

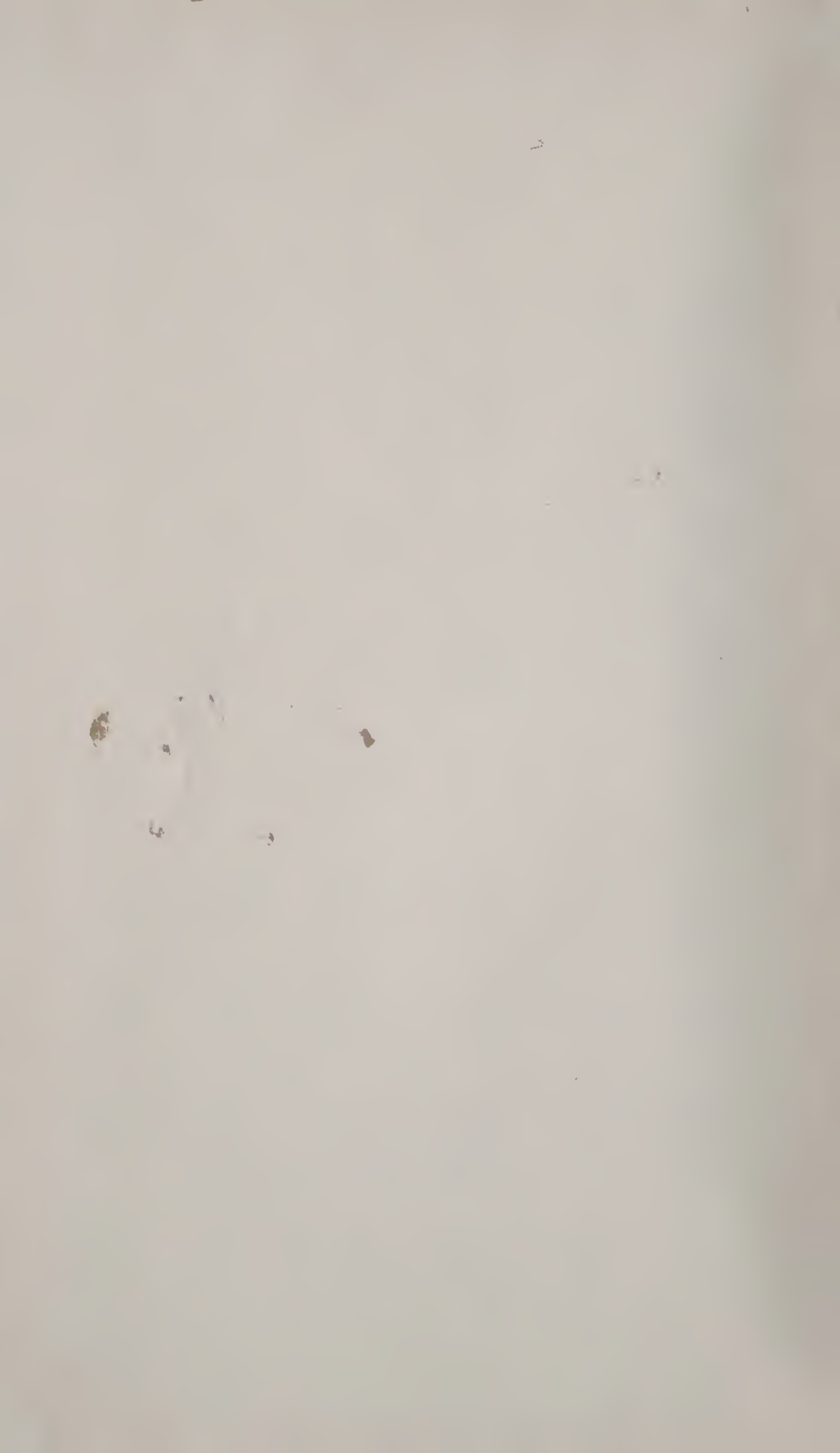
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Embalming and Embalming Fluids,

with the

Bibliography of Embalming.

A THESIS

PRESENTED BY

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Course E, Chemistry, of the University of Wooster, June 11, 1895.

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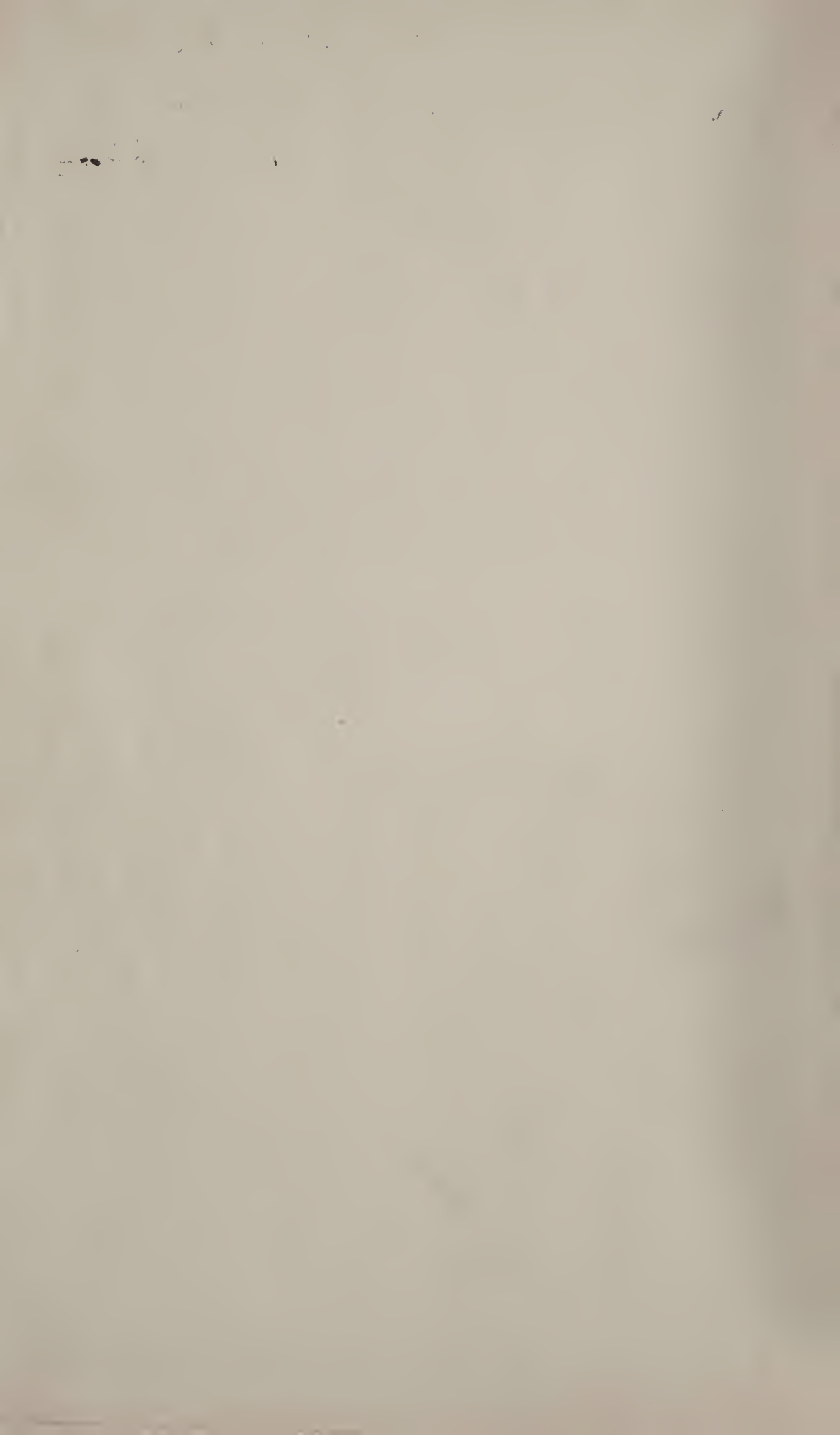
## PREFACE.

The thesis of Professor C. W. McCurdy, Sc. D., Ph. D., treating the subject of "Embalming and Embalming Fluids," is unique. It makes no pretension to being an exhaustive treatise on the subject, still less to being a practical guide to the professional embalmer. It does, however, present two real reasons for its being. First, to the laity, it presents all the leading facts of interest connected with this strange art, and will be read by large numbers of people whose interest is only of a general nature. The author's pleasing, and yet clear and forcible style, will be noted. Nowhere, so far as we know, has this subject been so pleasingly and accurately presented within moderate compass so as to meet the requirements of the general reader.

Second, the bibliography will be of the highest possible value to professional embalmers. To have at command a list of everything of importance which has been published on a subject, not only in book form, but also in the various journals, is to be supplied with a sword of sharpness for cutting one's way through difficulties to a full knowledge of a subject. This portion of the work will save an enormous amount of useless thumbing of old journals and hunting for books, and what is better, will put the sources of information before those who have not the time or patience to hunt. *This feature of the work is entirely new and is, therefore, a valuable contribution to the sum of human knowledge.* Do not suppose that original investigation is confined to the laboratory. Much is published and thereby thrown away. The author's investigations have been laborious and expensive, both in time and money, and will, we hope, be duly appreciated.

Every embalmer—and in these days every undertaker is required to be an embalmer—will readily find it to his advantage to have this list of books at his command, and those ignorant of the art will probably find here the most readable article on the subject. These two reasons for its being will assure to Professor McCurdy's thesis a warm welcome.

W. Z. BENNETT, Ph. D. (Harvard.)





*Smithsonian Institution  
Washington, D.C.  
With Compliments of the  
Author.*

## *Embalming and Embalming Fluids.*

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A Graduating Thesis; Course E, Chemistry.

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One of the peculiarities of our common nature is that we seem to pay greater respect to man in death than in life. In the flesh it is the custom to belittle, to disparage, to contemn, to ridicule, to abuse; but when one joins the silent majority, we esteem, eulogize and memorialize him. The tomb is a glamour to the living; beneath it heroes and heroines are made, and not infrequently the earliest murmurs of fame are echoed by the cold clod as it falls upon the coffin lid.

Hearts that have lived lives of stone, minds that have cherished the most sordid and selfish desires toward a fellow being in the routine of life's battle, in death forget all; and the unfriendly and caustic tongue, the covetous and mercenary hand are silent and still and linger alike over the lifeless body and compete in the honors of the mortuary celebration.

Chaplets and the most treasured articles belonging to the deceased are retained that they may be employed as immortelles before the living; and so, by some irrational casuistry, we seek to make amends for the past in the vault, the monument, or the slab which is erected over our departed.

This must be true, otherwise how can one account for the solicitude and veneration shown by all nations in every land, down through the centuries, for the lifeless body? Creed, clime, race seem not to have lessened the sacredness that attaches to that form, once a breathing, thinking, sympathetic being, the moment the divine spark has been snuffed out and that form becomes clay.

All nations, it matters not whether Pagan, Christian, Monotheistic, or Polytheistic, unite upon common ground of *post-mortem* veneration; and, as far as my reading and observation have extended, I have yet to learn of any people, however remote their antiquity, however rude or wild their existence, that have failed to observe sepulchral rites with more or less solemnity. Indeed, may not such observance mark the line between the human and the beast; for no order of the lower animals evinces any distinctive care or affection for their dead. Says one writer: "The annals of the race are revealed by the vestiges of tombs which antedate by ages the historic period, and which still puzzle the most learned of archaeologists."

