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A Consideration of Factors in the Discovery of Anesthesia and Their Effects on Its Development

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IN 1842, CRAWFORD LONG of Athens, Georgia, made one of the most important discoveries in history, when he found that inhalation of the vapor of diethyl ether produced a controllable, reversible state of unresponsiveness to pain. Long took advantage of this property of ether to produce surgical anesthesia, an accomplishment one or two others had already achieved, but Long did so repeatedly in a deliberate manner in order to operate without pain, and this distinguished him from previous occasional dabblers in experiments with ether.[1,2] Long discovered anesthesia. However, he did nothing to publicize his discovery, and the world remained ignorant of the potential benefits of ether until William Morton publicly demonstrated the practicality of ether anesthesia before a group of influential surgeons at the Massachusetts General Hospital in Boston on October 16, 1846.

The events and personalities associated with the discovery of anesthesia are an oft-told tale, a tale which, however, leaves the impression that the discovery of anesthesia came as a bolt out of the blue. In fact, it was almost inevitable that anesthesia would be discovered when it was. It was also not by happenstance alone that ether was the first anesthetic. Furthermore, the very reasons which made ether predestined to be the first anesthetic in turn almost preordained the direction in which anesthesia as a medical specialty would develop over the next hundred years. The richness of the history of anesthesia unfolds when one considers the factors which determined why anesthesia was introduced when it was, why ether was the first anesthetic, and how ether as the first anesthetic affected the subsequent development of the practice of anesthesia.

The first prerequisite for the discovery of anesthesia was development of the concept that each individual in a society bears responsibility for the welfare of his fellow man. In the absence of humanitarianism, political freedom could not develop, child labor would continue, penology would remain medieval, the care of the insane would remain cruel and inhumane, and also, in the absence of humanitarianism, anesthesia could not be discovered. Control of pain required the simultaneous development of a desire on the part of society to correct *all* the ailments which affect man. Pain is but one of them. There is nothing about pain as an affliction which dictates that it should be dealt with first and foremost. Humanism, an intellectual exercise, would not suffice. After humanism had developed to include humanitarianism, then ideas and concepts could develop which inevitably would include solving the problem of pain.

Today, one can say "all sane men would agree that the relief of suffering, both human and animal, is one of the noblest activities of man,"[3] but this has not always been the case. Indeed, man's activities suggest that for the majority of his history he has been more interested in inflicting pain than in relieving it. Only in relatively recent times has man be-

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come concerned enough with fate of individual members of society to devote the thought and attention necessary for relief of pain.

The political, cultural and religious climate had to be right for the discovery of anesthesia. In Western European history, this climate did not develop on a scale which affected significant numbers of individuals until the 18th century. In the 1,800 years prior to the introduction of anesthesia Western man had, in theory, a sense of obligation for the well-being of his fellow man. In practice, however, this concern was a rather abstract obligation in which welfare was ususally defined in spiritual or religious terms, not in a physical or material sense. So long as witches were being burned in Salem, anesthesia could not be discovered 20 miles away in Boston.

Man's inhumanity to man at a level incompatible with a discovery as humane as anesthesia was not limited to the Dark Ages or to 17th-century witch burnings. It continued beyond the massacres of the French Terror well into the 19th century, though on an ever-decreasing scale. Nevertheless, in 1815 there were no fewer than 223 crimes in England punishable by death, including offenses such as shooting at a rabbit, stealing an article worth more than 5 shillings, or cutting down a young tree. Not until 1833 did the English Parliament pass the first child labor law, a revolutionary act which prohibited children less than 11 years old from working more than 9 hours a day in the mines, and which prohibited children more than 11 years old from working more than 12 hours a day in the mines.

The cultural changes which affected Western European civilization from 1750 to 1850, and which eventually led to an atmosphere in which anesthesia could be discovered, had little effect on societies in other parts of the world. The progressive democratization and humanization seen in Western European and North America had no counterparts in Islamic, Russian, Hindu, or Far Eastern countries. The persistence in the rest of the world of feudal societies based upon concepts of man's place in the world which were inimical to the discovery of anesthesia almost guaranteed that anesthesia would be discovered in a country oriented to the ideas and concepts of Western Europe. It was no accident that anesthesia was not discovered in Asia, Africa, or South America, for in the mid-1800's these areas were still afflicted by the very conditions which had prevented anesthesia from being discovered in Western Europe before 1800.

