

# The Foregger Midget

## *A Machine that Traveled*

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### ABSTRACT

Next year marks the 100th anniversary of the founding of the Foregger Company, an important manufacturer of anesthetic equipment in the first half of the 20th century. Founded by Richard von Foregger in a barn in Long Island, New York in 1914, the Foregger Company developed equipment in collaboration with anesthesiologists. Their first product was the Gwathmey machine, built around the rudimentary flowmeter designed by the anesthesiologist, James Tayloe Gwathmey. This machine was the cornerstone of future anesthetic machine development. As the company grew, von Foregger formed other liaisons, joining forces with Ralph Waters to create the Waters to-and-fro canister for carbon dioxide absorption, and with Arthur Guedel, a variety of nontraumatic airways. The combined creativity of these three men ultimately led to the Foregger Midget. This portable machine extended the reach of the Foregger Company well beyond the shores of America, as far away as the isolated west coast of Australia.

*“Your delightful collection of pictures from Western Australia reached us for the holiday season and have been instructive as well as entertaining. I think it is amazing what beautiful places there are in every part of the world, if one only knows how to find them. I think, in the back of my mind, I had pictured Western Australia*

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*as a very bleak country. Now, I am sure that it is a most beautiful country.”*

— Ralph Waters to Gilbert Troup. January 15, 1936.<sup>1</sup>

IN 1914, Richard von Foregger, Ph.D. (1872–1960), founded the Foregger Company and established its headquarters in a barn in Long Island, New York. He had acquired the patent to Gwathmey's anesthesia machine, a simple machine built around a water sight-feed, the first rudimentary flowmeter, which allowed approximation of the gas flow being delivered to the patient. With this one product, and his close friendship with the machine's designer, anesthesiologist James Tayloe Gwathmey, M.D. (1862–1944), he was intent upon creating a business dedicated to the manufacture of anesthesiology equipment. Whatever aspirations Foregger had for the company, it is unlikely that he imagined its influence would one day extend to Perth, the remote capital city of Western Australia.

Perched on the edge of the Indian Ocean, Perth has spectacular sunsets; the sun sets over the sea, and nothing for hundreds of miles except water, wind, and waves. To the east is desert, beautiful, rugged, and unforgiving land, as far as you can see. Wherever you stand, whatever decade you look at it from, Perth is a very long way from anywhere. In 1935, it was effectively an island, reachable only by sea, but this small city of 200,000 individuals had some adventurous occupants.

Gilbert Troup, M.B. (Melbourne), M.R.C.P. (London), (Honorary Anesthetist, Perth Hospital; 1896–1962) was born in New Zealand and educated in Melbourne, Australia (fig. 1).<sup>2</sup> He commenced his residency in Western Australia in the early 1920s, and intent upon becoming a physician (internist), traveled to the United Kingdom in 1929, to obtain a Membership of the Royal College of Physicians. During his stay in England, he met and worked with the anesthesiologist, Dr. (later Sir) Ivan Magill, M.B., B.Ch. Belf., F.R.C.S., F.F.A.R.C.S. (Anesthetist, Brompton and Westminster Hospitals, London, England; 1888–1986), who was developing endotracheal anesthesia. Troup brought this innovative anesthetic skill back with him when he returned to set up practice in Perth. He was appointed as a physician to the Royal Perth Hospital, with a special interest in cardiology, and maybe this was what drew him to the cardiothoracic surgeons. His skills developed further as he became involved with thoracic anesthesia, an area where endotracheal intubation had obvious benefits. Eventually, he was also appointed as Honorary Anesthetist to the Thoracic



**Fig. 1.** Dr. Gilbert Troup, M.B. (Melb), M.R.C.P. (London), 1941. During World War II, Troup served in Ceylon as Officer Commanding the Australian General Hospital as Lieutenant-Colonel. Image courtesy of the Gwen Wilson Archives, Australian Society of Anaesthetists.

Unit in that hospital. Honorary positions were unpaid but important, as they were the only way to gain the reputation and connections required to earn money in private practice.

