an undertaking establishment, all are required to practice them constantly.

11th.—Assistants should be rather select in the choice of their acquaintances; while the occasional visit of a well behaved friend will be countenanced, lounging in the store will not be tolerated.

12th.—Each assistant shall have, if business permits, one afternoon and evening every week, and every other Sunday; the afternoon will comprise the time between twelve o'clock at noon and six o'clock P. M.; the evening, between six o'clock P. M. and the closing of the store. These privileges must not be interfered with unnecessarily.

13th.—No assistant residing in the house will be allowed to be absent at night after the closing of the store, without special permission.

14th.—A vacation of two weeks every year will be allowed each assistant.

15th.—It is not the wish of the proprietor that any of his employes should extol the goods beyond their merits to advance his pecuniary interests, or to say or do aught in the performance of his duties that he would not be willing that others should say or do to him under the same circumstances.

A cheerful compliance with the foregoing rules is

confidently expected, and the repeated infraction of a regulation of the store will be cause for dismissal.

In certain establishments, where a driver is kept for the purpose of taking care of horses and driving the hearse or other vehicles, this employe shall be under the immediate supervision of the proprietor.

MODIFICATIONS IN THE MODE OF EMBALMING BODIES.

THERE are modifications in the processes used for the preservation of bodies, which are governed by circumstances affecting the different conditions of the body at the time of death. Although we may lay general rules for the quantity and variety of antiseptics used in embalming, there are certain cases where the quantity of the chemicals which enter into the composition of the injecting fluid must be either increased or curtailed, as well as the amount of the injection.

It would require the scope of a cyclopedia to give in detail the proportions of each constituent in the number of different cases which may come under the notice of the embalmer.

The mode of operation in all cases may be the same, but the nature and quantity of the injection will vary, first, with the climatic circumstances of the atmosphere; second, with the cause of death; third, with the age of the deceased; fourth, with the state of the body after death; fifth, with the length of time which has elapsed since death took place.

It has been demonstrated in a previous chapter that a high temperature is conducive to rapid decom-

position of organic matter, also that a warm, moist atmosphere will operate in the same manner; it is therefore incumbent upon the operator to guard against these two agents of putrefaction by keeping the body in a moderately cool and well ventilated place until the work of preserving is accomplished; also to give the antiseptics employed time to successfully destroy and render harmless the dangerous effects of the heat.

It must not be understood by the preceding caution that a body cannot be embalmed in an ordinary room during the heat of the summer, but the suggestion herein given is solely for the purpose of facilitating the operation and rendering the success certain; besides, as it has been illustrated in some of the processes precedingly given, the strength as well as the quantity of the injection have been increased when used during the warm season.

As to the modifications to be observed in the treatment of bodies, when the cause of death is taken into consideration. It has formed the subject of some chapters to show that, in cases where death is the result of a certain class of diseases, the body is more prone to putrefy than in others; whilst in other cases, again, the body is to a certain extent preserved from corruption by the agents which have proved fatal to the organism; as, for instance, when death has been the result of poisoning, either by alcohol or arsenic.

The age of the person deceased, and the condition

of the body after death, as also the length of time elapsed since death took place, as affecting the mode of treatment, have all been discussed in a former part of this work, and it would hardly be necessary to have a new elucidation upon the same subject.

The important point we wish to impress now upon the minds of our professionals is, that circumstances in this case are to be strictly investigated; also, that a uniform treatment of all cases, however different the circumstances and conditions, will not prove successful; and that a thorough knowledge and experience are necessary to achieve satisfactory results.

Discrimination and judgment are to be used in every case. Some are too ready to condemn a certain process, or to question the properties of some antiseptics, because their first trial of either has proved an ignominious failure; whereas the real cause of all the trouble lies in their ignorance of the laws which govern the mode of proceeding, and the use of the chemicals placed at their disposition.

Others, again, are prone to extol the merits of some preparation, the component parts of which they do not know, but it may have done them good service in several instances; and when, contrary to their expectations, it fails to answer the purpose, they lose faith in it, discard it altogether as worthless, and never entertain the idea that an alteration in the quantity used, or in the combination and strength of the constituents, is the real source of mischief.

Hence, it is a fact not to be denied that a diagnosis

(if it may be called so) is necessary before the work of embalming be entered into. And he who would endeavor to preserve the body of a stout, fleshy person by the same means employed in the preserving of a body emaciated by long sufferings, and under different conditions of temperature, might not meet with a success equal to his expectations.

CHLORINE:

ITS PROPERTIES AND USES.

CHLORINATED LIME.—In consequence of its powers as a disinfectant, chlorinated lime is a very important compound in its application to medical police; it possesses the property of arresting or preventing animal or vegetable putrefaction, and perhaps of destroying pestilential and infectious miasma. It is used with advantage in preventing bodies from exhaling an unpleasant odor before interment in the summer season. In juridical exhumations its use is indispensable, as it effectually removes the disgusting and insupportable fetor of the corpse.

The mode in which it is applied in these cases is, to envelope the body in a sheet completely wet with a solution made by adding about one pound of the chloride to a bucketful of water. It is employed also for disinfecting dissecting rooms, vaults, cemeteries and other places, which exhale offensive effluvia.

In destroying contagion and infection it appears to be highly useful. In short, all places deemed infectious from having been the receptacle of virulent disease may be more or less disinfected by its use, after having undergone the ordinary process of cleansing.

Chlorinated lime acts exclusively by its chlorine, which, being loosely combined, is disengaged by the slightest affinities. All acids, even the carbonic, disengage it; and as this acid is a product of animal and vegetable decomposition, noxious effluvia furnish the means, to a certain extent, of their own disinfection. But the stronger acids disengage it more freely, and amongst these sulphuric acid is the most convenient. Accordingly, the powder may be dissolved in a very dilute solution of this acid; or a small quantity of the acid may be added to an aqueous solution already formed, if a more copious evolution of chlorine be desired than that which takes place from the mere action of the carbonic acid of the atmosphere.

The great and only objection, so far, against the use of chlorinated lime by the profession, has been the strong smell of the chlorine evolved; but taking into consideration the great antiseptic properties, and also the strong bleaching and disinfecting qualities of the chlorine, we find that it cannot be overlooked as an agent of major importance in the preservation of bodies.

There are certain modes of using the chlorinated lime whereby the offensive odor can be to a great extent diminished, if not altogether done away with. When used in its crude state, it will be found difficult to handle; besides, it could not be used for the purpose of an injection; it needs, then, a certain amount of preparation before it be used in a liquid

form. The following has been given as the simplest manner of preparing it for injecting:

Take, of chlorinated lime, one pound, carbonate of soda, two pounds, water, one gallon; dissolve the carbonate of soda in three pints of water by the aid of heat; to the remainder of the water add, by small portions at a time, the chlorinated lime, previously well triturated, stirring the mixture after each addition. Set the mixture by for several hours, that the dregs may subside; then decant the clear liquor, and mix it with the solution of carbonate of soda. Lastly, decant the clear liquor from the precipitated carbonate of lime, pass it through a linen cloth, and keep it in bottles secluded from the light.

The London *Pharmacopœia* gives a still better process for preparing it, for reasons which will be given hereafter:

Take, of carbonate of soda, one pound, water, forty-eight fluid ounces, chloride of sodium (common salt), four ounces, black oxide of manganese, three ounces, sulphuric acid, two fluid ounces and a half; dissolve the carbonate of soda in two pints of water; then put the chloride of sodium and the binoxide or black oxide of manganese, rubbed to powder, in a retort, and add to them the acid, previously mixed with three fluid ounces of water, and cooled. Heat the mixture, and pass the chlorine first through five fluid ounces of water, and afterwards into the solution of the carbonate above directed. Upon the addition of muriatic acid, both these solutions emit carbonic acid and chlorine together.

The foregoing given preparation will be found to answer the purpose for disinfecting, injecting and preserving corpses. For injecting purposes, the solution should be used fresh, and the muriatic acid only added to it, for a more copious liberation of both carbonic acid and chlorine, when ready to inject the liquid, as the antiseptic properties of the solution depend altogether on its gaseous evolutions.

To inject the solution, it will be found that the axillary artery on the left side is a good point; also, the right jugular vein should be punctured, so as to facilitate the flow of blood from the head. But to make the operation complete, and to be sure of a perfect and thorough injection, the ascending aorta should be injected, and the inferior vena cava severed at a corresponding point. This mode of injecting has been described in a former chapter.

It is not possible to specify here the amount of liquid to be injected; but as a general rule there should be enough of the solution injected to fill the circulatory system, and the injection be continued until after the blood has ceased to flow from the wound in the vena cava and the injecting fluid appears in its place.

When injected with this solution, a corpse may present for a few hours afterwards a bloated and swollen appearance, and the face and body may be marbled over with white spots; but these symptoms will soon disappear, the body will collapse again to its normal size, and the color become of a uniform shade.

