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# Modern Embalming, Circulation of Fluids, and the Voyage through the Human Arterial System: Carl L. Barnes and the Culture of Immortality in America

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**Abstract**
By considering the work of American embalmer, lawyer, and physician Carl Lewis Barnes (1872-1927), this paper analyzes the emergence of modern embalming in America. Barnes experimented with and exhibited the techniques by which embalming fluids travelled into the most remote cavities of the human body. In this sense, modern embalmers based their skills and methods on experimental medicine, turning the anatomy of blood vessels, physiology of circulation, and composition of blood into a circuit that allowed embalming fluids to move throughout the corpse. Embalmers in the late 19th century took ownership of the laws of hydrodynamics and the physiology of blood circulation to market their fluids and equipment, thus playing the role of physiologists of death, performing and demonstrating physiological experiments with dead bodies.

**Keywords**
embalming, formaldehyde, 19th century

## Introduction

French medical historian Philippe Charlier recently stated that "embalming is fashionable,"[1] not to promote embalming as a trendy treatment, but

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[1] Philippe Charlier, "L'évolution des procédures d'embaumement aristocratiques en France médiévale et moderne (Agnès Sorel, le Duc de Berry, Louis XI, Charlotte de Savoie, Louis XIII, Louis XIV et Louis XVIII)," *Medicina nei Secoli Arte e Scienza*, 2006, *18/3*: 777-98, p. 777.

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rather to point out the recent proliferation of articles in the fields of anthropology and paleopathology dealing with the tecniques of body conservation used in the medieval and modern times. Embalmed bodies, in fact, are currently being studied as archaeological deposits of different traditions throughout the long history of anatomical preparations, technical innovations, and the treatment of the dead.[2]

However, this proliferation likely also reflects the contemporary relevance that embalming has gained in the funerary industry of several countries. Embalming, a process that replaces the body's natural fluids by injecting a solution into the arterial system, has become common practice over the last two decades in several countries. In the United States, though, embalming was adopted in the second half of the 19th century as a sanitizing way to treat the body for funerals as well as to transport corpses.[3]

While the modern funeral embalming that developed in the United States, "put death on show,"[4] embalming procedures have now been confined to the embalmer's room.[5] Yet, this current invisibility hides the fact that modern embalming was consolidated through public demonstrations, and experiments with corpses and fragmented cadavers. Within the context of the "culture of immortality," promoters of modern embalming travelled across countries to market embalming fluids, perform injection methods, and display corpses and embalming equipment at scientific and industrial fairs.

By considering the work of American embalmer, lawyer, and physician Carl Lewis Barnes (1872-1927), this paper analyzes how experiments and the exhibition of the techniques by which embalming fluids can move into the most remote cavities of the human body established modern

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[2] Hélène Gérard-Rosay, "De l'embaumement au soin d'hygiène et de présentation moderne: bref retour historique, » *Études sur la mort*, 2004, *125*: 97-104; Pascale Trompette and Mélanie Lemonnier, "Funeral Embalming: the Transformation of a Medical Innovation," *Science Studies*, 2009, *22/2*: 9-30.

[3] Embalming in most European and Latin American countries, however, was resisted by the hygienist movements or confined to state funerals. In that sense, embalming has now become a characteristic of the American way of death that –like the American way of life- has expanded to other countries; see Philippe Ariès, *Essais sur l'histoire de la Mort en Occident: du Moyen Âge à nos jours* (Paris: du Seuil, 1975); Jessica Mitford, *The American Way of Death* (New York: Simon and Schuster, 1963).

[4] Trompette and Lemonnier "Funeral Embalming" (cit. note 2), p. 9; Karen Pomeroy Flood, *Contemplating Corpses: The Dead Body in American Culture, 1870-1920* (PhD Thesis, Harvard University, 2001).

[5] Alain Feuer, "In the End, There Is a Drain", *New York Times*, October 13, 2008. http://www.nytimes.com/2008/10/14/nyregion/14rooms.html?_r=1 see the reaction of professional embalmers in Wilson Beebe Jr., "Embalming Redux," *The Forum*, February 2009, p. 9.

embalming as a professional field in America. Modern embalmers based their skills and methods on experimental medicine, turning the anatomy of blood vessels, the physiology of circulation, and the composition of blood into means and circuits that allowed the voyage of embalming fluids through the corpse. Embalmers in the late 19th century took ownership of the laws of hydrodynamics and the physiology of blood circulation to market their fluids and equipment, thus playing the role of physiologists of death by performing and demonstrating physiological experiments with dead bodies.

## Carl Lewis Barnes

Carl Lewis Barnes (1872-1927) was the son of a prosperous undertaker in Connellsville, Pennsylvania. His father was well-known as a successful stock marketer and one of his uncles was a United States Senator from that state. At the age of 15, Carl Barnes turned his attention to the study of medicine and shortly thereafter he went to Indianapolis and entered the Medical College of Indiana, graduating in 1892. Barnes, who had also studied law, visited the main hospitals of New York City several times. His practice was limited almost exclusively to surgery and office practice. Presented as a "model physician," he worked at first as a surgeon specializing in the diseases of the eye, ear, nose, and throat.

Soon he gave up law to become associated with his brothers Thornton B. and Willard H. in the management of the United States Chemical Company of New York, which manufactured a standard line of disinfectants and even maintained its own embalming schools.[6] The family company – with its home office in New York City and a branch in Chicago – manufactured several varieties of embalming fluids and sold embalming instruments. Carl devoted a lot of time to the embalming process, and was one of the founders of the Embalming College of Indiana, becoming its president and one of its demonstrators. This college was eventually incorporated in 1893, the second one of its kind to be incorporated in the United States.

In the meantime, Carl Barnes had moved to Chicago, where he started the Barnes School of Sanitary Science and Embalming (established in 1892), which became part of the US Chemical Company's growing national chain of embalming schools operating in cities including San Francisco,

[6] John Woolf Jordan, James Hadden, *Genealogical and Personal History of Fayette County, Pennsylvania*, vols. I-II, Vol. 2 (New York: Lewis historical publishing company, 1912), p. 798.

Minneapolis, Boston, New York City (1890) and Dallas (1890).[7] Barnes was chair of anatomy and minor surgery in the Eclectic College of Physicians and Surgeons and was given an honorary degree by that institution. At the same time, his brother, Thornton, directed the embalming school in New York City and assisted Carl at many of the embalming seminars and demonstrations. By 1890, embalming had been established as customary practice in America. When Barnes and his brothers entered the business, some undertakers – such as their father – were already used to embalming corpses as a tribute to the dead as well as a means of entering the world of industry, politics, publication, and health administration.