In addition to the cultural and philosophic limitations which dictated the general era in which anesthesia could be discovered, there existed other constrictions to the early introduction of anesthesia. Chief among these were age-old concepts of the nature of pain itself. One of the oldest and most widespread of these attributed to pain a holy or religious quality. Pain was regarded as divinely inspired, a reasonable and just retribution for sins committed, known or unknown. The idea that pain has a religious quality is a concept which is perhaps particularly evident in civilizations which developed in the Mediterranean area. Its antiquity is evident in the derivation of the English word *pain* from the Latin word for punishment, *poena*, which in turn is derived from the Greek *poinê* for penalty. It applied, interestingly enough, particularly to naturally occurring or spontaneous pain, as differentiated from accidentally or intentionally inflicted pain. Pain which today we would recognize as being due to conditions such as peritonitis and carcinoma has been regarded by many civilizations in the past as possessing a moral quality subtly but definitely different from the pain of a femur fractured by a battle-axe. Not that the deliberate infliction of pain has always been devoid of religious connotations, as witnessed by use of pain during the Inquisition, but as a general principle pathologic pain had until recently a special mystique about it that was lacking in pain associated with trauma.

So long as pain was regarded as a manifestation of divine justice, nothing serious could be done to alter its course, for to do so would be to tamper with the will of God, an action incomprehensible to an individual living in the Dark Ages, no matter how enlightened (*i.e.*, heretical) he might have been by contemporary standards. Before anesthesia could be discovered, pain had to be regarded as a normal manifestation of response to physical stimulus, not as something visited on man by spirits or divine beings.

The concept of pain as a religious phenomenon was (and is) exemplified by the special qualities attributed to the pain of childbirth. Obstetrical pain possesses particularly strong religious overtones, especially in Western European Christian societies. The concept that obstetrical pain differs in moral quality from other types of pain dates back to the Judeo-Christian concept of original sin. As punishment for disobeying God's commands in the Garden of Eden, we are told in the Old Testament that Eve and all women were thenceforth condemned "to bring forth children in sorrow." This Judeo-Christian attitude towards obstetrical pain as divine punishment achieved further refinement as Christian theology developed in the Middle Ages. In the fifth century, Augustine first promulgated the concept that concupiscence fouls the act of generation. This gradually became expanded by medieval theologians to include the concept, especially in Western Christianity, that there was something immoral about the conjugal act itself and, therefore, something immoral about anything resulting from this act, including childbirth. The attitude that the pain of childbirth represented just desserts for engaging in an immoral act in the first place was to reach its epitome in Protestant and, especially, Calvinistic attitudes towards sex.

This religious attitude towards the pain of childbirth is not characteristic of other world religious, most of which do not invest this type of pain with the special aura found in Christian philosophy. It is, however, a concept which added yet a further impediment to the discovery of means of alleviating pain. Nowhere do we see this more strikingly than in the history of obstetrical anesthesia in Scotland, which, in view of the religious history of that country, is perhaps not surprising. We find, for example, that in 1591 a woman by the name of Eufame MacAlyane was burned alive on Castle Hill in Edinburgh because she sought relief of pain during delivery of her two sons.[4] It is also in Scotland that we find the celebrated controversy in 1847 associated with the attempt of Sir James Simpson to introduce chloroform into obstetrics.

Yet another ancient attitude toward pain which did little to advance the cause of anesthesia consisted of the widely held belief that the ability to withstand pain represents a noble attribute indicative of great personal character, especially in males, in whom the ability to withstand pain is frequently equated with virility. This concept, unlike the religious quality ascribed to pain, is not primarily a product of Western civilization. Nor is it an attitude which has changed greatly since the Age of Enlightenment. The high regard accorded the individual who reacts stoically to pain has been found among almost all cultures and civilizations in the past, as well as today. This moral judgment of a somatic response continues to appear in unexpected places and in unexpected ways. Witness, for example, the physician, trained to be objective in his care for those in pain, who nevertheless tells a patient "you're a good patient" because the patient does not complain of pain.