Anesthesia was restricted in Western Australia by virtue of its isolation; drugs and equipment had to be acquired from overseas and brought in by sea. Life was expensive; in 1933, Western Australia had attempted to secede from the rest of Australia by referendum, a process that failed, but one that was driven by the high tariffs paid by Western Australia. Western Australia derived its income from primary industries, such as farming and mining, and both of these were heavily taxed compared with the manufacturing sector, which was developing in the populous eastern states of Australia. According to Troup, this situation existed: "... in order that the secondary industries of the more closely populated areas, such as Victoria and New South Wales, may be fostered... it raises our overhead expenses considerably when we start buying efficient gas machines and importing anesthetic agents."<sup>3</sup>

Describing the state of anesthesia in Western Australia at that time, Troup stated, "We have no specialists in the true sense of the word, the small population and lack of adequate remuneration preventing specialization... One or two of us who give the large percentage of the less routine anesthetics, either combine anesthetic work with general practice or,

as in the case of myself, with the practice of a physician."<sup>3</sup> Anesthetic technique was dictated by expense and availability. Ether anesthesia could be administered with portable insufflation devices, but anesthetic machines, in 1935, were becoming more like the workstations of today. They delivered nitrous oxide and oxygen from cylinders, *via* pressure reducing valves and water depression flowmeters, to ether vaporizers, and they often incorporated a carbon dioxide absorber in the attached circuit. Mounted on casters for ease of movement around the theater, they also contained drawers for extra equipment. These machines were expensive to import and were not portable, thus, mitigating their use in a practice that involved travel to a number of different hospitals, separated by considerable distance. Even Troup, with his extensive experience and knowledge of modern techniques, administered 1,688 ether anesthetics out of 2,409 cases—something he apologetically reported in America in 1935. Nitrous oxide was available from Melbourne, "but it is still a relatively fantastic price" and ethylene, imported from the United States, "with carriage and exchange, is almost prohibitive." And, although carbon dioxide absorption was available and would potentially decrease the cost of nitrous oxide anesthesia, it necessitated the purchase of an efficient anesthetic machine. The other issue was training the surgeons to a different form of anesthesia: "This cooperation is slowly acquired by those who have been used to the corpse-like relaxation of the profoundly ether-anesthetized abdominal wall."<sup>3</sup>

No doubt these things occupied Gilbert Troup's thoughts, as he whiled away the weeks at sea aboard the *S.S. Mariposa*, journeying to the United States in 1935.<sup>1</sup> He had gone on a voyage of discovery, intent upon bringing new anesthetic techniques back to Western Australia. During the many months he was away, he traveled over 8,000 miles through Canada and the United States, visiting anesthesiologists in San Francisco, Los Angeles, Vancouver, Madison, Chicago, and the Mayo Clinic in Rochester. He spoke at the 14th Annual Congress of Anesthetists in Atlantic City<sup>†</sup> and then went on to more centers, such as Boston and New York. Only in the last few weeks did he catch up with his wife, and finally, do some sightseeing—traveling to Yosemite Valley and then to Hollywood in Los Angeles. But even there, he continued working, spending considerable time with Arthur Guedel.

He returned with many new friends and three important items—a Foregger Midget machine, two bottles of cyclopropane, and a Waters to-and-fro canister. There is no documented evidence that Troup met with Richard von Foregger, when the former was in New York, because Troup's diaries from this part of his journey have not survived, but it would seem extremely likely. Richard von Foregger would almost certainly have been at the Atlantic City Congress as well, and they could also have met there. Either way, some communication must have taken place between the two men as collaborations on the design of equipment were central to the Foregger Company's business.

<sup>†</sup> Australasian Address presented during the Fourteenth Annual Congress of Anesthetists, the International Anesthesia Research Society in joint meetings with the Associated Anesthetists of the United States and Canada and the Eastern Society of Anesthetists, Canadian and American Medical Associations Week, Hotel Chelsea, Atlantic City, New Jersey, June 1–14, 1935.