The present is linked to the past not in memory only, but by the visional signs that mark the silent city in the valley, on wooded hillside, in mountain fastness, behind sculptured walls, or within granite pyramids. The ancestry of man, this earth! who can compute its dwellers! "We are as a handful standing between the billions who have gone and the billions yet to come; on one hand the inheritors of Time, on the other the heirs of Eternity."

And so the disposition of the dead in all ages, whatever may have been its form, however crude and ugly may have been the preparation, has always been attended with a certain degree of respect for the living and sacredness for the deceased. Some conception of religious rites and ceremony seems to have imbued the race from the beginning, its birth, in many cases in form only, stripped of its faith and significance, meaningless in the extreme.

In view, therefore, of the interest which the race has manifested toward the future through all the centuries, resulting from the apprehension of evil or the hope of good, and the reverence and respect accorded to the departed, there have come to be three modes of disposing of the dead: (1) Embalm-

ing; (b) incineration; (c) interment.<sup>1</sup> This paper will consider at length the first mode only.

### I. EMBALMING IN HISTORY.

Embalming in Oriental thought signifies to preserve, to bitumenize, to mummify; in modern language it means to impregnate with poison, or aromatics; to prevent or arrest putrefaction. That object which was so preserved, either artificially or by natural processes, was termed by the ancients a *mummy*; hence mummifying signified the preservation of the body of a human being, animal, bird, fish or reptile, by means of bitumen, spices, gums, natron, or atmospheric causes for a very long period. The nineteenth century use of the term embalming is almost wholly limited to the human species; and the purpose is to arrest putrefaction for a few days, a few months, a few years, or for an indefinite period.

The Christian idea of the future state and ultimate purpose of the body has entirely changed the custom among certain nations in the disposition of their dead. To embalm the body of a dead man with a purpose that the body itself may live again in a future state, is one of the most extraordinary customs ever known to mankind. Its practice evidently implied, says Donnelly, the existence of several factors:

1. A highly religious and imaginative people, controlled and dominated by an influential priestcraft.

2. An implicit belief in the immortality of the soul; hence a belief in rewards and punishments; in a heaven and a hell.

3. A belief in the immortality of the body and its resurrection from the grave on some day of judgment in the great hereafter.

4. Furthermore, a supplemental belief to the last two propositions: that the very flesh and blood in which a man died shall rise with him on the last day and not a merely spiritual body; hence the dogged persistency that the body must not perish.

ORIGIN OF THE CUSTOM. According to Solon, Herodotus,<sup>2</sup>

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<sup>1</sup>Greenhill—The Art of Embalming, of Burial, and of Preserving Dead Bodies, etc., pp. 15-50, 1705 A. D.

<sup>2</sup>Herodotus—History of the World, 5 Vols.

Plato, Plutarch,<sup>1</sup> Donnelly,<sup>2</sup> Winchell<sup>3</sup> and others, the custom of embalming probably originated among the learned Atlanteans who were sun worshippers and who inhabited Atlantis, an antediluvian island, facing the Pillars of Hercules in the mid Atlantic, and from it spread to their colonies and the nations they dominated, to the Guanches of the Canary Islands, to the ancient Egyptians, the Assyrians, the Ethiopians, the Persians, and as a result of conquest to the Greeks, the Romans, and to a limited extent among the Hebrews;<sup>4</sup> while on the American continent the Peruvians, the Aztecs and the Mexicans embalmed their dead.

A few mummies of remarkable preservation have been found [among the Chinooks and Flatheads,<sup>5</sup> and the bodies of the kings of the Florida and Virginia Indians were so preserved; while good mummies have been discovered in considerable numbers among the Dakota or Sioux Indians,<sup>6</sup> and in the caves of Kentucky.

Other rude tribes inhabiting this Western Continent, however disfigured their crude ideas had become with respect to childish superstition and religious fancy, had attained, nevertheless, to the conception of a Great Spirit, Great Father, and the Evil One.<sup>7</sup> In the light of modern thought very many of these traditions vaporize into myths unworthy of serious consideration except as they may serve to illumine our theme and to point out more clearly its origin and the extent of its practice.

Some of these legends in common with those of the Aztecs, recite how, after the deluge, seven persons issued from their tombs where their mummified remains had been consigned, and by them the earth was re-peopled.

The Egyptians gave credence to a like belief, while Dr.

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<sup>1</sup>Plutarch—Parallel Lives.

<sup>2</sup>Donnelly—Atlantis, p. 144.

<sup>3</sup>Winchell—Preadamites.

<sup>4</sup>Bible, Genesis, 1:2.

<sup>5</sup>Schoolcraft, Vol. V, p. 693.

<sup>6</sup>Beverly, p. 47.

<sup>7</sup>Myths of the New World, p. 52.

Brinton<sup>1</sup> states that a similar legend is found among the Sanskrit writings.

However unthinkable such ideas appear in the noonday brilliancy of these closing years of nineteenth century culture and scientific accuracy, still there were people who dwelt along the shores of the Great Southern Continent that possessed more definite ideas and notions of the soul's state, past and future.

The Evil Spirit<sup>2</sup> as well as the Good Spirit undoubtedly influenced the emotions and judgment of those primitive people and gave bent to their conception of the hereafter. This is shown in the care and solicitude with which they sought to preserve the natural body and which they embalmed by a simple process symbolical of their primitive life and thought.

The body was first eviscerated after which it was subjected to exposure in the cold but exceedingly rarified atmosphere of the higher altitudes. Bodies thus treated have been found in Mexico and Central America; also the ancient Peruvians, as witnessed by Garcilasso,<sup>3</sup> preserved the bodies of the royalty without any semblance of foreign applications; and these mummified Incas were secreted in mounds of earth, in temples, or upon typias.<sup>4</sup>

In the temples of the sun at Cuzco, as chronicled by Prescott,<sup>5</sup> these monarchs sat natural as life in chairs of gold, clothed in their former princely attire, their heads inclined, covered with raven-black or silver-gray hair, and their hands placidly crossed over their bosoms as in obeisance to their anointed queens, ranged opposite in the grim dignity of death.

The aboriginal inhabitants of the Canary Islands, the Guanches, and the Atlanteans who spread westward from their island home giving their names to many places and nations, also rudely embalmed their corpses. To further protect the

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<sup>1</sup>Myths of the New World, p. 203.

<sup>2</sup>Yarrow, H. C., First Am. Report Bu. Ethnology, for 1879-89, pp. 130-137,

<sup>3</sup>Prescott—Conquest of Peru, Vol. I, p. 92.

<sup>4</sup>McCulloh—Researches on American Antiquities, p. 392.

<sup>5</sup>Prescott—Conquest of Peru, Bk. II, p. 506.

body it received a coating of varnish, after which it was wrapped in goat-skin and consigned to a wooden case.<sup>1</sup>

It was among the Egyptians, however, that embalming was carried to a high degree of perfection, and has come down to us as one of the "lost arts" of that learned and famous people.

EGYPTIAN CHARACTER AND BELIEF. The ancient Egyptians represented a character singularly devout, and their language, literature and art, as well as their daily lives, were strongly influenced by religion. Their earliest history, according to Diodorus,<sup>2</sup> shows them to have recognized but one God, "who had no beginning and would have no end; who made all things and was not himself made." And this thought is corroborated by the investigations of Pierrett.<sup>3</sup>

De Rouge,<sup>4</sup> however, is of the opinion that the most ancient Egyptians were sun-worshippers, which was the Eternal God, an object that had no beginning and no end and to which were ascribed the attributes named by Diodorus.

But whether the Egyptians worshipped an Eternal God, whose attributes were symbolized by their numerous deities; or whether their god had its basis in a solar myth, variously resolvable, is still a debatable question, an unsolved problem in Egyptology.

Nevertheless it is a fact that whatever was the character of the original, primal belief of the Egyptians it gradually gave way before the inventions and secretiveness of the priest-craft, and the people were led into idolatry and polytheism and worshipped and feared in turn many gods and goddesses, one writer naming seventy-three deities, another sixty-two; while the Egyptians themselves frequently speak of one thousand gods, male and female, principal among which were Osiris and Isis.<sup>5</sup>

From their primitive religion as taught them, it is clear how the Egyptians early evolved their notions of the soul's future state, of the impossibility of its entire separation from

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<sup>1</sup>Prescott—Conquest of Mexico, p. 11.

<sup>2</sup>Diodorus—Historical Library.

<sup>3</sup>Pierrett—Dictionnaire d'arch Egyptienne.

<sup>4</sup>De Rouge—Notice Sommaire des Monuments Egyptiens de Louvre.

<sup>5</sup>Fisher—Outlines of Universal History, p. 38.

the body for all time, hence accepted the logical sequence of the body's preservation.

—The Egyptians believed that after the lapse of many thousand years the souls of their departed would reanimate the body, hence their desire to preserve the same in its natural condition for the proper reception and rehabilitation of its vital force.<sup>1</sup> They certainly believed in a life after death, if not in the immortality of the soul and its judgment of the deeds done in the body. Their religion is said to have had three cardinal requirements: "love of God, love of virtue, and love of man."

With such conception of the migratory soul, and of the essential need and preservation of its earthly tabernacle, my reader will readily understand why embalming was universally resorted to by this people for more than three thousand years. It is stated that upwards of four hundred millions of human mummies were made in Egypt from the beginning of the art until its discontinuance in the seventh century, in addition to the thousands of fishes, reptiles, birds and inferior mammals that were embalmed.<sup>2</sup>

#### 1. THE EGYPTIAN SEPULCHRES.

The great depository of these mummified remains of a once gifted and learned nation was in the Necropoli, near Memphis, and at Thebes; but the curious, the mercenary and the scientific hand have so depleted this vast number as to make it difficult now to secure perfect specimens outside of the museums. Quantities of these wierd yet interesting corpses and carcasses have been appropriated for fuel by the Arabs; while whole ship loads have been converted into manure by the avaricious Englishmen for the growing of turnips.<sup>3</sup>

A REMARKABLE DISCOVERY. It has been only within the past quarter of a century, however, that Egyptologists have had their interest quickened, their knowledge greatly increased and have stood fairly bewildered before the wonderful discoveries which have made the Boolak Museum, at Cairo, a famous

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<sup>1</sup>Meyers—General History, pp. 37-39.

<sup>2</sup>The American Cyclopaedia, Vol. II, p. 38.

<sup>3</sup>Donnelly—Atlantis, p. 181.

repository of men of royal blood "who died and were made imperishable flesh by the embalmer's art between three and four thousand years ago."

To Professor Maspero, the director-general of the excavations and antiquities of Egypt, and Emil Brugsch Bey, Curator of the Boolak Museum, belong the credit and coveted honor of breaking the secrets of the rocky caverns, and for a money consideration, prompted by jealousy and avarice, induced a native Mohammedan to divulge his secret whereby these scholars were permitted "to put their hands not upon a royal tomb, but upon a hiding place wherein were piled thirty-six mummies of kings and queens, princes and high priests" in an excellent state of preservation, truly a marvellous disclosure of incalculable value to the students of archaeology and of the embalmer's art.

**THE THEBAN TREASURES.** The scene of this extraordinary discovery, according to Maspero,<sup>1</sup> was in the bottom of a pit in one of the loveliest nooks in the western cliffs of Thebes. The story of this resurrection, as told by several writers,<sup>2</sup> is most interesting and thrilling to the reader, and to the immediate explorers a sensation wierd and awful, growing more intense with each step as the treasures of the hoary past were unfolded to their view.