If the first requisite for the discovery of anesthesia was the development of the appropriate ethical attitude toward suffering, the second requisite was development of science to a certain level of technical and conceptual sophistication. Scientific knowledge was as necessary for the discovery of anesthesia as was moral spirit. Chemistry, for example, had to develop beyond the alchemist's preoccupation with transfiguration of base metals to the level where knowledge for knowledge's own sake was desired. This necessitated a change in objectives in chemistry, as well development of techniques. Techniques for the accurate identification and synthesis or isolation of simple organic compounds had to be available before anesthesia could be discovered. This necessary level of technical expertise was achieved in Western Europe only in the latter part of the 18th century. Anesthesia could not be discovered, for example, till chemistry and physics had developed to the point where in the 1770's a man such as Joseph Priestley could discover oxygen, carbon dioxide, and nitrous oxide.

Development of chemistry was not enough. Equally needed before anesthesia could be discovered was development of the art and science of medicine itself to the point where objective, rational analysis replaced dogma and superstition. Only when physicians broke with the orthodoxy of Galenic medicine would they be in a position to make the clinical observations necessary for discovery of something as pharmacologically complex as anesthesia. The scene became set for the discovery of anesthesia when physicians such as William Withering in 1775 could recognize the value of foxglove in the management of heart failure, and when Edward Jenner in 1796 could demonstrate the antagonism between cowpox and smallpox.

The discovery of anesthesia was essentially impossible before the end of the 18th century, but by the early part of the 19th century man's affairs had progressed to such a level that it was almost inevitable that anesthesia would be discovered prior to about 1850. By the mid-19th century man had for more than half a century been concerned enough about the welfare of his fellow man to set about deliberately searching for means of relieving pain. Pain was no longer regarded as inevitable, as something to be endured as stoically as possible, or as something to be accepted with resignation as divine retribution. By the 1850's chemistry had advanced to the stage where several compounds later to be identified as anesthetics had been isolated and synthesized. And, perhaps most important, a spirit of clinical inventiveness and curiosity had crept into practice of medicine. Physicians were beginning to make accurate observations. They were beginning to try different forms of treatment under relatively controlled conditions. It was inevitable that an inquiring mind would soon apply the materials at hand to the relief of pain.

Anesthesia was, however, destined to be discovered by dentists, not physicians, and this in retrospect was also almost predestined. The primary role of dentists in the discovery of anesthesia is hardly surprising. In the early part of the 19th century the number of surgical operations was negligible. The frequency with which physicians and surgeons deliberately produced pain was so low that pain must have represented a problem which occupied a position of relatively low priority in their minds. The endemic and epidemic infectious diseases which played such a prominent role in contemporary mortality rates must inevitably have distracted physicians from the problem of pain. After all, how important was pain in the order of things when for every patient which a physician encountered in pain he encountered three or four times as many patients dying from pneumonia, diphtheria, malaria, or typhoid. This, however, was not the case with dentists. Dentists were not dealing with potentially lethal problems every day. Indeed, they were dealing with patients who came to them because of pain. Dentists dealt with pain every day, much more than physicians. Dentists had day-to-day incentive for discovering means for the relief of pain; doctors did not. It is not surprising that a dentist, Horace Wells, was so concerned about pain that he pursued the anesthetic potential of nitrous oxide far more than others such as Boyle and Priestly, who, with less incentive, observed the effects of nitrous oxide on pain, but then let the matter drop. The same incentive for relief of pain was the motivating force behind the efforts of another dentist, William T. G. Morton, to relieve pain. Morton had developed a technique for crowning teeth which necessitated preliminary root extraction. Morton had to solve the problem of the pain of the root extraction before the restorative procedure would achieve acceptance. He turned to ether, and while Wells had failed with nitrous oxide due to factors he had no control over, Morton's efforts were successful. Having demonstrated the feasibility of surgical anesthesia, Morton then saw his discovery taken over by surgeons and applied to solution of their own problems. Without the incentive born of the necessity for control of dental pain, one wonders how long the discovery of anesthesia would have been delayed. It might have been quite a while. After all, Crawford Long, a physician, had found a method of relieving pain but had done nothing about it, perhaps because he did not regard pain as being that great a problem in his daily practice.

If there is a sense of inevitability surrounding the timing of the discovery of anesthesia, there is also inevitability in ether as the first successful anesthetic. Ether almost *had* to be the first anesthetic. This can best be realized by considering the attributes essential to the introduction of any compound as the first anesthetic.

