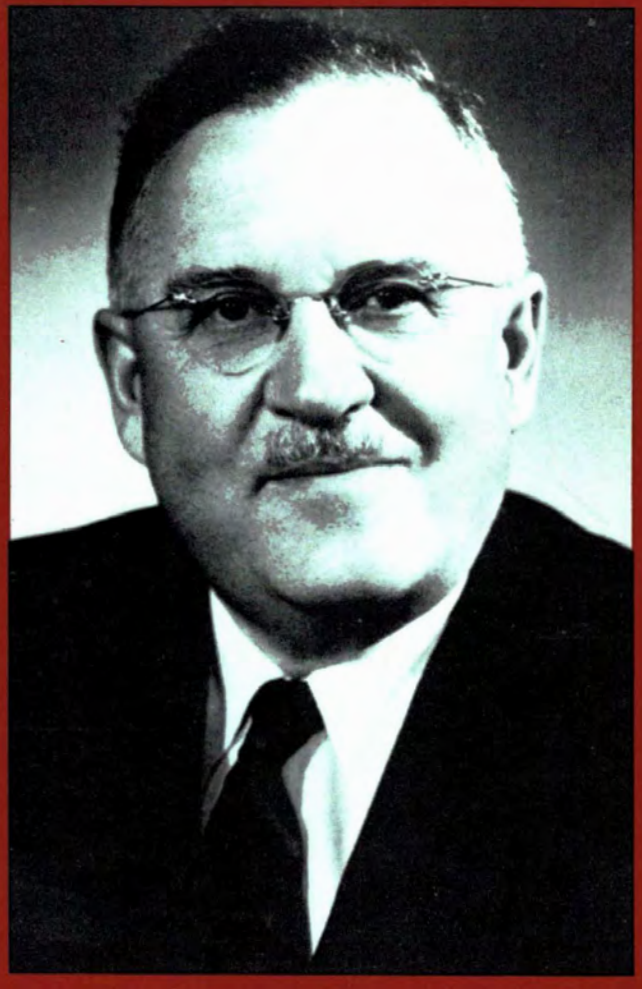
Harold Griffith

HIS LIFE AND LEGACY

A tribute on the 50th anniversary of the introduction of curare into anaesthetic practice

EDITED BY JR MALTBY
AND DAE SHEPHARD



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Canadian Anaesthetists' Society
Société Canadienne des Anesthésistes

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Preface

January 1992 marks the 50th anniversary of the introduction of curare into clinical anaesthesia. On January 23, 1942 Harold Griffith and Enid Johnson gave the drug to a patient under anaesthesia. Their report of its use in 25 patients led to changes in anaesthetic practice throughout the world. What is especially remarkable is that this contribution came from the Montreal Homoeopathic Hospital (now the Queen Elizabeth Hospital), a 120-bed community hospital where Griffith and Johnson, a third year resident, were the entire anaesthesia department.

Even though he had no university affiliation, Griffith was already an internationally respected leader. He had addressed major anaesthesia meetings and contributed to the literature on topics ranging from endotracheal intubation and cyclopropane to better training of anaesthetists and more respect in the medical community for their status. He had the ability to sort the wheat from the chaff, to distinguish those developments which were of genuine benefit from those which represented change for the sake of change. Once he was convinced that a new drug, technique, facility or organization would benefit patients or the profession he took every opportunity to promote it.

As 1992 approached, it seemed appropriate to recognize all of Griffith's contributions to anaesthesia in a volume containing the more significant of his publications. This project, which had its conception in initial efforts by Dr Roy Humble, of Edmonton, developed into a three-part commemorative volume. The first part is a Festschrift – a collection of tributes by Griffith's former students and colleagues who knew him at various times during his career and in his retirement. The contributors range from his 1930 intern at the Montreal Homoeopathic Hospital to the present professor and chairman of the department of anaesthesia at McGill University. The second part is a selection of Griffith's papers accompanied by commentaries by anaesthetists from the United States, England and Canada.

The third part is an annotated bibliography of all of Griffith's writings. These show the extent of his contributions to the overall growth of our specialty from 1922 through 1967 into what he called the boundless realm of anaesthesiology.

Griffith exerted an immense influence on the practice of anaesthesia and on the organization and development of our specialty. He made friends easily and respected all his colleagues, whether they were anaesthetists, surgeons, nurses or orderlies. Anaesthetists in several countries conferred honours upon him. Despite the greatness he achieved he remained a friend to all, and "Uncle Harold" to a generation of younger anaesthetists.

It is with gratitude that we present this record of the life and legacy of Harold Griffith.

JR Maltby
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Harold R Griffith MD CM
A Festschrift

DEIRDRE MM GILLIES,
J EARL WYNANDS

Harold Randall Griffith MD CM

The pioneer of the use of muscle relaxants in anaesthesia

Harold Randall Griffith, 1894-1985, was born in Montreal and graduated MD CM from McGill University in 1922, gaining a Doctorate of Homeopathic Medicine from Hahnemann Medical College of Philadelphia in 1923. We who practise anaesthesia shall be forever indebted to Dr Harold, as he was affectionately known by his peers, because, on January 23, 1942 he and his Resident, Dr Enid Johnson, used curare for the first time during anaesthesia to produce muscle relaxation. On that day, almost 100 years after ether anaesthesia had been demonstrated by William Morton, Dr Griffith revolutionized the practice of anaesthesia by demonstrating that a substance which, until then, was considered a poison could be used safely to produce muscle relaxation during surgery. Before the introduction of curare, this could only be produced by deep chloroform, ether or cyclopropane anaesthesia with its attendant morbidity. Thus, Harold Griffith introduced the most important advance since the launching of the infant specialty, not only in terms of reducing morbidity and probably mortality, but also because it greatly increased the scope of surgery. Despite the many advances in anaesthesia since 1942, there is nothing that compares to the importance of Dr Griffith's contribution.

We who were privileged to work with this quiet, humble man who dedicated his life to the practice of anaesthesia, are often surprised and frustrated by the number of young, and not so young anaesthetists – even at McGill University – who do not recognize his name, let alone the new approach and fresh look he gave the specialty. McGill University is in the process of creating a Research Chair in Anaesthesia in his memory and, therefore, it seems appropriate to review briefly his career and the circumstances that propelled him to international renown.

Dr Harold, early in his medical training, developed an intense interest in anaesthesia. He had the good fortune that his father was the medical director of Homeopathic Hospital in Montreal, subsequently to be renamed the Queen Elizabeth Hospital, and it was there that he cultivated his interest in anaesthesia. Although he did not have special training in anaesthesia he considered himself fortunate in having among his many friends three of the most important anaesthetists in the world. They were Dr Frank McMechan of Cleveland who founded the International Anaesthesia Research Society, Dr Wesley Bourne who became the first Professor of Anaesthesia at McGill University in 1946 and emphasized the importance of basic sciences in anaesthesia, and Dr Ralph Waters of Madison, Wisconsin who was a world expert on cyclopropane, and the first full Professor of Anaesthesia in a Medical School.

Dr Griffith published his first paper, in which he set out guidelines for the safe practice of anaesthesia, in 1922 while a medical student. He emphasized the importance of constant vigilance and the accurate recording of respiration, arterial pressure, pulse and the anaesthetic drugs given. He placed great importance on making sure that the patient was breathing adequately and, if not, recommended assisted ventilation. The interpretation of changes in arterial pressure and heart rate were clearly and accurately amplified. His meticulous record-keeping would solve many medico-legal problems if all practising anaesthetists would emulate him. He became the Chief of Anaesthesia at the Homeopathic Hospital in 1923, a post which he held until 1959. He continued to give anaesthetics until 1966. His younger brother Jim was the Chief of Surgery and his father was Medical Director; thus, he was in a good position to strive continually for important innovative changes in anaesthesia. For instance, in 1923 he felt ethylene was a better anaesthetic than nitrous oxide and used it almost exclusively for 10 years, the only physician in Montreal to do so. He soon began to deliver papers on his experience with this drug and this brought him to the attention of Dr

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McMechan and Dr Waters. They quickly recruited him into their cause of advancing the infant and poorly appreciated specialty of anaesthesia. His status as a clinician, researcher, teacher and organizer grew rapidly. In 1933 Ralph Waters drew his attention to cyclopropane; this he took up enthusiastically and used to the end of his practice. He published extensively, and became a world authority, on this particular anaesthetic drug. It was on this background that he was given the opportunity of being the first anaesthetist to use curare in anaesthesia, although it had previously been used in psychiatry. The circumstances surrounding the first use of this drug are best told in Dr Griffith's own words: "Like everyone else, I knew that there was a need for better muscular relaxation during certain surgical procedures so I pricked up my ears when, in 1940, Dr Lewis Wright told me of his idea that curare might provide that relaxation. He told me of the work of Dr AE Bennett, of Nebraska, who had been using the new preparation, Intocostrin to soften the convulsions of patients undergoing shock therapy for psychiatric disease. Because curare had a fabulous reputation as a poison, I was only mildly interested, but I kept thinking of the possibilities.

"I met Dr Wright again in 1941, and asked him how he was getting along with his idea. He said he still thought that curare might be of value to the anaesthetist but he hadn't been able to get anyone to try it in the Operating Room. I argued to myself that if it did not kill Dr Bennett's patients it could hardly do any serious harm to ours, because the major danger would be respiratory paralysis and even at that time anaesthetists were accustomed to maintaining controlled respiration over long periods so I asked Dr Wright to send me some Intocostrin.

"On January 23, 1942 at the Homeopathic Hospital in Montreal [now the Queen Elizabeth Hospital] my resident, Dr Enid Johnson, and I administered the first dose to a young man undergoing appendectomy. ..." Dr Harold observed rapid relaxation of the abdominal muscles, was able to reduce the concentration of cyclopropane and in this case did not need to assist ventilation. Twenty-four further patients were given Intocostrin and he concluded that the drug could be used safely and successfully. Even though only 25 patients had been studied, he felt it important to publish these results so that others could confirm or negate his findings. The first paper on the use of curare appeared in *Anesthesiology* in July 1942 and the reaction to it was swift in coming. Those who did not take time to try the drug were often scathing in their condemnation of its use and implied that Dr Griffith had acted irresponsibly in using the poison, while others who used curare in the operating room were unanimous in support of his findings.

Other prominent anaesthetists had been given the opportunity of being the first to use curare and, although they probably possessed equal wisdom, knowledge of physiology and anaesthesia as did Dr Griffith, they did not have the courage to use it first in man. Courage was part of his character, but it did not lead him to act irresponsibly and so, as has been related by him, it was first used in man after considerable thought had been given to the possible dangers of its use.

He had previously shown courage when, during the First World War, his medical studies being interrupted, he was awarded the Military Medal for bravery at the Battle of Vimy Ridge. He then transferred to the Royal Navy where he served as a Surgeon Sub-Lieutenant to the end of the war. In the Second World War, as a Wing Commander in the Royal Canadian Air Force, he developed a rapid training programme for physicians who would be going overseas to administer anaesthetics. Thus, he had the distinction of serving in all three branches of the Armed Forces. During World War II he trained many young men who subsequently became well known anaesthetists in Canada and abroad. He also gained the experience which led him to organize the McGill University Training Programme in Anaesthesia. When Dr Wesley Bourne became the first Professor of Anaesthesia at McGill University in 1946 he invited Dr Griffith to join his staff and when Dr Bourne retired Dr Griffith became Professor and Chairman in 1951, a position he held to 1956. In that year he was honoured by being named Professor Emeritus at McGill. He succeeded his father as Medical Director at the Homeopathic Hospital, a position which he held for 30 years. He also established the first recovery room in Canada.

He felt the advance of anaesthesia could best be achieved by communication and so he organized a society of Canadian anaesthetists in Montreal which was, 3 years later (in 1943), to become the Canadian Anaesthetists' Society and he its first President, a position he held for 3 years. He was Vice President of the American Society of Anesthesiologists in 1946. He was elected President of the International Anaesthesia Research Society in 1948 and from 1949 to 1952 served as Chairman of the Board of Trustees. From 1951 to 1955 he became involved in probably what he considered to be his greatest contribution to anaesthesia, namely the organization of the World Federation of Societies of Anaesthesiologists. He was elected President at the first meeting of the Federation in Holland in 1955 and at the second meeting in Toronto (in 1959) was elected permanent founder President. He was a trustee and member of the Editorial Board of *Anesthesia and Analgesia* from 1952 to 1961. He was Vice President of the Academy of Anesthesiology from 1952 to 1955. He was the beneficiary of many awards during his lifetime including:

Feltrinelli Prize Academe dei Lincei, Rome 1954
Hickman Medal of Royal Society of Medicine, London 1956
Distinguished Service Award of the ASA 1959
Founder-President World Federation 1959
Canadian Anaesthetists' Society Medal 1962
Ralph Waters Award, Illinois Society of Anesthesiology 1970
Officer of the Order of Canada 1974
Honorary LL.D. University of Saskatchewan 1974

The attitude, motivation, energy and courage of Harold Griffith can serve as a role model for all who wish to further our specialty. Dr Harold will always be remembered by those of us who had the good fortune to work with him. He was greatly concerned that anaesthesia research should always flourish. It is therefore most appropriate that McGill University establish the Harold R. Griffith Research Chair in Anaesthesia which fulfils his wishes and our desire that his name and contribution to our specialty be remembered in perpetuity.