"The story of its finding is more romantic than any told in Egypt since Isis gathered the scattered remains of Osiris and buried his head within the alabaster temple of Abydus."

Says Edwards:<sup>3</sup> "Slowly, with difficulty treading their way among desecrated tombs, and under the shadow of stupendous precepices, they followed their trembling guides to a spot unparalleled even in the desert, for gaunt solemnity. Here, behind a huge fragment of fallen rock—perhaps dislodged for that purpose from the cliffs overhead—they were shown the entrance to a pit so ingeniously hidden that one might pass it twenty times without observing it. Into this pit they were lowered. The shaft carved through the solid limestone, was two metres square by eleven and a half metres in depth, and ended in a narrow, subterranean passage trending westward. Onward it led for

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<sup>1</sup>Maspero—A la Societe d'anthropologie de France.

<sup>2</sup>The Century Magazine, May 1887, pp. 327.

<sup>3</sup>Edwards—A Thousand Miles up the Nile, Harper's Magazine, No. 386, pp. 185-204.



more than seven metres, then turned off abruptly to the right and stretched away northward in endless night and awful gloom."

"Now stooping when the roof was low, now stumbling when the floor was uneven, now descending a flight of roughly hewn stairs, and with every step penetrating deeper and farther into the bowels of the earth, the intruders, groped their way, each with his flickering candle in hand. Pieces of broken mummy cases and fragments of linen bandages strewed the floor; for the mercenary and extortionate Arab for years had been profiting by his secret. Against the walls were piled boxes, filled with porcelain statuettes, libation jars of bronze and terra cotta, and canopic vases of precious Lycopolitan alabaster."

"Then came huge sarcophagi of painted wood, and farther on still, some standing upright, some laid at length, a crowd of mummy cases fashioned in human form, with folded hands and solemn faces and ever wakeful eyes, each emblazoned with the name and title of its occupant."

"The men of to-day brought face to face with the greatest kings of Pharonic Egypt, stood bewildered, and asked each other if they were dreaming. Expecting to find a few petty princes of the Her-Hor line only, they found themselves confronted by the mortal remains of heroes who till this moment had survived only as names far echoed down the corridors of time."

"Farther on they stood on the threshold of a sepulchral chamber literally filled to the roof with sarcophagi of enormous size; brilliant with color and gilding they were as highly varnished as though but yesterday it were done."

In these burials each member was accorded the usual mortuary outfit, accompanied by his favorite pet animal, bird, jewel case, statuette or manuscript; but richer in this world's goods than any of the rest was queen Isi-em-kneb.

Besides statuettes and libation jars, she was richly furnished with a sumptuous funeral repast consisting of gazelle-haunches, trussed gesse, calves' heads, dried grapes, dates and nuts, the meats being mummified and bandaged and the whole packed in a rush hamper, sealed with her husband's unbroken seal.

And perchance this queen of Egyptian lore might still be wanting in some comfort, she was provided with ointments, alabaster cups, goblets of exquisite variegated glass, and a marvellous collection of huge full-dress wigs, curled, frizzed and perfumed, in separate basket. As the food was entombed with her for refreshment, so, evidently, were these things deposited in the grave for her use and adornment at the supreme hour of bodily resurrection when the justified dead,

clothed, fed, perfumed and annointed should go forth from the sepulchre into everlasting day.

From all accounts, this wonderful chamber in the mountain's fastness was not the original tomb of those royal personages. In the twelfth century sudden alarm caused their removal from the royal sepulchres, and when danger had passed, the secret cavern was undoubtedly forgotten, and its precious dead silently awaited the passing of the centuries to the morning of the new civilization to do honor to their ancestral learning and to the embalmer's skill.

Strange and peculiarly fascinating are these facts; but I must not longer pause for their consideration.

It was on the second of July, 1881, that the Arab divulged his secret, Judas like, for a pot of "bakhshish," and within a fortnight thereafter this ancient sepulchre had been depleted of its illustrious dead, borne away, honored enroute by the villagers, after three thousand years of sepulture, to the gates of Cairo, for the Boolak Museum, there to infuse fresh life into historical research and to illumine more brightly the dim page of Egyptology.

## 2. EGYPTIAN METHODS OF EMBALMING.

The art of mummifying among the Egyptians was confined to a special class,<sup>1</sup> the physicians; for we are informed that "Joseph commanded his servants, the physicians, to embalm his father; and the physicians embalmed Israel."<sup>2</sup> These men were held in high honor and were treated with much consideration; for their profession was hereditary.<sup>3</sup>

There have come down to us through Herodotus,<sup>4</sup> Diodorus,<sup>5</sup> Solomon and other ancient writers, quite accurate and full details of this phase of the physician's art. More recent study by Bunfrey, Erman, Muller, and Budge has only confirmed and elaborated these details. Four methods of embalming were in vogue, suited to the social standing and wealth of the deceased. The most expensive method, the one given the

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<sup>1</sup>Meyers, *General History*, p. 37.

<sup>2</sup>Bible, Genesis, 1:2; Luke xii; xxiv:1; John xix:39-41:

<sup>3</sup>Budge, *The Mummy*, p. 180.

<sup>4</sup>Book II, 36-89. *Historiarum*, lib. ix, ed. Schweig, 1817.

<sup>5</sup>Book I, 91. *Bibliothecae Histor.*

royalty, titled personages, and men of wealth, may be summarized as follows:

1. The body was first washed, then laid upon the ground, when an assistant traced with ink over the bowels indicating the lines where the surgeon's knife or sharp flint was to pierce. The intestines, stomach, liver, heart and lungs were removed; washed, saturated with palm oil, stuffed with aromatic gums and spices; and finally smeared with unguent and bandaged carefully with linen many yards in length and variously inscribed with the names and insignia of the gods which took the parts under their special protection.<sup>1</sup> Each portion so removed was securely sealed in a decorated, alabaster jar; the name of the deceased painted thereon that it might not be lost or misplaced, and each jar dedicated to a particular god. It was considered of the highest importance to have the portions preserved intact; for without them a man could not hope to live again. Not always, however, were the intestines<sup>2</sup> so carefully treated; in mummies of the best period these parts were sometimes placed in packets beneath the bandages.

The brain was next removed through the nostrils by the aid of an iron rod, crooked at one end; and with so much skill and thoroughness as not to impair the bridge of the nose, or to leave any of the soft tissues. This, too, was preserved, dried and buried with the body.

The perishable portions having been removed, the body was laid to cure in a quantity of natron—a solution of carbonate, sulfate and chlorid of soda—for seventy days. When completely saturated, the body was removed from the bath, washed and dried; when, we are told, "it presented a greenish-gray color, the flesh shrunken, the skin adhering loosely to the bones, the nails clear, while the face though more drawn and thin, was changed but little."

Slits were made in the fleshy portions of the fingers, toes, arms, and legs, then filled with myrrh, balm,<sup>3</sup> cassia, other spices and natron and set up.

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<sup>1</sup>Pettigrew—*History of Egyptian Mummies*, p. 58.

<sup>2</sup>Plutarch—VII, *Sap. Conv.* XVI, ed. Didot, p. 188; also *De Carniam Esu.* p. 1219.

<sup>3</sup>Penicher—*Traite de Embaumemes*, p. 2, enumerates four species of balm used in embalming: (a) Judaea, (b) Syria, (c) Egypt, (d) Mecca.

The cavities of the skull, the chest and bowels were filled with myrrh, frankincense, cassia, gums, powdered plaster and some bitumen; obsidian eyes were implanted in the sockets; the nails were stained with henna;<sup>1</sup> finger rings and other ornaments were restored; while a gold plate was neatly inscribed, dedicated to Horus, and placed upon the breast.

At intervals during the process of mummification, it is recorded that prayers appropriate to each stage of the work, were recited to various gods beseeching their approval of the embalmment, and of their continued care of the dead in the nether world. Various beads, jewels, the Book of the Dead, and other insignia were laid upon the body, after which it was ready for bandaging.

The body was first smeared with unguents; linen was torn into strips, gummed, moistened, then firmly wrapped about each finger, toe, hand foot, arm and leg until the little irregularities were rounded out by padding; again prayers were said; several hundred feet more of linen were consumed, and the embalmer's work was completed.

This was not all. The coffins, two in number, an outer and an inner one, had been steadily approaching completion during the long period of disembowment, cleansing and curing of the body. Skillful hands had been at work on sycamore wood fashioning the inner coffin after the form of a man, ornamenting it with a carved, human face with bronze eyelids and obsidian eyes, handsomely painted and variously inscribed within and without. Hands were not forgotten; clothes, food, anything the dead may need in his long journey were all provided for. In this elegant casket the mummy was laid, sealed and placed within the outer coffin; again blessed and sealed, and the departed worshipper of Osiris was ready to be carried to his everlasting home in the Theban hills, there laid to rest in a sarcophagus of stone.

The expense of this treatment varied from \$1000 to \$1500,<sup>2</sup> sometimes much greater. There were cheaper methods of

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<sup>1</sup>Denon Voyage dans Egypte, tom. II, p. 33.

<sup>1</sup>Madden, Travels, Vol. 11, p. 90.

<sup>2</sup>Diodorus Siculus, Lib. I, p. 91. The first method cost a talent of silver (\$1125); the second method twenty minae (\$375); the third a much smaller sum.

embalming which I shall presently describe; but at the best I do not see how Egyptians of the ordinary class could possibly afford to die. They, no doubt, lived longer than they otherwise would, prompted by a prudent economy to avoid the extravagance of burial as long as possible.

2. The second method of embalming in vogue among the Egyptians was much less expensive, being about \$300, and much less elaborate. No incisions were made for the removal of the entrails and chest organs; but the abdomen was filled with oil of cedar by injection through the fundament; having prevented the escape of oil the body was steeped in natron for the prescribed number of days. On the last day the oil was ejected which brought with it the intestines and vitals in a state of dissolution; the natron dissolved the softer flesh and nothing remained practically but the skin and bones. Later the body was returned to the relatives without further operation other than bandaging.

3. The third and cheapest method employed, adopted usually by the poor, consisted in thoroughly rinsing the body in syrmae, then steeping in natron for the usual period.<sup>1</sup> Sometimes the body received little more than a rubbing with these substances, wrapped in a single piece of linen and returned to the friends.

The bodies of the very poor were preserved by two very cheap modified methods of the above:

(a). This first consisted of soaking the body in a solution of hot salt and bitumen.

(b). The second in salt only.

By the first method bitumen filled the cavities; the eye brows, hair and nails were destroyed. Such treatment explains the origin of the word "mummy"<sup>2</sup> which is derived from the Arabic, and means a "bitumenized thing," or body preserved by bitumen.

By the second or salted method, the skin had a very papery appearance; features were greatly changed, and the bones were white and brittle.

These latter processes would suggest the application of

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<sup>1</sup>Carey's Translation, pp. 126-127.