Richard von Foregger is an extremely important figure in the history of anesthesiology. He founded the Foregger Company in 1914, a company that from the outset was based on cooperation with medical practitioners.<sup>4,5</sup> His original collaboration was with James Gwathmey, whom he had met some years earlier. Together they had developed an oxygenator, and Foregger had designed an anesthetic machine built around Gwathmey's rudimentary flowmeter.<sup>6</sup> This Gwathmey machine underwent many modifications, and by 1925, the Foregger designs incorporated a number of water depression flowmeters, and they were evolving into much larger machines. The original Gwathmey machine was the acknowledged origin of the Boyle machine in the United Kingdom,<sup>7</sup> and Foregger was at the heart of the development of anesthesia machines as we know them today. He was not the only manufacturer of anesthetic equipment in the United States; as stated by the Australian anesthesiologist, Geoffrey Kaye, M.B.B.S. (Honorary Anesthetist, Alfred Hospital, Melbourne, Australia) (1903–1986): “The field of equipment was largely dominated by three manufacturers, *viz.*, Foregger, McKesson, and Heidbrink. Each held a doctorate of one kind or other, and there was not much love lost between them. Their equipment, however, was the best in the world.”<sup>8</sup>

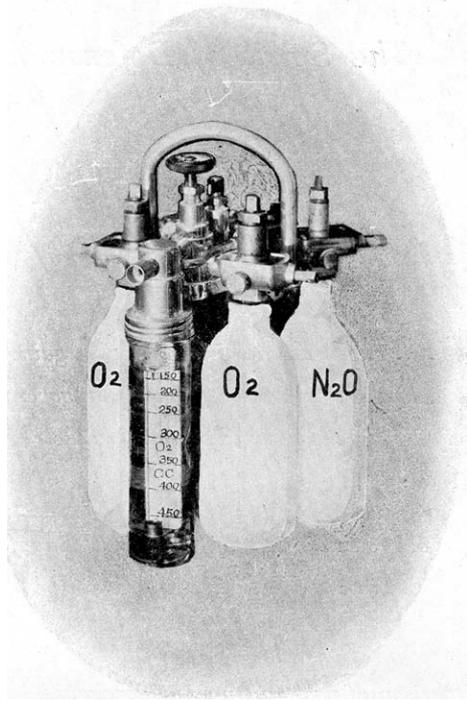
Foregger's collaboration with important anesthesiologists such as Sir Robert Macintosh (Nuffield Professor of Anesthetics, University of Oxford, England, 1897–1989), Arthur Guedel, M.D. (Professor of Anesthesia, University of Southern California, California, 1883–1956), and Ralph Waters, M.D. (Professor and Chair of Anesthesiology, University of Wisconsin, Madison, Wisconsin, 1884–1979), continued throughout his career. He worked with Ralph Waters to create the Water's to-and-fro canister, which was incorporated into the Foregger machines. This carbon dioxide absorber allowed low gas flow, decreasing expenditure on expensive agents like cyclopropane, and even oxygen. Low flow efficiency lent itself to a portable machine with small cylinders and may have been the inspiration for the first Foregger Midget machine. It is likely that this original machine grew out of collaboration between Ralph Waters, Arthur Guedel, and Foregger; first advertised in the 1927 Foregger catalog as being, “Designed upon specification of Dr. Ralph Waters” and in later catalogs it was referred to as, “...Guedel style.”

The first Foregger Midget machine represents an important landmark in the manufacture of anesthesia equipment. Up until the 1920s, most anesthesia equipment had, by necessity, been portable. Anesthesiologists travelled to operations and performed anesthesia in many locations, not all of them hospitals. Early ether and chloroform apparatus was small and easily carried, and even the introduction of nitrous oxide in heavy cylinders did not deter anesthesiologists from traveling with all their equipment. But the development of water depression flowmeters led to the design of bigger, heavier machines, and by 1925, the original Gwathmey machine had been through several evolutionary processes and consisted of three water sight-feeds with ethylene, nitrous oxide, and

