

An Exhibit of Inhalers and Vaporizers

1847–1968

*Illustrating Aspects of the Evolution of
Inhalation Anesthesia and Analgesia from Ether to Methoxyflurane*



Artifacts from the Canadian Anesthesiologists' Society Archives

Ottawa

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Anesthesia Artifacts in the CAS Archives

Through donations by some of its members, the Canadian Anesthesiologists' Society has, over the years, acquired a collection of anesthesia equipment. Some of the items are of considerable historical interest, and it therefore seemed appropriate to bring them to the attention of current members of the Society. The inhalers and vaporizers in the collection, which covers the period from 1847 to 1968, illustrate a key aspect of the evolution of anesthesia, and it was therefore decided, as an initial step, to select them for this exhibit.

These artifacts recall the efforts of our predecessors who joined their inventive skill with their desire to relieve the suffering of their patients. The achievements of those physicians, and the pain of their patients, brings to mind what Helen Keller observed: “although the world is full of suffering, it is also full of the overcoming of it.”

The inhalers and vaporizers are just a portion of the whole collection, and it is intended that other items will be exhibited on future occasions. It is hoped that this will not only highlight some aspects of the history of our specialty, but will encourage members to consider donating to the CAS equipment that



reflects this history. In this way, it may be possible to build up a collection that is representative of the development of the specialty of anesthesiology in Canada, and ultimately to house a variety of items as a national collection.

The present exhibit affords an appropriate opportunity for the CAS to express its gratitude to those who donated items. Of note among those individuals is Dr Harry Slater (1915-1993), of Toronto and Montreal and coinventor of the Stephen-Slater nonrebreathing valve. Other CAS members who kindly donated equipment include Dr Max Minuck, formerly of Winnipeg, and Dr Ken Goodwin, of Ottawa.

Inhalers and Vaporizers in the CAS Collection

1. Snow Ether Inhaler (1847)



Figure 1. John Snow

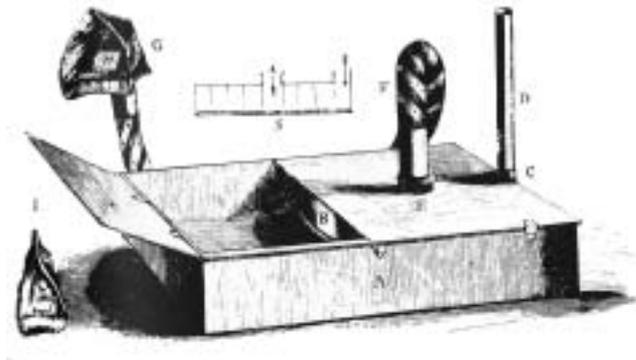
Reproduction: donated by Charles A King, 1963. The ether inhaler invented by John Snow (1813-1858) (Figure 1) is of interest because it incorporates the basic principles of vaporization of anesthetic gases. Within two weeks of first seeing ether administered in London in December 1846, Snow designed this forerunner of modern vaporizers. Realizing the importance of ambient temperature on the vaporization of ether, Snow at once determined how much ether vapor would be held in air at different temperatures. He wrote, "... by regulating the temperature of the air while it is exposed to the ether, we should have the means of ascertaining and adjusting the quantity of vapour that will be contained in it." In March 1847, Snow had a prototype inhaler constructed, and in June

1847 the definitive one, exhibited here, was made. Snow also designed a chloroform inhaler.

The components of the inhaler (Figure 2) are as follows: A — Japanned metal box, as bath for water at 50 to 60° F; B — vaporizing chamber (6 x 1.25 in) containing spiral baffle attached to roof and extending to 1/16 of an inch of the floor; C, D — metal tube screwed into box for ingress of air; E, F — breathing tube (wider than trachea); G, H — mask and one-way valve.



Figure 2.
Snow's ether inhaler



2. Clover Portable Regulating Ether Inhaler (1877)



Figure 3.
Joseph Clover,
administering chloroform

Like Snow, Joseph Clover (1825-1882) had a general medical practice, with some surgery, before specializing in anesthesia. After Snow's premature death, Clover's services were much sought after. Like Snow, Clover invented equipment for the administration of ether and for chloroform. The famous illustration of Clover giving chloroform (Figure 3) is notable for his monitoring of the patient's condition by feeling the pulse. His ether inhaler (Figure 4) was an efficient one that enabled anesthesiologists to regulate the amount of vapour inhaled, and so simplify induction and maintenance. He modified the ether inhaler for use with nitrous oxide as well as ether. The ether inhaler, which was used well into the 20th century, served as a model for Louis Ombredanne's inhaler (Item 5).

