TECHNICAL DEVELOPMENT OF GAS ANESTHESIA *

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IN the year 1790, Joseph Priestley, an English clergyman, published his "Experiments and Observations on Different Kinds of Air;" a work in three volumes, a revision of six volumes previously published (1). Priestley had obtained carbon dioxide at a nearby brewery and had studied its effects on plants and animals. He had produced oxygen by focusing the heat of the sun by means of a burning glass on some crystals of red precipitate. He had treated nitrous air with moist iron filings and had obtained a gas which he called dephlogisticated nitrous air (1772) and which we now know as nitrous oxide.

Fifty years later, young Humphrey Davy, working at Thomas Beddoes' Pneumatic Institution at Bristol, prepared nitrous oxide in larger quantities by heating ammonium nitrate in a retort. He inhaled the gas, at first cautiously, then more boldly, and, experiencing a new and strange sensation, predicted that the gas might be useful to allay the pain of surgical operations (2). For Davy's experiments, James Watts, renowned engineer, made an inhaler, probably the first to be invented.

In 1820, Henry Hill Hickman, at Ludlow, Shropshire, England, successfully produced insensibility to pain for surgical operations on animals by inhalation of carbon dioxide and of nitrous oxide. A country practitioner, Hickman was unable to impress the medical profession with the value of his experiments. His untimely death interrupted his work before he had found an opportunity to administer the gases to a single human subject.

Nitrous oxide then became a chemical toy, often exhibited for its exhilarating effect, and known as "laughing gas." This was the gas with which Horace Wells, Hartford dentist, in the year 1842, demonstrated insensibility to pain for a dental extraction. Wells himself was the patient; Gardner Q. Colton, an itinerant lecturer on chemistry, administered the gas. The extraction was done by John M. Riggs, otherwise famous for his description of pyorrhea alveolaris. Wells afterwards succeeded with the gas in a few dental operations. That he could not always be successful was to be expected: the gas was impure; the apparatus was a bag of rubber cloth which his wife had sewed, with a wooden tube for a mouthpiece. In Boston, his attempted demonstration was received with derision by the students at Harvard Medical

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School. Reports from those who attempted relief of pain with nitrous oxide were uniformly unfavorable. The agent seemed doomed to oblivion.

But the successful introduction of ether, in 1846, renewed the interest in nitrous oxide. For relieving the pain of short operations, particularly for dental extractions, it was increasingly adopted. Colton, the lecturer who had given gas to Wells at the original demonstration, formed a partnership with John Allen, a Hartford dentist, and in July, 1863, with the financial backing of P. T. Barnum, they opened in New York City the Colton Dental Association. Its object was the use of nitrous oxide for the painless extraction of teeth. This project was greatly successful, with branches in Cincinnati, St. Louis, Philadelphia, Baltimore, Brooklyn and Boston. In three years, Colton and his associates had administered nitrous oxide to more than 25,000 patients. Colton administered the gas pure with no admixture of air. He devised an inhaler with inspiratory and expiratory valves. In 1867, he visited Paris and demonstrated nitrous oxide anesthesia to the noted American dentist, Dr. Evans. In March of the following year, Evans went to England and gave a successful demonstration at the Dental Hospital of London.

Nitrous oxide then became the favorite dental anesthetic agent. Throughout the world it was given in millions of cases. In 1901, after forty years of use, Hewitt was able to find only 30 reported fatalities (3). It was the safest anesthetic agent known.

In the United States, the ingenious ether inhalers which had been devised by William T. G. Morton and his contemporaries were displaced by the ether sponge, a large sea sponge hollowed out to fit the face and which, when soaked with liquid ether, provided from its extensive evaporating surface sufficient ether vapor for the purpose of anesthesia. In England, ether was administered with closed inhalers, the patient breathing to-and-fro from a rubber bag. This method took no account of the physiological needs of respiration; there was little chance for admission of fresh air and the result was a combination of anesthesia and asphyxiation. The Portable Regulating Ether Inhaler of J. T. Clover had a spherical ether chamber, axially perforated by a tube which served as a by-pass. One end of the by-pass communicated with the face piece; to the other end was attached the rubber bag. The ether chamber was partially surrounded with warm water for the purpose of hastening the evaporation of the ether. By rotating the chamber, a greater or lesser amount of ether vapor was admitted to the air passage. The apparatus was ingenious in design but it failed to provide fresh air for the respiratory requirements or to dispose of exhaled carbon dioxide.