<sup>2</sup>Weidemann—Herodotus Zweites Buch; Leipzig, 1890, pp. 349, 358.

heat as a final impregnation of the body with bitumen; and recent investigation has supported this theory. Why the application of heat, and thereby the generation of creosote and its diffusion through the tissues, was not mentioned by the ancient authorities is not known; but evidently they wished the process to be kept a secret and thus enhance the dignity and mystery of the art. M. Rouyer, I find, also conceives that the bodies must have been put into stoves, or kept at a high temperature. He says: "Cette opération, dont aucun historien n'a parlé, étoit sans doute la principale et la plus importante de l' embaumement."<sup>1</sup>

4. The Egyptians and Hindoos also preserved their dead in honey, particularly infants and inferior animals.<sup>2</sup> Budge informs us that the body of Alexander the Great was preserved in unmelted, white honey.<sup>3</sup>

Only the rich and well to do received a costly or even a decent burial after their embalmment. "The poor were laid in a hole or cave, or even in the sands of the open desert, to set out on their last journey." Such disposition of the dead cost very little, indeed, probably not to exceed that of the average pauper funeral of the present day.

ANIMALS EMBALMED. In addition to the human species that were embalmed, the practice extended to the most common of the mammals, reptiles, birds, and fishes which the Egyptians deified or regarded as sacred to the gods, and which they mummified with great reverence and care. These were: the bull, antelope, jackal, hippopotamus, cat, monkey, crocodile, ichneumon, hedgehog, shrew, hawk, frog, toad, scorpion, beetle, snake, oxyrhynchus and silurian fishes; or more than fifty species in all.<sup>4</sup>

Rawlinson states that the sacred bull fared even better than his associates in the list, being carefully embalmed and deposited together with costly jewels, statuettes and vases in polished granite sarcophagi, specially designed. The cost of an apis funeral amounted sometimes to as much as 20,000

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<sup>1</sup>Rouyer—Description de l'Égypte, p. 212.

<sup>2</sup>Abd-el-Latit—Translation of DeLacy, p. 169.

<sup>3</sup>Budge—History of Alexander the Great, p. 141.

<sup>4</sup>Budge—The Mummy, p. 355.

<sup>5</sup>Pettigrew—History of Egyptian Mummies, pp. 178-180.

pounds sterling; and the number of apis bulls buried in the galleries around Memphis was found to be sixty-four.<sup>1</sup>

### 3. EFFECT OF CHRISTIANITY.

The art of mummifying met its death blow in the spiritual thought ushered in by Christianity; for the hope of the resurrection of the body as taught by Christ, practically killed the custom as early as the third century, though the practice was not entirely given up until the seventh century; while the linen and silk industry connected therewith continued to meet with success until the twelfth century of our era.

Mummification had prevailed through many dynasties with varying modifications, both as to the solutions and spices employed, and the mode and character of the wrappings. How far the custom extended beyond the historical period, that of King Menes, 4400 B. C.; and whether it originated with the nations to the east or to the west of Egypt, *authentic* history is silent thereon. Maspero<sup>2</sup> informs us that the oldest mummy in the world is that of Seker-em-saf, son of Seti I., B. C. 3200, found at Sakkarah in 1881, but since removed to Gezeh.

According to Manetho, thirty dynasties of kings and queens were thus prepared for burial. Many are the missing links in this chain of Egyptian history, and it is doubtful if the Egyptologists will ever succeed in discovering all the intervening data so as to properly classify and make clear and complete this wonderful record of a most remarkable people.

### 4. MODERN VIEW OF EMBALMING.

But enough of the past with its blackened mummies, its disjointed history, and its mystified theology! Passing over the interim we come now to the full brightness of funeral science and medical skill in the dawn of the twentieth century, scanning the passing centuries for such information only as will make more clear the art of embalming as taught by Chaussier, Gannal, Boudet, Renouard, Clarke, Sullivan, Barnes, Perrigo, Hohenschuh, Parcelly and others.

Embalming is not as difficult a feat as many suppose; the so-called "lost art" of the Egyptians is regarded as more of a

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<sup>1</sup>American Encyclopaedia, Vol. XII, p. 38.

<sup>2</sup>Maspero, Guide des Visiteurs au Musée de Boulaq, 1883, p. 347.

delusion than a fact. The methods practiced to-day are far superior to those in vogue three thousand years ago. In all other phases of human life, a progress most wonderful and marvelous has kept pace with the centuries, why not in this one under consideration?

In fact, the methods of embalming as taught and practiced in the present, demand a higher order of intelligence, a more thorough knowledge of the anatomy of the body, a steadier judgment, and a more skillful hand than was at any time required of or presented by the ancients who *relied largely upon atmospheric influences for the preservation of their dead.*

The mummies prepared under Egyptian skill were scarcely recognizable; while on the sands of Gobi, Arabian, Sahara and Great American deserts bodies have been found in a perfect state of preservation, a score of years after death.

Were modern embalmers so disposed, I have no doubt they could attain to the preservative excellence of their ancient brethren, indeed far surpass them, and prepare our dead for the judgment day; but embalming except for temporary convenience, as a rule, is not deemed desirable here or in Europe; and as it forms no part of the theological system of Christian nations, we have no ambition to rival them in mummification.

However the comparatively modern methods of embalming were not so very crude, and hence they are able to present abundant evidence for their support. The body of Charles I was easily recognized after one hundred and sixty-five years; King Edward I, buried in 1307, was found entire four hundred and sixty-three years later; Canute died in 1036, yet his body was in a fresh state of preservation seven hundred and forty years afterwards; and the bodies of William the Conqueror and his queen, Matilda, were intact in the sixteenth century after the lapse of more than five hundred years.<sup>1</sup>

And so, instead of long and costly funeral pageants, characteristic of the dwellers of the Nile, the erection of pyramids, the carving of magnificent sarcophagi within the catacombs of Thebes, at Rome, at Naples, Syracuse, Palermo,<sup>2</sup> or at Athens, or in secret caverns in the mountain's fastness, our

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<sup>1</sup>Renouard—Undertakers' Manual, p. 213.

<sup>2</sup>The Casket, Vol. XX, No. 10, p. 15.



modern sepulchral vanity manifests itself in choice epitaphs and sepulchred monuments, family vaults, or is more sensibly contented with the incinerated remains of the departed as preserved in the urn, instead of in desiccated forms and bituminized disguises of death.

Furthermore, the aesthetic character of all Christian nations and peoples would protest against the continuance of so extraordinary, if not barbarous practice, which made death more hideous to the vision, more repulsive to the sensibilities of a refined and devout soul, than it could possibly be made by the supremest superstition.

## II. EMBALMING IN SCIENCE.

Science is classified knowledge, the result of careful observation and experiment founded on experience and interpreted by the mind. Science, therefore, is the intellectual apprehension of whatever is objective in nature, or in the sphere of mathematics, pure and applied; a searching after the essentials wherever there is a complexus of impressions, mathematical, physical or mental; to ascertain the cause of an effect that has a logical sequence of phenomena; and to group, classify and arrange wherever there is a multiplicity of details.

In no business or profession are these principles more fully tested and require more skill in the application of them, if success be the end sought for, than in embalming; a cool head, a clear mind, a knowledge of what to do and how to do it are prime requisites to success.

The essentials, therefore, that the novice should seek to acquire and of which the expert embalmer must be master are:

1. An anatomical knowledge of the organs composing the head and trunk regions of the body.
2. A knowledge of the physical effect of disease, poison and death on the tissues.
3. What treatment to apply externally and internally to successfully disinfect and mummify the body.
4. A reliable embalming fluid and cabinet.
5. A knowledge of disinfectants and their application.
6. A good library.

These six essentials I now purpose to discuss at some length.

1. DIVISIONS OF THE HUMAN BODY.<sup>1</sup>

The human body is divided naturally into four parts: (a) the head; (b) the trunk; (c) the upper extremities; (d) the lower extremities.

The head consists of the skull with its various cavities and appendages.

The trunk is subdivided into two large cavities—the thoracic and the abdominal. The former cavity contains the heart, lungs and their corresponding envelopes; in the latter cavity are located the stomach, liver, spleen, pancreas, kidneys, bladder, the intestines, and in the female, the uterus.

Separating these two cavities, convex above, concave below, is the diaphragm, a muscular organ, pierced by the oesophageal, aortic and caval openings, and which aids in respiration.

Both cavities are air-tight and the entrance thereto is by the mouth and the openings above named; the exit therefrom is through the fundament.

*Heart*—This muscular organ lies obliquely in the chest, near the middle line, with its apex to the left where it may be felt between the cartilages of the fifth and sixth ribs, beating off the seconds of life. In the aves and mammalia the heart is four-chambered, the right and left auricles above, the right and left ventricles below. Its weight varies from eight to ten ounces in women and from ten to twelve ounces in man.

The function of the heart is to receive the dark, venous blood from the entire body through the superior and inferior vena cava into the right auricle, pass it to the right ventricle through the tricuspid valve, thence to the lungs for aeration by the branched pulmonary artery, whence it is returned by the pulmonary veins to the left auricle, passed to the left ventricle through the mitral valve, then into the aorta from which point it is distributed over the entire body in an ever ceaseless round while life lasts. The heart floats in a fluid inclosed in a loose bag, the pericardium.

This muscular organ is the hardest worked of all in the body; it beats seventy times per minute in health, sending

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<sup>1</sup>NOTE.—The author's extended experience in dissecting and in teaching anatomy and physiology have familiarized him with the following facts.

out through the aorta six and one-third ounces at each beat. The work done by both ventricles daily is equivalent to lifting one hundred and ninety-three tons one foot high. No wonder this tireless organ succumbs to disease and men die of "heart-failure"!

*Lungs.*—These consist of two elastic bags filled with air and are the principal organs of respiration. The heart divides them into two parts, the right having three lobes; the left, two. They are supported from above by the bronchial tubes which terminate in a capillary net work of air cells whence arises the pulmonary veins. The lower portion of the lungs rests upon the diaphragm, while the entire lung tissue is enveloped by the pleura.

*Abdomen.*—The contents of this, the largest cavity of the body, have been noted. The dissection of a cat or a cadaver will show the position of the organs as follows:

Immediately below the diaphragm, rather more to the right than to the left side, is a dark, reddish-brown organ, the liver, glandular, soft and pliable in texture, whose weight is from fifty to sixty ounces. On its under surface may be seen the gall bladder, several ducts and blood vessels; below and on the left is the anterior surface of the stomach; to the left of the stomach hidden by the lower ribs is the spleen; and behind lying transversely across it is the pancreas. The omentum reaches downward from the stomach and discloses the transverse colon, and the portions of the small intestines—duodenum, the jejunum, and the ileum; to the right below is the caecum; to the left, about equally distant, is the sigmoid flexure; the kidneys lie at the back of the cavity opposite the lumbar vertebrae, one on each side of the spine; the ureters carry the secretions to the urinary bladder below, thence through the urethra to the exterior of the body.

The organs of the abdomen are enveloped in the peritoneum, a serous membrane, smooth and soft; that portion inclosing the intestines is termed the mesentary and contains the lymphatic glands.

## 2. THE VASCULAR SYSTEMS.

Next to a knowledge of the character and location of the vital organs above enumerated is necessitated a thorough

acquaintance with the circulatory systems of the body; for, in embalming, the raising of the proper arteries and injecting therein a reliable fluid is oftentimes the only thing necessary to do while awaiting interment of the body.

The vascular system<sup>1</sup> as a whole consists of two main divisions: (1) the blood vascular system; (2) the lymph vascular system.

The organs of circulation are the heart and blood vessels; the latter are of three kinds,—arteries, capillaries and veins. The heart requires no further exposition here; the arteries carry bright, red blood from the heart to the capillaries; are highly elastic and extensible, retaining their form when cut and are composed of three coats: (a) a white connective tissue or ectal coat outside; (b) a middle coat of circular, muscular fibres; (c) the ental or inner coat. The capillaries in structure are simple, a continuation of the epitheloid layer of the arteries. The veins contain valves, are similar in structure to the arteries, but of thinner wall, hence collapse when cut.<sup>2</sup>

To master the process of embalming by arterial injection it is essential to have a clear conception of the location of the larger blood-vessels.