WILLIAM B NEFF

A former student remembers

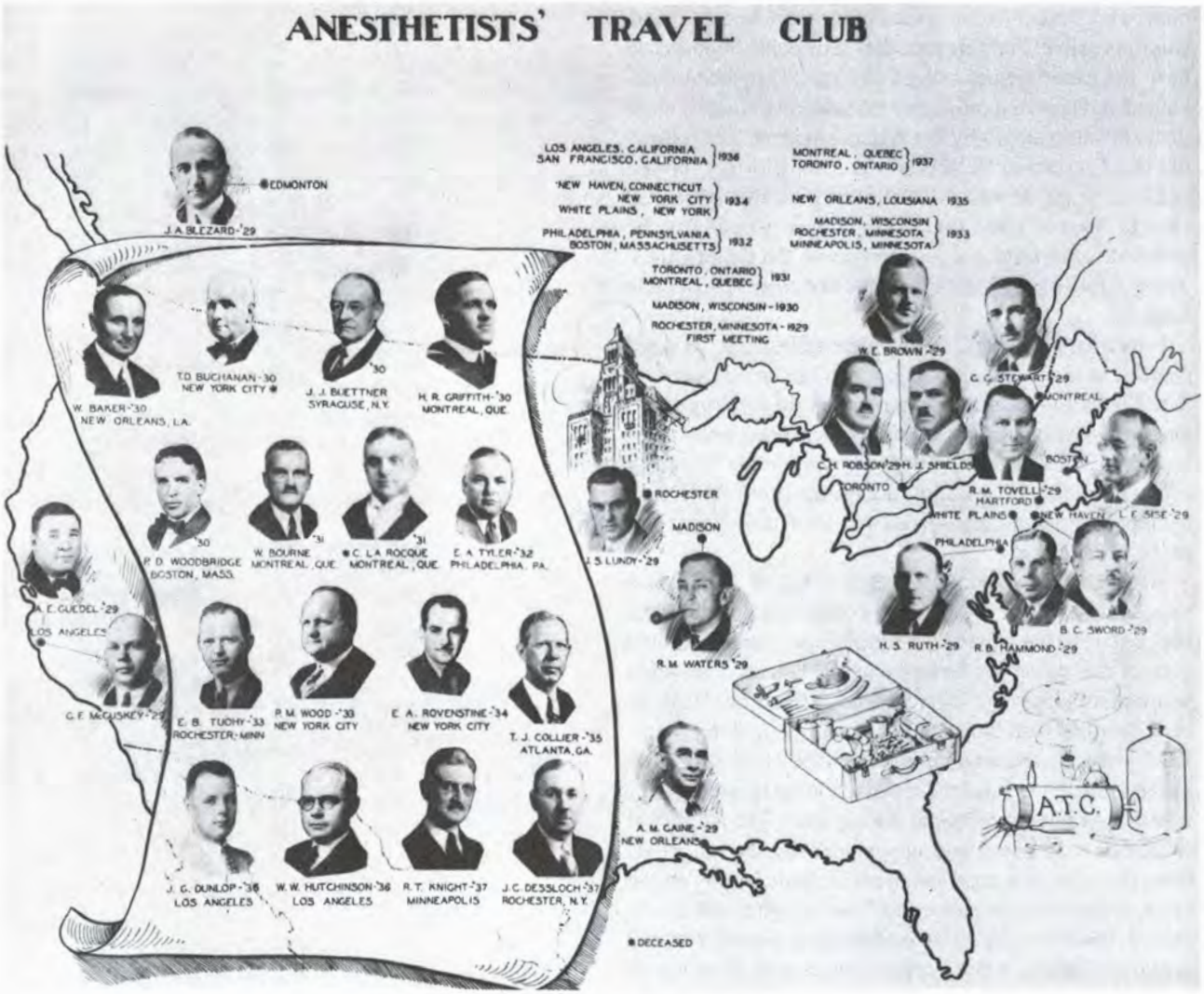
On my arrival at the Homoeopathic Hospital in Montreal in 1930 to begin a rotating internship, I was warmly welcomed by Harold Griffith who then introduced me to his father AR Griffith, the medical superintendent, and his brother James, a staff surgeon. The hospital was a new, small, well-equipped institution with an excellent nursing staff, all of which made it attractive to many McGill faculty members from both the Montreal General and Royal Victoria hospitals to become its section chiefs.

It soon became evident that although Griffith was primarily interested in specializing in internal medicine, a time came when he was rapidly becoming internationally known in the developing field of anaesthesia. He felt that in order for anaesthesia to progress as a specialty it had to be closely related to internal medicine, and must not be regarded as a 'handmaiden of surgery' which was a common North American custom at the time. As time went on I became more interested in his concept of anaesthesia as a branch of internal medicine than in other areas of my duty.

At that time rotations within the rotating internship were not clearly defined. While on the surgical rotation, the intern could be called upon to do blood chemistry on a patient, or while on the medical rotation we could be requested to assist in surgery. Griffith pointed out that the practice of assigning surgical residents 'to give the anaesthesia' as part of their training often resulted in a diversion of their attention, sometimes with disastrous consequences. He had a quiet way of sharing his medical knowledge with the interns not only in anaesthesia but in the broad spectrum of medicine, albeit, he always returned to his thesis that anaesthesia was a subspecialty of medicine rather than surgery. Since there was no resident staff he saw to it that the interns, in addition to guidance by department chiefs, received practical experience according to their capabilities. It was on these latter occasions, while holding retractors during lengthy operations, that I became aware of Griffith's ability to provide muscular relaxation for the surgeon only when really needed, usually resulting in a more rapid patient recovery.

Griffith's success with the endotracheal technique, both for anaesthesia and for resuscitation of the newborn, attracted visiting anaesthetists from many institutions, mostly from Canada and the United States. Olive Jones was sent by the London, England neurosurgeon, Hugh Cairns, to observe endotracheal anaesthesia as performed by Griffith. Since neurosurgical operations at the Homoeopathic Hospital were a rarity, Griffith demonstrated his technique on patients undergoing general surgical or otorhinolaryngological procedures, of which there were plenty. During the course of her stay, he recommended that she visit other Montreal hospitals, both English and French, and I was elected to be her guide. Transportation was entirely by bus and tram. On our return she told me that as far as the administration of anaesthesia was concerned she preferred what she had seen at Dr Griffith's hospital.

I find it interesting that all of Griffith's 1930 interns and their friends carried on a continuing respect for medical anaesthesia following subsequent advancement to responsible positions which included Medical Director at the Rockefeller Institute, Professor of Medicine at Oxford, and Professor of Paediatrics in British Columbia. Later in life, at one time or another, we met and reminisced over the direct personal association the interns had with McGill faculty members and others during the times we spent with Griffith at the old 'Homoeo.' On the lighter side, our conversation was directed to an appreciation of the amenities offered in days of deep economic depression, such as the high quality of the food served in style by uniformed Scotch waitresses. Although his father was the medical superintendent, Griffith was given full reign over the support structure of the hospital, including the housekeeping and dietary services which he handled in such a quiet, pleasant, effective manner that it evoked few, if any, complaints. We had the privilege of inviting colleagues



Anesthetists' Travel Club. Griffith is in the top right corner of the scroll. Many of the others were mentioned by Griffith in papers reprinted in this volume.

who were interns in other hospitals for dinner. They all agreed we had it pretty good. The Griffith family owned a country place on a lake in the Laurentian foothills where the interns were invited by Griffith for weekends of swimming, boating and, of course, eating.

Griffith had been interested in cyclopropane ever since Lucas and Henderson discovered its anaesthetic properties at the University of Toronto in 1929.[1] Easson Brown, the only clinical anaesthetist who participated in the original study, and Griffith, were members of the Anesthetists' Travel Club (Figure) and they both attended the 1930 gathering which was hosted by Ralph Waters at the University of Wisconsin. On Griffith's return, and before my departure for Wisconsin, he reported to an equally informal organization, the Montreal Society of Anaesthetists, on a possible promising extension of the original study to clinical application by Waters. Naturally with this background, I was highly pleased when shortly after my arrival at the University of Wisconsin I was assigned to the pharmacological and clinical study of cyclopropane then in progress, and thus to be included in the original team that published the first clinical report on cyclopropane.[2]

When the cyclopropane study was midway to completion, I had to return to Montreal for a non-related matter so Waters asked me to stop off in Toronto en route for a brief conference with Henderson, Lucas and Brown in the pharmacology laboratory. I was directed to convey Waters' opinion that, if at all possible, the first clinical report on cyclopropane should come from the University of Toronto. This I did, but they assured me that, for them, the

clinical introduction of any potentially explosive anaesthetic was impossible. Furthermore, they felt deeply honoured to have the experimental study and clinical application extended and reported only after the administration of more than 200 anaesthetics by the Wisconsin team. The following day I informed Griffith of the results of the Toronto conference and he was not at all surprised. He said he had already been advised that cyclopropane would first be released for clinical use to members of the Anesthetists' Travel Club. In 1933 he became the first to administer it in Canada.

Fifty years on, after his complete retirement, I visited Griffith in his Montreal home. Although he was very ill, when I told him I had been successful in substituting weak, non-explosive concentrations of cyclopropane, established by the U.S. Bureau of Mines, for meperidine to fortify nitrous oxide anaesthesia, his face beamed as he said, "Bill, cyclopropane certainly served me well throughout my professional career."

After Griffith's successful clinical use of curare as a muscle relaxant during cyclopropane anaesthesia, he suggested that the West Coast Squibb representative should contact me, relate his further experience and offer me a substantial supply for clinical trial at Stanford. Having been familiar with the safety of curare in properly ventilated animals, and knowing the reliability of Griffith's observation, I administered it and recorded its use for over a month without mentioning it to anyone. The additional relaxation was noted and appreciated by the surgeons. Even though it was recorded in detail, quite legibly on the chart, surgeons never seemed curious enough to refer to the record. The following summer, during my family's annual return to Canada, when I related the course of events to Griffith he responded with the usual big smile and shoulder shrug.

As I look back over a fifty year period of time, I realize that my continuing medical relationships with Harold Griffith were based entirely on the spoken word, either in the form of direct personal conversation or transmitted by third party association in which I was always referred to as his former student.

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EM PAPPER

The friend of the young anaesthetist

The purpose of this essay is to portray Harold Griffith as a guide and advisor to young people in our specialty, and to make further comments to indicate the way in which the mind of this wonderful statesman of anaesthesia operated.

I first met Griffith shortly before the Second World War during a visit to the Homoeopathic Hospital in Montreal. This was part of a tour of important anaesthesia centres in the United States and Canada, arranged by my teacher, Emery A Rovenstine of New York. My recollection of the visit to Griffith was one of very great pleasure and some excitement. When I called at his hospital and went to his office I found, much to my surprise, a very modest establishment and what seemed like a very much less hectic and less frenetic activity than I had been used to at Bellevue Hospital in New York.

I was surprised to meet a person who, in my very brash and inexperienced youth, seemed to me to be a pleasant, elderly, somewhat rotund gentleman who was kind enough to take some of his valuable time to show me the things that he was doing. The details of what was occurring clinically are now quite vague, except that I saw several patients anaesthetized smoothly, easily, and comfortably with cyclopropane. I also recall an environment in which Griffith was highly respected by his surgical colleagues, and that there was friendliness and affection between them. It was a most pleasant and happy experience, and I think it was the beginning of Griffith's correspondence with me. A subsequent visit, after the war, when I had already assumed the Chair in Anesthesiology at Columbia University, reinforced this first impression and added to my delight with the pleasant and friendly relaxed environment that I encountered.

This is not an occasion for a political treatise on the subject of the war, of Hitler, or of the details of military medicine, but it is an important occasion to stop to take note of the extraordinary gentle kindness that also took place in the midst of all the deadly trauma of that time. It is not generally known that there were many important people – Harold Griffith himself, Emery Rovenstine of New York, Ralph Waters of Madison, Robert Macintosh of Oxford, and Wesley Bourne of Montreal – who encouraged my generation to study, to work hard and, perhaps above all, to have faith in the free world that would emerge from the tragedy and misery of the war. They cared about those of us who seemed destined, at that time, either to eternal suspension of our lives, or perhaps a finite oblivion as an unhappy alternative in the war; they kept the faith with those of us who were younger, and encouraged us in darker hours.

Griffith was one of the remarkable letter writers of this period. I was one of a number of individuals (which I suspect is a good deal larger than we shall ever know) who during the war years received an occasional telephone call but more often a newsy and pleasant letter from Griffith. Most of these letters were information about what was going on in Montreal, and specifically at the Homoeopathic Hospital. There was also some pleasant discussion of a better world to come as anaesthetists throughout the world would and could get together to enjoy working with each other. It is possible that these thoughts were the earliest that Griffith had about the World Federation of Societies of Anaesthesiologists. Unfortunately, the letters that I received, which at the time seemed to be only friendly notes but which in retrospect were important documents, were consumed in a fire at home.

When we think back upon our beginnings, and if only the modern aspects of anaesthesia as a medical specialty are considered, the search is a relatively short retrospective. In this respect, there was an extraordinary series of events as well as of people. The major force, which was a milestone in the development of this field as a clinical specialty, was the Second World War, where much of the impetus occurred for the transition from the prewar activities of pioneering leaders to a postwar spread of the knowledge so essential

to the care of surgical patients, to the relief of their pain and suffering, and to the improvement in the care of severely injured patients. Griffith was one of those remarkable individuals who provided the leadership in this transitional era. He was also a most generous leader to people like me who were young in the specialty, and who had curiosity, energy, and ambition to contribute to the tradition already laid down by the leadership of the previous generation.

On another note, I wish to add something to the story of curare which points up the importance of Griffith's contribution. Harold Griffith and his resident colleague, Enid Johnson, deserve all the credit that has been showered upon them by a grateful world for their introduction of curare into clinical anaesthesia. The events that led to their description of its first successful clinical usage should be of interest to those who need to know more about the culture of our specialty.

The transfer of knowledge and the thought that muscle relaxants could be used in anaesthesia is properly credited to Lewis Wright who worked for the Squibb Corporation in the late 1930s and early 1940s. Wright was most unusual in that he was not only a physician, but also had completed a full residency in anaesthesia under Rovenstine and was therefore well educated in the field that was so important for this great discovery. He was aware of the older literature on the scientific use of curare for experimental purposes in animals, and of its use in psychiatry for the prevention of fractures and other severe injuries during shock treatment of mental disorders. He brought his suggestions for study to several people, of whom Rovenstine in New York was one and Stuart Cullen in Iowa was another. According to his own statements, Cullen was not convinced about the reliability of curare in experimental work that was performed by him and his colleagues. However, after the Griffith-Johnson paper[1] had been published, Cullen's group produced the first confirmatory clinical report[2] of the successful use of curare as an adjunct of great importance to surgical anaesthesia.

At New York University and Bellevue Hospital Rovenstine asked me to study the compound. In the physiology laboratory the common experimental animals were cats and monkeys. Monkeys were deemed too expensive for the trial of a new drug, and the cat was the inevitable choice. Two cats were given the Squibb preparation containing crude curare which Wright brought to Rovenstine, and both died asphyxial deaths after bouts of acute asthma, either because of the impurities or because of histamine release. The ethical environment in those days was vastly different from what it is today. Despite this paucity of animal experimental evidence, it was not unusual that Rovenstine suggested that I should try the preparation in man. In his department any new anaesthetically related drug was studied during diethyl ether anaesthesia. Curare was, therefore, used in two patients during diethyl ether anaesthesia, and each time it resulted in prolonged apnea which required fatiguing, manual artificial ventilation via an endotracheal tube. It must be remembered that in the culture and thinking of that time that apnea, however induced, except for very short periods of time, was not viewed as a satisfactory or manageable complication of anaesthetic drugs or techniques. Accordingly, I suggested to Rovenstine that the drug appeared too dangerous for use in clinical practice.