To preserve bodies during the summer season for a few days and without ice; also to prevent the swelling up of the abdomen and the purging at the mouth and nostrils, open the stomach, as explained in a previous chapter, empty out the contents, and inject into it some of the above solution; the bowels must be treated in the same manner, and also inject the lungs through the nostrils, by producing artificial respiration. If the liquid cannot be injected in this manner, cut into the trachea an incision large enough to admit of the nozzle of the injector being inserted, and pour in the necessary quantity.

If any fetor is exhaled from the corpse after being placed in the coffin, a sponge well saturated with the solution and being placed at the feet of the corpse will remove all foul effluvia; or better still, a china or porcelain bowl filled with the solution may be placed inside the case until a few minutes before the funeral and the screwing down of the lid.

The air of the room may also be purified by saturating some cloths with the solution and hanging them in different parts of the apartment. The vessels containing excretions should not be neglected, and some of the solution poured into them.

In fact, undertakers will find the above solution to be adapted to all purposes of disinfecting, deodorizing and preserving corpses.

INSTRUMENTS.

UNDERTAKERS will find it to their advantage to possess instruments of the best materials and make; they are always cheaper in the end, as they will resist the wear and tear to a greater extent, and will not be liable to get out of order when most needed.

Especially in injecting apparatus should a great amount of care be exercised about the selection. The greatest danger to be guarded against is corrosion, as all injecting fluids which are now in use contain more or less of either acids or metallic salts, all of which will attack and corrode, to a lesser or greater extent, the metals and other substances with which they come in direct contact.

Any injector, therefore, so constructed as to be free from danger to its mechanism from the corroding effects of the liquids above mentioned, will be the one to be chosen. According to the statements above given, any part of an apparatus which is required to operate with a certain degree of nicety must be kept from the corrosive effects of the fluids, and this result is to be gained only by the peculiar construction of the apparatus.

In the greater part of the injecting pumps now

manufactured and in use in this country, the body of the pump, which contains the working part of the apparatus, is also filled with the liquid while in use; and, therefore, this part, which ought to be protected from injury, is constantly immersed in the strong corrosive solution during all the time that the injector is being worked.

The result of this constant corroding action upon the apparatus will soon show itself in the working of it, and constant repairs will be found necessary to keep it in order or in a state of comparative effectiveness.

It must be well remembered, that upon the working of the apparatus depends, to a great extent, the good or poor success of embalming; also, that upon the manner of using an apparatus, of whatever description it may be, the length of its duration and its effectiveness will be in the same ratio.

The automatic apparatus of Girard, for injecting purposes, is a marvel of simplicity and durability; there is no piston or force pump, which is liable at any moment to get out of order; no valves, which will wear out by friction, or leak from the effects of the liquid used.

The force used in ejecting the fluid is that of a gas, highly antiseptic in its nature, and which, being generated insdie of a cylinder, saturates the injecting fluid (itself an antiseptic solution), and by its expansive force propels it into the arteries of the body.

All the appliances necessary to the perfect working

of the apparatus are condensed into a small compass. The amount of gas generated can be increased or diminished at will. A pressure gage indicates the force of expansion acquired by the gas. A glass tube, similar to the water tube in use on some boilers, and with a graduated scale attached, shows both the amount of liquid used and also the quantity remaining in the apparatus; while a relief-cock insures safety to the operator against too rapid an accumulation of gas.

This last danger need scarcely be apprehended, as, after the pressure gage indicates the force of expansion required, the further generation of the gas can be entirely stopped, until the vacuum created by the outflow of liquid needs to be replaced by a new supply of gas. For it is a fact well understood, that the force of expansion of the generating power decreases in the same proportion as the volume of the liquid is diminished, thereby causing a greater vacuum in the apparatus.

The inside of the apparatus is thickly coated with lead, as that metal is not sensibly acted on by either muriatic or sulphuric acid, except at very high temperatures.

The jet or stream of liquid can be regulated by a screw cock, attached to the neck of a metallic tube reaching to the bottom of the apparatus, inside, and provided at its inner extremity with a perforated bulb, which, acting as a filter, prevents any impurity or sediment from finding its way into and stopping

the circulation of the fluid through the arterial system; at the same time it prevents any excessive amount of pressure upon the rubber tube five or six feet in length, which is connected with the delivery tube outside, and at the end of which the nozzle is attached.

The nozzle or cannula itself is a very important part of the apparatus, and is of a peculiar shape; it consists of a thin copper tube about eight inches in length and a little over an eighth of an inch in diameter; it is to be inserted at full length, or nearly so, into the artery to be injected, as by doing so it meets a point where the walls of the artery are strengthened by the surrounding tissues.

The shape of the apparatus is that of an elongated cylinder, rounded off at both ends, resembling somewhat a soda fountain; it stands upright, upon four curved legs about four inches in height, and possesses a symmetrical and substantial appearance.

The other apparatus—Ronsard's—is about similar in construction, but the power exerted in forcing out the liquid is not gas, as in the former apparatus, but compressed air, forced into the body of the reservoir by means of a pump.

The body of the apparatus consists of a cylinder holding about five gallons; this constitutes the reservoir containing the liquid to be injected. Outside of this cylinder and running alongside of it is the body of the pump. The pipe communicating the air forced inside the cylinder above the liquid enters the bottom

of the reservoir, and, passing through the liquid, runs along the inner side of the vessel until it has reached a point almost to the top of the cylinder. In the center of the apex at the top of the cylinder is a small funnel connected to a pipe running inside of the apparatus; this pipe, which is furnished with a cock, is intended to conduct inside the apparatus the liquid poured in at the funnel; it will act also as a relief cock, should it be found necessary to relieve the pressure on the liquid.

This apparatus is not provided, like the other, with a pressure gage, from the fact that the pressure being the result of a mechanical cause, the operator will soon be able to judge the amount of pressure by the number of strokes of the piston.

The delivery pipe is similar in every respect to the one in the apparatus described formerly; the graduated tube outside showing the quantity of liquid inside the apparatus is also the same; in fact, the similarity between the two is striking. But the principal feature of the apparatus, and that which recommends it to the profession, is the perfect isolation of all the working parts of the apparatus from direct contact with the liquid injected. The greatest objection in this case, as in the other, is removed, as the most important part of the work, namely: that of compressing the air, is performed without any danger to the generator.

Another apparatus—that of Waldon—combines the two systems in one, and can be operated with equal

facility either by means of compressed air or by means of gaseous expansion.

Still, these instruments require a certain amount of familiarity in the handling before they can be operated with efficiency, as, to a person not fully conversant with their mechanism, they may prove awkward.

The instruments of Messrs. G. Tiemann & Co., of New York, which I have employed so far very successfully, could be rendered perfect by adopting some modifications in their make.

GASEOUS COMPOUNDS.

TOO little attention has been paid heretofore to the antiseptic powers of certain gases. It is a well known fact, that some of the gases which are the result of animal and vegetable decomposition are, to a certain extent, the means of their own disinfection; hence, some of these are endowed with deodorizing as well as antiseptic properties.

We have already given at length the properties of chlorine. Carbonic acid gas is another of those antiseptic agents which will occupy our attention.

It exists in the atmosphere as a product of combustion and of the respiration of animals; it is a result, also, of the slow decomposition of most vegetable substances, and is evolved in great quantities from the ground in volcanic countries. In the formation of sugar it is produced in abundance, along with alcohol.

For the purposes of the chemist, it is generally prepared by decomposing marble by means of some stronger acid. From its cheapness and the solubility of the residual salt, muriatic acid is generally employed.

The properties of carbonic acid are very remarkable; it is perfectly colorless and invisible; it is

irrespirable, producing, when an attempt is made to breathe it, violent spasms of the glottis. If it be respired mixed with air, even in the proportion of one to ten, it gradually produces stupor and death, acting as a narcotic poison. Hence, when disengaged in large quantities, whether by natural operations or in process of manufacture, it accumulates in all cavities within its reach, and may cause fatal accidents to animals who enter unadvisedly.

Carbonic acid does not support combustion; a taper plunged into a jar full of the gas is instantly extinguished. Carbonic acid is also a check on putrefaction, and arrests decay.

SULPHUROUS ACID.

Sulphurous acid exists at ordinary temperature and pressure in the gaseous form; it is one, however, of the most easily liquified gases. It is produced always when sulphur burns, either in air or in pure oxygen; sulphur not being capable of passing directly to a higher degree of oxydation. In the burning of sulphur, the volume of sulphurous acid gas formed is exactly equal to the amount of oxygen consumed.

Sulphurous acid gas may also be simply prepared by heating three parts of flowers of sulphur with four of peroxide of manganese. The reaction is very simple: one part of the sulphur uniting with the metal, and another with the oxygen, form sulphuret of manganese and sulphurous acid.

Another and quicker way to obtain this gas in small quantities is, to decompose a solution of hyposulphate of soda, by adding muriatic acid to it, so as to liberate the hyposulphurous acid, which immediately decomposes into sulphur and sulphurous acid.