In 1876, Clover conceived the idea of initiating anesthesia with nitrous oxide and continuing the anesthetic state with ether. For this purpose he added to the bag of his inhaler a tap through which nitrous oxide could be admitted for the induction of anesthesia (4). While nitrous oxide alone was suited only for the short operations of dentistry, the gas-ether sequence immediately attracted surgical attention. Many modifications of Clover's inhaler were devised. T. Wilson Smith placed glass windows in the sides of the ether chamber. Dudley Buxton's inhaler could be taken apart for cleansing. Ormsby inserted in the breathing channel a small sea sponge for use as an evaporating surface. Bellamy Gardner made in the ether chamber a pin hole through which a fine jet of ether played on the evaporating sponge; the temperature and the rate of flow of ether were to be regulated by the heat of the operator's hand. Hewitt placed the inspiratory and expiratory valves in a separate valve chamber, by whose rotation both valves could be put in or out of operation (5). It provided for breathing through valves or to-and-fro breathing of the contents of the bag. Thomas L. Bennett, a student of Hewitt's in London, devised an inhaler with separate units for nitrous oxide and for ether; the two combined for the gas-ether sequence. With this inhaler, Bennett introduced the gas-ether sequence by the closed method in New York.

James T. Gwathmey devised a closed gas-ether inhaler, on the face piece of which was mounted an expiratory valve, a chamber for ether evaporation perforated by a by-pass which could be thrown in or out of operation, and, in the chimney piece, inspiratory and expiratory valves which could be thrown out of operation for to-and-fro breathing (6). This inhaler was lighter and less cumbersome than Bennett's, simpler in operation and equally efficient. S. Griffith Davis discarded the ether chamber, and replaced it with a sight-feed dropper which fed ether to an evaporating surface within the breathing channel. Such closed inhalers, one or more of which were indispensable to the armamentarium of professional anesthetists in the early years of the century, are now museum pieces (7).

In 1898, George Flux of London described his open method for administering nitrous oxide, depending upon the fact that the gas is heavier than the atmospheric air. He devised a celluloid inhaler open at either end, the upper end straight but the lower end curved to fit the face and provided with an air cushion. In 250 cases he produced tranquil induction, without excitement, struggling, stertor or lividity; and without minor discomforts such as the smell of the gas bag, the noise of valves, the sound of the gas entering the bag, or restriction of the respiratory movements due to the narrow passages of an inhaler (8, 9).

Administration of nitrous oxide with air was an accepted procedure, used when ether was contraindicated, as in an appendectomy complicated by pulmonary tuberculosis or acute respiratory infection. Four breaths of gas alternated with one of air, the proportion being varied to meet in some manner the demands of anesthesia. In 1868, Professor Edmund A. Andrews of Chicago reported successful use of nitrous oxide in combination with oxygen as a surgical anesthetic. Eighteen years later, in 1886, Frederick W. Hewitt made a series of experiments on nitrous oxide with definite proportions of oxygen (3). For exact measurements of the gases he used a specially constructed gasometer. He found that as the proportion of oxygen was increased, the time required for induction was lengthened, and the period of available anesthesia was proportionately increased. Deep anesthesia could be maintained when the proportion of oxygen was greater than that in atmospheric air. Anesthesia could be maintained with a mixture of one-third oxygen with two-thirds nitrous oxide, but induction with this mixture was unduly prolonged. After a series of 100 administrations, Hewitt recommended a 7 per cent oxygen mixture, which gave a rapid induction and an available anesthesia for fifty seconds. He then devised an ingenious inhaler for gas-oxygen, with the gas and oxygen in separate bags and the oxygen admitted to the face piece through a succession of ten holes, each one-hundredth the size of the nitrous oxide opening. The proportion of oxygen in the mixture depended on the number of small holes which were opened. If there were ten holes open a 10 per cent oxygen mixture resulted. This percentage was ample for the brief operations for which the apparatus had been devised. Hewitt's experiments had been made in dental operations with a face inhaler which had to be removed for performance of the operation. He did not imagine that his recommendation of a 7 per cent oxygen mixture for a fifty second dental anesthesia would be adopted for surgical operations lasting an hour or more.