As noted, the aorta springs from the left ventricle of the heart, ascends forward to the right, curves backward to the left, and passes downward on the left side of the vertebral column to the fourth lumbar vertebra where it divides into the arch and thoracic aorta, and piercing the diaphragm becomes the abdominal aorta.<sup>3</sup>

It should be remembered that each side of the body is provided with its corresponding divisions of the aorta, hence there are the right and left carotid arteries, the right and left jugular veins. In this connection only the most important arteries will be named.

From the convexity of the arch of the aorta there arises (a) the coronary arteries which nourish the heart; (b) the innominate artery, short and subdivided into the right subclavian and right common carotid; the left common carotid and left subclavian.

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<sup>1</sup>Wilder and Gage—Anatomical Technology, p. 315.

<sup>2</sup>Weidershein—Comparative Anatomy of the Vertebrate, p. 228.

<sup>3</sup>Martin—The Human Body, pp. 210-214.

The carotid arteries ascend the neck, on the sides of the windpipe, branching into (a) external—to the temple, scalp, face and salivary glands; (b) internal—to the parts within the skull.

The subclavian artery takes the name axillary in the arm pit, brachial in the upper arm, and at the elbow-joint divides into the ulna and radial which lead down the forearm into the hand and fingers.

Concerning the aorta<sup>1</sup> in the thorax the intercostal arteries traverse the ribs and chest-walls, the bronchial and smaller arteries nourish the lungs and other tissues; in the abdomen the cardiac axis supplies the stomach, spleen, liver, and pancreas; the venal arteries feed the kidneys; while the mesenteries and phrenic arteries furnish substance to the intestines and diaphragm respectively.

In the lumbar region, the aorta divides into a trunk and two external iliacs, the trunk again dividing into the internal iliacs and caudal artery which feed the pelvic organs; while the right and left external iliacs lead respectively to the foot through the femoral in the thigh, the popliteal at the knee-joint, and the tibial and peroneal arteries in the leg.

The arteries terminate in the capillaries, microscopic vessels one-fiftieth of an inch long, whose diameter varies from one fifteen-hundredth to one three thousandth of an inch and through which only two or three corpuscles can pass abreast.<sup>2</sup> These tiny vessels ramify through every part of the tissues in life, nourishing and carrying away the oxidized matter.

Thus far the circulatory system may be compared to a tree with a trunk—the aorta; its branches, large and small—the carotid, ulna, renal, femoral and tibial arteries; its leaf circulation—the capillaries.

The veins have their origin in the capillaries, mere veinulets at first, but unite and reunite until the vena cava discharge their contents into the great central station of human existence.

As the blood circulates only one way through the body and cannot be reversed because of the valves in the veins, so the injection of antiseptic fluids into the blood-vessels must

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<sup>1</sup>Howell—Dissection of the Dog, pp. 44-54.

<sup>2</sup>Flint—Human Physiology, p. 79.

follow the same course, the operator piercing the veins only to permit the exit of the blood forced out by the fluid injected into larger arteries.

The great vascular system that I have described thus briefly is now regarded, technically, as having three divisions:

a. The *Systemic*, consisting of the flow of blood from the left side of the head to the right through nearly the entire body.

b. The *Pulmonary* from the right ventricle of the heart to the left auricle, through the lungs.

c. The *Portal*, which collects the dark blue venous blood from the stomach, pancreas, spleen and intestines into the portal vein leading to the liver, ramifying in every portion of that organ until discharged through the hepatic vein into the post-cava.

### 3. THE INTERNAL MEDIUM.

There is everywhere present in the body an internal or circulating medium which fulfills the same function towards the individual cells and the tissues that air, water and food do to the entire body. This medium the physiologist terms the plasma, or primarily the blood and lymph.

The blood circulates through the blood vascular system; while the lymph is the transuded liquid from the capillaries, due to osmotic processes, which finds its way back, together with the lacteal fluid, through the lymph system into the larger blood-vessels near the heart, thus ever renewing the impoverished blood and carrying off its poisonous gases.

COMPOSITION OF THE BLOOD. The blood is composed of two distinct elements: (1) the blood plasma or *liquor sanguinis*; (2) the blood corpuscles: (a) red, (b) white, (c) plaques.

The plasma is a pale, straw-colored liquid which penetrates every nook and corner of the body; it floats the corpuscles and tissue wastes.

The corpuscles vary in color, size and function. The red, whose color is due to haemoglobin, are, says Robin, one three thousand four hundred and thirty-seventh of an inch in diameter in man; they constitute one-half of the mass of the blood; and are the carriers of oxygen to the tissues. The white corpuscles or leucocytes are in proportion to the red as one to one thousand; diameter, one twenty-five hundredth of

an inch; the function is still an unsolved problem, unless, as pointed out by Bizzoyero, Martin and others, these bodies and the plaques aid in the coagulation of the blood.

In health the blood has a characteristic odor; slightly saline in taste; in reaction slightly alkaline; in color varying from red to dark blue; temperature, 98° F. All this is changed in disease, while after death the corpuscles undergo decomposition and clotting ensues.

Andral and Gavaret have fully elaborated this branch of chemical pathology and have proved that in diabetes, cholera, hemorrhages, fever and acute inflammation the composition of the blood is radically changed, as in cholera when the blood becomes so thick as to arrest circulation.

The embalmer cannot afford to be in ignorance of such knowledge of his art, otherwise his deficiency may compass his defeat and failure of the subject in hand.

According to Lecaun, an analysis of the blood and serum in the human subject in both sexes yields:

Water,	. . . . .	75.00 parts.
Albumen,	. . . . .	5.00 “
Globules,	. . . . .	7.14 “
Fibrin,	. . . . .	0.20 “

Martin states that about one half of the mass is composed of corpuscles, the remainder plasma. When exposed in a vacuum one hundred volumes of blood yield about sixty of oxygen, carbon dioxid and nitrogen. In one hundred parts of serum, ninety per cent is water; eight and five-tenths per cent are proteids; and one and five-tenths per cent, fats and salts.

The moist corpuscles yield fifty-six parts of water and forty-four of solids; of the latter ninety per cent is haemaglobin; eight and five-tenths proteids; one and five-tenths salts, chiefly chlorid and phosphate of potassium.

The total blood in the body is about one-thirteenth of its entire weight; its specific gravity averaging one and fifty-five thousandths.

The lymph is a colorless, watery fluid; feebly alkaline; contains no red corpuscles, but a quantity of carbon dioxid; specific gravity, one and forty-five thousandths. The lymph flowing from the intestines upward through the thoracic duct is known as chyle, a white, milky fluid, rich in nutriment.

COAGULATION OF THE BLOOD. The clotting or coagulation is a most remarkable, far-reaching and life-sustaining property; dispossessed of it and the slightest hemorrhage, or finger abrasion would eventually prove fatal.

This quality of the blood finds its basis in certain proteids present—*fibrinogen*. It is held that the leucocytes and plaques by their disintegration produce a substance—*fibrin ferment*, which converts the fibrinogen into fibrin; this active principle, aided by fibrinoplastin and certain salts, causes the blood to separate into clot and serum, when withdrawn from the body. If a solution of sodium sulphate or potassium nitrate be added to newly drawn blood, its coagulation is prevented. I have dissolved clotted blood by digesting it in a strong solution of nitre, a fact the practical embalmer should bear in mind.

Now, in a lingering death clotting may set in at the extremities before life has become extinct; at any rate from twelve to fourteen hours after circulation ceases clot forms in the chambers of the heart, and chiefly in the venous system as the arteries are usually emptied by post-mortem contraction of their muscular coat. This clot must be removed and the vessel cleared before a foreign fluid can be injected in any considerable quantity.

This may be effected as follows, a process I have often used when injecting a colored fluid into the blood-vessels preparatory to the dissection of a cat, dog, or a rabbit. With a scapel make an incision and carefully raise the blood-vessel and into the aorta where it leaves the heart, in the carotid, or the femoral artery, insert a cannula; then make a cut in the right auricle or jugular veins, and inject with a syringe a solution of nitre, or a six per cent solution of common salt. Continue the injections and ejections until all the blood has been washed out, after which the arteries and veins may be filled with any reliable fluid until the vessels are full or the tissues saturated.

#### 4. PRACTICAL INSTRUCTION INDISPENSIBLE.

A thorough knowledge of the other organs and systems of the body is essential for him who would succeed in this art; but the limitations of this article and the patience of my reader make it impossible to discuss at length their condition



in health, in disease and in a post-mortem state; also the special treatment to be given each subject as varied by its physical organism, character of the disease and mode of death.

In view of all this, I must refer the student to special treatises on the subject which are most instructive and entertaining. Among the many may be named Clarke's "New Work on Embalming," Sullivan's "Practical Embalming," Lessley's "Treatise on Embalming," Parcelly's "Etude Historique et Critique des Embaumements," Barnes's "The Science and Art of Embalming," Laskowski's "L'embaumement et la conservatiore des subjects," and the invaluable articles to be found in the trade journals from time to time.

In addition to the hundreds of manuals and scores of periodicals that are now available, rich in the literature of the science, there are "schools of embalming"<sup>1</sup> conducted by masters of the art in several of the large cities in America where the science and art are thoroughly taught and to which the embalmer should go from time to time for practical instruction. No progressive undertaker should be satisfied with anything short of the most advanced methods in this art which is comparatively in its infancy, as now taught.

The era of the ice-box for the preservation of the human dead is past. Freezing is only a temporary delay of putrefaction and when thawing sets in decomposition is rapid and offensive. The era of an intelligent use of chemicals is at hand. No longer the slow putrefaction, the obnoxious stench, the miasmatic effluvia, the poisonous gases of contagious diseases and plagues impregnate the soil, pollute the water we drink and the air we breathe, endanger the health of the community, or shatter the thought and religious sensibilities of the living. A thoroughly embalmed body will not become offensive, but when laid away 'neath the pines in the Silent City, in hallowed ground, or in granite tombs, to await the

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<sup>1</sup>Sullivan's Massachusetts School of Embalming, Boston.

<sup>1</sup>Renouard's United States School of Embalming, New York.

<sup>1</sup>Barnes's Chicago College of Embalming, Chicago.

<sup>1</sup>Ferguson's Ontario School of Embalming, Toronto.

<sup>1</sup>Rooney's National School of Embalming, New York.

<sup>1</sup>Clarke's School of Embalming, Springfield, O.

<sup>1</sup>Hohenschuh's Iowa School of Embalming, Iowa City.

judgment day, gradually dries, cures, hardens, until it is in a perfect state of mummification.

Mr. W. H. Devore,<sup>1</sup> of Pittsburg, Pa., has succeeded so well in the restoration of the art of mummification as to be able to exhibit at his establishment the mummified bodies of two adult human beings which were embalmed about twenty years ago. The bodies are somewhat shrunken, but the features have not changed so much as to be unrecognizable to those who knew them in life. The process is a secret which lies hidden away in the mind of the experimenter and inventor.

### III. EMBALMING IN PRACTICE.

There are in vogue two leading methods of embalming:

1. Cavity embalming or cavity injection.
2. Arterial injection.

And just here the writer would confess his deficiency in a thoroughly practical knowledge of, and an extended experience in the art; but he has often assisted masters of the art and physicians in preparing remains for interment; and is familiar with the use of the ice-box and with the process of cavity injection.