The fact that Rovenstine took my advice was evidence of his confidence in me. In retrospect, however, my advice was mistaken, partly due to the general thinking of the time about apnea as a complication of importance, and partly because of my own inexperience in anaesthesia. Although I had ample background in both internal medicine and physiology, my anaesthesia experience was that of a junior resident. The obvious and logical thought that a smaller dose of Intocostrin, as the substance was then known, should be tried had not occurred to me. This seems to have been the most obvious error that was made.

When Wright brought this same material to Griffith, Griffith and Johnson administered it cautiously, mostly for the opening and closing of the abdominal cavity, in twenty-five patients during cyclopropane anaesthesia. This was a very fortunate choice since cyclopropane did not enhance the action of curare as ether did.

The rest is history. Griffith and Johnson made the monumental discovery of the value of curare in clinical anaesthesia. They deserve the credit for the introduction of muscle relaxants into clinical use, and the gratitude of all of us for all time. History is replete with examples of able people who fail to see what is obvious except in retrospect. The heroes are those who make the crucial connections – and Harold Griffith was one of those.

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RODERICK A GORDON

A treasured friend

I first met Harold Griffith at the annual meeting of the Ontario Medical Association in Toronto in 1945. We were both in uniform, he as a squadron leader in the Royal Canadian Air Force as consultant in anaesthesia to that service, and I as a major in the Royal Canadian Army Medical Corps. He was the guest speaker at that meeting, describing his use of curare (Intocostrin) in anaesthesia. I had just returned that week from 5 1/2 years of overseas service, and although I had made honest endeavours to keep abreast of the literature I had entirely missed his paper on the use of curare. I was truly excited by his description of its use. As soon as possible I obtained an ampoule of Intocostrin and used it very tentatively on some of my military patients, becoming an ardent convert as a result.

Within a month I met Griffith again in his role as president of the Canadian Anaesthetists' Society (CAS) at the annual meeting in Montreal, while I was the member of council representing the Society of Anaesthetists of the Canadian Army Overseas, which had been given the status of a division of the CAS. From that time our contacts were almost entirely related to the business of the CAS and were reasonably frequent after I became secretary-treasurer in 1946.

Aside from his contributions to the literature of anaesthesia, there can be no doubt that perhaps his greatest contribution was his influence in the process of establishing the professionalism of anaesthesia as a specialty. He continued to be a dominant member of the council of the CAS for many years after his three years as president, and he brought his gift for sound reasoning and wise counsel to that body in many contentious issues. He was the author of the stated policy of the CAS which stressed that the administration of anaesthetics is the practice of medicine and not a hospital service. Whose opinion could carry more weight than his, since he was himself a hospital superintendent?

Griffith was an important ambassador-at-large for Canadian anaesthesia. He held important positions in American societies of anaesthetists. His role as the initiator of the use of curare in anaesthesia provided an international reputation which, with his personal charm, gave him secure access to anaesthetic circles in Europe. He was thus able to bring great influence to bear in his ambition to establish a world organization of anaesthetists. His election as founder-president of the World Federation of Societies of Anaesthesiologists in 1955 testified to the high esteem in which he was held by his colleagues throughout the world.

Harold Griffith was a fine gentleman and a modest man who made light of the many honours which came his way. To this writer he was a treasured friend.

C RONALD STEPHEN

Personal reminiscences

With the onset of the Second World War and the rapidly expanding military requirements, it became evident that more anaesthetists were needed than could be plucked from the existing number available. So it was that in 1942 a special training group was established in Montreal. Under the leadership of Wesley Bourne, a three-month postgraduate course in anaesthesia was organized for military personnel. Bourne was a consultant to the army with rank of lieutenant-colonel, Harold Griffith became a consultant to the air force with the rank of wing commander, and Digby Leigh was a consultant to the navy with the rank of commander. Four young officers in the Royal Canadian Army Medical Corps, of whom I was one, were posted to Montreal for this course. We had little or no concept of what was entailed in anaesthetizing a patient – in fact, we all had ambitions of becoming internists. But that situation did not last for long. Each of these teachers threw themselves headlong into the task of making anaesthetists out of these neophytes. Without a doubt it was the most stimulating, heart warming experience of my life. From early in the morning until late at night we were badgered, taught, and forced to reinvestigate many of the basic concepts we had learned relatively recently in medical school.

These instructors knew each other so well (Griffith described Bourne as his closest and dearest friend) that they could integrate their individual teachings into a near perfect balance. Bourne was the firebrand, emphasizing his points with a finger repeatedly thrust into the chest. Our journeys to the Grace Dart Hospital where tuberculous patients were provided pain relief with 1:1,500 Nupercaine injected into the subarachnoid space in the sitting position resulted in moments of sheer terror interspersed with lectures on the potential value of such techniques. Perhaps he was preparing us for some of our experiences overseas! Griffith, no less convincing, was the fatherly, unassuming type, so much so that among ourselves he came to be known as Uncle Harold. His demonstrations of the use of curare with cyclopropane, at the time causing international acclaim, were a wonder to behold. It was as if it were a well-known combination that had been in existence for years. Leigh, the chief at the Children's Memorial Hospital, was also a born teacher who allowed us to get into trouble and then rescued us with many well-chosen and provocative actions and words. Our fear of paediatric anaesthesia was changed into a degree of confidence, mixed with fun, in a short time. The three months that we were with these dynamic teachers went by like a shot from a rifle, and therefore memories are blurred. I do not believe that there is a written memoir of how many students were so trained, but it was only natural that these experiences showed the way and heightened the desire to these teachers to establish a department of anaesthesia.

One of my earliest recollections of Griffith occurred on a cold and frosty morning at the Homoeopathic Hospital. It was about 7:30 a.m. and the operating room was still cold and full of static electricity, as one could tell whenever anything metal was touched. Nevertheless, with characteristic aplomb and with carefully measured words of wisdom, he proceeded to anaesthetize his patient with cyclopropane and later to administer small amounts of curare. As I was to find out in relatively short order, it was a masterful demonstration performed by an extraordinary clinician. It was important for us to learn thoroughly the pharmacology of cyclopropane because, unlike the United States military, cyclopropane was available to Canadian military units: indeed it was one of our mainstays during the war. However, curare was not part of the armamentarium, at least overseas.

During those few months, it was a privilege to visit in Griffith's home and to meet his gracious wife, Linda. Their home on Northcliffe Avenue was only about a five minute walk from the hospital. It was a warm place, tastefully but modestly furnished, and the sincere reactions of the Griffiths made one feel it was a real home, to be emulated if at all

possible. We still visit Mrs Griffith whenever our journeys take us to Montreal.

In 1946 I returned to Montreal to find the Department of Anaesthesia at McGill established and functioning. I still had thoughts of being an internist, but the three teachers were persuasive and I found myself ensconced at the Montreal Neurological Institute. During the year there a new muscle relaxant, myanesin, became of interest to Griffith, and we did some work together on this compound.[1,2] As a neophyte in the investigation of new drugs, I learned a great deal from the guidance, perspective, and intuitive judgment of Griffith during this study.

In the postwar years, one of the teaching highlights of the programme in anaesthesia in Montreal was the Monday night meetings, held in the Ciba building in downtown Montreal. Originally organized by the Great Triumvirate, as Bourne, Griffith and Leigh were sometimes called, for the benefit of the residents in training, it soon attracted 50-75 anaesthetists, both English and French-Canadian, from throughout the city. At times there were guest speakers, from both in and out of town. Always there was vigorous discussion following the lecture. These meetings did much to enhance the specialty and encourage those practising it.

In 1947 when Leigh left Montreal for Vancouver, I was urged to go to the Children's Memorial Hospital even though my knowledge of paediatric anaesthesia was meagre. Knowing, however, that one could seek advice and counsel from Griffith at any time was a great comfort in the ensuing months and years.

In 1950 I left Montreal and contacts thereafter were, unfortunately, few and far between. Griffith did visit us at Duke University in North Carolina in 1953, no doubt to see how his young pupil was doing. In the autograph book he wrote, "such a happy visit," and it surely was for us. My last recollection is when my wife and I visited the Griffiths about a year before his death. They were living in an apartment and, although his activities were somewhat limited, his mind was as fertile as ever. As we talked and reminisced a bit, it was evident that this giant in the development of anaesthesia was as unassuming, serene, and full of humour as he had been some forty years previously.

Three of his dogmas[3] have stood the test of time:

> There is, however, one field in which I am sure the anaesthetist is better qualified than other consultants ... that is in the preoperative assessment of the risk of operation and the preparation of the patient.
>
> The next reminder from the wisdom of the anaesthesiologist is that there were never two people born exactly alike.
>
> We believe that there is no excuse in modern hospitals for preoperative or postoperative 'routine orders'. The very term makes me shudder.

Being as close to Griffith as some of us were in those days of his increasing preeminence in the field of anaesthesia makes it difficult to comprehend the invaluable contributions he made to the specialty. I shall always remember him as Uncle Harold, a true friend, unassuming, helpful, never a harsh word, a Christian gentleman. His message in his valedictory in 1967 rings just as true today.

> We stand at a critical time in medical history, and the greatest danger to our professional liberty lies in our own indifference. So, you young men and women, attend meetings, serve joyfully on committees, run for office; let your voices be heard, not only in your own specialists' organizations, but also in the hospitals, in general medical meetings, in politics, in school and church activities, and among your neighbours!

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T CECIL GRAY

A tribute to Uncle Harold

The oft-quoted passage from Shakespeare's Twelfth Night, "Some are born great, some achieve greatness, and some have greatness thrust upon them," is not completely applicable to Harold Griffith; 'Uncle Harold' was not born great, nor did he have greatness thrust upon him. However, he certainly achieved greatness, not only for his work with curare, but also as a stimulating teacher who forged close and lasting bonds of friendship with those he taught and influenced, both in Montreal and internationally. This and his great diplomatic ability was recognized by his enthusiastic election as the first president of the World Federation of Societies of Anaesthesiologists.

Shakespeare's advice was not to be afraid of greatness. Harold was not. He revelled in it. He obviously enjoyed the esteem and world recognition that resulted but, being a sincerely humble man, he rejoiced that it enabled him to bring yet further international acclaim to the McGill department, when he succeeded Wesley Bourne as its head. He cherished the professional contacts which worldwide travel brought and the friendships which resulted. All this was very evident to us in Britain.

I first met Harold when he visited Liverpool in August 1951. He was on his way to London to attend the 26th Annual Congress, jointly organized by the International Anesthesia Research Society (IARS) and the International College of Anesthetists with the assistance of a London committee. He was accompanied by Laurette McMechan, whose husband, Frank, had founded the IARS, and she was carrying on his work, editing the journal and, of course, she was the linchpin of the congress. Ivan Magill was its honorary president and he and Harold, chairman of the Board of Governors of the IARS, opened the congress. It was at this meeting that we first heard from Thesleff and von Dardel of the new short acting relaxant succinylcholine, up to then the most significant advance in the field of relaxant drugs since the introduction of curare. After visiting Liverpool he went up to Edinburgh where his host was John Gillies and it was at a dinner party with the Gillies family that Deirdre Gillies first met him. She sat next to him and he persuaded her to change her mind and not to go to New York to train with Virginia Apgar, but to join him in Montreal (personal communication from DMM Gillies, 1991).

In the May previous to the congress Harold, with Henry Beecher from Boston, Geoffrey Kaye from Melbourne, Harry Daly from Sydney and Harry Grant White of Durban had been elected honorary members of the Section of Anaesthesia of the Royal Society of Medicine. In 1956, as president of that section, I had the honour of presenting Harold to the president of the Royal Society of Medicine, Sir William Gilliatt, for the award of the Henry Hill Hickman Medal. This prestigious medal is awarded not less than every three years "for original work of outstanding merit in anaesthesia or in subjects directly connected thereto." The first recipient, in 1935, was Wesley Bourne, Harold's teacher and predecessor in the McGill Chair of Anaesthesia. The medallists over the next nine years were Ivan Magill, Arthur Guedel and Ralph Waters. During my citation I mentioned that Griffith's introduction of curare in 1942 had divided anaesthesia into two eras: before Griffith and after Griffith. After the ceremony there was a dinner in the historic Apothecaries' Hall which, miraculously, had been spared from destruction during the blitz. Harold had a profound sense of history and was greatly moved by the old hall, rebuilt in 1668 after the fire of London. He referred to it as "The very centre and shrine of British medicine ... and all that it has meant to the welfare of this world through the men commemorated on its walls."

In 1953 Harold and a group of his colleagues from Canada and the United States made a motor tour of England and Scotland. His friend, the late Professor Edgar Pask of Newcastle-upon-Tyne, organized the tour. Pask, of all British anaesthetists of that time, was the most scientifically brilliant. He was, however, intolerant of those who pretend

to science. His close friendship with Harold, who was essentially a clinician who never made any claim to be a scientist, said much for both men. The tour involved another memorable visit to Liverpool. Harold greatly enjoyed a party and the dinner on that evening at the University Club will not be forgotten by those who were present.

Six years later, at the Royal College of Surgeons, Pask presented Griffith to the dean of the Faculty of Anaesthetists, William Mushin, for admission to the Honorary Fellowship of the Faculty. Unfortunately, Pask's citation is lost, but I can remember being impressed by its moving but characteristically unemotional sincerity.

In 1963 the 21st anniversary of the first administration of curare was celebrated in Montreal. On the evening of the 23rd of January, the actual date of Griffith's first treatment of a patient with curare, a magnificent dinner was held in the beautiful and impressive century old Redpath Hall of McGill University. Gordon Robson, at that time Wellcome Research Professor at McGill and my host, has very kindly given me a tape recording of the speeches made. It was a superb occasion. I was privileged to be the last speaker and so was able to thank Harold, to whom I owed so much, and to pay tribute to him on behalf of his very many transatlantic friends. His speech, delivered in a characteristic, hesitant and light tenor voice, told the now well-known story of his first use of Intocostrin. He paid generous tribute to Lewis Wright who had made the suggestion to him, to his resident at the time, 'Johnny' as he called Enid MacLeod [née Johnson], and to all his staff. Among the latter was Deirdre Gillies who, with Bill Cullen, had "kept the flag flying whilst I went gallivanting around the world." There was touching reference also to Wesley Bourne who was present. In Harold's words Bourne "had put McGill on the map of the world as far as anaesthesia was concerned long before I came into it." Rocke Robertson, the principal of McGill, in proposing Harold's health, referred to the difficulty which he as a surgeon in the Second World War had had in getting sufficient relaxation when dealing with severe abdominal injuries with peritonitis and distension. He greatly regretted that Griffith "did not do his pioneering work a few years earlier."