oxygen cylinders. The carry handle on this model had been removed, and the machine rested on casters for easy movement. The evolution continued with the development of the Metric machine in the 1930s, a large machine with drawers, more closely resembling the workstations of today. The Boyle machine in the United Kingdom underwent similar evolution so that a separate evolutionary line was necessary for the development of portable equipment, required well into the 1970s. In the United States, there was a hybrid process, with Foregger anesthesia machines, such as the Watts “Six-Yoke Portable” being provided in a leather slip cover with a telescopic stand and handle. These machines resembled the Midget in some ways, but the cylinders had to be carried separately, and the telescopic stand allowed these large cylinders to be attached when required.<sup>9</sup> Others, such as the Foregger Portable Metric No. 1-Wesley Bourne Model, worked on a similar principle; advertised as portable, they were provided with a carrying case to transport the four D cylinders separately.<sup>9</sup> But the Foregger Midget was the beginning of a different evolutionary process, truly portable machines that could be carried with very small cylinders *in situ* due to the low gas requirements allowed by the carbon dioxide absorbers.

Ralph Waters made reference to a homemade anesthesia machine in 1924, describing his early work with carbon dioxide filters: “For work outside the hospital, in addition to the small expense is the great advantage of reduced bulk and weight of apparatus and containers.” For some time now, I have carried in my car an apparatus assembled from part of my old equipment, which weighs less than 30 pounds. This grip contains two 50-gallon nitrous oxide tanks, two 15-gallon oxygen tanks, and a filter, rebreathing bag and mask. There is also room for a tube of ethyl chlorid [*sic*] and a bottle of ether. With this apparatus, I am equipped for several hours anesthesia without the necessity of lugging apparatus and tanks into a private home and assembling them.”<sup>10</sup> It seems likely that this homemade apparatus was the beginning of the Foregger Midget machine. In 1941, an advertisement appeared in *ANESTHESIOLOGY* entitled “Progress in 1924” with a picture “Taken from a page of our 1927 catalogue” (fig. 2).<sup>11</sup> The Midget machine was first advertised in 1927,<sup>12</sup> it does not appear in the 1926 Foregger Catalog,<sup>13</sup> so the reference to the earlier date of 1924 would appear to relate to the initial work on the machine. This original Midget had a water depression flowmeter for oxygen, two 15-gallon AA cylinders of oxygen, and two AA cylinders of nitrous oxide. Nitrous oxide was given by approximation, whereas the oxygen flowmeter was calibrated to a maximum of “500 cc to control metabolic amounts.” It was, “Designed exclusively for use with the carbon dioxide absorption method (Waters to and from canister for soda lime).”<sup>11</sup>

By 1935, there were three Midget machines in the Foregger catalog, and there may have been more that were made for individuals but never marketed. “Since the advent of Cyclopropane, we have made, upon personal specification, a variety of Midgets providing, in addition to the O<sub>2</sub> flowmeter, also



**Fig. 2.** Drawing of the original Midget machine from an advertisement in *ANESTHESIOLOGY* 1941.<sup>11</sup> The heading reads: “Progress in 1924,” and below the lengthy description it states: “Designed upon specification of Dr. Ralph M. Waters, Madison, Wisconsin.” Image courtesy of the Wood Library-Museum of Anesthesiology, Park Ridge, Illinois.

a flowmeter for Cyclopropane. Both scales running usually to a maximum of 650 cc/min.”<sup>9</sup> The original Midget remained unchanged, but they now also offered a “Six-Yoke Midget, with Two Flowmeters Oxygen 1,000 c.c and Cyclopropane 1,000 c.c.” This combination, without the required carbon dioxide absorber and carrying case, sold for \$145.00. Also, in this catalog was “The Muir Midget,” which would appear to be the first marketed modification, built to specification for a particular anesthesiologist. This machine was built for Dr. R. M. Muir, M.B. (Senior Anesthetist, Grootte Schuur Hospital, Capetown, South Africa; 1891–1948), and was described as “unquestionably the “most midget” among the midgets, but also the most limited in capacity.” This modification had one oxygen cylinder, one cyclopropane cylinder, a carbon dioxide absorber, and provision for a carbon dioxide sparklet. There was an oxygen bypass and an ether bottle attachment. It was designed for use with 30-gallon A cylinders and, instead of a stand, it had a handle which doubled as a clamp to attach to the operating table. “For further information on this highly commendable little device, we suggest correspondence with South Africa.”