For over twenty years, Carl L. Barnes, as president of his company and health officer of Illinois, gave special attention to the subject of disinfection and disinfectants. During the yellow fever epidemic in 1897, Barnes was the sanitary officer for the city of Chicago. By 1910, the United States Chemical Company was one of the largest producers of antiseptics and disinfectants in the United States.

Carl Barnes was a correspondent for *The Casket* and *Western Undertaker,* two leading journals devoted to the undertaking business.[8] He wrote articles on embalming, which were widely published and gave him a reputation for his extensive knowledge of such subjects. Barnes wrote several medical and anatomy articles and textbooks. His book *Atlas of the Arterial and Venous Systems* (published in 1905), which included color anatomical drawings, was sold at USD 25 or USD 20 in rustica. He wrote a medical book on *Contagious and Infectious Diseases* in 1903. Barnes also wrote published an extensive 552-page embalming textbook with color plates in 1896 entitled: *The Art & Science of Embalming*. The book, sold at USD 5, was quite popular and eight editions of it were published. Written in order to promote his own methods and fluids, the manual represents a good source for understanding the connections between the medical and undertakers'

[7] By 1908, there were three other embalming schools in business: Hohenschuh-Carpenter School of Embalming (Des Moines, Iowa, established in 1891); Pennsylvania College of Embalming, Pittsburgh School of Anatomy (established in 1897), and Renouard Training School for Embalmers New York, see Harry Myers, *College and Private School Directory of the United States, A Complete List of the Colleges and Private Schools in the United States, with Data Concerning Each Institution* Vol. 2, (New York: Educational Aid Society, 1908).

[8] By 1904, the subjects of undertaking, embalming, cemeteries, and cremation were treated in several monthly journals. In Chicago, *Park and Cemetery*, *Western Undertaker,* and the *Embalmers' Monthly* were published. The *Sunflower Undertaker* appeared in Topeka, the *Casket,* in Rochester, NY and *Sunnyside*, in New York, see Frank Mott, *A History of American Magazines: 3* (Cambridge: Harvard University Press, 1938), p.132-3.

world. Carl Lewis Barnes was a Republican and belonged to the Masonic order and the Marion club.[9]

## Injection and Embalming Experiments

Embalming had been performed for centuries by imitating the procedures described by Herodotus for upper-hierarchy Egyptian mummies. This included preparing several drying substances, opening the cavities of the body and the skull, extracting the brain and viscera, which after being washed and sprinkled with drying powder, had to be replaced into the body treated with the same drying powder.[10] Beginning in the 16th century, anatomists dissected the blood-vessels with injection techniques, filling them with air, water, milk, ink, mercury, spirits, coloured solutions, coloured wax, or isinglass.[11]

Although interest in injections gradually declined in the 18th century,[12] the development of inorganic chemistry would import this technique to the experiments carried out to develop new embalming techniques. In France, Italy, and all across Europe, new arsenic solutions were invented to preserve organic tissues and to develop new ways of embalming that avoided evisceration. French apothecaries and embalmers developed the

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[9] *Pictorial and Biographical Memoirs of Indianapolis and Marion County, Indiana* (Chicago: Goodspeed, 1893), p. 175-6.

[10] Silvia Marinozzi and Gino Fornaciari, *Le mummie e l'arte medica nell'evo moderno*, *Medicina nei Secoli*, Supplemento, 1 (Roma: La Sapienza, 2005); Arthur Aufderheide, *The scientific study of mummies* (Cambridge: Cambridge University Press, 2003).

[11] Francis Joseph Cole, "The History of Anatomical Injections", in *Studies in the History and Method of Science*, edited by Charles Singer (Oxford: Clarendon Press, 1921), vol. 2, pp. 285-343; J. N. Lieberkühn, "Sur les moyens propres à découvrir la construction des viscères", *Histoire de l'Académie royale des sciences et des belles lettres de Berlin: année 1748*, 1750, pp. 28-31; Régis Olry, "Short History of Vascular Injections, with Special Reference to the Heart Vessels," *Journal of the International Society of Plastination,* 1998, *13/1*: 7-11; "Injection (Préparation d'anatomie)", in *Dictionnaire des sciences medicales*, vol. 25, INF-IOD (Paris: Panckoucke, 1818), p. 222-32; Pierre-Simon Rouhault, "Sur les injections anatomiques", *Histoire de l'Académie royale des sciences année 1718*, 1741, pp. 219-21; Joseph Hyrtl, *Handbuch der praktischen Zergliederungskunst als Anleitung zu den Sectionsübungen und zur Ausbreitung anatomischer Präparate*, (Wien: Braumüller, 1860), p. 603; Hans-Jörg Rheinberger, "Präparate- Bilder ihrer selbst. Ein bildtheoretische Glosse," *Bildwelten des Wissens. Kunsthistorisches Jahrbuch für Bildkritik* 2003, 1 (2): *9-19;* "Präparate", in *Epistemologie des Konkreten. Studien zur Geschichte der modernen Biologie* (Frankfurt: Suhrkamp, 2006), pp. 336-49.

[12] Cole "Anatomical Injections" (cit. note 12), p. 286-7.

procedure of injecting a solution of either arsenic or zinc chloride through the arteries.[13] As many authors have pointed out, embalming was promoted in France in relation to the new legislation on funerals, transportation of corpses, and cemeteries.[14] Marketed as a privilege for royalty that became accesible to the middle classes, embalming developed within the culture of immortality that blossomed in the 19th century, which also included post mortem photography, experiments with electricity applied to dead – and living – bodies, and sound recording.[15] In this constellation that combined new inventions with the mere possibility of expanding the limits of life into the future, the physical conservation of things deemed to disappear created new sensitivities and expectations. Thus, the preservation of remains flourished beyond anatomical theaters and museums: it became part of the habits of middle class citizens.

Many authors have underscored that the expansion of embalming in the US was connected to two additional events: the American Civil War and Abraham Lincoln's funeral. In December 1861, a few months after the outbreak of the Civil War, Thomas Holmes, considered to be the father of the American embalming industry, rushed to patent his own embalming apparatus, a regulating spigot combined with an air chamber containing a piston, cylinder, ejecting pipe, valve, and discharge pipe, which were placed over a vessel containing a fluid. The piston pumped the fluid upward and forced it through the ejecting pipe and spigot, which operated as a regulator, into a discharge pipe that was inserted into and fastened to an artery in one of the body's limbs. The fluid was thus injected through all the vessels of the aorta and veins of the corpse.[16] French and Italian apothecaries, who had been promoting arterial embalming since the 1840s, would never have expected that a war on the other side of the Atlantic would impel the

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[13] Jean Nicolas Gannal, *History of Embalming, and of Preparations in Anatomy, Pathology, and Natural History; Including an Account of a New Process for Embalming* (Philadelphia: Dobson, 1840); Jules Massé, "Petit traité pratique des embaumements par injection", *Revue de thérapeutique médico-chirurgicale,"* 1853, *1*: 503-6, 531-4, 560-2; J.-P. Sucquet, *De l'embaumement chez les anciens et chez les modernes et des conservations pour l'étude de l'anatomie* (Paris: Delahaye, 1872).