The first anesthetic had to be an inhalation anesthetic. It could not have been an intravenous or local anesthetic. It had to be effective by the simplest means possible and not dependent upon the simultaneous development of equipment necessary for its administration. Intravenous and local anesthesia required the invention of the hypodermic needle, and it was not until 1853 that Alexander Wood of Edinburgh introduced the first hollow metallic needle. It would also be many years before local or intravenous anesthetics could be isolated and synthesized in quantities adequate to make anesthesia possible by means other than by inhalation.

Another reason why the first anesthetic could never have achieved popularity had it been effective only by injection relates to the problem of infection. The safety of intravenous or local anesthesia is dependent upon the ability to avoid infection. Safe anesthesia by injection required, therefore, the prior development of the germ theory of disease and the development of practical and efficient means of antisepsis and asepsis. This was not achieved until 40 years after the introduction of anesthesia. In fact, asepsis was a stepchild of anesthesia. The principles of asepsis were developed principally as a result of the growth of surgery which the discovery of anesthesia permitted.

In addition to being effective by inhalation, the first anesthetic had to be easily synthesized from commonly available materials. Diethyl ether, or "sulfuric ether," as it was originally known, is produced by a simple chemical reaction between ethyl alcohol and sulfuric acid, two substances readily at hand. The ease with which ether was manufactured and purified was a major factor in its being the first anesthetic as well as in its subsequent popularity. The limitations imposed on the discovery of inhalation anesthetics by problems associated with their synthesis are exemplified by the years which elapsed before other inhalation anesthetics, with the exception of chloroform, were introduced. Cyclopropane, for example, represents such formidable problems in synthesis that it was not introduced until 1934. The difficulties inherent in the production of today's halogenated anesthetics proved even greater, and it was not until 1956 that halothane was introduced.

The first anesthetic was also most likely to be successful if it was already known to physicians and in medical use before it was introduced as an anesthetic. To discover anesthesia represented a formidable enough challenge; to do so with a completely new compound which no one had heard of and with which no one had had experience would add a practical difficulty which might delay or even discourage use of an otherwise suitable anesthetic. In the 1840's ether was already in use for frivolous purposes in "ether frolics," especially, it is interesting to note, among doctors, dentists, and medical students, rather than among the laity. Nitrous oxide was also used for the same purpose, but mainly by itinerant showmen who staged public displays for their own profit. The reasons for this difference between the uses of these two "mind-expanding" compounds are not clear, but the result was that ether was known to physicians and dentists, many of whom had had personal experience with it. In addition, ether was used not only for its exhilarating effects (the marijuana of the 1830's), it was used for therapeutic purposes.[5] Administered orally, it was employed in the treatment of conditions as diverse as chronic pulmonary disease, general debility, typhoid fever, and asthma. Administered topically by direct application to the afflicted part, ether was employed in the management of headache (one wonders how much analgesia was produced by its inhalation), strangulated hernia, and painful lacerations of the fingers. Ether was known to medical practitioners of the 1840's. When introduced as an anesthetic, the acceptance of ether in its new capacity was surely more readily granted than if the strange new state called anesthesia had involved use of a compound physicians of the time had never had contact with.

Another prerequisite of the first inhalation anesthetic was that it be strong enough so that when inhaled it could produce surgical levels of anesthesia. Nitrous oxide failed as the first anesthetic mainly because it lacked this vital attribute, anesthetic potency. When 80 per cent nitrous oxide is inhaled, analgesia results, not anesthesia. This was a nuance all too subtle when Wells in 1845 attempted to demonstrate the pain-relieving properties of nitrous oxide.

The first anesthetic had to be potent enough to produce true surgical anesthesia. It also had to be potent enough to do so without dilution of inhaled oxygen to the point where hypoxia occurred when the patient was breathing room air. An inhalation anesthetic which requires a concentration of 30 volumes per cent in inhaled air so dilutes the 21 per cent oxygen in room air that hypoxia inevitably ensues unless room air is replaced by an oxygen-enriched atmosphere. It takes an anesthetic such as ether, which maintains surgical anesthesia with 2 volumes per cent in the inspired air, to avoid both the Charybdis of inadequate anesthesia and the Scylla of hypoxia. Unless the first anesthetic simultaneously produced surgical levels of anesthesia and avoided asphyxia, it could not gain acceptance.