Sulphurous acid is absorbed by water. It is colorless and transparent, possessing an odor peculiarly irritating (the smell of burning sulphur), and cannot be breathed. It is not combustible, nor does it support combustion. Water dissolves about thirty-seven times its volume of sulphurous acid; the solution possesses the properties of the gas in a very high degree, and bleaches vegetable colors with great power; when kept for some time it gradually absorbs oxygen, and the sulphurous becomes changed into sulphuric acid. The sulphuric acid is one of the feeblest acids, and is expelled from its combinations by almost all but the carbonic acid.

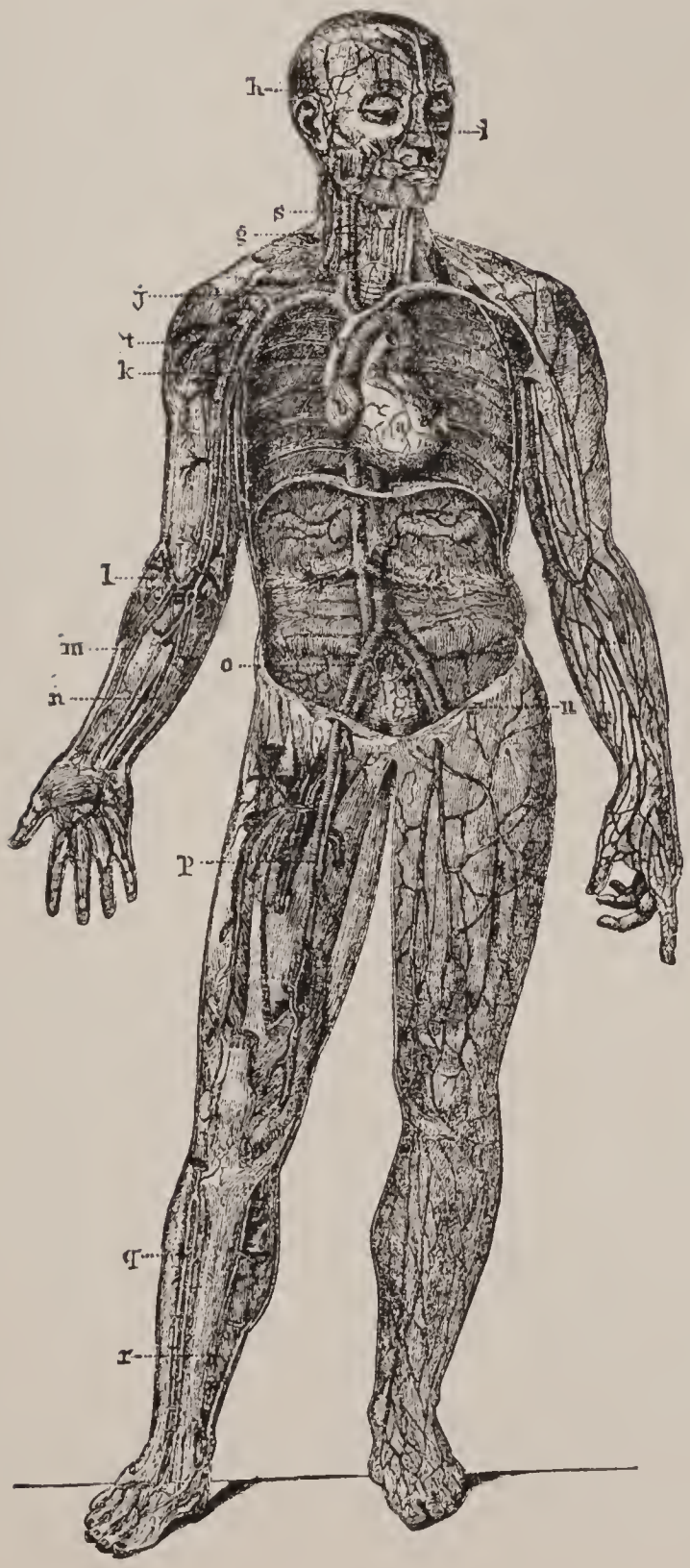
As has been demonstrated, all these gases are absorbed by water, and a saturated solution possesses the properties of the gases themselves.

PHYSIOLOGY.

GENERAL VIEW OF THE CIRCULATING APPARATUS OF MAN.

The course and relative positions of the principal arteries and veins of the Systemic circulation are shown in this plate. The arteries commence from the great arterial trunk, called the aorta, and their branches are distributed to all parts of the system. The venous branches, which accompany the arteries, unite into two great veins, the superior and inferior vena cava, which convey the blood back to the heart.

a, The left ventricle of the heart. *b*, The right auricle. *c*, The superior vena cava. *d*, The root of the pulmonary artery. *e*, *e*, The aorta, which is seen arching backward over the heart, and passing downward into the abdomen, where it divides into its two great branches, the iliac arteries, through which the blood passes to the lower extremities. *f*, The inferior vena cava, which accompanies the descending aorta and its branches, and returns the blood from the lower extremities. The dotted lines represent the outlines of the kidneys.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PRINCIPAL DIVISIONS OF THE AORTA AND VENA CAVA.

It should be remembered that most of the branches which spring from the great artery and vein are double—that is, each right branch has a corresponding one at the left side—so that there are, for instance, the right and the left carotid arteries, the right and the left jugular veins, etc.

From the arch of the aorta are sent off those arteries which are distributed to the head and arms. The principal ones among these are named as follows :

g, The carotid artery, which ascends in the side of the neck, and divides into the temporal artery, *h*, which is distributed in the temple, and the facial artery, *i*, which supplies the face; and also sends a branch, called the internal carotid, to the parts within the skull.

j, The sub-clavian artery, lying beneath the clavicle or collar-bone. That part of the continuation of this artery which passes through the axilla or arm-pit is called the axillary artery, *k;* that which lies in the upper arm, the brachial artery, *l;* and in the fore-arm it divides into the radial and ulnar arteries, *m*, *n*, which are distributed to the hand and fingers in the manner indicated in the plate.

The principal branches of the descending aorta are named as follows :

The iliac artery, *o*, on passing into the thigh becomes the femoral artery, *p*, and in the leg divides

into the tibial and peroneal arteries, *q*, *r*, which form numerous branches for the supply of the leg and foot.

Before dividing into the iliac arteries, the descending aorta gives off several important branches, as the cœliac artery, from which the stomach and liver are supplied; the renal artery, which goes to the kidneys, and the mesenteric artery, to the intestines; besides many other sub-divisions in various parts of its course.

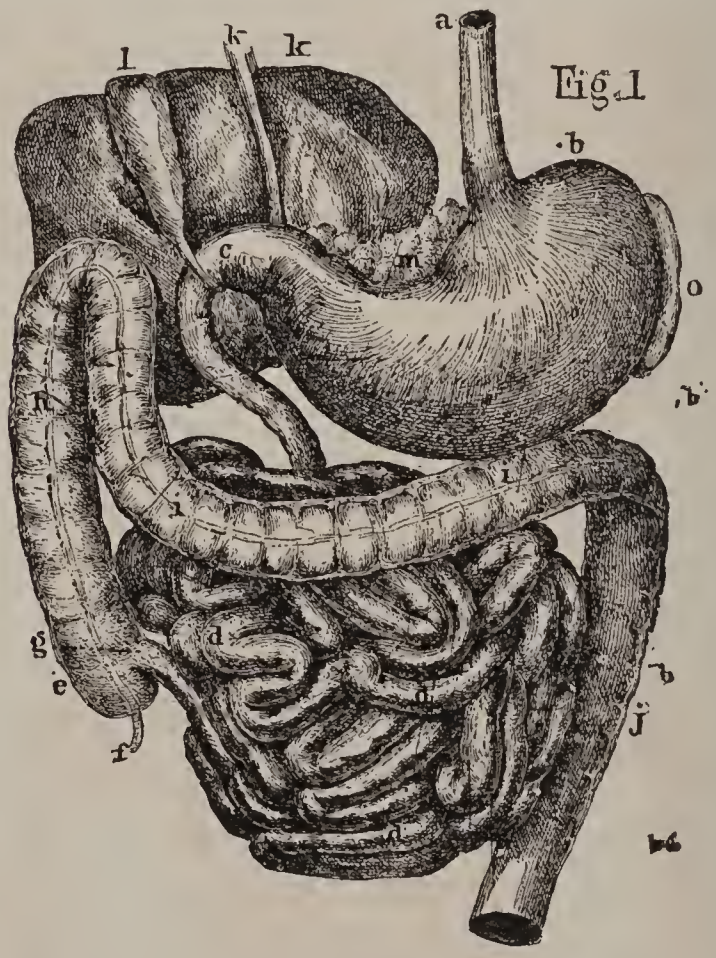
The branches of the vena cava generally accompany those of the aorta in their distribution, as shown in the figure, and are often called by the same names. The principal divisions of the superior vena cava are: The jugular vein, *s*, which accompanies the carotid artery; the sub-clavian vein, *t*, which accompanies the artery of the same name, and receives the blood from the arm and hand.