[14] Louis A. Becquerel, *Traité élémentaire d'hygiène, privée et publique* (Paris: Labé. 1854).

[15] Michael Steiner, *The Democratization of Immortality in Nineteenth-century America,* (PhD thesis, Saint Louis University, 1994); Hans Gumbrecht, *In 1926: Living at the Edge of Time*. (Cambridge: Harvard University Pres, 1997); Stanley B. Burns, *Sleeping Beauty: Memorial Photography in America*. Altadena (Calif: Twelvetrees Press, 1990).

[16] *Annual report of the Commissioner of Patents for the year* (Washington: G.P.O, 1860), p. 600.

embalming industry the way it did. Thousands of embalmed corpses were dispatched home thanks to the railroads connecting battlefields with cities. A few years later, in 1865, Abraham Lincoln was embalmed by the same method of arterial injection. A train with his corpse travelled all the way from Washington to Springfield, Illinois exhibiting the dead president's remains to crowds of mourning citizens who also appreciated the endeavours of the accompanying embalmers in fixing the body on its final voyage.[17]

The funeral industry in the United States followed international improvements in embalming tecniques with close attention. Inventors of embalming techniques and methods continued promoting their creations at international exhibitions and other fora atttended by investors, politicians, and enterpreneurs willing to commercialize new products, even though they would never be adopted with the same enthusiasm as in America. A report in 1880 on the medical section of the Paris Exhibition mentioned three different systems of preservation: glycerine and carbolic acid injection into the arteries, petrified specimens by Efisio Marini of Naples, and the preparations by Dr. Wywodzoff, chief surgeon at St. Petersburg military hospital,[18] who opened only the carotid and crural arteries and injected a liquid promoted as Wywodzoff's Fluid.[19] Marini and Wywodzoff presented their inventions at several international and national exhibitions, trying to sell their secrets to governments or whoever was willing to pay for them. They translated instructions, gave lectures, and exhibited embalmed and petrified organs that travelled with them across continents and oceans.[20] Embalming, in this sense, can help ellucidate the way a local industry, such as the American funerary, emerged by mixing different means and techniques developed in different contexts.

When Carl Barnes and his brothers entered into business, the American market was already populated with a vast number of publications, methods, and fluids for embalmers. Carl Barnes chose to promote his methods not as simply fluids or instruments, but rather within the frame of

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[17] Ralph Newman, "'In This Sad World of Ours, Sorrow Comes to All' a Timetable fort the Lincoln Funeral Train," *Journal of the Illinois State Historical Society,* 1965, *58*/*1*: 5-20.

[18] *Philadelphia Medical Times,* 1881, *11*: 268-9.

[19] "Preserving Subjects for Dissection," *The Medical and Surgical Reporter,* 1881, *44*: 248.

[20] I. Minis Hays, "International Exhibition, 1876, Official Catalogue. 4 vol. (Philadelphia: John R. Nagle, 1876)," *The American Journal of the Medical Sciences* 1876, *72*: 556-7. On Marini, see Alberto Carli, *Anatomie scapigliate: l'estetica della morte tra letteratura, arte e scienza* (Novara: Interlinea, 2004), p. 31; Corrado Zedda and Luigi Serra, *Il pietrificatore. Efisio Marini: Cagliari 1835-Napoli 1900* (Elmas: Grafiche Sainas, 2004).

experimentation, as if he were studying the dynamics of blood and vital fluids that characterized modern physiology. Barnes did not present his work with human corpses as a dissector; instead he associated his embalming experiments with the most modern techniques of peering into the human body and watching the way it worked. He not only experimented with body fragments but also with the circulatory system as an integrated circuit for the circulation and voyage of the embalming fluid, similar to the experiments done with living animals. He also adopted the gestures and poses of resuscitation by means of electrical shock. His demonstrations and photographs with corpses hint at the possibility of bringing the dead back to life (Fig. 1). This appearance of life in the embalmed body is connected with the main purpose of modern embalming: the cosmetic effect, i.e. the presentation of the dead during the funeral as if they were alive. Barnes staged his pictures of the embalming process as though it were a visit to a sick person. The doctor stands close to the bed, dressed in his physician's gown, treating the corpse as if it could speak, which looks like an attempt to resurrect the dead, applying electricity or a kind of reviving fluid (Fig. 2).

In order to market the reliability of his methods, Barnes was constantly introducing new experiments that based on ones that had been done in different fields of life sciences, namely medicine, physics, and chemistry. For example, Barnes proposed identifying the positive signs of death by means of the Röntgen (X) rays, discovered towards the end of 1895. In April 1896, Barnes was experimenting on dead and living tissue by photographing a dead hand and a living one with the same current on a single plate (Fig. 3). The many chemical and physical changes that occurred in the dead body between death and putrefaction made him want to observe the changes in soft tissues and the inside of the body through the X-rays. While a living person's hand held up to a lighted lamp would become scarlet red and allow the rays to pass through, the dead hand did not allow the rays to enter, thus remaining opaque and dark. After death, the red corpuscles in blood lost their circular shape and their refraction power. Therefore, skiagraphs showed slight differences in terms of light penetration: bones behaved the same way, but the soft tissues – the embalmer's subject matter – appeared a bit darker in the dead hand than in the living one. While Anna Röntgen, upon viewing her skeleton as photographed by her husband, is said to have exclaimed, "I have seen my death!"[21] Barnes showed

[21] http://wellcometrust.wordpress.com/2010/08/13/wellcome-image-of-the-month-the-left-hand-of-anna-roentgen/, accessed in December 2010.