The first anesthetic also had to have certain physical properties. It had to have a low boiling point, low enough so that at room temperature it exerted a vapor pressure great enough to allow the patient to inhale an effective concentration. Ether has a boiling point of 34 C, corresponding to a vapor pressure of 440 mm Hg at 20 C. Because of this, ether vaporizes so readily that it can be administered by the simplest of techniques, *i.e.*, "open drop" onto a cloth mask covering the mouth and nose. An anesthetic with a higher boiling point and a lower vapor pressure would prove so difficult to vaporize that an effective vapor pressure could not be achieved unless complex, specially designed vaporizers were used. The first anesthetic had to be effective at room temperature without the use of special equipment. Few anesthetics meet these requirements better than ether.

On the other hand, the first anesthetic could not have a boiling point so low that it existed as a gas at room temperature. The first anesthetic could not be a gas because, again, the equipment necessary for its administration would have proven too complex. Modern gaseous anesthetics are successful because of metal cylinders for storage, reducing valves and flowmeters for accurate administration, and directional valves and carbon dioxide absorbants for elimination of respiratory dead-space. The mechanical necessities associated with the administration of gaseous anesthetics precluded the introduction of anesthesia by an agent other than a liquid with a high vapor pressure.

The most important prerequisite for the first anesthetic was, however, safety. Safety in terms of the medically primitive scene of the mid-19th century meant reversibility, absence of depression of respiration, absence of depression of the cardiovascular system, and lack of histotoxicity. Ether was, and is, almost unique in these regards. It is reversible, and thus readily controllable, merely by altering the inhaled concentration. Even today, ether is the only general anesthetic agent capable of producing surgical levels of anesthesia without also depressing respiration. And the fact that its administration is accompanied by a concurrent increase in activity of the sympathetic nervous system means that its inherent negative inotropism is compensated for. Direct myocardial depression is an attribute common to all anesthetic agents, but only with ether and cyclopropane is this simultaneously offset by a neurogenically mediated positive inotropism. Finally, the safety of ether is related to the fact that it has no histotoxic properties. This attribute is shared by other anesthetics such as cyclopropane and nitrous oxide. This is not the case, however, with certain halogenated anesthetics such as chloroform, halothane, and methoxyflurane. These compounds all have the potential for histotoxicity, though of widely differing etiology and incidence.

If one set out to design a compound which would be most propitious as the first anesthetic, one could hardly pick an agent with more desirable features than ether, especially when administered by the inexperienced. It depresses neither respiration nor the cardiovascular system. Overdosage can readily be treated. It is not histotoxic. These very features had, however, unexpected and unfortunate effects on subsequent development of the art and science of anesthesia, particularly in the United States. These stemmed from the fact that because ether was apparently so safe, it was neglected. Ether was assumed to be an ideal anesthetic, and, because it was so nearly ideal, it was assumed that no problems existed in anesthesia. So long as no problems existed, the administration of anesthetics was relegated to technicians. For a hundred years after its discovery, anesthesia was administered by nurse anesthetists in the country of its birth. By and large competent, nurse anesthetists served well. The difficulty was that by virtue of their training and background, and because of their place in the medical hierarchy, nurse anesthetists were in no position to advance the practice of anesthesia, nor were they in a position to recognize the magnitude of the problems associated with anesthesia. Because anesthesia appeared so safe, so *automatically* safe, there was no challenge in anesthesia which attracted the interest of physicians. The neglect of clinical anesthesia was paralleled in the United States by an almost complete lack of interest on the part of basic scientists in studying the pharmacologic and physiologic aspects of anesthesia. It was not until World War II that the problems inherent in anesthesia became so evident that physicians and scientists in the United States finally became involved in serious attempts to understand the state of anesthesia. The heritage of the discovery of ether anesthesia in the United States was stagnation of anesthesia as a science and as an art. The initial blessing of safety was offset by the deadening effect this apparent safety had on the development of anesthesia as a medical specialty.