The doctor concerned, Dr. Royden Muir, had spoken in Chicago in 1933, referring to the isolation of his practice in Cape Town. When Gilbert Troup spoke to a similar audience in Atlantic City 2 yr later, he referred to Muir’s talk, commenting that conditions were similar in Western Australia.<sup>3</sup> Maybe it was Muir’s machine that made Gilbert

Troup contemplate a Midget for his practice. The machine that Foregger built for Troup was at the opposite end of the spectrum: “The most versatile of the Six-Yoke Midgets, with three flowmeters and four scales, three control valves and two bi-pass [*sic*] valves. The Australian Midget can well be termed “the smallest” anesthetic apparatus with “the biggest” range of utility” (fig. 3).<sup>14</sup> The three flowmeters were for oxygen, cyclopropane, and nitrous oxide, but the nitrous oxide flowmeter had two scales, the second scale allowing the same flowmeter to be used with ethylene, an extraordinary concept from a modern safety perspective (figs. 4 and 5). This complete outfit was expensive at \$286.00 complete with sole leather carrying case. The Muir Midget was then selling as a complete unit for \$222.50, but there was no mention of a leather carrying case for that machine.

By the 1942 edition of the catalog, all the Midget machines had undergone some changes and there was a new Chilean Midget listed. The original Midget, with a flowmeter for oxygen was still available but now came with a disclaimer: “The odd combination of the scientific dosing of oxygen, and the rather unscientific approximation of the anesthetic gas, places the original Midget in a light of progress as well as retrogression—safe and economic only in the hands of experts.”<sup>15</sup> It goes on to describe the various evolutionary stages concluding, “...which finally resulted in the Midget in its most accomplished form—the Six-Yoke Midget (original Australian).”<sup>15</sup> The Chilean Midget was a later development, created for Dr. Ernesto Frias (1908–1977) of Santiago, Chile; it had only four yokes, two for oxygen and two for cyclopropane, but by the time this catalog was published, it had already been modified, “The further modification of the original Chilean came through the demand for a flowmeter for nitrous oxide, in addition to oxygen and cyclopropane. Therefore, present specifications call for either Chilean Model 2 O.F. or Chilean Model 3 O.F.”<sup>15</sup> The drawing of Chilean Model 3 O.F. in the catalog would appear to have five yokes, one additional one for the nitrous oxide, as opposed to the two on the Australian Midget. All models in this catalog came with either “inside”, or “outside” flowmeters; the inside were water depression flowmeters, all contained within the one glass cylinder, or tank as it was known, whereas, the outside flowmeters were a flat bank of water depression flowmeters at the end of the machine. From the drawings, the latter would seem to have been much easier to read, and this modification did not add anything to the price.

The next edition of the catalog appeared in 1949, and all the entries for the Midget machines remain the same, except for the price. But there is one new addition to the fleet, the aptly named Fox Hole Midget. This machine was made for Commander Albert J. Wineland, M.D. (Chief, Department of Anesthesiology, Lion 1 Base Hospital; 1899–1963) by, “Dr. Richard Foregger of New York, who designed and made it in accordance with my suggestions. Its concept was initiated by my experience in the active area with the



### *Australian Midget*

*Design of Dr. C. R. Troup, West Australia*

The most versatile of the Six-Yoke Midgets with 3 flow meters, and 4 scales, 3 control valves and 2 bi-pass valves.

The Australian Midget can well be termed "the smallest" Anesthetic Apparatus with "the biggest" range of utility.

O<sub>2</sub> fine—1 control valve with 2 yokes, flow meter maximum.....700 c.c.  
 C<sub>3</sub>H<sub>6</sub> —1 control valve with 1 yoke, flow meter maximum.....700 c.c.  
 N<sub>2</sub>O —1 control valve with 1 yoke, flow meter maximum..... 6 liters

SAME FLOW METER with extra scale for C<sub>2</sub>H<sub>4</sub>, leaving yokes for direct feed but each supplied with a special bi-pass control valve. Ordinarily one used for O<sub>2</sub>, second for CO<sub>2</sub>.