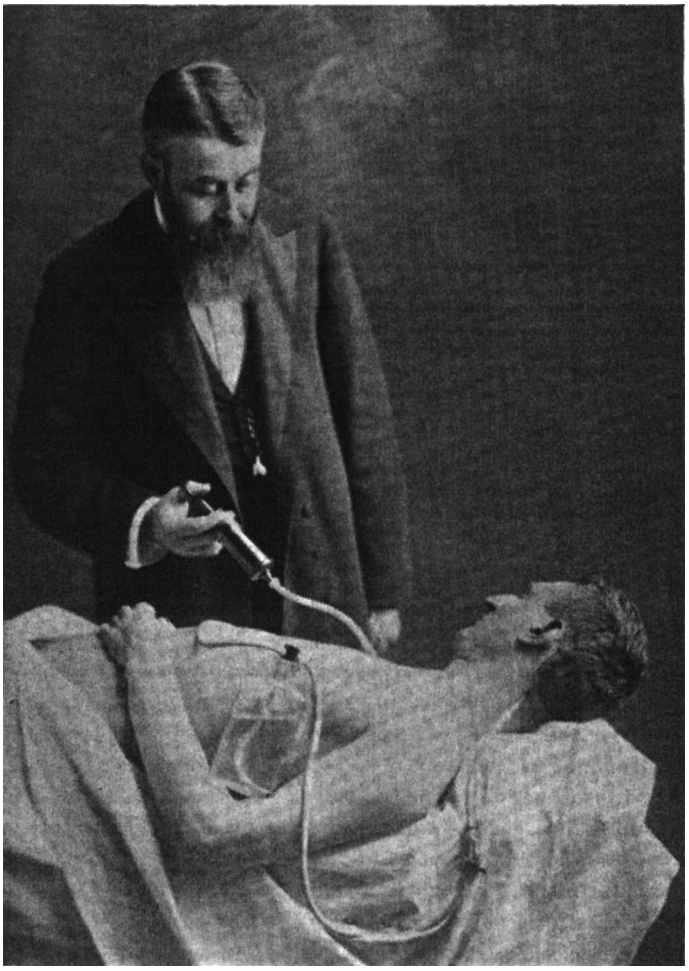

Figure 1. Barnes process of embalming (from Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative*, Chicago: Trade Periodical, 1898, p. 251).

that in the period following the ceasing of vital functions, death contributed to creating opacity. Barnes was optimistic: he was certain that the future would allow photographing life and death by means of the same plate.[22] This was probably the function he envisioned for his bodies filled

[22] Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative* (Chicago: Trade Periodical, 1898), pp. 23-4.

Figure 2. Methods of Resuscitation (from Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative*, Chicago: Trade Periodical, 1898, p. 18).

with fluids that could restore the appearance of life. Life and death – thanks to the embalmers' skills – could be seen as overlapped in the same object. If blood was the life of the flesh and blood changed with death, then embalmers had to fill the body with other fluids that could restore – at least to the sight of mourners – the power of blood.[23] Therefore, blood and circulation vessels were the core of modern embalming techniques and marketing strategies.

The opacity of dead soft tissues in X-rays was contrasted with the charts of veins and arteries made from traditional anatomical dissection techniques, the knowledge of the blood vessels' itineraries being central to

[23] Jani Scandura has pointed out the analogies between embalmers and vampires in the embalming practices of the Victorian period, see Jani Scandura, "Deadly Professions: Dracula, Undertakers, and the Embalmed Corpse," *Victorian Studies,* 1996, *40/1*: 1-30.

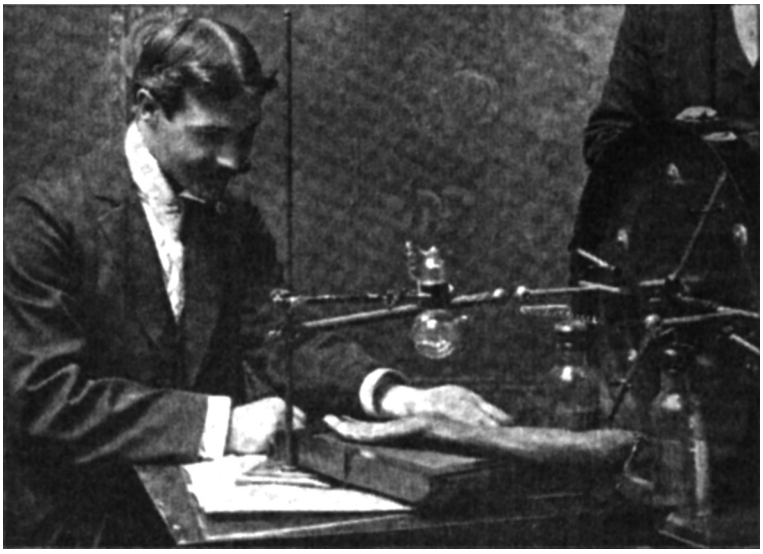

Figure 3. Barnes taking a skiagraph of his own hand with that of a cadaver (from Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative*, Chicago: Trade Periodical, 1898, p. 24).

the success of embalming injections and the best route for the embalming fluids to move through the dead body. The United States Chemical Company published such charts either included in the books written by Carl Barnes or as plates to be sold separately. These charts were linked to the methods of locating, raising, and injecting the arteries, defined as the most suitable means to inject and make the embalming fluid flow. Given the fact that blood leaves the arteries and escapes into the veins, capillaries and body tissues after death, the removal of the blood was suggested to aid the absorption of the fluid into the tissues. The complex chemical composition of blood prevented osmotic actions; the fluid injected into the arteries flowed more readily through the capillaries and into the veins when the blood was removed from the body creating a vacuum to be filled by the injected fluid. Like the substance Dracula injected into his victims while sucking blood from his victims' jugular veins, this embalming fluid flowed through the arterial system to preserve the flesh for immortality.[24]

[24] Scandura, "Deadly Professions" (cit. note 24).

Besides arterial embalming, other methods were proposed to make the embalming fluid flow through the corpse within the circulation system. Among them, needle embalming – also known as "eye injection" – a technique invented in London in the 1880s. It consisted of injecting the vascular system by and through the cerebral-spinal cavity. In the "eye process," the body to be embalmed had to be placed on a table with the head slightly elevated and undressed so as to avoid pressure upon the large venous trunks of the neck and to allow for an easy flow downwards through the jugulars. The operator inserted the needle at the inner corner of the eye, directed backward and along the sphenoidal fissure until it entered the cranial cavity. The needle had to be introduced three or four inches deep, and then the injection began and spurred the fluid's voyage.