**SIGNS OF DEATH.** Before beginning the operation of embalming a subject, it is essential to know that life is extinct; there should be no doubt of this fact. Ordinarily this is certified to by the family physician. The apparent indications of death are not always sure, hence the necessity for a few reliable tests.

The post-mortem rigidity or *rigor mortis* of the arms, neck, and muscles is evidence that life is extinct; the failure of the nervous system to respond to a blister on the arm, says Clarke, and the absence of moisture when burned is another; the disappearance of the pinkish lines between the fingers is a third indication; the want of irritability of the muscles under the battery; the putrefaction of the tissues, and the cadaverous appearance of the countenance all testify to the exit of life. On the other hand, the use of the mirror, the cessation of the circulation, or the appearance of the blood are not reliable proofs, in all cases, that the spark of life has been snuffed out and the soul has taken its flight.

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<sup>1</sup>The Casket, Rochester, N. Y., Vol. XX, No. 10, p. 2.

## 1. CAVITY EMBALMING.

This is the simplest method of embalming now used and is exclusively employed when it is known that the body will not be disturbed and that interment will shortly follow.

The process consists in placing the body in a horizontal position on an ordinary cooling board with an adjustable head-rest. Renouard<sup>1</sup> recommends that the board be provided with a raised border, open at the foot; this prevents the soiling of the carpet, as the drippings may easily be caught in a pail. The head should be elevated only a few inches, says Sullivan, after which sponge the entire surface of the body with a good fluid. If gases accumulate they may be removed by the introduction of the trocar a little below the ribs on the left of the medial line. Direct it upwards and inject about a quart of fluid into the thorax; withdraw the instrument and direct it downwards into the abdomen, puncturing the stomach and intestines, if distended with gases, and inject from a pint to a quart of the fluid. On withdrawing the trocar securely close the incision.

According to Clarke, the lungs and stomach may be injected through the trachea and oesophagus respectively. Finally Robinson recommends that the body be carefully wrapped or covered with cloths, saturated with the fluid, that the skin may become impregnated and absorb it inwardly.

Should there be a tendency to "purge,"<sup>2</sup> a condition not infrequently met with, lay the body on its side, head downward, and by pressure expel the fluid contents of the stomach through the mouth and nostrils. Refill the large cavities with the fluid and repeat till all tendency to ferment is arrested. As a rule, this method, when executed with care, will effect perfect preservation, for a limited time, of most of the cases that come under the care of the embalmer.

Within recent years processes of embalming have been patented which necessitate the removal of the brains and viscera and the filling of the cavities with cotton saturated

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<sup>1</sup>Demonstrator of the U. S. School of Embalming, the Nestor of the modern art and an *authority admitted by all to be the highest*.

<sup>2</sup>A bag of ice or snow placed on the abdomen and chest will usually check purging in its incipient stage.—GRICE.

with salt petre, sulphur dioxid, and water. The cavities are then closed and the body is steeped finally in the sulfurous gas.

This process in principle does not differ materially from that of Chaussier as modified by Boudet. An alcoholic solution of corrosive sublimate was employed as a plunge bath during the removal of the viscera and the body was finally immersed for three months in a dilute solution of mercuric chlorid, afterwards the body was suspended until completely desiccated.

The method was not popular, however, because of the costly fluids used, danger in manipulation, long treatment required and mutilation of the body, which rendered it disgusting and repugnant to the feelings, savoring as it did of the Egyptian methods of old.

In addition to the injecting of the abdominal and chest cavities already noted. the injecting of the brain cavity must not be omitted; for while cavity embalming is not a complete method in itself, no embalming operation is complete without it. The brain cavity may be filled by either of two methods known as the Richardson Eye Process, and Barnes's Needle Process.

The former method is accomplished by inserting in the inner angle of the eye a six inch hollow tube or needle, and pushing it well back, four and one-half inches, through the optic foramen, a bony opening in the skull.

The other method, discovered by President Barnes of the Chicago College of Embalming, and by him taught with great success, is accomplished by inserting a four inch needle in the back of the neck and through a large opening in the occipital bone, known as the foramen magnum. It is claimed for this process<sup>1</sup> that it is the most practical, simple and complete method ever discovered; that it does away with all the disagreeable features of the eye process; removes all possibility of discoloration of the face and neck; and possesses the advantages gained by injecting the brachial artery, as well as other features.

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<sup>1</sup>Announcement of the Indiana College of Embalming, 1895.

By either of the above methods, from one to three quarts of fluid may be injected into the brain cavity, and when the chest and abdominal cavities have been likewise treated and the arteries have been distended with the fluid, the subject is in a most excellent condition for preservation.

## 2. ARTERIAL EMBALMING.

To secure the best appearance of a body, to insure its preservation for a more or less indefinite period, the fluid must be injected arterially. Indeed, this is the only reliable method of embalming now practiced and when supplemented with cavity injection, as outlined above, the embalming is complete.

The process of arterial injection though simple is best acquired at a School of Embalming. The method may be briefly described as follows:

Simply stated, it consists in ejecting from the body all fluids that tend to discoloration and fermentation and injecting into the arterial system and cavities an embalming fluid, after which such external applications may be given as will insure the best appearance of the skin and features.

Having washed the body entire with soap and water, sponged it with an antiseptic or an embalming fluid, as in cavity injection, expel from the stomach all fluid contents possible, place the subject on the cooling board, somewhat inclined, with head slightly elevated.

According to Mills, if the subject be of usual flesh and color the common carotid or brachial artery may be used for injecting; if pale and emaciated the femoral artery will be better.

Sullivan advocates the making of two incisions in every case—in the carotid or brachial, and in the right or left femoral. It facilitates the removal of any clot that may have formed in the venous system and renders the irrigation of the blood vessels less difficult.

To inject either the brachial or femoral artery, or any other vessel for that matter, select the point of incision as determined by its anatomy; with a scapel lay open the flesh and raise the artery with the aneurism hook; make a tiny opening therein and insert the arterial tube, pointing it down-

wards, and around the artery and tube fix a ligature. Usually the circulatory system is first cleansed by washing with cold water or a salt solution, until it issues quite clear from the body. The system may be dehydrated by the injection of alcohol and this treatment followed with ether to extract the fatty matters. Many embalmers do not deem it necessary to first cleanse the circulatory system but proceed at once to slowly and carefully pump the fluid into the artery until the blood vessels of the face are slightly distended. In the latter case, says Grice, the heart is usually tapped and all the blood possible first extracted therefrom.

To close the incision quickly and securely, thread a needle with silk or heavy shoemaker's linen, completely encircle the wound with the silk, passing the needle a little below the cuticle, then tie tightly and the opening is closed.<sup>1</sup> The next step is to make the usual cavity injections, repeating both processes after a few hours, or until there is no further decomposition.

FOREIGN CUSTOMS OF BURIAL. The custom of embalming and modes of burial differ in different countries. In France, after one's demise, his late residence will be draped by the public authorities, the relatives having no choice in the matter except the decision whether or not the body shall be embalmed. For this service \$500 are charged. In America the cost of embalming varies from \$15 to \$75, sometimes more in difficult cases. But three states—Alabama, Missouri and Pennsylvania<sup>2</sup>—have enacted laws regulating the business; these states require an examination and a certificate to permit a person to engage in the business of undertaking and embalming. But on the continent of Europe, however, only authorized or government officials are allowed the final disposition of the dead; this is the case in France, Germany, Italy and Russia and a few minor nations. In these countries funerals are a government monopoly and the officials in charge in France are of military rank. The character of the funeral and the expense incurred depends on the social rank of the deceased, the cost being nothing for a pauper who constitutes the eleventh

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<sup>1</sup>The Embalmer's Monthly, Chicago, Vol. VII, No. 7, p. 120.

<sup>2</sup>The Sunny Side, New York, Vol. XXVI, No. 1, p. 18.

class; twelve dollars for a tenth class; and five thousand dollars for a first-class burial. Should the expense incurred be not paid promptly, the family goods may be confiscated by the government.<sup>1</sup>

### 3. GROWTH OF THE ART.

The processes above described are those in general use in this country. Other processes have been used in Europe during the present century and to their consideration I now turn.

The old Egyptian process of embalming, as I have shown, was founded on the principle of complete immersion of the body for a period<sup>2</sup> in a bath composed largely of antiseptics, notably salts of soda, which so impregnate the tissues as to render them imputrescible; or, after the removal of the viscera the cavities were filled with bitumen, the skin rubbed with antiseptic powders, various other chemicals and aromatic preservatives, and the body finally exposed to the desiccating effect of the Egyptian climate.

This seems to have been the mode of preserving the dead at the beginning of the nineteenth century and appears to have met all requirements; indeed, it was most successful, for the bodies of many of the royalty were in a perfect state of preservation several hundred years after death. But the investigations of Boudet, more especially those of Gannal, enabled the latter to inaugurate a new system, consequently the process of maceration was almost entirely abandoned.

Briefly stated Gannal's<sup>3</sup> process was to cleanse the body with soap and water; remove the contents of the visceral, thoracic and brain cavities; the immersion of the body for one week in a strong solution of nitre and alum; later the filling of the cavities with tow and white arsenic and the desiccation of the body by burying it in the sand for ten days. The replacement of the grave habiliments and the sealing of the body in a leaden coffin completed this expensive, tedious not to say repugnant process. It was no improvement over the better Egyptian method and did not become general.

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<sup>1</sup>The Western Undertaker, Chicago, Vol. XVI, No. 4.

<sup>2</sup>Herodote dit 70 jours, Diodore 72, et la Bible 42, Parcelly, p. 40.

<sup>3</sup>Gannal—Histoire des Embaumements, p. 208.

The process of Durand and Worth may be taken as the basis of our present excellent method of arterial embalming.

By them the circulatory system was punctured at several points. The contents of the digestive tract were removed and the whole filled by injecting an arsenical fluid, or one composed largely of soda hyposulfite.

Several years ago in Europe a series of competitive experiments were made looking to the improvement of the then crude method of preserving museum specimens and the human dead in which Gannal, Dupre, Sucquet,<sup>1</sup> Latour, Moullardi, Hunter<sup>2</sup> and others participated.

In this contest, Sucquet's method was preferred, he injecting into the arteries a solution, chiefly zinc chlorid; Gannal employed a strong solution of aluminum sulfate and chlorid, based upon the property of alumina to form an imputrescible compound with the tissue elements; while Dupre is said to have used carbonic and sulfurous acids, or more probably the acid oxids.

The process of Franchina<sup>3</sup> consists in injecting into the crural arteries a quantity of fluid composed largely of arsenic dissolved in water or brandy. No doubt this fluid effectually preserved the tissues; but the necessarily rapid desiccation of the body proved to be an objectional feature.

Other chemists and physicians have been interested in the preservative art, notably Marquez, Dusouard, Homolle, Kolbe,<sup>4</sup> Burnett, Becoeur and Goodby;<sup>5</sup> but as their experiments were devoted largely to compounding embalming fluids the discussion of them will be deferred for succeeding pages.