The inferior vena cava, like the aorta, divides into two great branches, the iliac veins, *u*, the sub-divisions of which accompany those of the arteries, and are called by the same names. The manner in which the superficial veins ramify and anastomose with each other is shown on the upper and lower extremity of the left side.

ORGANS OF DIGESTION.

FIGURE 1.—*General View of the Digestive Organs of Man.*—This figure is intended to give a general idea of the forms and relative positions of the organs

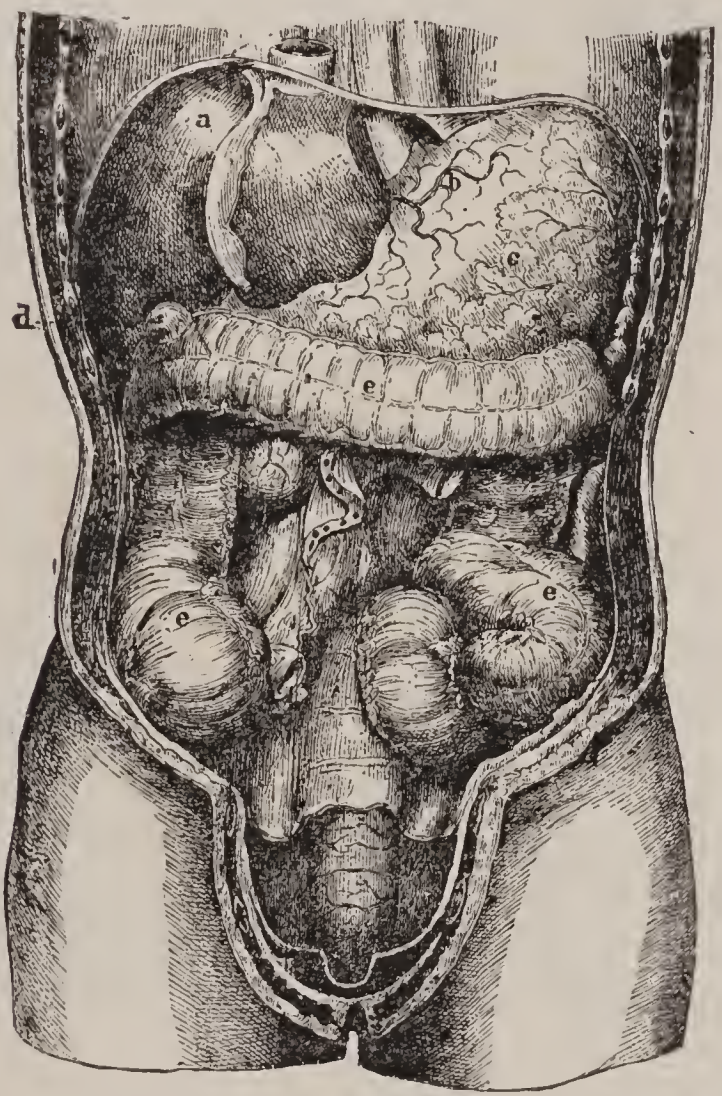
of digestion.—*a*, The œsophagus. *b*, The stomach. *c*, The duodenum. *d*, *d*, *d*, Convolutions of the small intestine. *e*, The cœcum. *f*, Appendix of the cœcum. *g*, Opening of the small into the large intestine. *h*, The ascending colon. *i*, *i*, Transverse arch of the



colon. *j*, The descending colon. *k*, The liver. *l*, The gall-bladder. *m*, The pancreas, mostly covered by the stomach. *o*, The spleen.—In this figure, the liver is raised up and the transverse arch of the colon drawn down, in order to show parts which they cover when in their natural situation.

FIGURE 2.—*General Aspect of the Abdominal Viscera.*—In this figure, the anterior walls of the abdomen are removed, so as to show the organs in their natural positions. The small intestine is removed.—

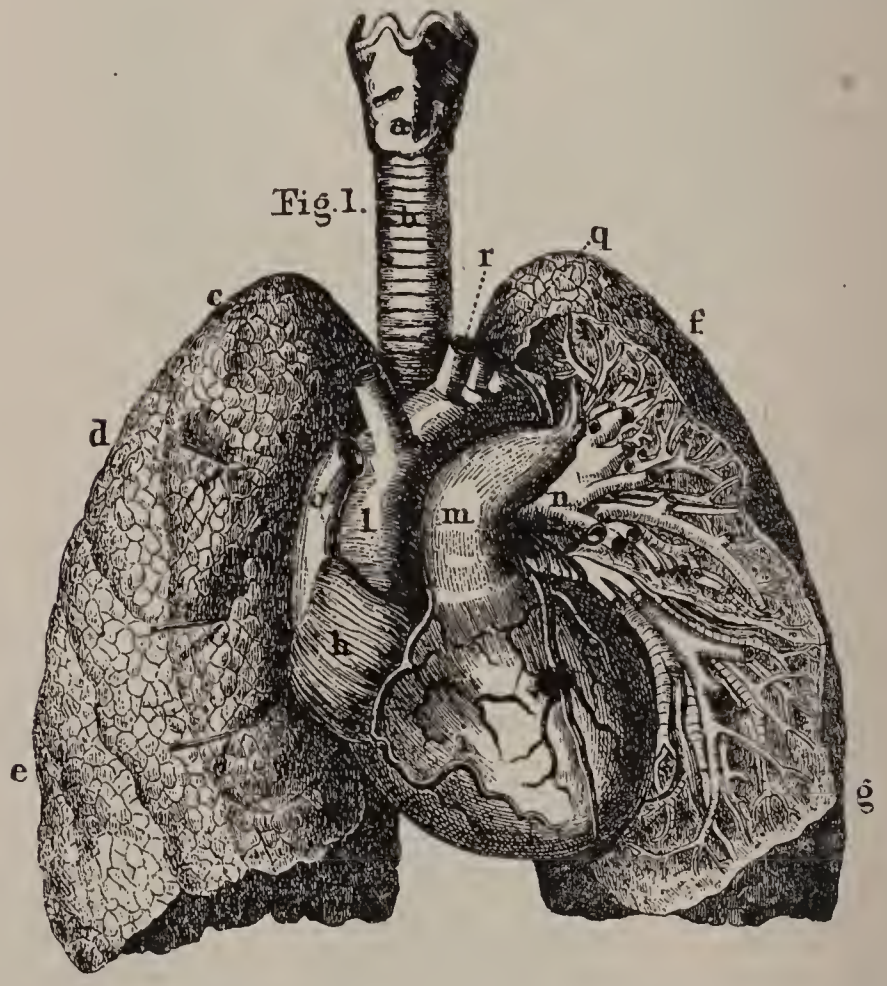
Fig. 2



a, The liver, situated beneath the right arch of the diaphragm. *b*, The stomach. *c*, Epiploa, or floating folds of the peritoneum. *d*, Summit of the gall-bladder. *e*, *e*, Large intestine, showing all its courses.

ORGANS OF CIRCULATION.—HEART AND LUNGS.

FIGURE 1.—*Front View of Heart and Lungs.*—Both organs are stripped of their envelopes, the pleura and pericardium. The right lung is drawn aside, so as to uncover the heart and large vessels. The left lung is



deeply dissected, to show the distribution and mode of ramification of the air-tubes and blood-vessels.

a, The larynx. *b*, The trachea.—The right lung is somewhat shorter than the left, and is divided into

three lobes, *c*, *d*, *e*; while the left lung has but two lobes, *f*, *g*. The surface of the lobes is sub-divided into lobules, by the intersection of great numbers of depressed lines. *h*, Right auricle of the heart. *i*, Right ventricle. *j*, Left auricle. *k*, Left ventricle. *l*, The aorta. *m*, The pulmonary artery. *n*, Left pulmonary veins.—These veins are four in number, two for each lung; and they return to the heart the blood which has been conveyed into the lungs by the pulmonary artery. The division of the pulmonary artery into right and left branches cannot be seen in this figure, being hidden by the aorta. *o*, The superior vena cava. *p*, Root of the right innominate artery, springing from the arch of the aorta. *q*, Root of the left sub-clavian artery. *r*, Root of the left carotid artery.

Fig. 2.