PRICE—Complete outfit, including short ether attachment, Waters To and Fro Filter, small accessories and sole leather carrying case...**\$286.00**

MIDGET ONLY without accessories .....**\$215.00**

**Fig. 3.** Australian Midget advertisement, Catalog No.7, The Foregger Company, New York 1937. Note that Gilbert R.Troup's name is incorrectly spelt as C.R Troup, a spelling mistake that is inexplicably perpetuated through all versions of the catalog. Image courtesy of the Wood Library-Museum of Anesthesiology, Park Ridge, Illinois.



**Fig. 4.** Australian Foregger Midget machine. This machine is an earlier model with the water depression flowmeters enclosed in one tank (see fig. 5 for details of flowmeters). There are six yokes: two for oxygen, two for cyclopropane, and two for nitrous oxide and/or ethylene. Image courtesy of the Wood Library-Museum of Anesthesiology, Park Ridge, Illinois.

Marines”<sup>16</sup> (fig. 6). This was a considerably pared-down version of the Midget with only three yokes, the fourth yoke space being taken up by the ether bottle. The total weight was only 18 pounds.

Commander Wineland was a veteran of World War I, who entered the Reserve in 1936 as a full Lieutenant and a qualified anesthesiologist. Earlier in his career, he had worked with Ralph Waters in Wisconsin, and coauthored a number of papers on gas delivery systems, with him.<sup>17,18</sup> As World War II loomed on the horizon, he remained in close correspondence with Waters, who, in 1940, was appointed as chair of a subcommittee on anesthesia.<sup>19,20</sup> This subcommittee had two tasks, to evaluate the existing anesthesia resources among U.S. physicians, and to train new personnel to administer anesthesia in a military setting. Commander Wineland, as Chief of the Department of Anesthesiology for Lion 1 Base Hospital, was training his own personnel and sharing his experiences with Waters. “...I trained 14 corpsmen and 3 officers in anesthesia, and these men formed our anesthesia department. In a previous letter to you, I think I explained the course of training in details, and also said I was surprised at the rapidity of the corpsmen in learning the technical end of the anesthesia game. The officers were much more difficult to train and teach because, among other things, they were not primarily interested in anesthesia.”<sup>21</sup>



**Fig. 5.** The flowmeter tank on the Australian Foregger Midget (see fig. 4). This tank contains three flowmeters with four scales. The left hand scale is for ethylene, and the one to the right of it, for nitrous oxide. Both these scales relate to the left hand flowmeter (marked  $N_2O$ ), which could be used for either anesthetic. The remaining flowmeters are for oxygen and cyclopropane (marked  $O_2$  and  $C_3H_6$ , respectively). Image courtesy of the Wood Library-Museum of Anesthesiology, Park Ridge, Illinois.

Wineland was sent overseas on active duty in the South Pacific in 1943 and took a Foregger Midget machine and a soldering set with him. Equipment was extremely scarce and, “I...make a lot of my own equipment out of tin cans.” He remarked on the difficulty of anesthetizing in the confined space of the fox hole stations, the usefulness of his Midget machine and the need to conserve his very limited supply of cyclopropane, “...I’m the only Navy anesthetist in the So. Pacific who has any of this equipment, especially cyclopropane. It has come in handy and saved the life of several chest cases in our Bougainville Campaign.”

The Fox Hole Midget was manufactured by the Foregger Company after his return and it seems likely that Wineland would have communicated with Ralph Waters to facilitate his approach to the company. The machine was described in the 1949 Foregger catalog: “The Fox Hole Midget is now a piece of history. While the history is past (and pray never to repeat itself), the object is not necessarily past... while not a regular production item, may be obtained on special order.”<sup>22</sup>

All these machines were designed with specific requirements in mind and for specific situations. Gilbert Troup spent some time working on the optimal design, and it is



**Fig. 6.** Commander Albert J. Wineland, M.D., with the Foxhole Midget, made for him by the Foregger Company in 1943. Image from: The Oak Leaf. 1945 March 3. Image courtesy of the Office of Medical History, U.S. Navy Bureau of Medicine and Surgery, Virginia.