Embalmers wanted to decide whether the eye injection or the arterial method provided better results. An embalmer named W. W. Harris conducted an experiment where a decapitated head was placed upon a table and two needles were introduced through the sphenoid fissure into the cranium, the needles connected to a single syringe by rubber attachments and a "Y" connection (Fig. 4). The experiment continued as follows:

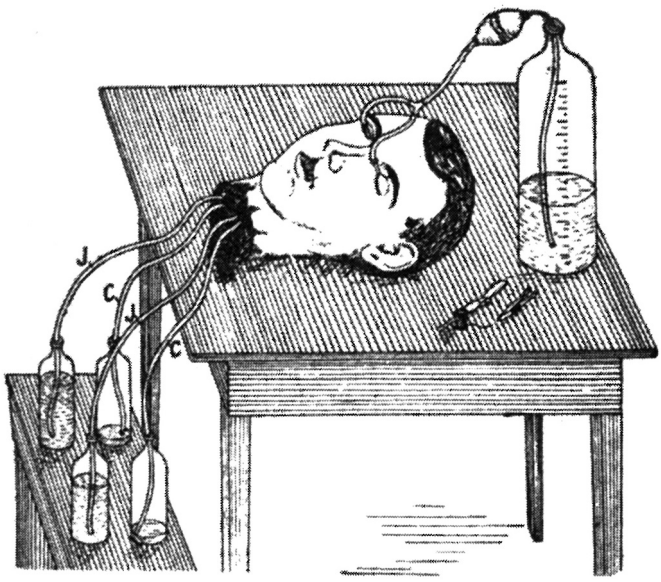


Figure 4. Experiment on eye process (from Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative*, Chicago: Trade Periodical, 1898, p. 241).

> Arterial nozzles were inserted into the carotid arteries and internal jugular veins, where they had been severed in the decapitation. The same were securely tied and tubing attacked, leading each to a separate bottle. Those bottles, for convenience, were placed on a bench somewhat lower than the table. After the connections were competed, the injection was begun. The first few contractions of the bulb forced the fluid out of the spinal canal, from which it flowed freely and as fast as the operator would naturally pump. This opening was then stopped as securely as possible, almost entirely arresting the flow of fluid, and the injection begun for the second time. The fluid at once made its appearance in the bottles containing the tubes leading from the internal jugular veins; as long as the injection was continued the fluid flowed in a steady stream from these vessels. At the same time a very small percentage of the fluid was deposited in the bottles containing the tubes leading from the carotid arteries.[25]

These kinds of experiments, which adopt the settings of physiology, combined the dynamics and chemistry of living matter with the voyage of fluids inside dead bodies' vessels. Embalmers transformed the body in a mere means where fluids circulated solely by mechanical forces. Pumps, pressure, injections, and tubes recreated analogies with experimental physiology but they defined the voyage of fluids along the body in a completely different way, in a mechanical model of the body. Without life, the vascular system worked as mere tubes that conducted the fluids administered by the embalmer.

In this respect, Barnes claimed to have discovered the most scientific and simplest method of embalming. His method did away with any cutting instrument, the needle reaching the most central part of the cerebral-spinal cavity without entering the structure of the eye. Given the importance of the cosmetic effect and the possibility of overlapping death and life in the same body, the swelling and bulging of the eye created discomfort among both embalmers and customers. The "eye process" was discarded by American embalmers because it made it obvious that they were dealing with dead bodies: the method disfigured the eyes and was hard for the deceased person's relatives to tolerate. They saw the inserting of a needle through the eye socket as a kind of ordeal that was close to the evisceration that characterised old embalming methods. Experiments were only possible on destitute bodies, which could be used at that time the same way as animals are in contemporary physiology. Whereas in physiological experiments living animals could be opened and filled with all kind of fluids, the

[25] Barnes, "*Art and Science of Embalming*" (cit. note 23), pp. 241-2.

practice of embalmers was constrained by the feelings and money of the relatives. Their effect was more convincing than that of anti-vivisectionist movements.

The "Barnes Needle Process," which did not altere the dead person's traits, claimed to reach the cerebral spinal cavity and ensure complete circulation, as though the fluid was injected into the brachial arterial itself. The cavity was reached by using a small hollow needle inserted into the posterior part of the neck and through the foramen magnum in the occipital bone (Fig. 5). The embalming fluid was very slowly forced into the channel until circulation was fully establshed. Once the fluid entered the

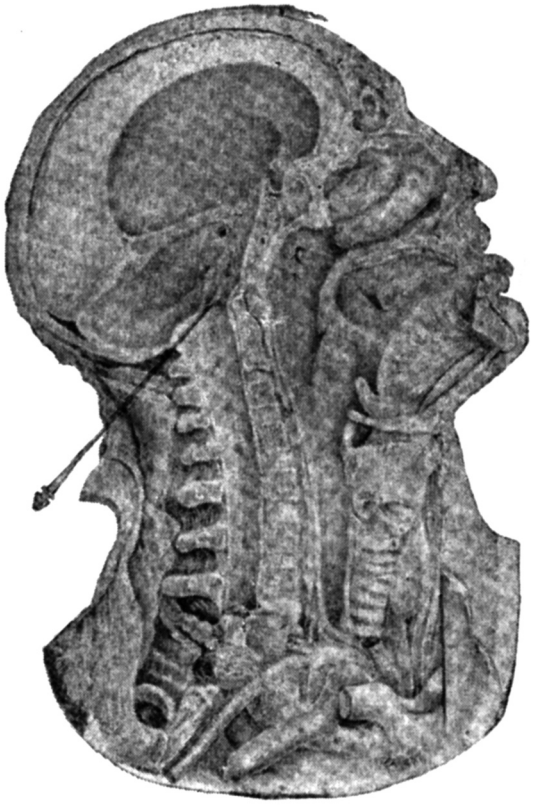

Figure 5. Barnes needle process. Way of introducing the needle (from Carl L. Barnes, *The Art and Science of Embalming: Descriptive and Operative*, Chicago: Trade Periodical, 1898, p. 245).

circulation, the voyage continued: veins in the neck were swollen, the fluid reached the right auricle of the heart, and then took its natural course into pulmonary circulation. The introduction of the fluid was thus presented as a replication of circulation, the fluid naturally taking the least resisted direction.

However, the fluids did not always flow smoothly. The practice of anatomical dissection by physicians and naturalists showed the other side of embalming techniques tested in those destitute corpses available for medical training. Embalmers who performed demonstrations explained what happened to subjects on the embalming table when they were not limited by the need for obtaining good cosmetic effects:

> Sometimes when injecting a body, you meet with an obstruction, and it may be that the fluid will not penetrate into one limb or into the arms. Sometimes we overcome this obstruction if it is in the limb, by hanging the subject up in such a way as to make the liquid penetrate to the feet. When we find tha one of the arteries has been oblterated and the fluid will not reach to the parts, we take an aspirating needle and inject the fluid into those parts so as to save the body, and we very often succed.[26]

The voyage of the embalming fluid through the dead body was not, as Barnes promoted, a replica of circulation dynamics. Resistance had to be overcome by hanging the bodies to let gravity work or else by entering into the circulatory system by recurrent injection at different spots and cavities by means of syringes, tubes, pumps, trocars, and injectors. The voyage of embalming fluids was, in fact, less pleasant than the natural process replicated by the embalmer; it was a conjunction of instruments, apparatuses, and human forces pushing liquids into bodies that would never feel the power of blood again.