The inhibitory effect of ether on the subsequent development of anesthesia in the country in which it was discovered stands in contrast to the course events took elsewhere, especially in the United Kingdom. In November 1847, 13 months after the introduction of ether in Boston, Sir James Simpson introduced chloroform in Edinburgh. Within a short time, chloroform was the prevalent anesthetic throughout Britain. There were probably several reasons why chloroform achieved such popularity in the British Isles, often to the exclusion of ether. These reasons included the fact that chloroform, unlike ether, was nonexplosive, but in retrospect many of these reasons appear to be less solidly based. In fact, the literature of the times indicates a major basis for chloroform's popularity was aesthetic: "Chloroform doesn't smell as bad as ether." Another reason was chauvinism, a reluctance to accept as better anything, ether included, which came from a country as young and brash as the United States, so recently a colony, one whose capitol had even been burned by the British only 30 years previously. The chauvinism associated with chloroform was evident even within the British Isles: until recently the frequency of the use of chloroform was an inverse function of distance from Edinburgh. More chloroform than ether was administered in London in the 19th century, but in Edinburgh nothing but chloroform was used.

Chloroform has many of the attributes discussed above which would make it a good first anesthetic, but there are significant differences between chloroform and ether. These can be summed up in one word: safety. The only major advantage chloroform has over ether in terms of safety is its nonflammability. On the other hand, chloroform depresses respiration. Furthermore, while chloroform, like ether, depresses the force of contraction of the heart, unlike ether, this negative inotropism is not compensated for by reflex increase in sympathetic activity. In addition to this potential for cardiovascular depression is the fact that chloroform increases ventricular irritability and sensitizes the heart to the arrhythmic effects of epinephrine, a reaction absent during ether anesthesia. Ventricular arrhythmias, including ventricular fibrillation, were to prove a constant source of concern, especially during induction of anesthesia in a frightened, anxious patient.

Another important difference in safety between ether and chloroform is that while ether has no histotoxic properties, chloroform does. The tissue toxicity of chloroform is most evident in its ability to produce dose-dependent, reproducible hepatic damage. This effect on the liver, vastly different from the rare sensitization type of hepatic reaction associated with modern halogenated anesthetics such as halothane and methoxyflurane, meant that hepatic failure following chloroform anesthesia was, especially in the early days, both frequent and severe.

The pharmacologic differences between chloroform and ether meant that deaths due to chloroform began to be reported within weeks[6] after the introduction of chloroform, whereas deaths associated with ether were first reported much later and less often. This, however, was not as self-evident at the time as it is looking back, and, in fact, from 1848 until well into the 20th century the relative merits of ether in the United States and chloroform in the United Kingdom were argued in what has since been termed "The Great Trans-Atlantic Debate." Purposeless, tedious, and often irrational on both sides, the Debate accomplished little except to detract from the stature of those involved and to provide an illustration of the difficulties practitioners of medicine have in making objective clinical observations in their own practices in a statistically valid manner. Despite the Debate, however, it gradually became apparent to the majority of physicians in the United Kingdom that while chloroform was a clinically useful and acceptable anesthetic, it was by no means ideal. It was recognized that the administration of chloroform was associated with real dangers, and that anesthesia was not something to be entered into lightly or inadvisedly, an attitude many decades off in the United States. Because chloroform anesthesia represented a danger clearly recognizable to anyone who dealt with it, chloroform anesthesia represented a challenge, a challenge which soon attracted the attention of outstanding thinkers and investigators in Britain, including the first real pioneers in anesthesia, John Snow and Joseph Clover. The ingenuity, insight and clarity of thinking of Snow and Clover, especially Snow, would not be equalled on the American scene until a hundred years had passed after the discovery of anesthesia. Snow was the first full-time physician anesthetist in Britain or, indeed, in the world. In Britain, however, he was only the first of many full-time physician anesthetists, for from the outset anesthesia in Great Britain was always administered by physicians, and by physicians only. The prompt delegation of the responsibility for the administration of anesthetics to physicians in Britain was, it is submitted, in large part due to the widespread use of chloroform in that country. Had chloroform not been discovered, and had ether remained the sole anesthetic for the first 50 years of anesthesia, the practice of anesthesia in Britain might well have evolved in a completely different way. Men like Snow and Clover probably would not have become involved, and the technical and clinical superiority which British anesthetists had over their American nurse counterparts for a hundred years would not have arisen. Had ether been the only anesthetic available in Britain, anesthesia might well have sunk to the same low estate of Amercian anesthesia prior to World War II. It was the challenge of chloroform anesthesia that made the difference. The dangers inherent in chloroform dictated that they be compensated for by assuring that anesthesia be administered under the best possible conditions. Ether allowed the introduction of safe anesthesia, but in so doing it stifled the development of the science and art of anesthesia in the country of its discovery.

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