In 1899, the S. S. White Dental Manufacturing Company produced the first American gas-oxygen apparatus. Samuel Stockton White had been a dentist practicing in Philadelphia and also carrying on a business of manufacturing porcelain artificial teeth. As this business increased he gave up the practice of dentistry. White was interested in Colton's work with nitrous oxide and supplied fused nitrate of ammonia for making the gas, rubber bags, rubber tubing, and apparatus for the manufacture and use of the gas. The White catalog for 1867 pictures a complete nitrous oxide gas apparatus with retort, purifier, gasometer and inhaler. Also pictured is a new inhaler designed to cover both mouth and nostrils, and a nose compress, "convenient for administering the gas, where the inhaler used is without a face piece." In 1871, Johnston Brothers, at Williamsburg, Long Island, began commercial production of nitrous oxide, liquefied by compression by a pump turned by hand, and supplied in wrought iron cylinders. The firm of Johnston Brothers afterward consolidated with the S. S. White Company. Soon powerful steam pumps were devised for compressing the gas into cylinders. Seamless steel cylinders replaced those of wrought iron.

In the original American gas-oxygen apparatus, the S. S. White Company followed the plan which had been devised by Hewitt. The gas and oxygen were contained in separate bags. A succession of ten holes, each one-hundredth the size of the nitrous oxide opening, admitted oxygen to a mixing chamber. On top of the mixing chamber an inspiratory check valve was mounted. A four foot breathing tube led to the inhaler, on which the expiratory valve was placed. This was an intermittent flow apparatus, the gas and oxygen flowing only during the patient's inspiration. It was necessary to keep the two bags filled, but not distended, by hand adjustment of the valves of the nitrous oxide and of the oxygen cylinders.

Gas-oxygen anesthesia became increasingly popular in the United States; numerous apparatus for its administration were devised. Manufacturers discovered a large demand for nitrous oxide, oxygen, and apparatus for their use. All recommended a 7 or 9 per cent oxygen mixture.

Charles K. Teter of Cleveland, Ohio, was among the first in this country to use nitrous oxide extensively. He devised a gas-oxygen apparatus which was widely popular. Gas and oxygen passed from the cylinders to separate bags. The oxygen bag was fitted with an inspiratory check valve; the nitrous oxide bag allowed rebreathing. The two gases passed to a mixing chamber and then through coils of small pipe immersed in water and heated by an alcohol lamp enclosed in a miner's safety device. The warm gas then passed through a tube to an inhalation mask on which was the expiratory valve controlled by a spiral spring for the purpose of securing increased pressure within the respiratory passages. An ether attachment permitted addition of ether vapor by passing the warm gas over the surface of liquid ether.

Willis D. Gatch of Johns Hopkins Hospital, in 1910, recommended rebreathing as a measure of economy in the use of gas and oxygen (10). His apparatus had a single bag filled from cylinders of gas and of oxygen, a connecting tube, and an inhaler. The inhaler was provided with valves which allowed either breathing through valves or rebreathing. An ether attachment consisted of a roll of wire gauze on which ether could be poured through a small funnel. The apparatus made no provision for measurement of the amounts of gas, oxygen or ether. Gatch soon modified his apparatus by addition of a sight feed ether dropper (11).

In 1911, E. I. McKesson of Toledo, Ohio, introduced the principle of fractional rebreathing (12, 13), by which the first part of each expiration, consisting of gas from the inhaler and upper air passages, is saved to be inspired again, while the last part of the expiration, coming from deeper in the lungs, passes away through the expiratory valve. McKesson's original apparatus had three separate bags, one for nitrous oxide, one for oxygen and one for expired gases (the rebreathing bag graduated so that the amount of gas to be rebreathed could be measured), graduated distributing valves for the gas and oxygen, a device for warming the gases heated by an electric light bulb and a sight feed ether dropper.

In 1912, Walter M. Boothby and Frederic J. Cotton of Boston presented an apparatus which promised to overcome all mechanical and operative difficulties attending gas-oxygen administration (14). Reducing valves controlled the high pressure of the gas and oxygen as supplied in cylinders. The gas and oxygen bubbled through water bottles, the rate of bubbling indicating the percentage of the gases. An ether attachment allowed the gas to pass over the surface of liquid ether or to bubble through it; the mixture was warmed by an electric heater. There was a single breathing bag. A spring on the expiratory valve on the inhaler provided for the use of McKesson's fractional rebreathing. An electric pump provided ether vapor with air. This apparatus presaged the advantages of the later constant flow apparatus.