## Embalming Fluids

The injection of drying substances through the circulatory system was advertised as the best way of preserving or embalming bodies for delays in burial, transportation or dissection. Embalming fluids and patents for injectable preservatives abounded in the second half of the 19th century.

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[26] Edouard Souchon, "On Embalming," *Proceedings of the Nineteenth Annual Meeting of the Conference of State of Provincial Boards of Health of North America, Washington, June 3 and 4, 1904* (Providence: Snow & Farnham, 1904), p. 13.

World exhibitions became one of the marketing spots for Russian, French, German, Italian, and American inventions, all of them claiming to possess extraordinary preservation capacities. Originally used as a means for preservation in medicine schools, their inventors soon realized that they could also sell fluid formulae and injectors to the expanding funerary industry.

By 1896, there were several reliable embalming fluids on the American market. Among them, Mills and Lacy, Oriental, Champion, Perfection, Ralcohl, Ideal, Mystic, Imperial, Clark's Best, Utopia, Owen's fluid, Renouard fluid, Mead's embalmer, Shaw's fluid compound, Phorencina, and Uptimum. The names, bottles, and selling strategies of these fluids were reminiscent of the the lotions, balms, and liquids of travelling doctors. As L.T. Christian, a prominent embalmer from Richmond, realized: "there are new fluids on the market from time to time, and most of them are commercial commodities which the embalmer cannot use with any degree of certainty, and with the assurance that they are what they claim to be."[27]

Arsenic and alcohol were the foremost employed chemicals in the manufacturing of those fluids. Zinc constituted an important base, while creosote, mercuric chloride, aluminum sulfate, carbolic acid, and thymol were the leading constituents of a large number of fluids used in America, Germany and England. In France, however, the use of arsenic as a preservative was only allowed for museum specimens.[28] Arsenic was prohibited in America as a compound for embalming fluids around 1900. This gradually changed the practices of embalmers and funeral directors.[29]

In 1900, the state and provincial boards of health appointed a committee to determine what was an "approved disinfecting fluid" within the rules governing the transportation of the dead, which appeared to provide that the same fluid was to be used both inside and outside the body to be shipped. This restricted the choice of substances: some disinfecting fluids were unsuitable for embalming, though useful for the outside of the body. However, some embalming fluids were unsuitable for desinfecting the outside of the body. In the framework of these debates, Carl Barnes started promoting the use of an approved disinfectant as embalming fluid.

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[27] Langdon T. Christian, "On Embalming," *Proceedings* (cit. note 26), p. 9.

[28] Charles McCurdy, "Embalming and Embalming fluids," *The Post-Graduate and Wooster Quarterly,* 1896, *39*, p. 207 and 211.

[29] Clark Bell, "The Case of Patrick", and "Presidential Inaugural Address. Poisons in Embalming Fluids," *The Medico Legal Journal,* 1906, *24*: 1-46 and 536-8.

The best results, following Barnes' experiments, were obtained with the formula of one and a half gallons of formaldehyde in fifteen gallons of distilled water and one gallon methyl alcohol, 95 per cent.[30]

Although formaldehyde gas was first described by August Wilhem Hoffman in 1867, its use as fixative developed from a fortuitous observation made by Ferdinand Blum in 1893 after it hardened the skin of his fingers. Formaldehyde was already considered the most important disinfectant of the day. It was a gas, found in the market as an aqueous solution containing from thirty-five to forty per cent of available formaldehyde gas. It had an unpleasant, penetrating odor and was quite irritating. Mixed with calcium chloride, it had to be heated under pressure, which raised the boiling point of the liquid. In the early 20th century, various generators, apparatuses, and formaldehyde sprinklers were on the market and adopted by the boards of health in several American states for room disinfection in hospitals and dwellings.[31]

Barnes had been observing and reporting on formaldehyde since the yellow fever epidemic of 1897, when he inspected the trains arriving to Chicago from the south to investigate the methods of disinfection employed by the railway company.[32] The desinfectant used was formaldehyde gas and calcium chloride, the gas being generated by means of a high "C" formaldehyde gas generator. The formula used in the generator was considered to be excellent and was composed of 1000 parts formaldehyde (40% strong), 200 parts calcium chloride and 400 parts water. Given his experience as an embalmer and the fact that it was well known that liquid formaldehyde had a very intense tanning effect on the skin, Barnes could not refrain from observing the action of this disinfectant on the hands of the operator. Thousands of pounds of gas were used by the railway company, which provided a wonderful opportunity to investigate its effect on man. Barnes observed:

> For the first few weeks the operator did not use gloves. This his hands came in direct contact with the liquid while mixing it and preparing it for the generator.

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[30] Barnes, "Disinfection of Bodies," *Proceedings* (cit. note 26), p.18-9.

[31] Henry M. Bracken, *Disinfection and Disinfectants. A Treatise upon the Best Known Disinfectants, Their Use in the Destruction of Disease Germs, with Special Instruction for Their Application in the Commonly Recognized Infections and Contagious Diseases* (Chicago: The Trade Periodical Company, 1900).

[32] Barnes "Train Inspection at Chicago during the Epidemic of Yellow Fever in the South," *Twentieth Annual Report of the Illinois State Board of Health fort the Year Ending December 31, 1897*, (Springfield, 1898), p. LXX-LXXI.

> The tanning effect was severe, and so hardened the skin and flesh of the fingers that they cracked to the bone, due to the hardening effect of the chemical on the tissues. In the use of this gas and in coming in contact with the liquids he experinced no physical depression whatever, and appeared to be in the best of health, having suffered nothing except the injury to his hands, which, however, soon got well after protecting them with gloves.[33]

Formaldehyde would soon change the attire worn for the job of disinfecting. Disinfecting the rooms of the dead was incorporated as part of the embalmer's tasks. The remains of all who died of an infectious disease had to be injected with a reliable embalming fluid and the entire surface of the body, including the hair, had to be cleansed with desinfectant. The embalmer/disinfector was to be provided with special gowns, his mouth and nose protected by some covering (Fig. 6).[34] Although all of these instructions were given in the case of infectious diseases, the debates of the American boards of health showed that embalmers, health officers, and lay physicians interpreted the rules in different ways: embalmers looked at this matter from a business standpoint and health officers did so from a sanitary point of view.[35] Many physicians, such as Barnes, integrated the health departments to defend their own businesses. Health officers with no connections to the embalming or chemical industries questioned the need for embalming: the less the body was handled, the less likely it was to pass on disease. But that question was not heard: it had become customary for the American people to have their relatives embalmed and health officers found no reason to forbid it. Furthermore, they understood that one of the main problems of germicides was that they did not provide the "cosmetic effect", the most important accomplishment of modern American embalmers. As the United States Chemical Company advertised: "Bodies embalmed by us never turn black!"[36]

By 1904, embalmers were still cautious about the cosmetic effects of formaldehyde fluid, acknowledging that they had a great variety of conditions to consider. In the case of young people who had died from tuberculosis, the tissues became very thin and delicate. Formaldehyde would absolutely destroy the appearance of the body and make it dry and hard.