In Clover's inhaler (Figure 5), ether was placed in the chamber (3.5 in diameter), which could be warmed by water and by hand. His first inhaler included one "whistle-tip" tube inside another; when the indicator was at "Full" all the respired air passed



Figure 4.
Clover's ether inhaler

into the ether chamber, and when the tips were in alignment the patient

breathed only air. In a later model, a single tube fitted with ports and a baffle passed through the centre of the chamber, allowing air to pass through with rotation of the tube. Clover claimed advantages in the absence of valves, ability to supply ether gradually, and rapid onset of anesthesia.

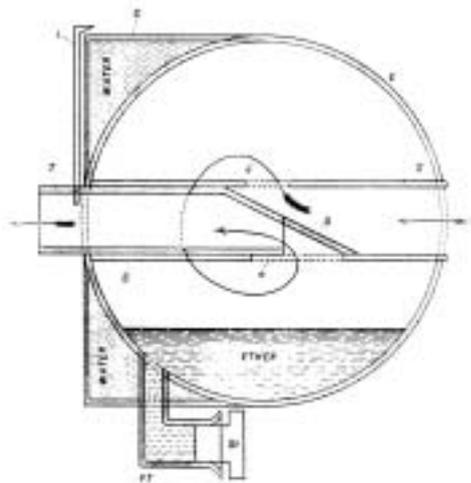


Figure 5. Cross-section of Clover's ether inhaler

3. Vernon Harcourt Chloroform Inhaler (circa 1903)

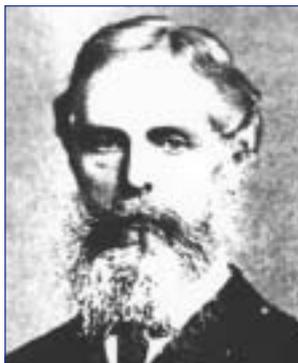


Figure 6. AG Vernon Harcourt

A Reader in Chemistry at Oxford University and a Fellow of the Royal Society, AG Vernon Harcourt (1834–1919) (Figure 6) made many contributions to the study of the physiological responses to chloroform. He developed his inhaler (Figure 7) while working with the BMA's committee on chloroform (1901–1909). It was praised for its simplicity and accuracy, and for its portability. Because the amount inhaled did not exceed 2%, it was relatively safe. It is unlikely that this inhaler was used after the First World War because it was somewhat fragile and because deaths continued to be associated with chloroform.

The inhaler functioned as follows. The double-necked glass bottle was filled with chloroform, and a red bead and a blue bead placed in it. When the temperature of the chloroform exceeded 18 C, both beads sank, and the proportion of chloroform inhaled would be higher than indicated; below 16 C, both beads floated, and the proportion of chloroform inhaled would be less than indicated. By moving an indicator on the scale, the concentration of chloroform could be adjusted; when it was set at 2 %, air was admitted only via the vaporizing bottle. Evaporation and cooling were prevented by warming the bottle (by means of a candle sometimes) to the point when both beads sank. The inlet and the outlet of the glass bottle, placed near to each other and some way from the liquid surface, compensated for varying rates of respiration. The diameter of the bottle at the upper part was proportioned to the average rate of respiration and to the rate of evaporation of chloroform between 16 C and 18 C; and to compensate for the lowering of the chloroform level, the bottle was made wider towards its base. A unidirectional valve was built into the glass expansion of the tubing leading from the chloroform. Finally, the apparatus could be worn around the chloroformist's neck!

(Inhaler loaned by David AE Shephard)

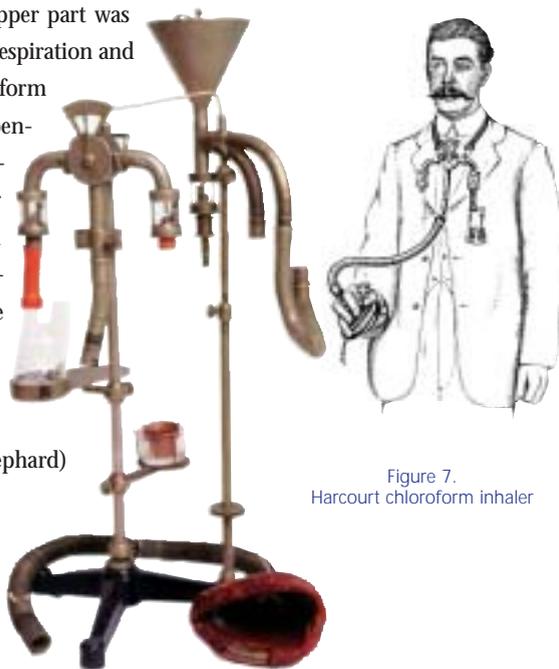


Figure 7.
Harcourt chloroform inhaler

4. Bottle of Chloroform

Manufactured by Duncan, Flockhart & Co. Note the light-excluding brown glass.