unfortunate that no correspondence survives between him and Richard von Foregger. There are some surviving diary entries from his trip to visit Ralph Waters in America in 1935, where he discusses the design and function of the Midget, “Got 1 or 2 ‘low downs’ about the ‘Midget’. He approves of the layout of the yolk [*sic*]. Advises a to-fro w out...possibility of leak. Advises the inlet to be on the prox side of the absorber and not through the bag—reason pt gets changes of mixture much sooner.” (Gilbert Troup diary, personal written communication, Toby Nichols, December 27, 2012) Just before his return to Australia, he spent time with Arthur Guedel and “picked up many excellent wrinkles from him, especially, practical points in the administration of gas anesthetics with the Foregger Midget.”<sup>1</sup>

Presumably Foregger made a prototype machine that Troup carried back to Australia with his 60 gallons of cyclopropane. He wasted no time putting it to use and by November, reported to Waters, “I have been using it extensively since I returned, and now feel that I have got the workings of the machine sufficiently well to tackle cyclopropane...”<sup>1</sup>

Troup was the first to use cyclopropane in Australia, and he and his partner, Dr. L. A. Hayward, M.B., B.S. (Honorary Anesthetist, Perth Hospital) reported 46 cases of cyclopropane anesthesia with the Foregger Midget, in 1936.<sup>23</sup> Two years later, Troup credited the Foregger Midget with cyclopropane’s success, “Confidence grows with its use, and I am now either producing better relaxation in abdominal cases, or else the surgeons are becoming more gas-minded in their manipulations in that much abused cavity of the peritoneum. Probably it is a little of both. The Foregger Midget, with the to-and-fro absorber, has done much to popularize

gas anesthesia in this small community of ours of 200,000 odd. Four machines are in action now, with two more on the way.”<sup>1</sup>

A serendipitous find in a second-hand book uncovered a letter dated November 24, 1938, from Gilbert Troup to Dr. Walter Seed, M.B., B.S. (Anesthetist, Perth Children’s Hospital), with instructions for the Foregger Midget.<sup>24</sup> It contains some very practical advice, which highlights the trials of monitoring machines at the time: “Put a small piece of strapping (adhesive tape) on each cylinder on which can be noted whether cylinder is new or part used...note on the Cyclopropane cylinder each anesthetic given...Roughly, an average anesthetic takes about a gallon and a bit of Cyclopropane.” And similarly, for the soda-lime absorber, a piece of strapping with eight squares was recommended with a cross drawn in a square after each hour. “The container holds 1 lb of soda lime and should last about 8 h.” Instructions are also provided on the actual administration of cyclopropane. The suggested anesthetic technique commenced with 100% oxygen followed by 3 min of oxygen and cyclopropane at 500 cc each, then oxygen at 300–500 cc/min. Maintenance required the addition of 300 cc/min of cyclopropane “when required,” at ever increasing intervals, as the operation proceeded. Apnea, irregular pulse rate, or a pulse less than 50 were suggested as indicators of cyclopropane overdose.

It is not known how many of these Australian Foregger Midgets were sold but they were regularly included in the Foregger catalog until 1949. Eventually, Australian companies began developing anesthesia equipment, and Commonwealth Industrial Gases built a portable machine, also known as a Midget, which was widely used in the 1950s

and 1960s, throughout the eastern states of Australia. This machine had rotameters, rather than the water depression flowmeters on the Foregger Midget machines.