Those involved in more recent wars will not have known what it was like 'BG' – before Griffith. Nevertheless, I am sure they, with all anaesthetists and surgeons, in this anniversary year will join those of us who can vividly recall the bad old days in giving thanks that Harold ignored Sati's advice: "Never be a pioneer. It's the early Christian that gets the fattest lion." I am proud to have known and enjoyed the friendship of such a pioneer.

PHILIP SMITH

Background to *Arrows of Mercy*

If a layman's appearance in these pages seems surprising, I can only plead that my debt to Harold Griffith, and my admiration and affection for him, match those that must be shared by the many students he inspired and the colleagues he worked alongside during his long career. I am honoured to have been invited to contribute to this salute to his memory.

I first heard about Griffith and his 'taming' of curare from my friend Alex Wielhorski in 1960. Alex was at that time working hard in Montreal to establish himself in his chosen profession of anaesthesia, and I was a copy-desk editor on *Weekend Magazine* anxious to demonstrate that I could graduate to the eminence of feature writer. I was surprised when Alex told me the story that the name of Griffith was not as famous in my adopted country as that of Banting, and I was amazed when my bosses turned down my suggestion that Harold Griffith would be a good subject for an article. Over the next few months, my conviction that his story should be more widely known turned into a resolve to try to write a book about him myself.

The question then became, how did I, an unknown journalist with a desire to write but with no published evidence that I could do so, arrange to meet Griffith and to secure his cooperation? Opportunity knocked when I read in one of the local papers that the Queen Elizabeth Hospital was carrying out an experiment with something called Progressive Patient Care. Among the moonlighting I did in those days to help to pay my first mortgage was a series of on-the-spot interviews for a CBC radio programme called *On the Move*. In this capacity I called Griffith, the hospital's medical director, and he agreed to accompany the mandatory CBC technician and me, microphone in hand, on an explanatory tour of the kitchen and other facilities established at the hospital to ease patients recovering from serious illnesses back into their normal lives.

The interview over, I asked him if I might see him privately. He probably suspected I had contracted an unmentionable disease and wanted some confidential advice, but he agreed to my request with his customary amiability and led the way to his office. As soon as we were seated, on opposite sides of his desk, I came straight to the point, told him I had heard something of his achievements with curare and other advances in anaesthesia, and said I would like to write his life story.

Not surprisingly, he was quite taken aback and did not answer immediately. When he did, he seemed almost to be thinking aloud. He had, he confessed, sometimes thought about writing his memoirs. After all, he was past the normal retirement age so the medical powers-that-be could hardly object. He was, I think, sixty-seven at the time.

Sensing that he was at least interested in what might have seemed my outrageous proposition, I told him a bit about myself and how I thought I could use his life as a sort of thread to tell something of the history of anaesthesia. I had been boning up with Alex in preparation for this crucial interview.

Harold asked for time to think about it over the Christmas holidays. When he called me early in January he said, "If you really think you can make a book out of my life story, I'll cooperate with you." I have often wondered since what made him take that chance on me. His whole career shows, of course, that this quiet little man, so unassuming, had within him the capacity to make bold decisions. In my case, I suspect his decision stemmed from what I believe to have been the driving force of his character - his lifelong desire to help people. I am sure he was just as interested in helping me to achieve my ambition to write a book as he was in having his own achievements enshrined for all time in a biography.

At any rate, we now began to meet every Wednesday evening after dinner at his house near the hospital which was comfortable and entirely unpretentious. Dear Linda,

his wife, with the patience born of an earlier, more gracious age, would welcome me in and then sit uncomplainingly watching television while I monopolized her husband's time downstairs in his office, the one in which he must have examined hundreds of patients during his practice as a family doctor. There he would pour us each a generous measure of Scotch, always Johnny Walker Black Label I recall, and we would sit turning the air blue with smoke from the House of Lords cigars he provided. As I said, it was an earlier age!

Those were the most pleasant, relaxing, and for me, rewarding 'interviews' I have ever conducted. Not that I really conducted interviews. We could have been yarning around a campfire at the family cottage in the Laurentians, which remained a joy to him well into his old age, as Harold recalled his boyhood, his service in the First World War, his years at McGill, homoeopathy, the development of anaesthesia through the years – his own contributions to which I often had to press him hard to admit. But our talk was by no means restricted to medical matters. His reminiscences ranged from the Beauharnois scandal, some of the principals in which I think he knew, to other long-forgotten political shenanigans. He was interested in everything, and I can see him still, eyes twinkling behind his glasses, chuckling delightedly over the inside stories about Quebec politics and the ever-active Montreal crime scene I was able to bring him from Press Club gossip.

After a long series of these meetings, and some additional library research on my part, I wrote a detailed chapter-by-chapter outline of what I still intended to be a biography of Harold, and at the suggestion of a colleague sent it to a leading U.S. literary agent, Willis Kingsley Wing. Wing liked it and spent many months trying to interest a publisher without, as I reported to Harold with sinking heart, any success. Late in 1963 when I at last received my first writing assignment from *Weekend*, it took me to New York City, and I seized the opportunity to introduce myself to Wing in person. "I'm sorry," he told me, "but there seems to be no way I can sell the biography of an unknown Canadian doctor in the United States. Have you ever thought of writing a biography of the substance, so to speak? Your man would still have a big part in a history of curare." I protested that this would involve an awful lot of research, that I did not know whether I could fit it in with my regular full-time job, but promised to think it over.

Full of apologies, I went along to report to Harold. If he was disappointed that his life would not be celebrated in a full-length biography, he certainly did not let me see it. He was immediately enthusiastic and urged me to accept Wing's suggestion. He promised to help me with advice and introductions, and in the years of research that followed did so constantly. Harold, I am sure, was as pleased as I was when Wing managed to sell the new outline to Doubleday. *Arrows of Mercy* was finally published at the end of 1969.

By then I had been moved by *Weekend* to Toronto and to my intense regret our regular meetings ended. I was able to repay his kindness only once and in a small way. Just before Christmas 1969, and coincidentally on the weekend that *Arrows of Mercy* was reviewed in the Montreal press, my wife and I parked the kids with friends and drove to Montreal where, having invited Harold and Linda to join us for a small celebration, I had booked a suite at the Windsor Hotel. Without telling him until the last minute, I had also sought out the names of some of his oldest colleagues and invited them too. One of them came all the way from Laval University I believe. And recalling Griffith's liking for inside stories, I invited some of my press friends to join us. It was quite a party, perhaps somewhat less decorous than those he usually attended, but his twinkling eyes assured me that he enjoyed it.

For me *Arrows of Mercy* led to a new career as a corporate historian, and so much travelling that I was never able to resume my meetings with Harold. We kept in touch occasionally by mail though, and I don't think I am betraying his confidence by quoting just a couple of brief extracts from his letters.

The first is typical of the man's humility: "Thank you so much for your nice newsy letter and for your congratulations on my unexpected award. I have no idea who put my name up for consideration by the Order of Canada, but I wouldn't be surprised if some member of the Advisory Council had happened to read *Arrows of Mercy* and passed the word along. So probably you are more or less responsible – and I thank you again for writing the book."

The last letter I ever received from him came after a long interval in November 1982. My heart leapt when I saw the familiar, though now shaky, handwriting on the envelope, but I was saddened by the letter. He had been rereading *Arrows*, he said. Once again he congratulated me on it, just as though I had done it all by myself without his constant guidance and encouragement. Then came this poignant passage: "I am more incapacitated than ever with my Parkinsonism. I am unable to take a single step without the help of my nurse, my eyes are failing and my hearing is poor. Yet I have so much to be thankful for."

Let us all be thankful to Harold Griffith, for his courage, his vision, his example. His legacy.

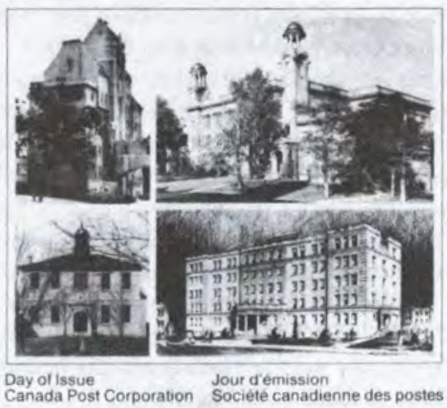
DAVID R BEVAN

A commemorative stamp

Canada Post Corporation issued a stamp to honour Harold Griffith (1894-1985) in anticipation of the 50th anniversary (1992) of the introduction of curare into anaesthesia. The stamp was one of a block of four to remember four distinguished Canadian physicans and included Wilder Penfield (1891-1976) neurosurgeon, Frederick Banting (1891-1941) for his work with insulin, and Jennie Trout (1841-1921) first woman licensed to practice medicine in Canada. The stamps of the Montreal doctors, Griffith and Penfield, were unveiled in a ceremony held on March 15th 1991 in the Osler Library, McIntyre Medical Building, in the presence of the families and representatives of the Department of Anesthesia, Montreal Neurological Institute, and Faculty of Medicine of McGill.

Few anesthetists have appeared in the philatelic history of medicine. However, Dr Crawford Long was on a U.S. stamp to celebrate the 50th anniversary of ether anaesthesia (1892), and Dr William Morton was remembered in a stamp from Transkei in 1984.

Canada Post receives several hundred recommendations each year from which fifteen were included in the 1991 programme. The submission on behalf of Griffith was initiated at McGill with supporting correspondence from anaesthesia chairmen and political and academic leaders



Day of Issue
Canada Post Corporation

Jour d'émission
Société canadienne des postes

First Day Cover of the commemorative stamps issued March 15, 1991 by Canada Post to honour Jennie Trout, Wilder Penfield, Sir Frederick Banting and Harold Griffith.

from Canada, U.S.A, and U.K. To be accepted, the aim is "to ensure that the stamps instil national pride in their country and in the hearts and minds of all Canadians, are of interest and have popular appeal to broad segments of the Canadian population, encourage Canadians to buy and collect stamps, and enhance the regard in which Canadian stamps are held in Canadian international philatelic circles." Subjects are selected which are "primarily related to Canada and of national interest." The Griffith stamp broke the rule that none except royalty, a deceased prime minister or a Governor General can be shown on a postage stamp within ten years of that person's death. Canadian anaesthetists were delighted with the decision to publish.

Commentaries and reprints

RODERICK K CALVERLEY
J ROGER MALTBY

Endotracheal intubation

Endotracheal intubation is one of the skills that distinguishes anaesthetists from other clinicians. In 1918 when Harold Griffith gave his first anaesthetics as a medical student, most of the techniques which we now employ routinely were unknown or rarely used. Long before then, however, a few clinicians developed a variety of devices to maintain a clear airway, although their suggestions were rarely appreciated and most were soon forgotten.

Some 18th century physicians advocated the use of rigid endotracheal tubes during attempts to resuscitate after drowning. After the introduction of ether anaesthesia in 1846 emergency tracheotomies were occasionally attempted on anaesthetized patients. John Snow may have been the first to attempt to administer an elective anaesthetic to a patient through a pre-existing tracheotomy. He also performed a tracheotomy upon an anaesthetized rabbit while studying the effect of chloroform on its heart.[1] Sir William Macewan, a surgeon in Glasgow, Scotland performed tactile orotracheal intubation with the patient awake using a flexible metal tube on four occasions in 1878.[2] Other inventions before the First World War[3] included Lyman's (1881) narrow flexible tubes to insufflate air or oxygen into the airway of animals paralyzed with curare, O'Dwyer's (1888) rigid tube whose conical tip covered the larynx while the end protruded from the mouth to form a T-piece, Eisenmenger's (1893) rigid endotracheal tube with an inflatable cuff and pilot balloon, Head's (1889) double-lumen endobronchial tube for respiratory studies in dogs, and Kuhn's (1900-12) flexible metal tubes for oral and nasal intubation. After 1910 some British and American anaesthetists passed Meltzer and Auer's narrow gum-elastic insufflation tubes into the trachea. Anaesthetic agents were blown continuously through the insufflation tube and the expired gases flowed passively back round the tube. These tubes were placed in the airway under direct vision with the assistance of Chevalier Jackson's U-shaped laryngoscope. In 1911 Dorrance created a cuffed endotracheal tube which permitted bidirectional flow of anaesthetic gases, but this and other advances were never widely employed.

Griffith's medical education at McGill University was interrupted by military service during the First World War. When he returned after the war he met some of his medical school expenses by giving anaesthetics at the Montreal Homoeopathic Hospital and in patients' homes. He completed his medical studies and graduated in 1922. His senior class essay 'Some Practical Observations on General Anaesthesia' was based on his personal series of more than 400 anaesthetics and won a $15 second prize. It was published in 1963 among his collected papers in *The Boundless Realm of Anaesthesiology*.[4] Griffith's observations give a vivid image of his trials. He could provide anaesthesia with ether or chloroform via a gauze-covered wire mask,[5] but could do little to overcome inadequate or obstructed ventilation in the anaesthetized patient. In common with almost every other hospital of that period, the Montreal Homoeopathic lacked the equipment now used to achieve intubation.

Within two decades after that time new devices, agents and techniques became available through the efforts of a few score anaesthetists in Canada, Britain and the United States of America. Most of these men, Griffith included, never had formal training in anaesthesia. These self-trained pioneers of anaesthesia encouraged innovation and fostered an exchange of information by forming professional societies which made new inventions known to all anaesthetists. Griffith was a leader of that remarkable group which revolutionized the practice of anaesthesia.

In 1925, as a consequence of a tragedy in the operating room,[6] Griffith became keenly interested in improving the anaesthetist's ability to control a patient's airway. At that time a grossly obese man, who weighed 180 kg (400 lb), refused a spinal anaesthetic for the biopsy of a scrotal mass. The patient insisted on a general anaesthetic, but during

induction he developed intense laryngospasm. Griffith attempted to resuscitate him with oxygen and artificial ventilation by external chest compression while the surgeon struggled to perform a tracheotomy through a 10 cm (4 in) layer of fat. Regrettably, the patient died before the trachea was found. From that time forward, the ability to achieve a clear airway by means of an endotracheal tube became an obsession. In his search to find a satisfactory product, Griffith experimented with narrow double catheters, woven wire tubes, flexible brass tubes, and grey lisle (knitted fabric) catheters which he wrapped with adhesive tape to prevent cracking. It was the last variety which he favoured when his first paper entitled 'Intratracheal Gas-Oxygen Anesthesia'[7] was published in 1929.