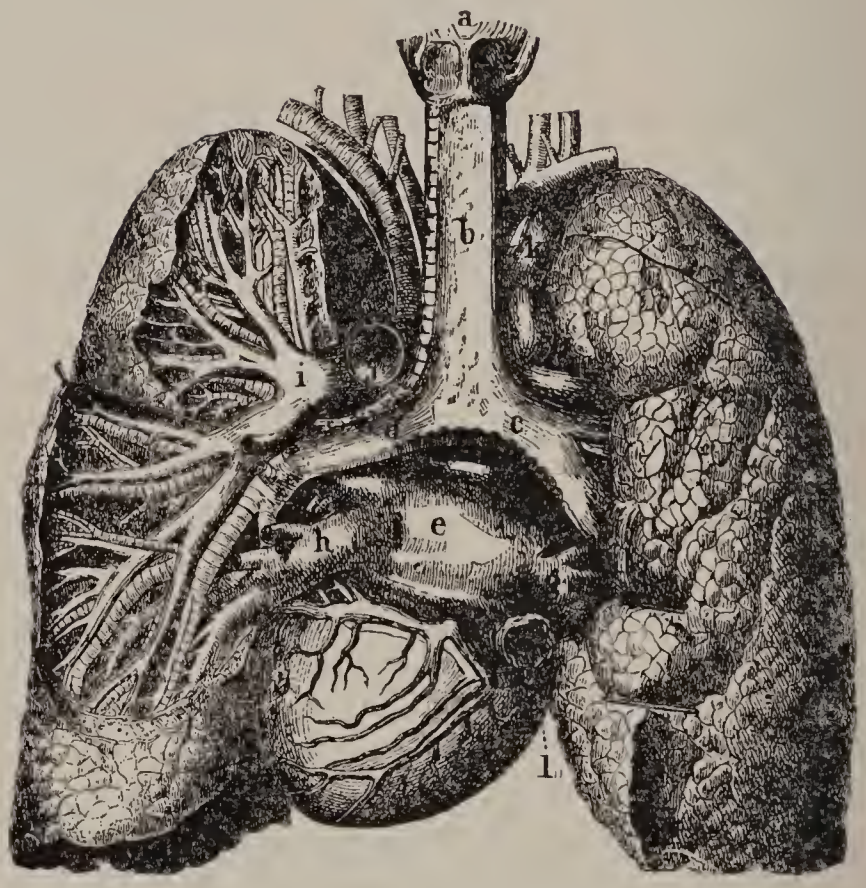


FIGURE 2.—*Back View of the Heart and Lungs.*—*a*, Larynx. *b*, Trachea. *c*, Right bronchus. *d*, Left bronchus. *e*, Left auricle of the heart. *f*, Left ventricle. *g*, Right pulmonary veins. *h*, Left pulmonary veins. *i*, Left pulmonary artery. *j*, Section of the aorta, *k*. Trunks of the brachio-cephalic veins (those which belong to the arms and head). *l*, The opening of the inferior vena cava.—The sub-divisions of the pulmonary arteries and veins, and of the air-tubes or bronchi, are seen accompanying each other in the left lung in both figures.

GLOSSARY AND INDEX.

A

ABDOMEN (L. *abdo*, to hide). So called from its containing the intestines, &c.

ABDUCTOR (L. *abduco*, to draw from). *Abducent.* A muscle, whose office is to draw one part of the body away from another.

ABSORPTION. The act or process of imbibing or swallowing.

ABSORBENTS. Vessels which imbibe, as lymphatics and lacteals.

ALBUMEN (L. *albus*, white). Albumen is of two kinds, animal and vegetable: 1. *Animal albumen* exists in two forms, the liquid and the solid. In the *liquid* state, it is a thick, glairy fluid, constituting the principal part of the white of egg. In the *solid* state, it is contained in several of the textures of the body, as the cellular membrane, the skin, glands and vessels.—2. *Vegetable albumen* closely resembles animal albumen, and has been found in wheat, rye, barley, peas and beans.

ANASTOMOSIS (Gr. *anâ*, through, and *stoma*, a mouth). The communication of vessels with each other, as of the arteries with the veins, which, by touching at numerous points, form a net-work or reticulation. See *Inosculation.*

ANATOMY (Gr. *anatémnō*, to cut up). The science of organization; the science whose object is the examination of the organs or *instruments* of life. Animal anatomy is divided into *human anatomy* and *comparative anatomy*, according as it treats of the organization of the human body, or of that of other animals.

AORTA (Gr. *aèr*, air, *teréō*, to keep; as having been formerly supposed to contain only air). The great artery of the heart. It is distinguished into the *ascending* and *descending.*

Aqueous. Watery.

Aracanoid Membrane (Gr. *arachnē*, a spider, and *eīdos*, likeness). The fine *cobweb-like* membrane situated between the dura and pia mater. It is the serous membrane of the cerebro-spinal centers.

Arbor Vitæ. Literally, *tree of life*. A term applied to the *arborescent* appearance presented by the cerebellum, when cut into vertically.

Artery (Gr. *aèr*, air, and *teréō*, to hold). A vessel which carries the blood from the heart; formerly supposed, from its being found empty after death, to contain only air.

Arytænoid (Gr. *arútaina*, a ewer, and *eīdos*, likeness). A term applied to two triangular cartilages of the larynx.

Auditory (L. *audio*, to hear). Belonging to parts connected with the sense of hearing.

Auricula (L. dim of *auris*, the ear). An auricle; the prominent part of the ear. Also, the name of two cavities of the heart.

Automatic Motions (Gr. *automatos*, of his own accord). Those muscular actions which are not dependent on the mind.

B

Bilis. Bile, gall, or choler; the secretion of the liver. A term employed to characterize a class of diseases caused by a too copious secretion of bile.

Bronchus (Gr. *brôngchos*, the windpipe, from *bréchō*, to moisten). The windpipe; a ramification of the trachea; so called from ancient belief that the solids were conveyed into the stomach by the œsophagus, and the fluids by the bronchia.

Bronchial-tubes. The minute ramifications of the bronchi, terminating in the *bronchial cells*, or air cells of the lungs.

Bronchitis. Inflammation of the bronchi or ramifications of the trachea.

Bursæ Mucosæ (*mucous bags*). Small sacs situated about the joints, being parts of the sheaths of tendons

CÆCUM, or CŒCUM (L. *cæcus*, blind). The first part of the colon, or *blind* intestine.

CALLUS (Latin, *hardness*). New bone, or the substance which serves to join together the ends of a fracture, and to restore destroyed portions of bone.

CAPILLARY (L. *capillus*, a hair). Resembling a hair in size; a term applied to the *vessels* which intervene between the minute arteries and veins.

CAPSULA (L. dim. of *capsa*, a chest). Literally, a little chest. A capsule or bag, which incloses any part.

CARBON (L. *carbo*, a coal). A substance well known under the form of coal, charcoal, lamp-black, &c. In chemical language, it denotes the pure inflammable principle of charcoal; in its state of absolute purity it constitutes the *diamond*.

CARBONIC ACID. Carbon and oxygen combined.

CARDIA (Gr. *kardia*, the heart). The entrance into the stomach; so called from being near the heart.

CARDIAC (Gr. *kardia*, the heart). Relating to the heart.

CAROTID (Gr. *karóō*, to induce sleep). The name of two large arteries of the neck; so called from an idea that tying them would induce stupor.

CARPUS (Gr. *karpós*, fruit). The wrist. The *ossa carpi*, or carpal bones, are eight in number, and form two rows.

CARTILAGE. Gristle. It is attached to bones, and must be distinguished from the ligaments of joints and tendons of muscles.

CEREBELLUM (dim. of *cerebrum*). The little brain, situated behind the larger or cerebrum.

CEREBRUM (Gr. *kâre*, the head). The brain; the chief portion of the brain, occupying the whole upper cavity of the skull.

CEREBRO-SPINAL. System.

CERVIX. The neck; the hinder part of the neck. The fore part is called *collum*.

CHEST. *Thorax.* An old English term, commonly traced to the Latin *cista.*—"When it is considered that the same word was anciently used for a *basket*, the appropriation of it to the human thorax will appear quite natural to any one who has ever seen a skeleton."—*Forbes.*

CHYLE (Gr. *chulòs*, juice). The milk-like fluid absorbed by the lacteal vessels.

CHYLIFICATION (L. *fio*, to become). The process by which the chyle is separated from the chyme.

CHYME (Gr. *chumòs*, juice). The semi-fluid matter which passes from the stomach into the duodenum.

CHYMIFICATION (L. *fio*, to become). The process by which the aliment is converted into chyme.

CLAVICULA (dim. of *clavis*, a key). The clavicle, or collar-bone; so called from its resemblance to an ancient key.

COCCYX (Gr. *kókkux*, a cuckoo). The lower end of the spine; so called from its resemblance to a cuckoo's beak.

COLON (Gr. *kolōn*, quasi, *koīlon*, hollow). The first of the large intestines, commencing at the cœcum, and terminating at the rectum.

COMA (Gr. *kōma*, drowsiness, from *kéō*, to lie). Drowsiness; lethargic sleep; dead sleep; torpor.

COMMISSURE (L. *commissura*). To joint or sever the place where two bodies or parts of a body meet and unite.

CONDYLE (Gr. *kóndulos*, a knuckle). A rounded eminence in the joints of several bones, as the humerus and the femur.