#### IV. EMBALMING FLUIDS.

As heretofore stated one of the prime essentials, next to a thorough knowledge of the business and the possession of a *good embalming cabinet*, is a reliable fluid of which there are

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<sup>1</sup>Sucquet—*Del 'embannement chez les anciens et chez les modernes.*

<sup>2</sup>Hahn and Thomas—*Dict. des Sciences Medicales au mot Em-  
baumement.*

<sup>3</sup>Franchina—*Bericht uber Ausstellung einbalsamister Leichen  
Heapel.*

<sup>4</sup>*Journal for practische, Vol. XXVI.*

<sup>5</sup>Gorini—*Nouva Methoda per le Conservazione dei Caderi.*



a score on the market. Some of these fluids I have subjected to a partial examination; others have received a complete analysis. Many of these fluids are public property and their composition may be found in any complete work on embalming; but the constitution of others and some of the best and most recent, too, are still the personal property of the inventors, being protected by patents; and hence I do not consider that I have the moral or legal right to publish their formulae in an article of this character.

Among the fluids that have come under my inspection are: the Mills and Lacy fluid, the Oriental, the Champion, the Perfection, the Ralcohol, the Ideal, the Mystic, the Imperial, Clarke's Best, the Utopia, the Owen's fluid, the Renouard fluid, Mead's embalmer, Shaw's fluid compound, Phorencina and Uptimum.

A careful examination of these fluids revealed the fact that arsenic is foremost while alcohol is second among the chemicals employed in their compounding. Zinc constitutes an important base; while such chemicals as mercuric chlorid, aluminum sulfate; the chlorids, sulfates and permanganates of iron, sodium and potassium; the bichromates; certain salts of copper and lead; tin chlorid and the borates in general; also creosote, carbolic acid, camphor, chloral hydrate, glycerin, thyme, menthol, tannin, salicylic acid and picric and formic acids were the chemicals most frequently occurring. Creosote was a common ingredient of the fluids, one of the most valuable; it is also the most ancient, and, devoid of all other pyrogenous products, it possesses in the highest degree antiputrid properties.

Other fluids that have been long and favorably known either for the preservation of anatomical specimens or for embalming purposes contain the constituents named below.

For the preservation of museum specimens Laton gives this compound:

Potassium antimonyl tartrate, . . . . .	6 parts.
Iodin or bromin, . . . . .	5 "
Pure water, . . . . .	300 "

Moullardi<sup>1</sup> employed a solution of the following:

Mercuric chlorid, . . . . .	3 parts.
Glycerin, . . . . .	20 "

<sup>1</sup>Dict. des Sciences Medicales, art. Embaument, p. 592.

A fluid extensively employed in Europe at one time for preserving the tissues and color of muscles contained of

Brown cane sugar,	. . . . .	5.0 ounces.
Sodium chlorid,	. . . . .	10.0 "
Pure water,	. . . . .	5.0 gallons.

Solution of creosote or of carbolic acid in the proportion of one to fifty of water are good preservatives as well as disinfectants, often employed by the writer. But probably the most common preventative of putrefaction is ethylic alcohol and water in varying proportions.

For a purely embalming fluid Renouard<sup>1</sup> made use of this formula:

Mercuric chlorid,	. . . . .	2.0 ounces.
Zinc chlorid,	. . . . .	4.0 "
Creosote,	. . . . .	4.0 "
Alcohol,	. . . . .	1.0 gallon.

As a lotion for the saturation of cloths to be laid upon the body he used:

Aluminum acetate,	. . . . .	12.0 ounces.
Iron sulfate,	. . . . .	4.0 "
Mercuric chlorid,	. . . . .	2.0 "
Pure water,	. . . . .	1.0 gallon.

A fluid largely employed in cavity injection has the following composition:

Mercuric chlorid,	. . . . .	2.0 ounces.
Zinc chlorid,	. . . . .	3.0 "
Creosote,	. . . . .	4.0 "
Alcohol,	. . . . .	5.0 gallons.
Pyroligneous acid,	. . . . .	5.0 "

Gannal<sup>2</sup> was the inventor of several embalming fluids and one largely consumed in Europe had the formula:

Aluminum sulfate,	. . . . .	48.0 ounces,
Arsenious acid,	. . . . .	4.0 "
Creosote,	. . . . .	4.0 "
Pure water,	. . . . .	1.0 gallon.

The following formula was often modified to meet the conditions of the subject and variations in temperature, being largely used on fleshy persons and in summer:

<sup>1</sup>Renouard—Undertaker's Manual, p. 182.

<sup>2</sup>Gannal—Histoire des Embaumements.

Aluminum chlorid, . . . . .	7.20 ounces.
Mercuric chlorid, . . . . .	2.0 “
Salicylic acid, . . . . .	12.0 “
Pure water, . . . . .	1.5 gallons.

Durand and Worth made use of an injecting fluid composed of:

Arsenious acid, . . . . .	3.0 ounces.
Soda carbonate, . . . . .	4.0 “
Pure water, . . . . .	3.0 quarts.

Still another preparation contained:

Soda hyposulfite, . . . . .	12.0 ounces.
Sulfuric acid, . . . . .	6.0 “
Pure water, . . . . .	4.0 quarts.

Capron's formula for an embalming fluid which gained considerable repute in Europe was:

Carbolic acid, . . . . .	4.0 ounces,
Glycerin, . . . . .	1.0 quart.
Alcohol, . . . . .	2.0 “
Pure water, . . . . .	2.0 “

The color, firmness of the tissues and naturalness of the features were reported as being well preserved by this anti-septic.

Paracelley<sup>1</sup> states in his valuable publication, a work that should be found in the library of every skillful embalmer:

“A Lyon, les liquides conservateurs qu' on emploie sont les suivants:

1. A l'ampitheatre d'anatomie ou j'ai vu des corps tres bien conserves, apres un temps assez long ecoule depuis la mort, on se sert de cette formule:

Acide phenique liquide, . . . . .	2.50
Acide arsenieux, . . . . .	2.50
Glycerine, . . . . .	100.00
Alcool methylique, . . . . .	200.00
Eau, . . . . .	650.00

2. Les formules de l'amphitheatre de medecine opera-toire sont celles qui suivent.

(a) Pour l'injection du sujet:

Glycerine, . . . . .	1200.0 grams.
Acide arsenieux, . . . . .	100.0 “
Acide phenique, . . . . .	300.0 “
Alcool, . . . . .	25.0 “
Camphre, . . . . .	5.0 “
Eau, . . . . .	4.0 litres.

<sup>1</sup>Parcelley—Etude Historique et Critique des Embaumements, p. 147.

(b) Pour la conservation de pieces anatomiques:

Glycerine, . . . . .	} a a
Alcool, . . . . .	
Sublime 2 grms, . . . . .	} par litre.
Chlorure de zinc 0.50, . . . . .	

(c) Pour les embaumements en ville, le liquide conservateur est le suivant pour un seul cadavre:

Sublime, . . . . .	200.0
Alcool, . . . . .	300.0
Camphre, . . . . .	30.0
Sulfure de zinc, . . . . .	20.0
Acide phenique, . . . . .	100.0
Glycerine blanche, . . . . .	7.0 Litres."

A solution for embalming as prepared and injected by Marquez has as constituents:

Mercuric chlorid, . . . . .	12.0 ounces.
Arsenious acid, . . . . .	1.0 "
Alcohol, . . . . .	2.0 quarts.
Cologne water, . . . . .	2.0 "
Warm water, . . . . .	2.0 "

The Scientific American states there was patented in New York in 1878 an embalming fluid containing potassium nitrate, aluminum chlorid, salicylic acid, thymol, glycerin, alcohol, and water; but in what proportions I am unable to state.

A very excellent German fluid is said to contain these ingredients:

Alum, . . . . .	10.0 parts.
Sodium chlorid, . . . . .	2.5 "
Potassium nitrate, . . . . .	1.2 "
Potash, . . . . .	6.0 "
Arsenic acid, . . . . .	1.1 "
Boiling water, . . . . .	300.0 "

To the cold filtered solution was added 0.4 litre of glycerine and 0.1 litre of methylic alcohol.

The Pharmaceutical Era gives this formula:

Thymol, . . . . .	15.0 grains.
Alcohol, . . . . .	3.0 drams.
Glycerin, . . . . .	10.0 ounces.
Water, . . . . .	5.0 ounces.

Dissolve the thymol in the alcohol, add the glycerine and then the water. This fluid may be employed with good results also for preserving anatomical specimens.

According to the Boston Journal of Chemistry, Wicker-

sheimer's famous preserving fluid as now put up by the prominent manufacturers in Berlin contains respectively, according as it is to be used for injecting or immersing bodies:

Arsenious acid,	. . . . .	16 grams; 12 grams.
Sodium chlorid,	. . . . .	80 " ; 60 "
Potassium sulfate,	. . . . .	200 " ; 150 "
Potassium nitrate,	. . . . .	25 " ; 18 "
Potassium carbonate,	. . . . .	10 " ; 15 "
Water,	. . . . .	20 lit.; 10 litres.
Glycerin,	. . . . .	4 " ; 4 "
Methylic alcohol,	. . . . .	$\frac{3}{4}$ " ; $\frac{3}{4}$ "

Hager suggests the following as a substitute for the above preparation:

Salicylic acid,	. . . . .	4.0 drams,
Boracic acid,	. . . . .	5.0 "
Potassium carbonate,	. . . . .	1.0 "
Dissolve in hot water,	. . . . .	12.5 ounces.
Glycerin,	. . . . .	5.0 "

Then add:

Oil cinnamon, oil cloves each 3 ounces dissolved in 12.5 ounces of alcohol.

This latter fluid is not poisonous and possesses the desirable property of acting as an antiseptic and also as a preventive and exterminator of moths and vermin, and is possessed of a pleasant odor.

As a preserver of cadavers for anatomical investigations and clinical purposes, Dr. Thywodzoff<sup>1</sup> of St. Petersburg, Russia, recommends this fluid:

Thymol,	. . . . .	2.0 ounces.
Alcohol,	. . . . .	2.0 quarts.
Glycerin,	. . . . .	2.0 "
Water,	. . . . .	2.0 "

Used as an arterial injection.

In the foregoing list, it will be observed that arsenic, alcohol, mercuric chlorid, aluminum sulfate, carbolic acid and thymol compose the leading constituents of a large number of fluids as compounded and used in this country, and in Germany and England; but in France, however, the use of arsenic as a preservative is quite generally prohibited except for preserving museum specimens.

When handling embalming fluids to any extent the oper-

<sup>1</sup>"The Sunnyside," New York, Vol. XXV, No. 10, p. 14.

ator is frequently afflicted with sore hands. Mills and Lacy recommend the washing of the hands after returning from an embalmment in a solution containing:

Soda bicarbonate,	. . . . .	4.0 ounces.
Soda sulfite,	. . . . .	4.0 onnces.
Rain water,	. . . . .	5.0 quarts.

#### V. DISINFECTANTS.

In the preceding pages I have endeavored to sketch briefly but clearly the history of embalming; to show the solicitude of the living for their dead in all ages; to point out the fact that all animal tissues tend to putrefy and decompose; to explain the vital and circulatory systems of the body; and to bring before the reader the methods in vogue and fluids employed to arrest decomposition and to effect the preservation of the tissues in their post-mortem condition for varying periods, as applied to the human dead.

But the living should receive greater consideration than the dead that our lives may be more tranquil and peaceful; our bodies less subject to physical pain and disease; that joy and not sorrow, success not failure, may prevail; and that longevity may be greatly augmented among men and nations.