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[33] Barnes, "Train Inspection" (cit. note 33), p. LXXI.

[34] Bracken, *Disinfection* (cit. note 32).

[35] The oppposite happened in Argentina, where health officers fought commercial embalming claiming that this funerary practice was against progress and the laws of life see Podgorny "Recuerden que están muertos" (cit. note 3).

[36] http://observatoryroom.org/2009/06/18/bodies-embalmed-by-us-never-turn-black/

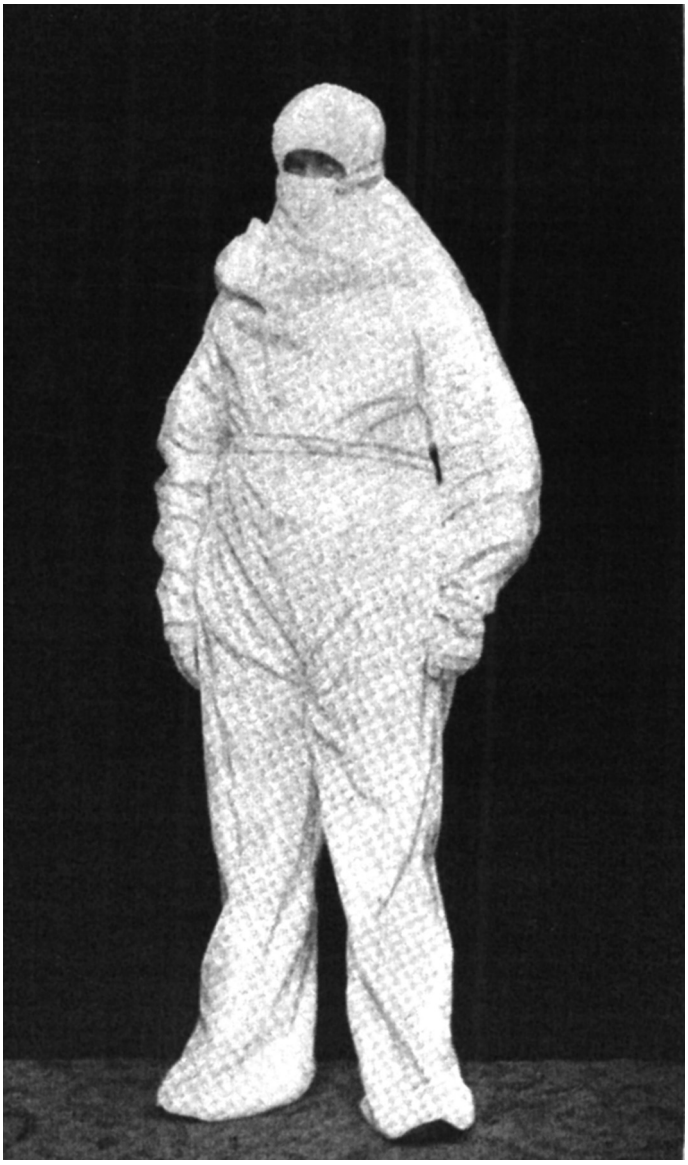

Figure 6. A disinfector dressed for service (from H. M. Bracken, *Disinfection and Disinfectants.* Chicago: The Trade Periodical Company, 1900, p. 38-9).

In the case of persons who died from alcohol poisoning, the injection with formaldehyde fluid would fail because of the chemical condition of the body. Embalmers asserted: "while some of the manufacturers of embalming fluids say that there are fluids to preserve all cases, still the thoroughly skillful embalmer would tell you it is not so."[37] A great number of funeral directors were convinced of the fact that formaldehyde was not the best preservative to use. However, they were willing to work with the health officers to decide upon the appropriate chemicals to use in the future that was opening before them.

In the debates, Barnes insisted on the fact that the solution he proposed, which used formaldehyde, did not affect the color of the face to any appreciable extent; however, a large amount of formaldehyde would act upon the blood and give it a bluish-blanck appearance. It is worth noting that this was not the fluid that Barnes had on the market. His embalming fluid in 1904 was not a disinfectant and was sold under the name of Bisga. It was the embalming fluid that the United States Chemical Company advertised by portrarying a perfectly preserved corpse, embalmed three months before, fully dressed in business attire, seated, and holding a newspaper.[38] Whereas Barnes claimed extensively that Bisga had no arsenic, by 1906, a professor of chemistry of the Medical-Chirurgical college of Philadelphia found that it contained arsenic and chloroform. Therefore, it was prohibited.[39] Barnes, as Scandura pointed out, had played deadly tricks and "the embalmed corpse became a threatening signifier of deception in a culture where appearance was all."[40] It is, thus, not surprising that Barnes wanted to move to formaldehyde. Pressed by the new regulations regarding body disinfection and the prohibition on using arsenic compounds, he patented a new process of embalming in 1908:

> 978,814. PROCESS OF EMBALMING. Carl L. Barnes, Chicago, 111. Filed June 11, 1908. Serial No. 437,810.
> 1. The process of embalming without cutting or mutilation of the body, consisting in filling only the larger cavities of the body with a solution of formaldehyde, placing the same in an air tight receptacle in the presence of formaldehyde and allowing the body to remain therein until the formaldehyde has thoroughly permeated the body.

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[37] Christian, "On Embalming," *Proceedings* (cit. note 26), p. 9-10.

[38] Scandura "Deadly professions" (cit. note 24), p. 14-15, Fig. 4; see John Troyer *Technologies of the Human Corpse* (PhD Thesis, University of Minnesota, 2006).

[39] *XV Congrès International de Médecine. Lisbonne, 19-26 Avril 1906:* [*rapports et Comptes Rendus.*] *Section Médécine Légale* (Lisbon: A. de Mendonça, 1906), p. 135.

[40] Scandura, "Deadly Professions" (cit. note 23), p. 16.