CONGESTION (L. *congero*, to amass). Undue fullness of the blood-vessels.

CONJUNCTIVA (L. *conjungo*, to unite). The mucous membrane which lines the posterior surface of the eyelids, and is continued over the fore-part of the globe of the eye.

CORIUM. Leather. The deep layer of cutis, or true skin, forming the basis of the support of the skin.

CORPUSCULUM (L. dim. of *corpus*, a body). A corpuscle, or little body.

CRANIUM (Gr. *kára*, the head). The skull, or cavity, which contains the brain, its membranes and vessels.

CRICOS (Gr. *krikíos*, a ring). Whence *cricoïd*, the name of the ring-like cartilage of the larynx.

CRYSTALLINE (Gr. *krústallos*, ice). A term applied to the lens of the eye.

CUTICLE (L. dim. of *cutis*). The epidermis or scarf-skin.

CUTIS (Gr. *kútos*, the skin). The true skin, as distinguished from the cuticle, epidermis or scarf-skin.

D

DEGLUTITION (L. *deglutio*, to swallow). The act of swallowing.

DIAPHRAGM (Gr. *diàphragma*, a partition). The midriff; the transverse muscular partition which separates the thorax from the abdomen.

DIGESTION (L. *digero*, from *diversim gero*, to carry into different parts). In *Physiology*, the change of food into *chyme* by the mouth, stomach and small intestines; and the absorption and distribution of the more nutritious parts, or the *chyle*, through the system.

DORSUM (Latin). The back; the round part of the back of a man or beast. Whence *Dorsal*, appertaining to the back, as applied to a region, ligaments, &c.

DUODENUM (L. *duodeni*, twelve). The twelve-inch intestine; so called from its being equal in length to the breadth of twelve fingers. The first portion of the small intestines, beginning from the pylorus.

DURA MATER (*hard-mother*). The outermost membrane of the brain.

E

Effluvia (L. *effluo*, to flow out). Exhalations, vapors, &c.

Elasticity. The property or power by which a body compressed or extended returns to its former state.

Enamel. The hard exterior surface of the teeth.

Encephalon (Gr. *ἐn*, in, *kephalē*, the head). The brain; the contents of the skull, consisting of the cerebrum, cerebellum, medulla oblongata, and membranes.

Epidermis (Gr. *epi*, upon, and *dérma*, the skin). The cuticle, or scarf-skin; the thin, horny layer which protects the surface of the integument.

Epiglottis. A cartilage of the larynx, situated above the glottis.

Epiploon (Gr. *plēo*, to sail). The omentum; a membranous expansion which *floats* upon the intestines.

Epithelium (Gr. *títhēmi*, to place). The cuticle on the red part of the lips, and on the mucous membranes in general.

Excretion (L. *excerno*, to separate from). A general term for the perspiration, fæces, &c., which are separated and voided from the blood or the food.

Expiration (L. *expiro*, to breathe). That part of the respiration in which the air is expelled. Compare *Inspiration*.

Exudation. *Transpiration*. The flow of liquid from the surface of the skin or membrane, an ulcer, &c.

F

Facial (L. *facies*, the face). Belonging to the face; as *facial nerve*, *facial vein*, &c.

Falx. A scythe or sickle. The *sickle*-like processes of the dura mater, situated between the lobes of the cerebrum and cerebellum.

Fascia (L. *fascis*, a bundle). Literally, a scarf or large band. Hence it is applied to the aponeurotic expansion of a muscle.

FASCICULUS (L. dim. of *fascis*, a bundle). A little bundle; a handful. Thus, a muscle consists of *fasciculi* of fibres.

FAUCES. The gullet or upper part of the throat; the space surrounded by the vellum palati, the uvula, the tonsils, and the posterior part of the tongue.

FEMUR, FEMORIS. *Os femoris.* The thigh-bone; the longest, largest and heaviest of all the bones of the body.

FIBRE (L. *fibra*, a filament). A filament or thread, of animal, vegetable or mineral composition.

FIBRIL. A small filament or fibre, as the ultimate division of a nerve. The term is derived from *fibrilla*, L. dim. of *fibra*, a filament.

FIBRIN. A tough, fibrous mass, which, together with albumen, forms the basis of muscle.

FIBRO-CARTILAGE. Membraniform cartilage; a substance intermediate between proper cartilage and ligament.

FILAMENT (L. *filum*, a thread, *forma*, likeness). Thread-like; applied to the papillæ at the edges of the tongue.

FISSURE. A cleft; a longitudinal opening.

FLEXOR (L. *flecto*, to bend). A muscle which bends the part into which it is inserted. Its antagonist is termed *extensor.*

FLUIDS. Substances which have the quality of fluidity, and are, in consequence, of no fixed shape.

FOLLICLE (L. dim. of *follis*, a pair of bellows). Literally, a little bag or scrip of leather. In anatomy, a very minute secreting cavity.

FORAMEN (L. *foro*, to pierce). An opening.

FOSSA (L. *fodio*, to dig). A ditch or trench; a little depression, or sinus.

FUNCTION (L. *fungor*, to discharge an office). The office of an organ in the animal or vegetable economy; as of the heart in circulation, of the leaf in respiration, &c.

G

GALL-BLADDER. A membranous reservoir, lodged in a fissure on the under surface of the right lobe of the liver, and containing the bile.

GALL-DUCTS. These are the *cystic*, proceeding from the gall-bladder; the *hepatic*, proceeding from the liver; and the *ductus communis choledochus*, resulting from the union of the two preceding.

GANGLION (Gr. *ganggli'on*, a nerve-knot). A small nervous center, or an enlargement in the course of a nerve, sometimes termed a *diminutive brain*.

GASTER. The Greek term for stomach.

GASTRIC (Gr. *gaster*, the stomach). Pertaining to the stomach; as the gastric juice, &c.

GASTRIC JUICE. The peculiar digestive fluid secreted by the stomach.

GELATINE (L. *gelu*, frost). The principle of jelly. It is found in the skin, cartilages, tendons, membranes and bones. The purest variety of gelatine is *isinglass*.

GLAND (L. *glans*, *glandis*, an acorn). A soft body, composed of various tissues, vessels, nerves, &c., usually destined to separate some fluids from the blood.

GLENOID (Gr. *glēne*, a cavity, *eīdos*, likeness). The name of a part having a shallow cavity; as the socket of the shoulder joint.

GLOBULES RED (L. dim. of *globus*, a ball). The red coloring matter of the blood; a peculiar animal principle.

GLOSSA, or GLOTTA (Gr. *glōtta*). The tongue; the organ of speech. *Glosso*. Terms compounded of this word belong to nerves or muscles attached to the tongue.

GLOTTIS. The aperture of the larynx between the arytænoid cartilages. It is covered by a cartilage called the *epi-glottis*.

GRANULE. A small particle.

H

Hæmatosin (Gr. *haima*, blood). A characteristic constituent of the blood, derived from the globules.

Hæmorrhage. A rupture of a blood-vessel; a bursting forth of blood; loss of blood.

Hepatic. A term applied to any part belonging to the liver.

Humerus. The bone of the upper arm.

Humor (L. *humeo*, to be moist). An aqueous substance; as the humors of the eye.

Hygiene (Gr. to be well). Health; the preservation of health; that part of medicine which regards the preservation of health.

Hyoides (the Greek letter *upsilon*). A bone situated between the root of the tongue and the larynx.

Hypogastrium. The lower anterior region of the abdomen.

Hypoglossal. The name of the *lingualis*, or ninth pair of nerves, situated beneath the tongue.

I, J

Ichor. A thin, acrid discharge, issuing from wounds, ulcers, &c.

Jejunum (L. *jejunus*, hungry). The upper two fifths of the small intestines; so named from this portion being generally found *empty*.

Ileum (to turn about). The lower three-fifths of the *small intestines;* so called from their convolutions or peristaltic motions.

Iliac Bone. Another name for the *os innominatum*, derived from the circumstance that this compound bone supports the parts which the ancients called *ilia*, or the flanks.

Iliac Region. The region situated on each side of the hypogastrium.

Index (L. *indico*, to point out). The fore-finger; the finger usually employed in *pointing* at any object.

INFRA-SPINATUS. A muscle arising from the scapula below the spine, and inserted into the humerus.

INNOMINATUS (L. *in*, priv., *nomen*, name). Hence, *Innominatum os*, a bone composed of three portions, viz: 1, The *ilium*, or haunch-bone; 2. The *ischium*, or hip-bone; 3, The *os pubis*, or share bone.

INTEGUMENT (L. *in*, and *tego*, to cover). The covering of any part of the body, as the cuticle, cutis, &c.

INTER-COSTAL. The name of two sets of muscles between the ribs—the *external* and the *internal.*

INTESTINES (L. *intus*, within). That part of the alimentary canal which extends from the stomach to the anus.

JUGULAR. Belonging to the neck; applied chiefly to the principal veins of the neck.