Those who have become anaesthetists since Griffith's introduction of muscle-relaxant drugs have difficulty fully appreciating the mastery of technique he would have had to develop. Griffith described intubation after a mask induction with nitrous oxide or ethylene, occasionally supplemented with only a few breaths of ether. Visualization of the vocal cords with the U-shaped Chevalier Jackson laryngoscope would have been difficult and laryngospasm would be an ever-present hazard. He urged a cautious approach to intubation. We echo his concerns each time that we teach a student to intubate today. He warned that "the upper incisor teeth may be broken if leverage is used instead of the proper lifting movement. If the larynx is not successfully exposed at once, it is unwise to struggle with the patient half awake. One should return to the face mask, and try once more as soon as the patient is again relaxed. In nearly half my cases I have to make a second attempt ... It is very important that the catheter be large enough to prevent inhalation around it of much air. On the other hand, a catheter that is too large may irritate the larynx, especially in children.[8]

Griffith was dissatisfied with narrow-bore catheters, but endotracheal tubes were not manufactured commercially. In England, Magill's solution was to obtain coils of red rubber tubing of different diameters from a hardware store. He cut these into appropriate lengths and smoothed the bevelled tips with emery paper.[9] Griffith, on the other hand, asked his supplier in France to provide wider and wider bore urethral catheters. These proved excellent for his purpose, and his technique, like Magill's, evolved from narrow-bore insufflation to wide-bore to-and-fro respiration. By 1929 he had endotracheal tubes which varied in size from F12 for infants to F34 for adults.[7]

Griffith delivered his first presentation on endotracheal anaesthesia in Boston in 1928.[8] His audience listened politely, but made little comment because "at least 75% of the so-called anaesthesiologists in that audience had never passed an endotracheal tube."[10] One person who did take note was Ralph Waters of Madison, Wisconsin. He was impressed with what Griffith had said, introduced himself, and made Griffith feel that he was doing something worthwhile.[11] The following year, Waters visited Griffith in Montreal and, impressed with the Canadian's clinical skills, invited him to join the Anesthetists' Travel Club. Both Griffith and Waters became leaders in the fields of airway management and controlled ventilation.

As early as 1929 Griffith was concerned with two problems of endotracheal anaesthesia.[7,8] He emphasized the need to position the tip of the tube correctly and the importance of not overinflating the patient's lungs by excessive pressures within the breathing circuit. He recommended that tracheal catheters should be passed about 22 cm from the upper teeth so that the tip would lie 3 cm above the carina. It was not until 1959 that centimetre markings on endotracheal tubes were introduced by the manufacturer Mr David Sheridan. Aware of the risk of dangerous elevations of pressure within the breathing circuit, Griffith incorporated into the breathing circuit a mercury manometer set to relieve pressures above 20 mm Hg. Adjustable pressure limiting (APL) valves set to release at 40 cm H_2O[12] only became a Canadian Standard after 1979.

Many improvements in the quality and variety of endotracheal equipment have been made since the days of insufflation catheters and improvised tubes. In 1926 Arthur Guedel of Indianapolis experimented with cuffed tubes[13] to combine the safety of endotracheal anaesthesia with the economy of closed circuit anaesthesia. The cuffs were made from the rubber of dental dams, condoms, and surgical gloves glued on to the outer wall of tubes. He experimented with three positions for the cuff before recommending that it be placed just below the vocal cords, rather than above or at the level of the cords. Waters later recommended double-layered cuffs which could be slipped over the tube and which could be replaced when necessary.

In 1935 Griffith was using French silk catheters, 9 to 13 mm in diameter, with the Guedel-Waters inflatable cuff for closed circuit cyclopropane anaesthesia.[14] He intubated patients for upper abdominal surgery, prolonged bowel resections, operations where the patient was turned in an awkward position, very fat patients, or whenever he feared respiratory obstruction. In other patients he used Guedel's corrugated, soft sponge rubber laryngeal plug on the end of a short tube. The plug fitted snugly into the larynx between the cords and made a satisfactory closed circuit without laryngeal or tracheal irritation. In spontaneously breathing patients,[10] Griffith also used the Leech pharyngeal bulb gasway[15] for closed circuit cyclopropane anaesthesia. The usefulness of these last two devices was lessened with the introduction of muscle relaxants, especially succinylcholine, which allowed tracheal intubation to be performed quickly and easily. Nevertheless, interest in the concept of an

above-the-larynx seal has recently been renewed by the introduction of the laryngeal mask airway.[16]

Special tubes for special circumstances have also been developed. The danger of tubes becoming kinked was first solved by using a flexible metal tube, and in 1932 a soft rubber tube reinforced with an internal wire spiral was described by Hargrave of Toronto.[17] The first double-cuffed endobronchial tube for one-lung anaesthesia was described in 1931 in the first volume of the Journal of Thoracic Surgery by Griffith's friend, Ralph Waters.[18] Griffith promptly introduced this tube in Montreal where he met the approval of E Archibald, professor of surgery at McGill University. While there is no evidence that Griffith invented a specific tube for thoracic cases, he was the first to advocate the use of a balloon bronchial blocker to forestall a potentially lethal complication which arose during thoracic surgery in the lateral position. By 1934 several American surgeons had reported multiple deaths during pulmonary resections when fluid escaping from a diseased lobe flooded segments of normal lung. In 1935 Archibald reported the first series of successful applications of a bronchial blocker to prevent this complication. In that article Archibald recorded his debt to Griffith by stating, "... several years ago, I adopted the suggestion made to me by Dr Harold Griffiths (sic), that the main bronchus of the infected lobe might be occluded by an inflatable balloon, ... I have used the balloon eight times, and it has prevented all escape of pus from the affected lobe in seven."[19] A variety of bronchial blockers, endobronchial tubes, and double-lumen tubes were introduced in the 1940s and 1950s for thoracic surgery.[20]

Griffith's[21] introduction of curare into clinical anaesthesia in 1942 might have been expected to lead to the widespread use of tracheal intubation, but this did not occur immediately. Anaesthetic equipment in most hospitals remained primitive, and many anaesthetics were given by anaesthetists with little or no formal training. In the 1948 edition of *Endotracheal Anaesthesia* Gillespie wrote that curare had been found to facilitate endoscopy by promoting muscular relaxation and that "in the future it will probably be used increasingly for the purpose."[22] By the time succinylcholine became available in 1953, however, the training and professional stature of anaesthetists had improved, tracheal tubes were commercially available, and endotracheal intubation soon became a routine procedure.

The Second World War was the catalyst for the birth of the modern plastics industry.[23] In 1943 a dental surgeon in London, England, who was also a manufacturer of flexible dental tubing, visited a wartime maxillo-facial surgical unit. He discussed the use of polyvinyl chloride (PVC) as an alternative to red rubber for endotracheal tubes and clinical trials were undertaken by Gordon.[24] The main advantage of the new material was that it did not kink in the nasopharynx with movement of the head and neck. Compared with red rubber, PVC was nonirritant, nontoxic, and could be produced cheaply enough for each tube to be considered for single use. Use of disposable cuffed PVC endotracheal tubes eventually became almost universal. Subsequent development of the high-volume, low-pressure cuff has reduced tracheal injury during prolonged intubation. More recently the science of fiberoptics led to the introduction of the fiberoptic bronchoscope which can be passed through either the nose or mouth to visualize the vocal cords in patients whose anatomy previously made laryngoscopy difficult or impossible.

In 1939 Griffith stressed the importance of intubation. He urged, "I cannot speak too strongly of the life-saving value of endotracheal oxygen in all forms of respiratory depression during anesthesia, and I feel that it is a primary duty of everyone who calls himself an anesthetist to become an expert in the introduction of endotracheal tubes."[25] As new technology became available, he performed clinical studies to demonstrate the importance of avoiding inadequate ventilation. In 1956 Griffith used capnography to document the superiority of a good mechanical ventilator over the 'educated hand' in assuring adequate elimination of carbon dioxide.[26]

Throughout his career Griffith emphasized the value of effective ventilation. When his obese patient died in 1925 Griffith, like most anaesthetists of his day, could do little to overcome respiratory obstruction. To meet this challenge, Griffith soon learned the skills of laryngoscopy when tracheal intubation was still a difficult and controversial technique, but one which he recognized was essential for patient safety. Griffith became, and remained, an enthusiastic advocate of its use. Even in one of his last publications, a retrospective assessment in 1962 of the important advances in anaesthesia which he had witnessed throughout his career, he stressed that an unobstructed airway and adequate pulmonary ventilation were paramount factors of good anaesthesia.[10] Through the improved conditions for laryngoscopy provided by muscle relaxants after 1942, all anaesthetists had an opportunity to learn the art which Griffith was among the earliest Canadians to master. Even today, as well as teaching our juniors the skill of intubation, we stress points of safety and good technique which Griffith was the first to emphasize to all anaesthetists.

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HAROLD R GRIFFITH

Some practical observations on general anaesthesia*

McGill Medical Society, 1922

The following observations on general anaesthesia are based on an experience in over four hundred cases at the Homoeopathic Hospital of Montreal, and in private homes. The operations were of all kinds, and were performed under the varying methods of forty-seven different surgeons and obstetricians. The patients were almost all private or semi-private cases. It is under such circumstances that the young doctor will ordinarily be called upon to administer anaesthetics. It is hoped, therefore, that these few hints may be of value to the average practitioner rather than to the specialist in anaesthesia – to whose ranks the writer does not pretend to belong.

I. The choice of an anaesthetic

The general anaesthetics in common use in this country are ether, chloroform, and nitrous oxide-oxygen. Ethyl chloride is used occasionally. Ether is, and should be, the favourite. It is cheap, convenient, safe, and may be given without much discomfort to the patient provided a few simple rules of preparation and administration are followed. The great objection to ether is the frequent post-operative nausea and vomiting. The severity of this complication depends both on the idiosyncrasy of the patient and the nature of the operation. Some patients vomit violently after a simple minor operation and others not at all after an abdominal section, although conditions of administration and the amount of ether used may be identical. The handling of the bowel in an already inflamed peritoneal cavity which may take place during an operation is often responsible for vomiting which is attributed to the anaesthetic. Recently I was asked to give an anaesthetic to a nervous woman on whom a laparotomy was to be performed. She had had a very unpleasant time following a previous ether anaesthetic, so I chose nitrous oxide-oxygen without any ether. However, vomiting came on a few hours after the operation, and persisted for three days. In such circumstances I feel one is justified in attributing the condition to the great irritation of the peritoneum during the extensive exploration. But ether is often undoubtedly responsible for much nausea, and various measures have been recommended to counteract it. A favourite procedure is lavage of the stomach with two or three quarts of warm water while the patient is still on the table. An ounce or two of milk of magnesia may be left in the stomach. In some cases this does good, especially where there has been much swallowing and an oversecretion of mucus – but it is by no means a specific, and I have seen patients just as sick following the lavage as they were after a previous laparotomy without it. We have found it best as a rule to let the patient have plenty of fluid early. Hot water is usually better than cold. Even if the water is soon vomited that is better than dry retching – provided, of course, the vomiting is not due to some serious post-operative complication.

I have noticed that a patient who has had little to eat for two or three days suffers less from ether nausea than one who has simply gone without the previous meal. I remember one case of a young adult who came in for a submucous resection. She had eaten heartily the night before, but of course was given no breakfast. Ether anaesthesia was for one and a half hours, following gas-oxygen induction. There was persistent and exhausting vomiting for twenty hours. Three weeks later the same patient returned for tonsillectomy. This time she had eaten very little for three days. She had the same anaesthetist and anaesthetic, and the operation lasted for more than an hour. The vomiting was very much less, and all nausea had disappeared after eight hours.

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For a simple abdominal section the anaesthetic I would choose for myself is Nitrous Oxide and Oxygen, if available. It is very easy to take, the induction is rapid, it does not produce nausea, and it is safe. It is more expensive than ether, but still surprisingly cheap. In Montreal at present nitrous oxide costs four cents a gallon, and oxygen three and a half cents. In a favourable case with a good machine and with expert administration about fifty gallons of nitrous oxide and forty gallons of oxygen will be used in an hour. So the actual cost of the gas and oxygen should not be more than three to five dollars an hour. The initial cost of the machine varies greatly, but a very satisfactory one may be obtained for two hundred and fifty dollars.

Nitrous oxide-oxygen gives a most satisfactory induction for ether. Consciousness disappears after a few breaths without any sense of discomfort. Ether may then be gradually added, and in two or three minutes the gas discontinued.

A good deep ether induction, and then ether vapour pumped into the naso-pharynx from a bottle is best for tonsils and adenoids. Deep anaesthesia before attempting to start the operation is important, as the pharyngeal reflex is one of the last to disappear.

For a short dental operation nitrous oxide-oxygen is satisfactory, but when this is not available ether does very well. In this case the anaesthetic should be carried just to the point of complete relaxation without the loss of the pharyngeal reflex, for it is much safer to have the patient cough immediately the teeth are drawn.

Chloroform makes a very easy and convenient induction for ether, but the possibility of sudden death should always be remembered, and chloroform never administered when there is any doubt at all about the patient's ability to stand an anaesthetic.

II. Methods of administration

The usual preliminary medication for ether anaesthesia is a hypodermic of morphine and atropine given an hour before the operation. After administering anaesthetics of all kinds, both with and without this preparation, I am firmly convinced that the hypodermic should be given all cases where it is not expressly contra-indicated. The quieting effect of the morphine makes the induction much easier for both patient and anaesthetist, and the drying up of the secretions by the atropine tends to lessen the danger of post-operative respiratory complications. But some surgeons seem unalterably prejudiced against any preliminary hypodermic, so the anaesthetist must always be ready to get along without it.

It is very important that the anaesthetist should secure the confidence of the patient. If they are not already acquainted it is well for him to meet the patient beforehand and say a reassuring word. The anaesthetic room should be absolutely quiet, and it should be remembered that the patient's mental and physical comfort is the prime consideration, and not some irrelevant discussion by the doctors.