The failure to adopt the rotameter early in its development is one of the reasons the Foregger Company began to lose its market dominance.<sup>4,5</sup> The malfunction of a water depression flowmeter on a Foregger Military machine, reported through military channels in 1940, led to the cancellation of the U.S. Army contract.<sup>4</sup> Despite this, and other problems, rotameters were not added to Foregger machines until the 1950s, and by this stage, the Foregger Company was running into other difficulties. Sadly, Richard von Foregger, a man who had built his successful business in collaboration with anesthesiologists, eventually became more dictatorial in both his business and family life, and crucially, failed to make succession plans for the business. The flexibility and determination that had allowed him to facilitate the creative ideas of others deserted him and was replaced by paranoia; he was declared incompetent by a Long Island jury in 1958 and died 2 yr later in 1960. The company was sold but the previous 2 yr had seen a loss of knowledge and significant employees. The business floundered without direction and was eventually dissolved in 1984. It ended sadly, but at its peak, the Foregger Company was a significant manufacturer of anesthetic equipment, and Richard von Foregger provided an important link between the manufacturing process and the anesthesiologists working in the operating theaters. This collaboration had consequences well beyond America's shores, in the confined fox hole stations of World War II, in countries such as Chile and South Africa, and importantly in Australia, where the development of the Australian Midget clearly influenced the acceptance of modern anesthesia techniques.

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## References

1. Waters RM, Troup G: Correspondence. Ralph M Waters Box 17, Folder T Misc. Madison, Wisconsin, University of Wisconsin Archives
2. Cohen H: Gilbert Reynolds Troup. *Anaesth Intensive Care* 1973; 1:323-4
3. Troup G: Anesthesia in Australia. *Curr Res Anesth Analg* 1935; 14:249-52
4. Foregger R: Richard von Foregger, Ph.D., 1872-1960. Manufacturer of anesthesia equipment. *ANESTHESIOLOGY* 1996; 84:190-200
5. Foregger R: *Death of a Company*. 2nd edition. Milwaukee, Richard Foregger, 2000
6. Ball C: Gwathmey, Foregger and the sad tale of the water depression flowmeter, *The History of Anesthesia. Proceedings of the Sixth International Symposium on the History of Anaesthesia*. Edited by Drury PME. Berkshire, Conservatree, 2007, pp 531-8
7. Boyle HE: Experiences in the use of nitrous oxide and oxygen with rebreathing in military surgery. *Lancet* 1917; 190:667-9
8. Kaye G: *Anaesthetics since 1927: People & ideas*. GWAP file 1023, pp1-13: Geoffrey Kaye Museum of Anaesthetic History. Melbourne, Australia
9. *Catalog 1935*. New York, The Foregger Company, Inc., 1935
10. Waters RM: Clinical scope and utility of carbon dioxide filtration and inhalation of anesthesia. *Curr Res Anesth Analg* 1924; 3:20-8
11. Advertisement: Progress in 1924. *ANESTHESIOLOGY* 1941; 2:ii
12. *The Foregger Catalogue 1927*. New York, 1927
13. *The Foregger Catalogue 1926*. New York, 1926
14. *Catalog No.7*. New York, The Foregger Company, Inc., 1937
15. *Catalog No.8*. New York, The Foregger Company, Inc., 1942
16. *Foxhole Midget Result of South Pacific Experiences*. The Oak Leaf. 1945 March 3, pp 3
17. Wineland AJ, Waters RM: Oxygen therapy: Insufflation into oral pharynx. *Arch Surg* 1930; 22:67-1
18. Waters RM, Wineland AJ, SeEVERS MH: Carbon dioxide and oxygen problems in anesthesia. *Curr Res Anesth Analg* 1931; 10:10-20
19. Parks CL, Schroeder ME: Military anesthesia trainees in WWII at the University of Wisconsin: Their training, careers, and contributions. *ANESTHESIOLOGY* 2013; 118:1019-27
20. Waisel DB: The role of World War II and the European theater of operations in the development of anesthesiology as a physician specialty in the USA. *ANESTHESIOLOGY* 2001; 94:907-14
21. Wineland AJ: Series 12/4/3 Box 18 Folder Wineland: University of Wisconsin Archives. Madison, Wisconsin
22. *Catalog No. 9*. New York, The Foregger Company, Inc., 1949
23. Hayward LA, Troup G: An analysis of forty six cases of anaesthesia with cyclopropane. *West Aust Clin Rep* 1936; 1:77-4
24. Troup G: 1938 Letter to Walter Seed. Geoffrey Kaye Museum of Anaesthetic History. Melbourne, Australia