K

KINGDOM. A term denoting any of the principal divisions of nature. Thus we have the *organic kingdom*, comprehending substances which organize; and the *inorganic kingdom*, comprehending substances which crystallize.

KNEE-PAN. Patella; the small round bone at the front of the knee-joint.

KIDNEYS. Two oblong glands, which secrete the urine.

L

LABIA. The lips. They are laterally united by means of two acute angles, which are called their *commissures.*

LABYRINTH. The name of a series of cavities of the inner ear, viz: the vestibule, the cochlea, and the semi-circular canals.

LACHRYMA. A tear; the fluid secreted by the *lachrymal gland*, and flowing on the surface of the eye.

LACTEALS (L. *lac*, milk). Numerous minute tubes which *absorb* or take up the chyle, or *milk-like* fluid, from the alimentary canal.

LACTIC ACID (L. *lac*, *lactis*, milk). An acid produced whenever milk—and perhaps most animal fluids—become spontaneously sour.

LAMINA. Literally, a small plate of any metal. A term applied to the foliated structure of bones or other organs.

LARYNX (Gr. *larungx*, the larynx). The superior part of the trachea, situated immediately under the os hyoïdes.

LENS (L. *lens*, *lentis*, a bean). Properly, a small roundish glass, shaped like a *lentil*, or bean.

LIGAMENT (L. *ligo*, to bind). A membrane of a flexible but compact texture, which connects the articular surfaces of bones and cartilages; and sometimes protects the joints by a capsular envelope.

LINGUA (L. *lingo*, to lick). The tongue; the organ of taste and speech.

LIVER. The largest glandular apparatus in the body, the office of which is to secrete the bile.

LUMBI. The loins; the inferior part of the back; whence *Lumbar*, the designation of nerves, arteries, veins, &c., belonging to the region of the loins.

LUNGS. The organs of respiration.

LUXATION (L. *luxo*, to put out of joint). Dislocation; or the removal of the articular surface of bones out of their proper situation.

LYMPH (L. *lympha*, water). A colorless liquid which circulates in the lymphatics.

LYMPHATICS (L. *lympha*, water). Minute tubes which pervade every part of the body, which they *absorb*, or take up, in the form of *lymph*.

M

MAGNESIUM. A metal having the color and lustre of silver.

MASSETER (Gr. to chew). A muscle which assists in chewing.

MASTOID (Gr. a breast). Shaped like the breast or nipple; as applied to a *process*, and a *foramen* of the temporal bone.

MEATUS (L. *meo*, to pass, to flow). Literally, a passage.

MEDULLA. Marrow; a kind of fixed oil, occupying the cavities of bones.

MEDULLA OBLONGATA. The upper enlarged portion of the spina cord.

MEDULLA SPINALIS. The spinal marrow or cord.

MEDULLARY. The designation of the *white* substance of the brain.

MESENTERY (Gr. between the bowels). The membrane which connects the small intestines and the posterior wall of the abdomen.

META-CARPUS (Gr. after, the wrist). That part of the hand which is situated between the carpus and the fingers.

META-TARSUS. That part of the foot which is situated between the tarsus and the toes.

MIDRIFF. *Diaphragm.* The muscle which divides the body into the thorax and the abdomen.

MITRAL VALVES (L. *mitra*, a mitre). The name of two valves which guard the left ventricle of the heart.

MOLAR (L. *mola*, a mill-stone). The double or grinding teeth. Those with two fangs are called bicuspid, or false molars.

MOTOR (L. *moveo*, to move). A mover; a part whose function is *motion.*

MUCUS. The liquid secreted by the mucous surfaces, as of the nostrils, intended as a protection to the parts exposed to external influences.

N

NARCOTICS (Gr. stupor). Medicines which induce sleep or stupor, as opiates.

NASUS. The nose, or organ of smell; whence *nasal*, belonging to the nose.

NERVES (L. *nervus*, a string). White cords arising from the brain or the spinal marrow, and distributed to every part of the system.

NEURON (Gr.) A nerve; a cord arising from the brain or spinal marrow. Whence *Neurilemma*, the sheath of a nerve; and *Neurology*, the doctrine of the nerves.

NITROGEN. *Azote*. An elementary principle, constituting four-fifths of the volume of atmospheric air.

NUTRITION (L. *nutrio*, to nourish). The process of nourishing the frame.

O

OBTURATOR (L. *obturo*, to stop up). The name of two muscles of the thigh, and of a nerve.

OCCIPUT (L. *ob caput*). The back part of the head; the part *opposite* to the front or *sinciput*.

ŒSOPHAGUS (Gr. to carry, to eat). A canal leading from the mouth to the stomach.

OLEAGINOUS (L. *oleum*, oil). That which contains or resembles oil.

OLFACTORY (L. *olfacio*, to smell). Belonging to the smell; the name of the first pair of cerebral nerves, &c.

OMENTUM. The caul; a fold or reflexion of the peritoneum.

OMO (Gr. the shoulder). Words compounded with this term belong to muscles attached to the scapula.

OPTIC. Belonging to the sight.

ORBIT (L. *orbita*, an orbit, a track). The cavity under the forehead, in which the eye is fixed.

ORGAN. A part which has a determinate office in the animal economy.

ORGANIZATION. A term applied to a system, composed of several individual parts, each of which has its proper function, but all conduce to the existence of the entire system.

ORIGIN (L. *origo*). The commencement of a muscle from any part. Its attachment to the part it moves is called its *insertion*.

OS, OSSIS. A bone; a portion of the skeleton, constituting a *passive* organ of locomotion, as distinguished from a muscle or *active* organ of this faculty.

OSSIFICATION. The formation of bone; the deposition of calcareous phosphate, or carbonate, on the soft solids of animal bodies.

OXIDES. Substances combined with oxygen, without being in the state of an acid.

OXYGEN. A gas which forms about one-fifth of atmospheric air, is capable of supporting flame, and is essential to the respiration of animals.

P

PANCREAS. A gland, situated transversely across the posterior wall of the abdomen. In cattle it is called the *sweet-bread*.

PANCREATIC JUICE. The peculiar fluid secreted by the pancreas.

PAPILLA. The term *papillæ* denotes the small eminences which constitute the roughness of the upper surface of the tongue.

PARALYSIS. Palsy; the total loss, or diminution, of sensation or of motion, or of both.

PAROTID. The name of the large salivary gland situated near the ear.

PARIES, PARIETIS. The wall of a house or any other building; whence *Parietal*, belonging to the walls of an organ.

PATELLA (L. dim. of *patina*, a pan). Literally, a small pan. The knee-pan.

PECTORAL (L. *pectus*, the breast). Pertaining to the breast.

PECTORALIS. The name of two muscles of the trunk.

PEDAL (L. *pedules*). Pertaining to a foot.

PELVIS (Gr. *a basin*). The basin or large bony cavity which terminates the trunk inferiorly.

PERICARDIUM (Gr. *around the heart*). A fibro-serous membrane which surrounds the heart.

PERICRANIUM. The periosteum or membrane which covers the bones of the cranium.

PERIOSTEUM. The membrane which surrounds the bones.

PERISTALTIC. A term applied to the vermicular contractions of the intestines upon themselves.

PERITONÆUM. The serous membrane which lines the interior of the abdomen, and invests all the viscera contained therein.

PERMEABILITY (L. *per*, through, *meo*, to pass). That property of certain bodies by which they admit the passage of other bodies through their substance.

PERSPIRATION (L. *perspiro*, to breathe through). The watery vapor which is constantly passing off through the skin.

PHARYNX (Gr. *the throat*). A musculo-membranous bag, situated at the back part of the mouth, leading to the stomach.

PHRENES (Gr. *the mind*). The diaphragm; so called because the ancients supposed it to be the seat of the mind. Hence the term *Phrenic*, a designation of the internal respiratory nerve, which goes to the diaphragm.

PHRENOLOGY (Gr. *an account*). A description of the mind; a science, introduced by Gall and Spurzheim, by which particular characters and propensities are indicated by the conformation and protuberances of the skull.

PHYSIOLOGY (Gr. *phusis*, nature, *logos*, an account). The science which treats of the properties of organic bodies, animal and vegetable, of the phenomena which they present, and of the laws which govern their actions.

Pia Mater. A vascular membrane, investing the whole surface of the brain.

Pituitary Membrane. A designation of the Schneiderian membrane, which lines the cavities of the nose.

Plexus (L. *plecto*, to weave). A kind of net-work of blood-vessels or nerves.

Pneumo-Gastric Nerves (Gr. *pneumon*, the lung, *gastér*, the stomach). The par vagnum, nervi vagi, or eighth pair of nerves, distributed to the stomach.

Portal Circulation. A subordinate part of the venous circulation, in which the blood makes an additional circuit before it joins the rest of the venous blood.

Portal Vein (L. *vena portæ*). A vein originating from the organs within the abdomen.

Potassium. The metallic base of the well known alkaline substance, potassa.