In the reducing valves which Boothby and Cotton introduced, gas is admitted from the high pressure cylinder through an opening controlled by a needle valve. The valve seat is attached to a metal diaphragm, which forms the roof of the chamber, in such a fashion that as soon as any pressure is built up in the chamber the diaphragm is pressed upon, the valve is closed, and the flow of gas is immediately shut off. If pressure is exerted on the diaphragm by a spring compressed by a screw, the valve does not close until there is an equal pressure in the chamber. With such a reducing valve it is possible to deliver gas at a pressure as low as may be desired regardless of the height of the tank pressure. Reducing valves were promptly adopted by all manufacturers of gas-oxygen machines.

J. A. Heidbrink of Minneapolis devised a system whereby the reducing valve serves to measure the rate of flow as well as to control the pressure of the gases. From the chamber of the reducing valve the gas passes out through a small calibrated opening. The rate of flow is controlled by the pressure in the chamber and is indicated by the reading of a pressure gage.

James T. Gwathmey and William C. Woolsey, of New York, developed a simple and efficient gas-oxygen apparatus. A reducing valve controlled the flow of nitrous oxide; a needle valve regulated the flow of oxygen. Nitrous oxide and oxygen entered a sight feed through separate tubes which dipped below the surface of the water. In 1915, Gwathwey introduced a succession of calibrated holes along the side of each tube which allowed the gas and oxygen to bubble through the water. The flows of gas and of oxygen were indicated by the number of the holes through which each was bubbling. From the sight feed the mixture of gas and oxygen passed, without an interposed mixing chamber, through tubing to a single breathing bag. The water in the sight feed was heated by an alcohol lamp. The inhaler was attached directly to the breathing bag. By using a Gwathmey gas-ether inhaler, ether could be added to the gas-oxygen mixture when required. R. V. Foregger produced needle valves of such efficiency as to control nitrous oxide gas as well as oxygen at the high tank pressures, without the aid of reducing valves. He equipped the Gwathmey apparatus with these.

Beside those mentioned, gas-oxygen apparatus were devised by Clarke, Connell (15), Coburn (16), Cunningham (17), Flagg (18), Guedel (19), Peairs (20), Miller (21), Morgan, and others. By the year 1915, gas-oxygen had been standardized under two types: 1, intermittent flow, (exemplified by McKesson), and 2, constant flow (as in the apparatus of Teter and of Gwathmey). The requirement of measured flow of gas and oxygen was recognized and provided for. Heating devices had been found useless and were discarded. While dental apparatus lacked the ether attachment, every surgical gas-oxygen apparatus was equipped with an attachment for vaporizing ether by passing the gases over or through the liquid, or for adding liquid ether by a sight feed dropper.

In the years 1910 to 1920, widespread adoption of nitrous oxide oxygen was accompanied by increased attention to the whole subject of anesthesia. In 1910 there were but a handful of full time anesthetists in the country. In 1912 the American Association of Anesthetists was founded with James T. Gwathmey, President, and William C. Woolsey, Secretary. By 1920 the Association had a hundred and seventy-five members. In 1921 a Session on Anesthesia was held in the Section on Miscellaneous Topics of the American Medical Association.

The greatest impetus to nitrous oxide-oxygen anesthesia was given by George W. Crile at the Lakeside Hospital at Cleveland. Teter, who had been administering gas and oxygen for abdominal cases since 1904, gave the anesthetic first for Crile in January, 1907 (22). In 1910 Crile reported a series of 575 nitrous oxide cases (23). A year later he presented before the American Surgical Association his principle of "Anoci-association" (24). With a combination of regional nerve block, tactful surgery, and nitrous oxide-oxygen anesthesia, he had reduced postoperative discomfort, minimized nausea and vomiting, prevented pulmonary complications, abolished surgical shock, and reduced his surgical mortality from 4.4 per cent to 1.9 per cent. At the 1915 meeting of the American Association of Anesthetists, he was able to report over 15,000 nitrous oxide-oxygen administrations without a death.

While surgeons received the theory of "Anoci-association" with some skepticism, they adopted nitrous oxide-oxygen anesthesia with enthusiasm. In 1910, while the Committee on Anesthesia of the American Medical Association reported "That the use of nitrous oxide, whether or not combined with air or oxygen, and whether or not preceded by scopolamine and morphia, be confined invariably to the care of an expert" (25), Haggard wrote, with approval of the same committee, "It has already been proved that nitrous oxide is the safest anesthetic and the most pleasant to take,—It is not absolutely free from danger,—It can be given longer with safety than any other anesthetic" (26, 27). Soon more than a thousand gas-oxygen machines had been sold in this country. As there were fewer than a hundred professional anesthetists at the time, most of these machines must have been acquired by surgeons, clinics and hospitals. Each machine was accompanied by an instruction book which gave directions for its use in every sort of surgical operation.