The ether mask we have found most serviceable is a simple wire frame, six or seven inches long, by five inches wide and four inches deep. This is covered by a layer of thick stockinette which may easily be removed and washed. A towel is placed lightly over the patient's eyes – this is better than sealing them up with rubber tissue, as the object now is to get the patient asleep as quietly and with as little fuss as possible. Rubber tissue may be used later if the eyes need more protection. The mask is held over the patient's face, but not touching it. The ether is started slowly and steadily, and as soon as consciousness begins to go may be poured on freely. When the patient is asleep a towel should be wrapped around the mask, and the ether given in concentrated form. This is absolutely necessary for good anaesthesia. There need be no fear of suffocating the patient, for with the open method it is almost impossible to get too concentrated a mixture of ether and air. The patient may vomit or cough or spit, but as long as he is getting an occasional breath the ether should be continued steadily. I have seen very many good inductions spoiled by panic at this stage. The anaesthetist removes the mask and gives the patient air when what he needs is not air but ether. In some cases the patient may clench his teeth, refuse to breathe, and turn blue. This is certainly alarming, but before actual asphyxia can take place the jaws are bound to relax. However, one doesn't like to wait for this, so it is well to have always a mouth-gag handy, and a wooden wedge to pry open the teeth. When the mouth is open the tongue should be grasped with forceps and pulled forward. If this does not suffice to restore breathing at once, gentle pressure on the abdomen may help, or lowering the head of the table and a few movements of artificial respiration. Much of this early trouble with ether may be avoided by preliminary morphine and atropine, and by a slow steady induction, with concentrated vapour as soon as the patient is asleep.

The establishment of surgical anaesthesia is heralded by more regular and deeper breathing. Swallowing ceases, the eyes become fixed, and there is complete muscular relaxation. Beware of too quiet and easy an induction. There are patients who simply drop off to sleep so quietly that they never breathe deeply enough to absorb sufficient ether. The stimulus of the surgeon's knife may cause choking and retching, but if the anaesthetic is then pushed without hesitation surgical anaesthesia is soon established. It is often embarrassing, however, for a young anaesthetist to tell the surgeon the patient is ready, and then to have him nearly jump off the table at the first touch of the knife.

The anaesthetist will now be concerned with watching the depth of anaesthesia and the condition of the patient.

Important information is gained from the eyes, the colour, respiration, and pulse.

The pupils are a useful but not altogether dependable aid. Widely dilated pupils should always cause the anaesthetist concern until he is satisfied from other signs that the patient's condition is satisfactory.

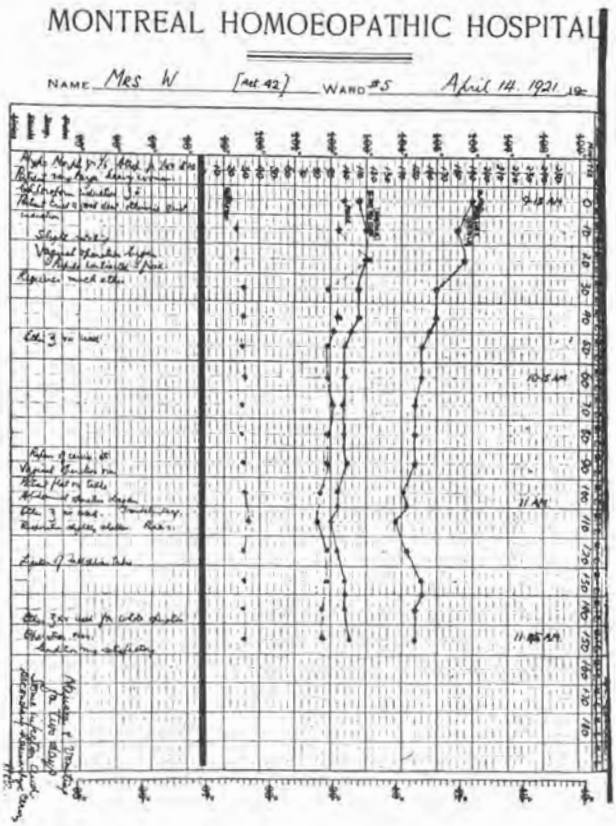
The patient's colour should be pink always. Cyanosis is most often due to respiratory obstruction from dropping back of the tongue, or to mucus. One soon acquires a knack of holding up the jaw and chin. This can be done easily with one hand, and should be continued all through the anaesthetic in any case where the breathing gives difficulty. In some cases the tongue may have to be held forward, but the less manipulation with the tongue the better – both for the patient's feelings and the reputation of the anaesthetist. Continual and forcible swabbing of the mouth for mucus is useless and harmful. A simple metal "airway" will do away with most of this trouble. This is a piece of flat tubing curved to fit over the back of the tongue, with openings near the glottis. It is easily slipped in the mouth after deep anaesthesia is established, and can do no damage.

Sometimes there may be a change in the patient's colour when there is no obstruction to the air passages. Pallor or cyanosis under these circumstances calls for a very careful watch on the general condition, and a light anaesthesia. When an oxygen tank is available one may slip the end of the tube under the mask and give extra oxygen.

Breathing should be regular, and is most satisfactory when it is of a fairly deep, blowing character. The rate is variable, and not usually of much significance, but very rapid shallow breathing is one of the signs of too deep anaesthesia, or shock.

The pulse is the most valuable indicator of the patient's condition. Everyone giving anaesthetics should constantly practise feeling the pulse at the temporal or external maxillary (facial) arteries. Its quality, rate, and rhythm are all important, and should be carefully considered before the anaesthetic starts in order that comparisons may be accurate. An extreme rise in the pulse rate with failure of quality should give serious concern to the anaesthetist, and if he considers the condition is one of shock he should tell the surgeon, and let the responsibility rest with him.

Knowledge of the exact condition of the patient is a problem which will often puzzle the inexperienced anaesthetist. Following the plan of many specialists in anaesthesia I have found it of great service to keep a chart showing graphically the blood pressure, pulse, and respiration, and correlating these conditions with the various stages of the operation. The example here illustrated is one of the actual charts made during the operations. Many of the larger hospitals have their own printed "Anaesthesia Record", but a satisfactory form may easily be improvised, as has been done here, from an ordinary Temperature



One of the four anaesthesia records illustrating entry for the McGill Medical Society competition in 1922.

Chart. If the anaesthetist is too busy with stimulative measures to record so carefully all that happens, the essentials may be jotted down on a card, so that he will always have ready for the surgeon exact information on the condition of the patient.

It has been observed that a marked fall in blood pressure is an early and accurate indication of surgical shock. Complete dependence on the pulse is not always satisfactory. It has been our experience that during an operation ether and chloroform are entirely depressant. How much of the fall in blood pressure is to be attributed to the anaesthetic and how much to the operation it is hard to say, but I have never seen an appreciable rise in blood pressure during ether anaesthesia. The pressure may rise temporarily if there is asphyxia during induction, but this is due rather to carbon dioxide stimulation than to the ether, and can usually be avoided.

A slight fall in blood pressure is the usual thing to expect in an ether anaesthesia. A fall to below 100 (systolic) is no cause for worry if there has been sudden bleeding, or pulling on the mesentery. Squeezing the gut is especially depressing, as is also the severance of large nerves during the amputation of an extremity. The danger, however, lies

in the blood pressure remaining at an extremely low level for a period longer than five or ten minutes. Dr. Wesley Bourne once told me that he had never seen a patient recover whose systolic pressure had fallen to 70 during an operation and had remained at that level for twenty minutes.

The method by which blood pressure may be recorded during an operation is simple. The arm band of an ordinary aneroid sphygmomanometer is attached above the elbow, and the chest piece of a Bowles' stethoscope fastened with adhesive over the bifurcation of the brachial artery, before the anaesthetic starts. Long rubber tubing brings the bulb and dial of the instrument, and the ear pieces of the stethoscope within reach of the anaesthetist at the patient's head. Readings may be made without any disturbance, and as often as desired.

The advantages, therefore, of the graphic form of chart may be summarized briefly:

1 Gives the anaesthetist a satisfactory knowledge of the condition of his patient – especially valuable when shock is feared.
2 Shows the surgeon at a glance the actual condition, without having to depend on the judgment of an anaesthetist who may be a stranger.
3 Provides a permanent scientific record for statistical purposes, and for consultation if the patient comes up for another operation.
4 Gives the anaesthetist something to do which will keep his mind on the patient during a tedious operation.

If the patient's condition is not satisfactory less zeal on the part of the surgeon may be all that is needed, or a more rapid termination of the operation. But this must be left to the surgeon, and the whole duty of the anaesthetist lies in keeping him informed as to the condition of the patient. The surgeon is in charge, and he is responsible.

The main points on administration have been covered, but there are a few important facts to be kept in mind when dealing especially with chloroform. Chloroform certainly has a place in practical anaesthesia, but in view of its dangers I believe that no anaesthetist no matter how experienced, has the right to feel comfortable while administering it. One cardinal difference in the administration of ether and chloroform is that while ether should be given in fairly concentrated vapour, chloroform *must* be freely mixed with air. It is through neglect of this prime consideration that most cases of overdosing arise. It is a good practice to use a very small mask, never to let the mask touch the patient's face, and never to surround it with a towel. This ensures plenty of air, and it is certainly less terrifying to the patient than having a suffocating mask pressed down firmly over the nose and mouth. I feel one cannot lay too much stress on this important point. If the chloroform is being used only for induction, a change may be made to the larger mask and to ether as soon as the patient is well asleep.

Chloroform is often given to very young children. It should be used here with extreme caution, remembering that one drop will go farther than with the adult, or in other words, that the margin of safety between satisfactory anaesthesia and an overdose is very much reduced.

It is a good idea always to smell the bottle as well as look at the label before administering any anaesthetic. Once I had an amusing time trying to put a big labouring man to sleep with alcohol in a chloroform bottle – but the results might be more disastrous if one should get chloroform in an ether bottle!

In such a brief paper space forbids a full consideration of the very wide subject of anaesthesia in Obstetrics. Under ordinary circumstances chloroform is now, and probably always will be, the anaesthetic of choice. It seems to be much safer in the Delivery Room than in the Operating Theatre. But I believe that nitrous oxide-oxygen "analgesia" is destined to become more important. My own experience has not been large, but in the two cases in which I was able to administer it through the whole of the second stage the results were very encouraging. A satisfactory analgesia was obtained with every "pain", and there was no diminution in the force of the contractions, nor in the patient's voluntary effort. Complete anaesthesia was easily established for the actual delivery and the repair of the episiotomy wound; and in each case the baby was a good colour and breathed spontaneously. In one case the actual cost of the nitrous oxide and oxygen was less than five dollars for one hour, and in the other eight dollars for four hours.

A very complete report on this form of anaesthesia may be found in the article by Dr. W.C. Danforth on "Nitrous Oxid-Oxygen Analgesia in Normal Labour and Operative Obstetrics" in the American Journal of Surgery, January, 1919.

HAROLD R GRIFFITH MD

Montreal

Intratracheal ethylene-oxygen anaesthesia*

At the Montreal convention of the Eastern and Canadian Societies of Anaesthetists in 1926, Dr. McMechan gave a report on intratracheal nitrous oxide-oxygen anaesthesia as practised by Magill and others in England. This work appealed especially to us in Montreal, since for several years intratracheal ether anaesthesia had been our routine procedure in adult nose and throat cases. So Stewart[1] at the Montreal General Hospital began intratracheal nitrous oxide in a few selected cases, and since then he, Hargrave,[2] and others[3,4] have continued and developed this method.

For four years at the Homoeopathic Hospital of Montreal I have been using ethylene, and I have grown to appreciate its value. Therefore after a few intratracheal nitrous oxide administrations, I felt I could safely substitute ethylene with its unquestioned advantages. We have thus evolved a technique for intratracheal ethylene-oxygen anaesthesia which has proved most satisfactory in a comprehensive series of cases, and which I feel has enabled us to anaesthetize certain patients with a new degree of safety and comfort.

We have used intratracheal ethylene successfully in the following types of cases:

1. Tonsillectomies in both adults and children, when ether was for some reason contra-indicated, or when the patient was anxious to avoid the discomforts of ether anaesthesia. In some cases the operation lasted for more than an hour, with the patient satisfactorily relaxed.

2. Mastoidectomies. We had a series of cases last winter in small and very frail children following an epidemic of measles in an orphans' home. Gas seemed the anaesthetic of choice, and intratracheal ethylene enabled us to bring these children through long operations with a minimum of danger. Respiration is delightfully under control, there is no choking with mucus, and the anaesthetist is well out of the surgeon's way. At the other extremity of age, we recently operated on a man of seventy with an acute and extensive mastoid infection. He was an alcoholic with myocardial degeneration, and came to the operating room with no preliminary morphine. I regarded him as an extremely poor prospect for anaesthesia. However I was able to keep him perfectly relaxed for over two hours with intratracheal ethylene, and no more ether than a few breaths during the induction. He left the operating room wide awake, and has made an astonishingly rapid recovery.

3. A series of septum, antrum, and other sinus, eye, face, and brain operations. Our surgeons usually prefer to do their septa under local anaesthesia, but in cases where the patient has insisted on being put to sleep, they have told me that there is much less congestion of the mucous membranes with intratracheal gas than with ordinary ether anaesthesia.

4. Thyroidectomies. Intratracheal anaesthesia is here favoured by our surgeons because of the impossibility of tracheal collapse, and because the firm catheter forms an excellent landmark in the larynx and the trachea. My experience has been that ethylene is more satisfactory in these cases than nitrous oxide, and with it I have had a patient well relaxed and in good condition for as long as three hours, without once resorting to ether.

Technique of administration

The patients are usually prepared with morphine 1/4 grain and hyoscine 1/150 grain one hour before operation, and another hypodermic of morphine 1/6 grain half an hour later, but in this I follow no set formula, and many of our cases, especially children, have had no preliminary hypnotic medication.

Anaesthesia is induced in the usual way with nitrous oxide oxygen, using a little carbon dioxide if necessary. Then I switch to ethylene for more complete relaxation,

*Read before the joint meeting of the Eastern and Canadian Societies of Anaesthetists, Boston, October 9, 1928.
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occasionally adding a few breaths of ether. The head is thrown back into position for intubation, then the face mask is removed and the larynx exposed as quickly as possible with a Jackson speculum of suitable size. This is really the only part of the technique which requires any particular dexterity; and skill comes only with experience. I would not advise an anaesthetist to attempt this procedure under gas until he has become accustomed to using the direct laryngeal speculum with the patient more completely relaxed under ether. Great care must be taken not to damage the posterior wall of the pharynx, and the upper incisor teeth may be broken if leverage is used instead of the proper lifting movement. If the larynx is not successfully exposed at once, it is unwise to struggle with the patient half awake, but one should return to the face mask, and try once more as soon as the patient is again relaxed.