To attain this end the utmost care and vigilance should be exercised by the individual, the community and the state in the disposal of the putrefying matter about the home, in public places, and in the atmosphere and waters; for, should we neglect or fail to arrest such decomposition and dissemination in the air we inhale, the water we drink, and the food we consume, poisonous gases, putrid matter, and polluted water will eventually impregnate our systems, death may strike us down prematurely, and we may become fit subjects for the embalmer's art.

Putrefaction is a process of fermentation by which azotized or nitrogenous bodies undergo decomposition spontaneously with the evolution of foul and fetid odors. Pasteur himself defined putrefaction as "fermentation without oxygen," and showed that all decay was due to the action of organisms, the *Bacterium termo* being the common organism which begins eremacausis. The process, as every chemist knows, is complicated, resulting in the evolution of carbon dioxid, sulfurated hydrogen, phosforated hydrogen, methane, ammonia, nitrogen,

hydrogen, water, acetic, lactic, butyric, valerianic, oxalic, carbolic, and other organic acids and bases such as the ptomaines and leucomaines.<sup>1</sup> The process differs essentially, as shown by Pasteur, according as the materials undergoing change are exposed to, or protected from the access of free oxygen, moisture and heat.

The conditions essential to putrefaction are, therefore: (1) moisture, (2) a temperature between 32° F. and 200° F., (3) atmospheric air, or free oxygen, (4) bacteria.

On the other hand, the *desiccation*<sup>2</sup> of a body effectually arrests putrefaction, and this process played an important part in Egyptian mummification; *congelation*, as shown by the preservation of gigantic prehistoric animals in the glaciers of northern latitudes, and farther exemplified in the "cold storage industry" of the present day; and *heat*, for the boiling temperature<sup>3</sup> as well as zero<sup>4</sup> will usually destroy nearly all bacteria whereby putrefaction is possible.

As suggested, putrefaction may be prevented and when once set in may be arrested by the application of disinfectants almost everywhere accessible. Probably one of the first applications of disinfectants, says Thorpe, was that involved in the ancient process of embalming the dead by treatment with aromatic gums and resins; and as the embalmer to-day, five thousand years later, has frequent occasion for recourse to disinfectants, their further consideration here will not be inappropriate.

Before the universal acceptance of the germ theory the term disinfection was used to include the destruction of infectious matter, the removal of any noxious odors to which such matter gave rise, and to the action of any substance which served as a mask for noxious odors.

Now, however, with the wonderful work of Pasteur, Koch, Sternburg, Cohn, Hoffman, Buchner, Vaughan and other bacteriologists before us, it is possible to define a disinfectant as a germicide. Disinfection has ceased to mean simply *puri-*

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<sup>1</sup>Sadtler and Trimble's *Pharmaceutical and Medical Chemistry*, p. 776.

<sup>2</sup>Dr. Buchner—*Ohio San. Record*, April, 1894.

<sup>3</sup>*Mitt. a. d. Kais. Gesundh.*, 1881, pp. 301 and 322.

<sup>4</sup>Ianowski—*Centr. f. Bakteriologie*, 1881, Vol. IV, p. 547.

*fication*, but has acquired the special meaning of *sterilization*. A true disinfectant, therefore, must not only mask the smell, but must destroy or kill the germs which give rise to it; a substance that will kill those germs which act injuriously on the higher forms of life, without having any marked action upon such higher forms; furthermore, a substance which must be efficient in destroying the spores of pathogenic organisms, the product of bacterial action.<sup>1</sup> Hence an ideal disinfectant really goes to the source of the trouble, and by killing the organism, prevents the spread of epidemic disease, poison and death.

Disinfectants are of two kinds: (1) natural; (2) artificial; and are classed as (a) preservatives, (b) deodorants, (c) antiseptics. A *preservative* is a preventive of putrefaction, of decomposition, as alcohol, or a good embalming fluid; a *deodorant* does not prevent putrefaction but simply absorbs offensive or unpleasant odors emitted from matter undergoing decay, as charcoal, infusorial earth, gypsum; while an *antiseptic* is an agent that arrests putrefaction, but does not possess the power of destroying germ life, as carbolic acid, carbon disulfid.

Cheapest among the natural disinfectants are:

(a) The *atmosphere*, by removing the offensive gases and partially oxidizing them.

(b) *Water*,<sup>2</sup> chiefly mechanical, by removing impurities, the products of putrefaction and decay.

(c) *Dry earth*, by absorbing the gases and effecting their oxidation.

(d) *Soot*, as an absorbant and because of its empyreumatic and bituminous properties.

(e) *Sawdust*, moderately absorbent; possesses resinous and aromatic properties, if cut from pine wood.

(f) *Lime*, similar in its action to earth; also chemically combines with certain gases.

(g) *Charcoal*, a wonderful absorbent of gases, a decolorizer, and a purifier of liquid and semi-liquid substances.

(h) *Coal tar*, similar in its properties to charcoal, but whose partial volatility enables it to act more favorably upon an impure atmosphere.

<sup>1</sup>Rideal—Disinfection and Disinfectants, p. 1.

<sup>2</sup>Ann. de l'Inst. Pasteur, 1892, Vol. VI, p. 21.



(i) *Dried peat*, a great absorbent of water and gases, hence valuable in dry closets; also has a disinfectant action upon cholera vibrios.

(j) *Light*,<sup>1</sup> specially sunlight, chiefly chemical, has a deleterious action on bacteria in their vegetative and in their spore forms.

The artificial disinfectants as classified may be grouped as:

(a) *Oxids*: peroxid of hydrogen, trioxid and peroxid of nitrogen, dioxid of sulfur and of carbon, etc.

(b) *Acids*: (a) mineral,—hydrochloric, sulfuric, sulfurous, nitric, nitrous, chromic, permanganic, arsenious, arsenic; (b) organic,—carbolic,<sup>2</sup> carbonic, acetic, picric, boracic, salicylic, tannic, benzoic, anisic, gallic, oxalic, oleic, formic,<sup>3</sup> pyroligneous and others.

(c) *Salts* of mercury, iron, zinc, copper, manganese, aluminum, lead, arsenic, tin, etc.; also the various derivatives of coal and wood tar, petroleum, and of the nitro, amido and pyridine groups.

(d) *Gases*: chlorin, iodin, bromin, fluorin, sulfur, ozone, oxygen, nitrogen, carbon; smoke, chloroform, etc.

(e) *Volatile oils*: cedar, cloves, peppermint, turpentine, creosote, camphor, caraway, thymol,<sup>4</sup> menthol, cinnamon, verbena, geranium,<sup>5</sup> hops, etc.

(f) *Alcohols*, chiefly ethylic and methylic; the aldehydes and derivatives therefrom.

Some one, or several of these disinfectants, is regularly used in every sick room, death chamber and living room. Ordinarily the circulation of the pure atmosphere through the room, or lumps of charcoal scattered about, will disinfect sufficiently; but in cases of fever, diphtheria, cholera or other contagious diseases, the saturation and fumigation of the closed room with sulfurous gas, chlorin, carbolic acid, corrosive sublimate, etc., become an absolute necessity; while the embalming of the body may not require a more complex fluid

<sup>1</sup>Koch—Zeitschrift für Hygiene, Vol. X, p. 285.

<sup>2</sup>Journ. Soc. Chem. Ind., 1889, p. 131.

<sup>3</sup>Am. Chem. Journal, Vol. VII, p. 62.

<sup>4</sup>Brit. Med. Journ., 1875, Vol. I, p. 680.

<sup>5</sup>Rey. Therap., 1893, p. 290.

than a solution of arsenious acid, mercuric chlorid or aluminum sulfate.

But it matters not how simple or how complicated may be the cause of the difficulty and its remedy, the nurse, the physician and the embalmer must be masters of the situation.

And now in conclusion, what I shall say? What matters it to the dead as to their disposition? Who can say which are wisest, the Egyptians who embalmed, the Greeks and Romans who cremated,<sup>1</sup> the Celts, the Europeans and the Americans,—all nations over all the globe, in every land, in every time,—who buried;<sup>2</sup> or some of the American aborigines who desiccated the body or left it to the birds of heaven after the spirit had been gathered to Manitou in the happy hunting grounds? Certainly the mortal body has no part in it; for “in a moment, in the twinkling of an eye, at the last trump, . . . we shall be changed, for this corruptible must put on incorruption and this mortal must put on immortality.”

In the disposal of the dead that process is most natural, most scientific, most holy which best protects the living from disease, death and anguish of soul; and makes the heart of man more tender and charitable toward his fellow creatures as they halt on this paltry planet in their journey to the immeasurable future of uncertain reward. Rather may those who have gone before into the promised land remember us who remain, not by our tomb, covered with immortelles, our storied urns, or eulogistic epitaphs; but rather for our gentleness, and sympathy, and helpfulness along the pathway of life.

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<sup>1</sup>Dr. Bauweus—*Inhumation et Cremation*, p. 303.

<sup>1</sup>Dr. Martin—*Les Cimetieres et la Cremation*, pp. 88-89.

<sup>2</sup>Penicher—*Traite des embaumements*, p. 111.

*BIBLIOGRAPHY OF EMBALMING.*

In the following pages an attempt has been made to collect the titles of books on embalming, embalming fluids, mummies, sanitation, and preservation of animal matter from an historical, theoretical and practical view-point; and to supplement the same with articles of similar character published in the various scientific and literary periodicals, technical journals, bulletins, reports and papers.

So far as I am aware, and this conclusion has been reached after a wide correspondence and personal research, there has never been undertaken, heretofore, in any language or form, the preparation of a bibliography of embalming and its cognate literature.

In the preparation of this work, our time and facilities were limited, hence our desire to gain access to all the shelves and journals devoted to the science and art of embalming was unattainable, as it was also impossible to secure competent assistance, in all cases, to undertake the work of compilation in the oldest and most noted institutions of learning at home and abroad, not to name the great libraries at the national capital.

In the preparation of this bibliography I have, however, enjoyed the facilities offered by a few of the national libraries of Europe and America, and my hearty thanks are due to the Librarians and other officers of the British Museum, London; University libraries of Cambridge and Oxford; Bibliotheque National, Paris, the largest in France; Libraries of the Medical School, Paris; Library of the Museum of Natural History, Paris; Grossh. Universitate Bibliothek, Heidelberg and Leipzig; Bohmisch National Museum, Prag; Library of National Museum, Rome; Libraries of Congress and of the Smithsonian Institute, Washington; Harvard University Library, Cambridge; Columbia College Library, New York; and the files of the technical journals devoted to embalming, medicine and surgery published in America and Europe.

I am under obligation to Professor Henry DeVarigny, M. D., Sc. D., of the Museum of Natural History, Paris, who personally supervised the collection of data in that city; to Dr. Joseph F. James, of the Division of Pathology, Washington, who copied with accuracy and fidelity several hundred titles for my use; to Gustav E. Stechert, New York, and his agents in Europe; to the editors of *THE POST-GRADUATE AND WOOSTER QUARTERLY*, who have arranged for the publication of this paper and did the proof-reading. To all these gentlemen and others who have in any way assisted me, I express my sincere thanks for their assiduity, promptness and fidelity to my interests. For convenience the titles have been grouped under three heads: I. General Works; II. Periodicals; III. Contributions to Periodicals and Technical Journals. With few exceptions, the matter has been arranged alphabetically by authors. Many of the references cited in the foregoing thesis, for obvious reasons, do not appear here.

For the conception and contents of this paper in its entirety, the author alone is responsible for whatever it may contain that is valuable to scientific literature.

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