> 2. The process of embalming without cutting or mutilation of the body, consisting in filling only the larger cavities of the body with a solution of formaldehyde, inclosing the body in wrappers saturated with a solution of formaldehyde, and retaining the body thus prepared in an air tight receptacle until thoroughly impregnated with formaldehyde.
> 3. The process of embalming consisting in filling the larger cavities of the body with an alcoholic solution of formaldehyde, inclosing the body In wrappers saturated with an alcoholic solution of formaldehyde and retaining the body thus prepared in an air tight receptacle until thoroughly impregnated with formaldehyde.[41]

Barnes ensured his patent just in time. The resistance of embalmers to formaldehyde would come to an end very soon. The amendments of the Sanitary Codes of several American states in the 1910s started requiring that the transportation of bodies perished from smallpox, plague, Asiatic cholera, yellow fever, thyphus fever, diphteria, scarlet fever, erysipelas, anthrax, and leprosy had to be thoroughly embalmed with an approved disifectant fluid, in many cases stating that the fluid had to contain formaldehyde gas in a certain proportion.[42]

In 1915, a surgeon from the United States Public Health Service, lecturing on the importance of the technique of injection before the State Directors' Association in Savannah, Georgia, could state that the Public Health Service, the Army and Navy, the funeral directors, and state funerals found no difficulty in meeting all the requirements regarding preservation of all parts of the body and their complete sterilization.[43] Agreement was almost unanimous about the method of injecting a fluid equal to 15 per cent of the body weight into the arterial system via several entry points (femoral, brachial, and carotid arteries), the apparatus to be used, and the fluid's composition. Formaldehyde had been tested and the formula to be used devised

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[41] *Official gazette of the United States Patent Office*, Volume 16, 1910, p. 597.

[42] George Weinmann, "Survey of the Law Concerning Dead Human Bodies," *Bulletin of the National Research Council* 1929, *73*, see "Louisiana: Embalming (Amendments to Sanitary Code, Board of Health, Feb. 26, 1913)," *Public Health Reports* 1913, *28, 36*: 1879-80; "Dead Bodies. Transportation of. Embalming (Chap. 351, Act Mar. 27, 1914)," *Ibid*., 1915, *30/16*: 1216-7; "South Dakota: Embalming, Burial (Reg. Bd. of H., July 25, 1913)," *Ibid*., 1914, *29/9*: 550-1; "Los Angeles, Cal. Burial. Funerals. Embalming. Communicable Diseases. Funerals. Transportation of Bodies (Ord. 30619, Aug 13, 1914)," *Ibid*., 1915, *30/2*: 126-8; "Johnston, Pa. Burial and Transportation of Bodies. Funerals. Embalming. Disinterment (Ord. 20 Mar. 17, 1914)," *Ibid*., 1914, *29/49*: 3301-5; "Alaska: Embalming. Practice of. Burial. Transportation of Dead Bodies. Communicable Diseases (Reg. Registrar of Vital Statistics, Aug. 28, 1915)," *Ibid*., 1916, *31/18*: 1152-8.

[43] Edward Francis, "Embalming. A Satisfactory Method of Performing," *Ibid*., 1915, *30/31*: 2223-6, p. 2223.

at the Hygienic Laboratory of the Public Health Service. It had been found stable in composition after standing two years and eight months and proven effective in preserving human subjects exposed for two months to a temperature of 98° Farenheit. By 1915, formaldehyde constituted the essential ingredient in nearly all commercial fluids analyzed at the Hygienic Laboratory and was claimed as the best preservative and disinfectant for use in embalming fluid.[44] Formaldehyde has been adopted and turned out to be particularly favored because of its ability to fix the tissue that makes flesh firmer, to such an extent that US cemeteries bury almost a million gallon of formaldehyde-based embalming fluids each year. The reluctance of embalmers to using formaldehyde has been fully forgotten. Furthermore, now that formaldehyde is considered a potential or known human carcinogen, embalmers seem reluctant to try new fluids that could travel into the dead body to produce the same hibernating appearance to which Americasn have become accustomed to seeing when mourning their lost loved ones.

## Concluding Remarks

The stories connected with Carl L. Barnes' embalming industries reflect how American embalmers of the second half of the 19th century defined their practice around the cosmetic effect they could achieve with dead bodies. Embalmers used fluids and performed experiments as if they could help in restoring life during the grieving period. In that context, embalming was put on show. Experiments and exhibitions of embalmed bodies promoted fluids that could travel through the arterial system, presented as a method connected with the understanding of the physics and dynamics of the afterlife.

By the turn of the century, however, embalming was linked to sanitary measures: fluids had to be transformed into desinfectants, the embalmer into a public health agent. The consolidation of formaldehyde and of a standarized process defined by the chemical properties of the fluid, were associated with this new role of funeral directors resulting from the

[44] Norman Roberts, "Chemical Examinations of 24 Commercial Embalming Fluids", Proceedings of the 29th Annual Convention, National Funeral Director's Association, September, 1910, quoted in Francis "Embalming" (cit. note 43, p. 2225, note 2); Simon Mendelsohn, *Embalming Fluids; Their Historical Development and Formulation: From the Standpoint of the Chemical Aspects of the Scientific Art of Preserving Human Remains* (New York: Chemical Publishing, 1940).

strategic alliance of chemical companies, embalmers, and health officers. Shaped by the protocols of disinfection adopted by American health officers to stop the spread of contagious diseases, the standarization of the embalming process not only tied embalming to desinfectant fluids but also hid the process from public view. Embalmers concealed their experiments and practices in the secrecy of the embalming room. This account of the development of the American funerary industry poses several questions beyond the local case. As this article mentions, embalming was an international endeauvour, combining methods of injection, fluids, and instruments discussed and reviewed in many countries. If embalming was such an international enterprise, why did human embalmers succeed primarily in the United States? While the alliances between the chemical industry and sanitary officers undoubtedly played a role, there is a cultural element that was lacking in other contexts. While in countrties such as Argentina, embalming was seen as a step backwards in health management, American health officers, Barnes, and other embalmers tied the embalming industry to the concept of progress and the future of science. Immortality of the body was not an anchor with the past but a link to the optimism of the future. As expressed by the lines that crowned the gentleman corpse of Barnes' advertisement of Bisga: "I naver thought I would live to see what Bisga fluid accomplished today". These words were said by one of Atlanta's prominent undertakers after witnessing the injection of Bisga fluid into the subject's arteries, yet appeared as though uttered by the the embalmed dead man. Embalmers and embalmed were linked together to face whatever the future would bring. The voyage of the fluids through the vessels became a way to wait for the glory to come.