Then when the larynx is in view, a silk or lisle catheter of the proper size is introduced, and the end pushed down to about three centimetres above the bifurcation of the bronchi. In the average adult this will be about 22 centimetres from the teeth. In the meantime an assistant has turned a two-way valve on the gas machine, which directs the gas into a small nasal bag to which is attached an ordinary irrigator nozzle. This is at once inserted into the end of the catheter projecting from the mouth, and the anaesthesia continues. A mouth-gag is adjusted to prevent any possibility of the patient biting the intratracheal tube, the speculum is then removed, and the patient is put in position for the operation.

The catheter is of such a size that it will nearly fill the trachea. I use all sizes from F16 or F18, for infants, up to F32, which is the largest size I have been able to obtain. Stewart uses an ordinary rubber rectal tube. It is very important that the catheter be large enough to prevent inhalation around it of much air. On the other hand, a catheter that is too large may irritate the larynx, especially in children.

The patient should do a good deal of rebreathing into the small rubber bag to which the catheter is attached. I usually keep my hand on this bag, and thus even when the patient is completely covered, I can follow the depth and rate of respiration and can control the intrathoracic pressure. The bag may be greatly distended before the pressure becomes dangerously high, giving one plenty of warning to reduce the flow of gases. But as an extra precaution I have a mercury manometer on the machine, set to blow off at twenty millimetres. I feel that the use of this small rubber bag is a very great advantage in this method of anaesthesia.

During such an anaesthesia the patient's respiration is always under control, with no possibility of obstruction. One can obtain an almost immediate response to carbon dioxide or oxygen stimulation when necessary. Relaxation with ethylene is more satisfactory than with nitrous oxide: the patient is awake immediately after the operation, and nausea seldom occurs. The method is extremely economical, since the consumption of ethylene during an average administration is from three and a half to four litres (or less than one gallon) a minute. With small children I often use as little as one and a half litres a minute.

I have kept in mind constantly the possibility of explosion with ethylene, but so far after four years and about twelve hundred administrations we have had no accident in our hospital. We use the Foregger "Metric" and the "Safety" machines, both of which are of the type which contains water. In order that the gas may flow only over a wet surface, I introduce also a few drops of water into the rubber tubing and the rebreathing bag. I have never used any grounding device.

The experimental work of Hornor and Gardenier,[5] and of Poe[6] and others has demonstrated that we may maintain in the machine and bag an anaesthetic mixture of ethylene and oxygen which is entirely outside the range of explosibility. I start and finish my anaesthesia with nitrous oxide instead of ethylene, and the addition of carbon dioxide still further reduces the explosion hazard. On the other hand, the exhaled gas soon becomes so dilute in a well ventilated room that it will not explode, and I do not hesitate to run a properly shielded electric suction machine within a few feet of the patient. However, there must always be a certain region near the patient's face where the exhaled gas is just the right mixture for explosion, so we make it a rule never to allow the use of a cautery or other open flame or spark in the operating room during the administration of ethylene, and we never use this gas except under the carefully supervised technique of the operating or delivery rooms.

We have used intratracheal ethylene for patients of all ages between fourteen months and seventy years. It seems to me to be an almost ideal anaesthetic method for small children, provided one is careful not to damage the pharynx with the speculum, and a catheter of exactly the proper size is used. There is no hypersecretion of mucus as with ether, and the respiratory effort is not laboured. The gases are delivered directly into the lungs under a gentle positive pressure, and so the dead space which might be present with ordinary mask administration is entirely abolished. I have never had any resulting pulmonary complications, even in cases with pre-operative respiratory infection. However, in one case of a child of eighteen months there was a sharp temporary laryngitis. This was due to the use of a catheter a little too large.

In conclusion, I would like to express my thanks to those surgeons who have given me the opportunity to develop this method, and especially to Dr AW Furness, on whose otolaryngological service all our first cases were undertaken.

Summary

1 Intratracheal ethylene-oxygen anaesthesia has been used successfully in a series of nose, throat and ear operations, and in thyroidectomies.
2 The technique of administration is described, and safety factors in the use of ethylene considered.
3 This method seems of special value in operations upon children.

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Further experiences with endotracheal gas-oxygen anesthesia*

Three years ago in Boston it was my privilege to report a small series of cases of endotracheal (or intratracheal) ethylene-oxygen anesthesia.[1] Since that time we have continued to use this method, and our series has grown to over 1500 administrations in almost every possible kind of operation. Therefore, I feel justified in trying to express some definite conclusions as to the value and the limitations of endotracheal gas in the equipment of the modern anesthetist.

Wide range of utility

The longer I am interested in anesthesia the more certain I am that no one method of administration is the best for all cases, and that many men hurt themselves by becoming faddists along some particular line no matter how skillful they may be. When I hear men saying they use spinal anesthesia routinely for all abdominal cases, or that they have administered tribromethanol or some other drug to 1000 consecutive cases my opinion of them as scientific anesthetists falls. Our specialty is not so broad that we cannot all be conversant with every useful method of anesthesia. Our real success will depend not only on technical skill, but on our judgment in choosing the very best type of anesthesia for the particular patient and operation in view. So whatever I may say about the advantages of endotracheal gas I do not want to give the impression that that is the only field of anesthesia in which I am interested. However, we have found such a wide range of usefulness for this method, and it has made such a difference in the recovery of many of our patients, that I really do not see how any anesthetist can be doing his best work without frequent use of endotracheal methods.

Head Cases. The advantages of endotracheal gas in operations about the mouth and nose are obvious. It enables one to carry out prolonged operative procedures without undue haste and with all the advantages that gas-oxygen has over old style ether. I am aware of the excellent work of McKesson, Ruth,[2] and others in using nasal nitrous oxid-oxygen for tonsillectomies and I have used their technique with success, but in my opinion it is an expensive and limited method when compared with the endotracheal route. We have carried out all kinds of operations about the head under endotracheal ethylene, from cleft palate in babies a few weeks old, to radical antra in old asthmatic emphysematous men.

Surgeons with whom I have been associated in this work have successfully completed a number of amazingly extensive multiple sinus operations at one session of three or four hours. For instance we have done as much as a septum, ethmoid, sphenoid, bilateral radical antra, tonsillectomy and bronchoscopy on one patient. That sounds very radical, and although I am satisfied by the results that it is at times good surgery, I am not qualified to discuss the procedure from a surgical standpoint. I merely want to point out how much is possible under endotracheal ethylene. The patient leaves the operating room in surprisingly good condition, without any anesthetic shock, and usually makes as rapid a recovery as if he had just had a tonsillectomy under ether. It certainly is the least toxic and least depressing anesthetic procedure that I know of for such extensive cases.

Abdominal Cases. However, valuable as endotracheal is in head cases, it is its use in abdominal surgery which I wish to emphasize. I have just read with much appreciation

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an article on "Airways" by Geoffrey Kaye,[3] an Australian anesthetist. I would like to recommend it to you all for careful study. Who among us but remembers many cases where difficulty with the patient's breathing turned into failure one's best efforts for smooth anesthesia? And who would not jump at a simple remedy for overcoming all respiratory embarrassment? That is what makes me wonder why endotracheal anesthesia is still looked upon as almost a curiosity in many American clinics. I feel that the great advantage of endotracheal in difficult abdominal cases is that it ensures an unobstructed airway. It is not our practice to use endotracheal gas routinely in all abdominal cases, but we do use it for our poorest risks, for all fat patients, and in operations upon the upper abdomen when we feel general anesthesia is indicated in preference to spinal. I always have an endotracheal tube at hand, and many times I have introduced it when some difficulty has been encountered during an operation, to the satisfaction of the surgeons and I believe also for the greatly increased safety of the patients. No one who is not familiar with endotracheal can realize the sense of security which the ready means of introduction of a tracheal tube gives one in poor risk cases. Breathing becomes quiet, the abdomen is relaxed, and anoxemia may be completely avoided.

With a large endotracheal tube in place we have at hand the very best means possible of artificial respiration and it really becomes a matter of indifference whether or not the patient takes a breath for long periods. One can always supply the necessary oxygen, and keep the patient a good color as long as circulation is maintained. I was able to demonstrate the mechanical efficacy of endotracheal resuscitation in one case of a very fat old woman who died suddenly on the table from coronary thrombosis at the beginning of an operation for ruptured gall-bladder. I had a large F36 tube already in the trachea when I noticed sudden circulatory failure. Immediately we began resuscitation with oxygen-carbon dioxid and for more than an hour we were able to maintain an absolutely natural simulance of respiration with chest and diaphragm moving, although life was completely extinct.

While I am speaking of endotracheal resuscitation methods I would like to say a word about the success we have had in resuscitation of the newborn with endotracheal carbon dioxid-oxygen after the method suggested by Flagg,[4] but using a much simpler apparatus. Our outfit consists only of a small laryngeal speculum, a silk catheter size F12 and a small rubber breathing bag which is attached to a cylinder of 5 per cent or 10 per cent carbon dioxid with oxygen. Manual pressure on the bag which is partly filled is a safe method of inflating the infant's lungs without any need for complicated manometers and regulatory apparatus. We have proved this in at least 50 infants without any damage to larynx or lungs. If the heart is beating at all, it is a sure method of bringing the little one to life, temporarily at least.

Technical details

The technique of endotracheal gas-oxygen anesthesia has been so completely described by Magill,[5] Stewart,[6] Hargrave,[7] Tovell[8] and others[9] that I do not feel it is necessary to go into details here. Difficulty in introducing the endotracheal tube seems to be what has kept many anesthetists from adopting the method. Here, of course, dexterity comes only with practice, but anyone can learn by proceeding cautiously and patiently. My advice to those interested in trying the method is to begin, as we Canadian anesthetists did, with your first patients deeply asleep and relaxed under ether anesthesia. This gives one time to go slowly and to become familiar with the anatomical landmarks. In the introduction of the tube under gas-oxygen speed is an important factor, and the beginner is too apt to do damage to the nose, teeth, sidewalls of the pharynx, the palate, or epiglottis. So I think it wise to become proficient with ether first.

Lately Magill has advocated the use of soft rubber endotracheal tubes which may be introduced blindly through the nose. Lundy and Tovell, of the Mayo Clinic have enthusiastically endorsed this technique. In spite of all this weight of authority I am going to be bold enough to say that I prefer in the average case to continue introducing semi-rigid silk tubes by direct vision through the mouth. I say this advisedly after a fair trial with genuine Magill tubes imported from London. Perhaps I have not practiced enough to become expert with the Magill tubes but they do not always slip into the larynx for me on the first attempt, and no matter how well lubricated they almost always make the nose bleed.

My friends among oto-laryngologists tell me they believe there is more danger from trauma or infection in passing a large tube through the nose blindly, than in passing one through the mouth. This can usually be done without touching any soft parts but the tip of the epiglottis. To a surgeon, who is accustomed to endotracheal anesthesia, the tube in the mouth does not interfere with his work even during tonsillectomies, whereas in all sinus and nose operations, which constitute a fair proportion of our endotracheal work, it is impossible to use a nasal tube. A nasal tube must be removed before adenoidectomy, which is, I think, a disadvantage, for I prefer to leave the tube in the trachea until the patient has full control of his reflexes and I often leave it in place until after he is returned to his room. However, I am glad to have the Magill tubes as part of our equipment, for there are cases where, on account of anatomical difficulties in the mouth, or for other reasons, a nasal tube is undoubtedly preferable.

In any discussion of technique we should not forget the

possibility of manual introduction of endotracheal tubes. In many difficult cases this is a method which we have found to be harmless and efficient, but it requires, I believe, more skill and experience than the use of the direct speculum.

Trauma to the larynx as differentiated from avoidable injury to the teeth, nose or pharynx during the introduction of the tube, is a subject to which we have given considerable thought. We have noticed in a few patients after a long endotracheal anesthesia a temporary hoarseness with a tendency to irritative tickling cough or a desire to clear the throat. This has never been serious, but has been one reason which has kept us from using endotracheal gas in abdominal cases unless there is definite indication for that method. More serious perhaps have been five or six cases we have seen of benign papilloma of the vocal cords following endotracheal intubation. I have not been able to decide whether this condition is due to trauma during introduction, to pressure of a large tube against the cord for a considerable length of time, or to predisposition on the part of the patient. It has occurred just often enough to make me wonder whether our methods cannot be still improved.

In endotracheal anesthesia I have always preferred ethylene to nitrous oxid-oxygen, except where a cautery or electro-coagulation is being used about the face. Ethylene is definitely more relaxing, it allows better oxygenation, and is probably even less toxic than nitrous oxid. I have described elsewhere[10] the precautions we have taken with regard to the explosion hazard, and I shall not go into details here other than to say that our chief fear is of static sparks, and our main reliance has been on humidity both inside and outside the machine. At a small expenditure we have been able satisfactorily to humidify our operating rooms, and we have passed through the coldest days of a Canadian winter without any sign of sparks.

In most of our cases we add a little ether to the ethylene-oxygen mixture at some time during the administration, either to facilitate the introduction of the tube or to obtain better relaxation during the operation. By this method a few drops of ether go a very long way and this does not add materially to the toxicity of the anesthetic. I have combined endotracheal ethylene successfully with sodium amytal and nembutal either intravenously or by mouth, with tribromethanol, and with varying doses of morphin, hyoscin and other preliminary hypnotics. I think the combination of drugs should be not laid down as a routine, but should be adjusted to meet the requirements of the individual patient.

The absorption technique

I have followed the work of Waters[11] in carbon dioxid absorption with a great deal of interest and admiration. He and Guedel have devised an ingenious inflatable balloon to use with endotracheal tubes in order that a true closed circuit may be formed. I have enjoyed using these balloons in an experimental way, but I have not adopted them for regular use. To be perfectly frank I have not been convinced of any particular value of the carbon dioxid absorption technique other than that of economy. Our semi-closed endotracheal technique with large tube and rebreathing bag is really quite economical, using only 3 or 4 liters of the gases per minute, and I have not felt justified in tremendously complicating a simple technique for the sake of saving a little gas. However, there are some cases in which I am glad to have available a Waters' soda-lime filter. Occasionally during the course of an operation the tube will completely block the larynx so that exhalation around it is difficult. Accumulated carbon dioxid causes excessive respiration, and in these cases we can quickly restore quiet breathing by placing a Waters' filter between the end of the tracheal tube and the rebreathing bag.

Recently Waters has developed a method of closed circuit endobronchial gas anesthesia for lung surgery. It gives promise of being a very valuable advance in technique. He pushes the endotracheal tube past the bifurcation and into the main bronchus of the good lung, then he inflates the balloon at the bifurcation, and thus produces closed circuit respiration in the good lung, and completely blocks off the lung to be operated upon. Dr Archibald, professor of surgery at McGill, and one of the "fathers" of thoracic surgery in America is very enthusiastic about this improvement in our anesthetic methods, as he feels it will make possible operations upon large numbers of cases which the surgeons have been afraid to attempt on account of the danger of the patient becoming drowned in pus and blood from the affected lung.