The anesthetists soon recognized the dangers of gas-oxygen anesthesia. In 1901, Bennett wrote "It is therefore probable that nitrous oxide is the safest general anesthetic if its use is restricted to momentary administrations as for tooth extraction. The prolonged administration of this anesthetic is quite a different matter, however, and at the present time there are not sufficient data of its use to warrant conclusions as to its safety. The writer has administered gas with air or with oxygen for operations lasting from a few minutes to more than two hours in several hundred cases, and while he has had no death, alarming states have several times appeared with such rapidity, and with so little warning, that it seems possible that the general adoption of this form of anesthesia would lead to a mortality more nearly approximating, if not exceeding, that of chloroform or ether. This opinion is strengthened by the occurrence of 4 such deaths in New York City which have come to the writer's notice within one year" (28).

The object stated in Teter's paper presented before the American Medical Association in 1909, was to "encourage the professional anesthetist to take up nitrous oxide and oxygen anesthesia and develop it to a science" (29); in 1912, his subject was "The Limitations of Nitrous Oxide with Oxygen" (30). In 1912, Gwathmey wrote "Numbers of deaths that have not been reported have occurred under nitrous oxide and oxygen anesthesia. This is not the innocuous anesthesia that manufacturers of gas and apparatus, and enthusiasts like Crile and Gatch, would have us believe" (31). In the same year, Freeman Allen wrote, "Prolonged administration of nitrous oxide-oxygen for major surgery is quite a different proposition from the brief administrations of dentistry. Deaths occurring during the administration of nitrous oxide-oxygen are not uncommon. At the present time there are not enough statistics as to the safety of nitrous oxide and oxygen in major surgery to show that it is as safe as ether or chloroform" (32).

Except for such warnings from the anesthetists, the early papers on gas-oxygen anesthesia were uniformly in favor of its extensive adoption, but by 1915, 26 gas-oxygen deaths had been reported in the journals (28, 33, 34, 35). Of these 26 fatalities, 19 had been reported by anesthetists, from their own observation or personal knowledge. In the same year, Mosher of Kansas City collected adverse reports from most eminent surgeons (36, 37). Bevan wrote "nitrous oxide in the hands of the tyro is the most dangerous anesthetic." Mayo wrote "nitrous oxide in general hands is more dangerous than chloroform." J. F. Baldwin, Ex-President of the Ohio State Medical Society, in 1917 published a paper under the heading, "Nitrous Oxide Oxygen, the Most

Dangerous Anesthetic." He reported in detail 14 deaths which had occurred in Ohio and reckoned the death rate at one in a hundred (38). This paper started a bitter controversy in which The Journal of the American Medical Association found the death rate from nitrous oxide to be one in a million (39), while Baldwin reported an estimated 1,000 deaths from nitrous oxide in this country (40). McCormick of Akron collected 163 reported deaths (41).

Baldwin accused the anesthetists of a conspiracy of silence in concealing deaths from anesthetics. This accusation was obviously unfounded. The anesthetists had been outspoken in their warnings of the dangers of nitrous oxide oxygen; they had reported the majority of the deaths which had been recorded. If there had been a conspiracy of silence they had had little part in it. But the controversy delayed the advancement of anesthesia as a medical specialty. Many hospitals dispensed with their medical anesthetists and displaced them by nurses, unsupervised and often uninstructed in their vitally important duties. But mortality from anesthetics was not thereby prevented nor was the proportion of anesthetic deaths which were reported thereby increased. Hospital authorities met complaints of the quality of anesthesia by the purchase of more expensive and more complicated gas machines, not recognizing the evident fact that safety in anesthesia abides not in apparatus but in those who use it.