5. Ombredanne Ether Inhaler (1908)



Figure 8.
Louis Ombredanne

Louis Ombredanne (1871–1956) (Figure 8) was a Paris surgeon who was interested in pediatrics and plastic surgery. In a 1908 paper he formulated several propositions on the administration of ether. He stated that the ether mixture had to be “more or less restricted,” with a small amount of fresh air added and some air rebreathed. His inhaler was a direct descendant of Clover’s inhaler, which he criticized for its lack of fresh air and its “useless” water chamber. This inhaler remained in use until the 1950s, even, according to one source, being used by Argentinian troops in the Falklands war with Great Britain.

The inhaler functioned as follows (Figure 9): Ether was absorbed on either sponges or felt. A tube open to the air at one end contained a second tube perforated by holes (o and ol) that could be opened by manipulating the air inlet at k, o2 remaining open. The gases passed from the bag through two “chimneys” (g and gl) into the ether chamber and then to the mask via h.

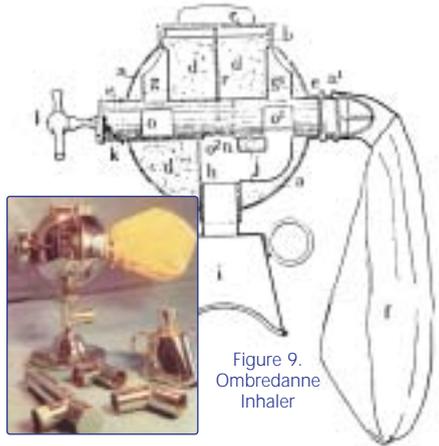


Figure 9.
Ombredanne
Inhaler

6. Somnoform Inhaler (1908)



Figure 10.
Somnoform inhaler

The Somnoform mixture of ethyl chloride, methyl chloride, and ethyl bromide in proportions of 60:35:5 was introduced by Georges Rolland, of Bordeaux, in 1901. The efficacy of the mixture was controversial. Its use was no longer accepted after 1931, though it was not until 1945 that Somnoform was reported to be an “irrational” mixture.

The manner in which the Somnoform inhaler was attached to the patient is indicated in Figure 10, while its components are shown in Figure 11. In practice, a capsule of Somnoform was cracked into the chamber I with the aid of a breaking device K in the chamber G, the liquid dropping into the bag O. The inhaler was placed over the nose, a mouth cover preventing respiration through the mouth; intake of air of was controlled by a valve F.



Figure 11. Somnoform inhaler components

7. Yankauer Mask (circa 1910)

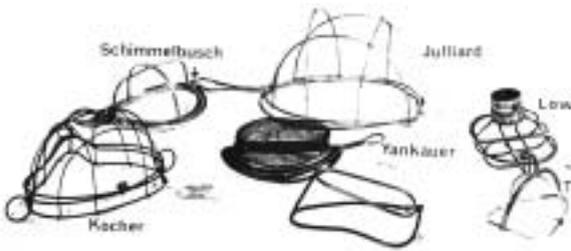


Figure 12. Variety of open-drop masks

The mask was covered with lint, flannel or gauze, onto which were dropped agents such as ether, chloroform, divinyl ether and ethyl chloride. Open-drop masks remained in use until these agents were replaced by halothane and then other fluorine-containing anesthetics beginning in the late 1950s.

8. Drop Bottle

When administering anesthesia by an open system, an anesthesiologist would drop a volatile agent from a bottle onto a mask such as the Yankauer. Anesthesiologists in developed countries may not be able to appreciate the effectiveness of this form of administration, which is still current in developing countries.

9. Oxford Vinethene Inhaler (1940)

Divinyl ether was used extensively following the recommendation of Samuel Gelfand and Irving Bell, of Edmonton, in 1933 that it be used as an anesthetic. It could be given by open administration from a dropper (such as that illustrated in Item 8) or by semiclosed administration with a Goldman inhaler (Figure 13) and later by a modified version known as the Oxford

Vinethene (MIE) inhaler (Figure 14).

For use in dental surgery, the Oxford

Vinethene inhaler was attached to a mask placed over the nose. A one-way inlet valve for air operated only

if the breathing bag became empty and it allowed the patient to breathe in fresh air; expired air passed into the bag and a bypass device allowed the anesthesiologist to gradually increase the concentration of Vinethene.

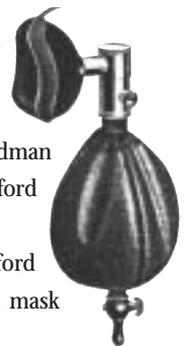


Figure 13. Goldman Vinethene inhaler



Figure 14. Oxford Vinethene inhaler (MIE)

10. Oxy-Columbus Trilene Inhaler (circa 1950)



Figure 15.
Oxy-Columbus
Trilene inhaler

The value of trichlorethylene (Trilene) in anesthesia was reported in 1934 by Dennis Jackson (1865–1958). The analgesic properties of trichlorethylene had been recognized in the First World War. It was subsequently used by Oppenheim to treat trigeminal neuralgia and as a narcotic by Glaser. The Oxy-Columbus inhaler, developed by Hans Hosemann (1913–1994) in association with the Drager Company, was found to be effective in controlling the pain of childbirth, dentistry, otolaryngological procedures and dressing changes.