Process. *Apophysis*. A process or eminence of a bone. Also, a lobe or portion of the brain.

Pronation (L. *pronus*, bending downward). The act of turning the palm of the hand downwards, by rotating the radius upon the ulna by means of the pronator muscles.

Pronator (L. *pronus*, bending downward). The name of two muscles which turn the radius and the hand inwards and downwards.

Proximate Principle. A term applied, in analyzing any body, to the principle which is *nearest* to the natural constitution of the body, and more immediately the object of sense, as distinguished from intermediate or ultimate principles. *Ultimate principles* are the elements of which proximate principles are composed.

Pulmonary, *pulmonic* (L. *pulmo*, the lungs). Relating or belonging to the lungs.

Pulse (L. *pùlsus*, a stroke). A beating or striking; and hence, the stroke or beat of an artery.

PUNCTA LACHRYMALIA. The external commencements of the lacrymal ducts.

PUPILA (L. dim. of *pupa*, a puppet). The pupil, or the round aperture in the center of the iris of the eye.

PYLORUS (Gr. *púle*, a gate, *ora*, care). Literally a *gate-keeper*. The lower and contracted orifice of the stomach, guarding the entrance into the bowels.

Q

QUARTZ. A species of silicious minerals.

R

RAMIFICATION (L. *ramus*, a branch, *fio*, to become). The issuing of a small branch from a large one, as of the minute branches from the larger arteries.

RAMUS. A branch of a tree; the designation of portions of several bones.

RECTUM (L. *rectus*, straight). The last portion of the intestines.

REFRACTION (L. *refractus*, broken back). The property of light, by which a ray becomes bent, or *refracted*, when passing from a rarer into a denser medium, and *vice versâ*.

RESPIRATION. The function of breathing.

RETINA (L. *rete*, a net). The *net* like expansion of the optic nerve on the inner surface of the eye.

S

SAC (L. *saccus*, a bag). A term applied to a small cavity, as the lacrymal sac.

SACRUM (L. *Sacred*). The bone which forms the basis of the vertebral column; so called from its having been offered in sacrifice, and hence considered *sacred*.

SACRO. A term applied to parts connected with the sacrum. Hence we have *sacro*-iliac symphysis, *sacro*-spinal ligament, *sacro*-vertebral angle, &c.

SALIVA. The insipid, transparent, viscous liquid secreted by the salivary glands, principally the parotid.

SANGUIS. Blood; the fluid which circulates in the heart, arteries and veins.

SARTORIUS (L. *sartor*, a tailor). The muscle by means of which the tailor crosses his legs.

SCAPULA. The shoulder-blade.

SCHNEIDERIAN MEMBRANE. The *pituitary membrane*, which secretes the mucous of the nose; so named from Schneider, who first described it.

SCLEROTICA (Gr. *sklērós*, hard). The dense fibrous membrane which, with the *cornea*, forms the external tunic of the eye ball.

SEBACEOUS (L. *sebum*, suet). Suety; a term applied to *follicles*, which secrete a peculiar oily matter, and are abundant in some parts of the skin, as in the nose, &c.

SECRETION (L. *secerno*, to separate). A substance *secreted* or separated from the blood by the action of a secreting organ.

SERUM. The thin yellowish fluid constituent of the blood.

SINCIPUT. The fore part of the head. The back part is called *occiput*.

SINEW. The ligament which joins two bones.

SINUS. A gulf. Hence it denotes a cavity or cell within the substance of a bone, as of the forehead; also a large venous canal, as those of the dura mater.

SKELETON (Gr. *skéllo*, to dry up). The dry, bony frame work of an animal, which sustains the other organs.

SPINAL CORD. *Medulla spinalis*. The medullary matter contained within the *spine*, or vertebral column.

SPLEEN. A spongy organ situated at the left and behind the stomach.

SPLINT-BONE. The fibula or small bone of the leg; so named from its resembling a surgical splint.

STERNUM. The breast bone.

SUB. A Latin preposition, denoting a position *beneath* any body.

SUB-CLAVIAN. Situated under the clavicle.

SUB-CLAVIUS. A muscle arising from the cartilage of the first rib, and inserted into the lower surface of the clavicle.

SUB-CUTANEOUS. Beneath the skin.

SUB-LINGUAL. Beneath the tongue.

SUB-MAXILLARY. Beneath the jaw.

SUDOR (L. *sudo*, to sweat). Sweat; the vapor which passes through the skin and condenses on the surface of the body.

SUDORIFEROUS CANALS. Minute spiral follicles, distributed over the whole surface of the skin, for the secretion of the sweat.

SUTURE (L. *suo*, to sew). A seam; the junction of the bones of the cranium by a serrated line, resembling the stitches of a seam.

SYMPATHETIC NERVE. A nerve consisting of a chain of ganglia, extending along the side of the vertebral column from the head to the coccyx, communicating with all the other nerves of the body, and supposed to produce a *sympathy* between the affections of different parts.

T

TARSUS. The instep; the space between the bones of the leg and metatarsus.

TEARS. A peculiar fluid which lubricates the eye.

TEMPORA (L. pl. of *tempus*, time). The temples, or that part of the head on which the hair generally begins to turn gray, thus indicating *the age;* whence *temporal*, pertaining to the temples, as temporal bones.

TENACITY (L. *teneo*, to hold). The degree of force with which the particles of bodies cohere or are held together.

TENDON (L. *téino*, to stretch). A fibrous cord at the extremity of a muscle, by which the muscle is attached to a bone.

TENSOR (L. *tendo*, to stretch). A muscle which *stretches* any part.

TENTACULA. A filliform process or organ on the bodies of various animals.

THORAX (Gr. *thórax*). The chest; or that cavity of the body which contains the heart and lungs.

THORACIC DUCT. The great trunk formed by the junction of the absorbent vessels.

THYROID (Gr. *thureòs*, a shield). The name given to a shield-shaped cartilage of the larynx, and of a gland situated on the trachea.

TIBIA. Literally, a flute or pipe. The shin-bone, or the great bone of the leg.

TIBIAL *Tibialis*. Pertaining to the tibia.

TISSUE. A web, or web-like structure, constituting the elementary structures of animals and plants.

TONSILS (L. *tondeo*, to clip or shear). The round gland situated in the throat between the pillars of the velum palati.

TRACHEA (Gr. *trachus*, rough). The wind-pipe. The term is derived from the inequality of its cartilages.

TRICEPS. Having three heads. Applied to several muscles.

TRICUSPID. Having three points. A term applied to three triangular fords or *valves* situated between the right auricle and the right ventricle of the heart.

TRIFACIAL. Triple-facial. A term applied to the fifth pair of nerves, the grand sensitive nerve of the head and face.

TROCHANTER (Gr. *trochâo*, to run or roll). The name of two processes of the thigh-bone—the *major* and the *minor*.

TUNIC. The upper garment of the Romans. Hence it is applied to several membranes of the body.

TYMPANUM (Gr. *túmpanon*, a drum). The drum of the ear.

U

Ulna (Gr. *oléné*, the eubit). The large bone of the fore-arm; so named from its being often used as a measure, under the term *ell.*

Uvea (L. *uva*, grape). The posterior surface of the iris; so called from its resemblance in color to a ripe grape.

V

Vacuum (L. *vaccus*, empty). Literally, an empty place. This term generally denotes the interior of a close vessel, from which the atmospheric air and every other gas have been extracted.

Valve (L. *valvæ*, folding-doors). A close lid affixed to a tube or opening in some vessel, by means of a hinge or other movable joint, and which can be opened only in one direction. Hence it signifies a little membrane which prevents the return of fluid in the blood-vessels and absorbents.

Valvula (L. dim. of *valve*). A little valve.

Vas, Vasis. Plural, *Vasa.* A vessel, or any utensil to hold liquor.

Vascular System. That part of the animal economy which relates to the vessels.

Venous. Belonging to a vein.

Ventriculus (L. dim. of *venter*, the belly). The term *ventricle* is also applied to two cavities of the heart, and to several cavities in other parts of the body.

Vertebra (L. *verto*, to turn). A bone of the spine; so named from its *turning* upon the adjoining one.

Vertebral. Connected with the vertebra.

Vessicle (L. dim. of *vesica*, a bladder). A little bladder.

Villus. Literally, the shaggy hair of beasts. Some of the membranes of the body, as the mucous membrane of the intestinal canal, present a surface of minute papillæ, termed *villi*, villosities, resembling a downy tissue, continually covered with fluid.

VITREOUS BODY (L. *vitrum*, glass). *Vitreous humour.* A transparent mass, resembling melted glass, occupying the globe of the eye, and inclosed in the hyaloïd membrane.

W

WARM-BLOODED. A term applied to the mammalia and birds which have a two-fold circulation.

X

XYPHOID (Gr. *xíphos*, a sword, *eîdos*, likeness). Sword-like; a term applied to the cartilage of the sternum.

THE END.