Nitrous oxide, the safest anesthetic, within a few years had become the most dangerous anesthetic. What factors were responsible for this change? First to be considered is the admixture of oxygen. With pure nitrous oxide the danger signals were so manifest that they could not be mistaken; cyanosis and jactitation demanded instant removal of the inhaler. Mounting carbon dioxide soon stimulated the respiratory center to activity, but the addition of even an insufficient amount of oxygen so masked the danger signs that an irreversible state of anoxemia often developed without warning. The second factor was the addition of ether to the gas-oxygen mixture. Every surgical gas-oxygen machine has an ether attachment. The administrator who adds just a little ether to his gas mixture does not know how little or how much he is using. The ether attachment added also an element of dishonesty to gas anesthesia. Teter used ether in 10 per cent of his gas-oxygen cases. At Johns Hopkins ether was used in 75 per cent of the cases (27). In some clinics all of the so-called gas anesthesia is really ether anesthesia—ether anesthesia given by a method both crude and inexact. The mixture of ether with gas and oxygen introduced also the hazard of explosion, previously unknown. The third and most deadly factor is to be found in the instructions furnished with gas-oxygen-ether apparatus. These instructions recommend a 5 to 10 per cent oxygen mixture, disregard cyanosis as a danger signal and endorse a state of anoxemia as essential to gas anesthesia (42, 20).

While nitrous oxide is not an efficient agent, it is a true anesthetic; anoxemia is not required to produce its effect. If satisfactory anesthesia is not secured with a proper percentage of oxygen the condition will not be improved by reducing the oxygen percentage below the anoxemic level. Nitrous oxide should be administered with 13 to 20 per cent oxygen; greater dilution is often required.

In his notable experiments with nitrous oxide and oxygen, Hewitt found that jactitation was avoided with 6 per cent oxygen, cyanosis disappeared with 11 per cent oxygen, and deep anesthesia was obtainable with 20 per cent oxygen (3). Physiologists find that 13 per cent oxygen is the smallest amount compatible with preservation of the vitality of cerebral cells. The danger zone of gas anesthesia extends from the 6 per cent oxygen which prevents jactitation to the 13 per cent required for preservation of the cerebral centers, but this is the zone commonly recommended and used for nitrous oxide-oxygen anesthesia. The zone of safety lies between 13 per cent oxygen and the larger amounts which the reaction of the patient indicates. The efficiency of nitrous oxide may be increased by proper premedication but if ether is required there are much better ways of administering it than any gas-oxygen machine provides.

While Hewitt required a special gasometer for his experiments, any anesthetist with a modern accurate gas-oxygen apparatus can corroborate his results. He can prove to his own satisfaction that nitrous oxide with 13 to 20 per cent oxygen produces anesthesia and that the state is not one of anoxemia.

CONCLUSION

This paper traces the technical development of gas anesthesia up to the year 1920. In 1910, nitrous oxide was the safest anesthetic; in 1920, it had declined to the extent of being cited as the most dangerous anesthetic. Several factors contributed to this decline: over-zealous advocation of this form of anesthesia; lack of measurement of the dosage; the addition of unmeasured quantities of ether; failure to apply rudimentary principles of the physiology of respiration to gas-oxygen administration; and finally, the teaching that nitrous oxide has no anesthetic power, that its effect is due to anoxemia, and that anoxemia is permissible or even desirable in nitrous oxide anesthesia.

A historical study is of little value unless it teaches some lesson of present practical interest. The present study shows that an anesthetic agent or method may have extensive vogue and then may rapidly fall into disfavor. In the choice of an anesthetic, not the preference of the anesthetist nor the comfort of the surgeon, but the safety of the patient, must be the final determining factor. The anesthetic apparatus is of less influence on the factor of safety than is the knowledge and skill of the one who uses it.

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SECTION ON ANESTHESIA OF THE INDIANA MEDICAL ASSOCIATION

CLAYPOOL HOTEL—INDIANAPOLIS—WEDNESDAY, SEPTEMBER 24, 1941

12:30 Luncheon in honor of Paul M. Wood, M.D., New York, N. Y.
2:00 Lillian B. Mueller, M.D., Indianapolis, Ind.
Subject: A Simple Device for Administering Intravenous Barbiturates.
2:10 Paul M. Wood, M.D., New York, N. Y.
Subject: Facts and Fallacies Concerning Modern Anesthesia.
2:30 Discussion by E. P. Buckley, M.D., Jeffersonville, Ind.
2:40 Merrill E. Liston, M.D., South Bend, Ind.
Subject: Preliminary Medication.
3:00 Discussion by F. W. Ratcliff, M.D., Lafayette, Ind.
3:10 J. M. Whitehead, M.D., Indianapolis, Ind.
Subject: Anesthetic Agents and Anesthetic Failures.
3:30 Discussion by Paul M. Wood, M.D., New York, N. Y.
3:40 Round table discussion.
4:00 Election of section officers.