The Trilene inhaler (Figure 15), with its chain passed around the patient's neck, was held to the nose or mouth, vaporization being effected by the warmth of the patient's hand. She could control the concentration of Trilene by adjusting the intake of air through an air hole; as she became unconscious the inhaler fell from her hand. Either air or oxygen could be added.

11. Vial of Trilene

12. Duke Trilene Inhaler (1952)

The Duke inhaler for the administration of Trilene (Figure 16) was developed in 1951–1952 by Ronald Stephen (formerly of Montreal) (Figure 17) and others at Duke University. It was used primarily as a self-administered means of pain relief in childbirth, but like the Columbus inhaler, it could be used to provide analgesia during dentistry and dressing changes. It is of interest that similar self-administration devices had been used in the 19th century for the delivery of chloroform during childbirth. The Duke inhaler was evidently successful: some 50,000 inhalers were sold, with the royalty of \$2.00 per inhaler going to improve laboratory facilities in the

Duke department of anesthesia. (The department was a division of surgery rather than an autonomous department, which is why laboratories were, in Stephen's words "sorely needed" — and why Stephen moved to Dallas and then to St Louis.)

The inhaler made use of the drawover principle, and a nonbreathing mechanism prevented accumulation of carbon dioxide. An inlet tube at the neck of the apparatus permitted the addition of oxygen. The concentration of Trilene, which did not exceed 0.3 to 0.5 %, could be controlled by the patient. The face mask was applied over the nose and mouth. A wrist strap kept the inhaler from falling too far from the patient when not in use.

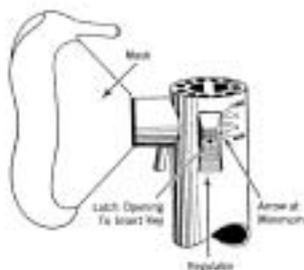


Figure 16. Duke Trilene inhaler



Figure 17.
C. Ronald Stephen

13. Drager Bar Trilene Inhaler (circa 1955)

The principle of safe self-administration of analgesia with Trilene was well established when Drager manufactured its Bar inhaler. Like the Oxy-Columbus and Duke inhalers, it was loosely secured to the patient, hand-held, and used to relieve the pains of labour. Overdosing was said to be “practically impossible,” as the inhaler fell from the hand with the onset of semi-consciousness. As well as its use in obstetrics, the Drager inhaler could be used to relieve the pain of minor surgical procedures.

The inhaler could be applied over the nose or the mouth, depending on the ancillary equipment (Figure 18). The inhaler was designed so that the concentration of Trilene could not exceed 1%. A built-in thermostat compensated for the decrease in temperature of the Trilene as vaporization proceeded.



Figure 18.
Drager Bar inhaler

14. Penthrane Analgizer (1968)

The use of methoxyflurane (Penthrane) in anesthesia was first reported by JF Artusio in 1960. He and his colleagues described its administration to 100 patients by closed, semiclosed, and open techniques. It is therefore not surprising that Penthrane was soon used in self-administration systems, and its analgesic properties led to its use to relieve the pain of labour.



Figure 19.
Penthrane
Analgizer
(Abbott)

The development of the Analgizer (Figure 19) followed logically from the use of Trilene inhalers, but it was notable as the first disposable analgesic inhaler. The inhaler comprised a plastic cylindrical tube fitted with a mouthpiece and containing a wick; it had no valves, but an orifice allowed the patient to dilute the Penthrane with air. It provided a Penthrane concentration of 0.75 to 0.85%. Its advantages included its small size, its light weight, its use without a face mask, and its disposability.

15. Vial of Penthrane

16. Telephone Inhalers

Induction of anesthesia for children calls for art as well as skill, and anesthesiologists have been remarkably inventive in developing devices to facilitate smooth and anxiety-free induction. The two inhalers in the form of a telephone



Figure 20. Telephone inhalers



Figure 21. Harry Slater,
shown with his brother
in his space-helmet
inhaler

(Figure 20) illustrate this inventiveness. Harry Slater had a particular interest in anesthetizing children for dental surgery, and was Director of the Montreal Anaesthesia Centre in the 1950s and 1960s. He is shown in Figure 21 along with his brother inside a space helmet, another Slater invention. Slater's name is also attached, with that of Ronald Stephen, to the Stephen-Slater nonbreathing valve (also in the CAS archives collection).

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