Conclusions

So we find it worthwhile to be equipped with every device which experience has shown to be of value under all sorts of varying conditions. I think that with the development of nursing anesthesia in the United States there has been too much tendency toward standardization of anesthetic procedures. Our efforts now should be to train medical anesthetists who will be qualified to suit the anesthetic procedure to the individual requirements of that important but sometimes neglected person, the patient.

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Cyclopropane

The practice of anaesthesia changed little between the 1840s, when the anaesthetic effects of nitrous oxide, ether and chloroform were discovered, and 1907 when Harold Griffith was 12 years old. In that year he wrote in his diary, "I am going to have my appendix out, will miss examinations, hurrah!" A few days later he added "had operation, ether was rotten!"[1] When Griffith, as a medical student, started giving anaesthetics in Montreal in 1918 the only anaesthetics in his hospital were ether and chloroform.[2] He still remembered the suffocating ether and postoperative distress, and this was sufficient reason for him to search for better anaesthetics. He recognized that the principal needs of anaesthesia were better agents and better airways.[3] Within a few years he was using both.

When ethylene became available in 1923[4] Griffith was already familiar with nitrous oxide anaesthesia. He found ethylene-oxygen anaesthesia more satisfactory because it provided adequate muscle relaxation for most cases with 25% oxygen, thus removing the need for hypoxic mixtures of nitrous oxide or the addition of ether. Griffith learned to intubate the trachea using nitrous oxide and ether, and then with ethylene. In 1928 he was invited to read a paper in Boston, Massachusetts on intratracheal ethylene-oxygen anaesthesia.[5] Ralph Waters of Madison, Wisconsin, congratulated him on his presentation and Griffith felt that, even though he was working at one of the smaller hospitals in Montreal, he was doing something useful. Intubation was important for the safe use of cyclopropane which, unlike ether, was a respiratory depressant.

Lucas and Henderson's preliminary report on cyclopropane[6] was published in 1929. In 1933 Griffith visited Madison and was impressed by Waters' demonstration of cyclopropane anaesthesia in surgical patients. In October of that year Griffith introduced cyclopropane at the Homoeopathic Hospital in Montreal. By June 1935 he had administered it to 1,108 cases,[7] of which 592 were abdominal operations. Griffith was very impressed by the potency and controllabilty of cyclopropane.[3] For surgical anaesthesia, instead of 75% ethylene with only 25% oxygen, with cyclopropane the proportions were reversed. He could now give oxygen with just enough cyclopropane to keep the patient asleep and there was no problem keeping the patients well oxygenated. Cyclopropane was much more potent than any other gas anaesthetic available then, or at any time since. Griffith always preferred gases because they were so rapidly and easily controllable compared with ether and chloroform.

Griffith used closed-circuit anaesthesia with soda-lime absorption. He preferred Foregger's circle filter over Waters' to-and-fro filter. For good endotracheal anaesthesia a machine was needed that measured low flows of gases. Cyclopropane was expensive although when used in closed circuit it proved economical. Griffith's detailed accounts of anaesthesia costs showed a balanced budget.[7] The average annual cost for anaesthetic agents in the years 1931-33 before the introduction of cyclopropane was $2,688. The following year his efficient use of closed circuit cyclopropane reduced the total budget by $10, and the average cost of supplies per anaesthetic from $1.15 to $1.13. Sixty years later, even with the help of computers, few anaesthetists keep such detailed records.

Griffith recognized the risk of explosion[8,9] although he believed the risk could be eliminated by taking simple precautions. Humidity inside the machine was maintained by adding a little water to the breathing bag and rubber tubing, and in the operating room by using a commercial humidifier which provided 40-55% humidity, even in the coldest weather. Use of electrocautery was prohibited in head and neck cases but it was allowed in abdominal cases because, with closed circuit anaesthesia, the concentration of cyclopropane in the abdomen was below its explosive range. It would be "just as difficult to cause an explosion by the use of an electric cautery in the abdomen as it would

be to light one's kitchen stove by striking a match on the opposite side of the room."

Compared with ether, chloroform, nitrous oxide, and ethylene, there were many qualities of cyclopropane which Griffith appreciated. It was pleasant and non-irritating to inhale, it produced rapid induction, and it provided adequate relaxation even for upper abdominal surgery. He was not afraid to use deep cyclopropane anaesthesia because he could use plenty of oxygen and he was prepared to help the patients to breathe by squeezing the bag. It was potent, rapidly controllable, non-toxic to the liver and kidneys, and it could always be given in a high percentage of oxygen.[1,7] Its disadvantages were its explosiveness and, to a lesser extent, respiratory depression and cardiac arrhythmias. Griffith particularly appreciated the ability to change the depth of anaesthesia rapidly while maintaining good oxygenation. Minimum alveolar concentration (MAC) and uptake and distribution curves for anaesthetic agents had not been described, but Griffith understood the physical properties which made cyclopropane such a useful agent. It was a gas, delivered through a calibrated flowmeter; its low MAC value, compared with those of nitrous oxide and ethylene, allowed high concentrations of oxygen; and its low blood/gas partition coefficient permitted rapid changes in depth of anaesthesia.

Within 10 years Griffith had used cyclopropane 10,000 times and had published four papers, demonstrating that even in a 120 bed general hospital useful statistics could be accumulated. With that experience Griffith concluded that cyclopropane was "a pretty useful agent."

In the 60 years since the introduction of cyclopropane no agent with similar properties has been introduced. All newer inhaled anaesthetic agents have been volatile liquids, ranging from the highly soluble, low-MAC trichloroethylene and methoxyflurane to the less soluble, higher-MAC halothane, enflurane and isoflurane. The major breakthrough in inhalational anaesthetics after the Second World War was the introduction of halothane in 1956, with enflurane and isoflurane representing minor but significant improvements. Halothane appeared near the end of Griffith's career, and it is interesting that he regarded it as an alternative to chloroform[10] rather than a replacement for cyclopropane.

Fear of explosion from the use of electrocautery in the presence of explosive agents led to the demise of cyclopropane. The desirable properties of new inhalational agents for the 1990s[11] are almost the same as those which Griffith recognized in cyclopropane. These are inherent molecular stability in the presence of soda-lime, low blood solubility, potency sufficient to allow high concentrations of oxygen, pleasant and non-irritating to inhale, no metabolism, and rapid reversal of central nervous system effects. Desflurane is the agent which most closely approximates this ideal, although it is irritant to the airway. Its boiling point is 23.5°C and it may be delivered as flow-metered saturated vapour from an electrically heated vaporiser. The absence of flammability, explosiveness, and sensitization of the heart to catecholamines are the only significant improvements over cyclopropane. The properties of the 'better agent' which Griffith's recognized in cyclopropane in 1933 are now being rediscovered.

Griffith maintained that cyclopropane was not toxic, at least in his personal experience of 30,000 administrations. He claimed that he had probably inhaled more cyclopropane than any one else. (Personal communication from HR Griffith to GT Moonie, 1967) Early in his practice he acquired "what was probably a very bad habit" of taking a sniff or two of the mask before he applied it to the patient, in order to estimate what concentration was in the bag. He really never gave himself an anaesthetic but he often felt some momentary effect. Although he subsequently developed Parkinson's disease, in 1967 he was in his 73rd year, apparently in good health with no neurological or metabolic disturbance, and he could still enjoy a curling game three times a week. Few anaesthetic agents (or anaesthetists!) have had such a thorough personal evaluation.

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Cyclopropane anesthesia*

At this meeting which marks the sincere and age-old friendship of Canadian and American physicians, it is fitting that we should have brought to our attention cyclopropane, a new anesthetic gas for which credit is shared equally between Canadian and American scientists. In 1929, Henderson and Lucas, in the Pharmacological Laboratories of the University of Toronto, first suggested the use of cyclopropane as an anesthetic agent. They performed interesting and valuable experiments on animals,[1,2] but were unable at that time to give the gas a clinical trial.

Scope and utility

In 1933 after much preliminary investigation, Waters, of the University of Wisconsin, introduced cyclopropane into the operating room, and used it in a considerable number of cases.[3 4] He and his Madison associates, particularly Rovenstine, Seevers, Stiles and Meek have continued their clinical and pharmacological investigations with uniformly gratifying results.[5] Raginsky and Bourne, in Montreal have investigated the gas with regard to its effect on liver function[6] and Schakell and Blumenthal have demonstrated its value in experiments on tuberculous monkeys.[7] But it is to the wisdom, independence and scientific courage of Ralph Waters that we owe not only our first practical knowledge of the gas but also the equipment which makes possible its economical administration. I wish here, as a Canadian, to pay tribute to this great American anesthetist, representative of all that is best in the profession.

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In October 1933, following a visit to Madison, a few of us began to use cyclopropane. A year ago I reported the results in my first 350 cases.[8] My conclusions then were that cyclopropane is a very valuable and widely useful anesthetic agent. My series of administrations at the Homeopathic Hospital of Montreal up to June 1, 1935, numbers 1108, and the purpose of this paper is merely to reiterate our favorable impression of the gas after this more extensive trial. My observations and research have been entirely clinical and I have been concerned mostly with trying out methods and deciding on indications for the use of this anesthetic agent.

Use in Abdominal Surgery. We have used cyclopropane in all sorts of patients and in a wide variety of operations. Of the 1108 cases, 592 were abdominal sections. In this group the commonest operations were as follows:

Appendicectomies	273
Hysterectomies	82
Cesarean Sections	58
Stomach and Gall Bladder Operations	53

We were able to produce adequate relaxation without the addition of any ether in about ninety percent of these cases. Cyclopropane is so much more powerful than the other anesthetic gases that we never have any difficulty in securing relaxation in extra-abdominal operations, even in strong laboring men without preliminary medication. This is evidenced by the satisfactory use of cyclopropane in 63 cases for the reduction of fractures. In the few abdominal cases which require extra anesthesia I have recently been adding very small amounts of chloroform instead of ether. This gives rapid relaxation without irritation, and in the presence of a large excess of oxygen I do not believe we need fear toxic effects in the average case. The only objection I have to ether is that it often produces a period of strain and respiratory irritation, and this causes exces-

sive secretion of mucus. The same may be said about vinyl ether (vinethene), in the use of which for this purpose I have been disappointed.

Combination with Avertin. Three hundred and seventy-one of our cases have received avertin (tribromethanol) preoperatively, in doses of 70 to 100 mg. per Kg. of body weight. I believe that the combination of avertin with cyclopropane forms the nearest approach we have yet made to the "ideal anesthetic". Patients like the pleasant way they drop off to sleep in their own beds, and I feel that on the whole, avertin is safer and more controllable than any of the barbiturates, especially with children. Patients who have had avertin and cyclopropane for abdominal operations have had less postoperative discomfort than any previous series of patients in my experience. Certainly there has been less vomiting and less distention than in the patients to whom I formerly gave avertin, ethylene, and ether. The administration of avertin makes the anesthetist's schedule a little more difficult to arrange, but I think results justify its use, especially for our private patients. I do not now give morphin before operation when avertin is to be used, as I have known this combination to produce alarming respiratory depression.

Endotracheal Administration of Cyclopropane. I have administered cyclopropane 267 times by the endotracheal method, using in most of these cases a short, open end, thin walled, French silk catheter, 9 to 13 mm. in diameter, with the Guedel-Waters inflatable cuff to provide closed circuit anesthesia. After introduction with the direct laryngoscope this catheter is hooked up to a circle filter for carbon dioxid absorption. The advantages of endotracheal anesthesia in operations on the head and neck are obvious, and for such cases it is used routinely, but 120 of these administrations have been for abdominal operations, and I think this requires some explanation. We use endotracheal anesthesia for almost all our upper abdominal operations, for long bowel resections, for kidney operations where the patient has to be turned in an awkward position, for very fat patients or whenever we have reason to fear respiratory obstruction.

Once the tube is in place the anesthesia proceeds so comfortably for both patient and anesthetist, and the breathing is so quiet and so well under control, that I would be tempted to use this method more routinely in abdominal operations were it not that the presence of the tube and the inflated cuff in the trachea does set up in some cases a little postoperative irritation. The patient has a sensation of tickling with a desire to cough which is uncomfortable during the first few days after an abdominal operation. There is no necessity ever for severe trauma if the intubation is carefully performed, but this slight tracheal irritation has made me feel that I won't intubate a patient unless there is a real reason for doing so. However, within the last few months, Arthur Guedel, with his usual ingenuity, has devised a corrugated, soft, sponge rubber, laryngeal plug, which I believe will overcome this objection to endotracheal methods. This plug on the end of the tracheal tube fits snugly into the larynx between the cords. Its size makes it more difficult to introduce than the inflatable cuff, but once in the larynx, it makes a satisfactory closed circuit without laryngeal or tracheal irritation.

Carbon Dioxide Absorption Technique. We always use the carbon dioxid absorption technique when giving cyclopropane. This has been imperative because of the high cost of the gas, but I believe that I would stick to closed circuit methods even if the price of cyclopropane were reduced to that of nitrous oxid. I have found Foregger's circle filter very satisfactory, and perhaps a little more convenient than Waters' to-and-fro filter. For good endotracheal anesthesia one needs a machine which will deliver a measured fine flow of the gases used. Closed circuit anesthesia with cyclopropane is somewhat easier to handle than with nitrous oxid or ethylene, as, on account of the potency of the gas, the presence of air, or an excess of oxygen in the circuit, does not upset the anesthesia.

Even when the patient has had no preliminary medication I induce anesthesia with cyclopropane, as it is a pleasant smelling gas which sends one off to sleep very gently. I usually fill the bag with oxygen, then add cyclopropane at the rate of 500 or 600 cc. a minute until anesthesia is established at the required depth. Then oxygen and cyclopropane need be added only to meet metabolic requirements and to make up for any loss from leakage.

Use in Obstetrics. In 147 obstetrical cases we have used cyclopropane with very gratifying results; 58 of these cases were cesarean sections. Here we usually give 3 grains of pentobarbital sodium and 1/150 grain of atropin half an hour before operation, and no morphin for fear of depressing the baby's respiration. Anesthesia in practically every case has been maintained satisfactorily with cyclopropane alone. The postoperative course of these patients has been remarkably comfortable. At first we thought the freedom from gas pains and the common post-cesarean distention was just a run of luck, but since it has continued without exception throughout this whole series of cases we have concluded that the anesthetic agent is an important factor. The nurses who care for these patients are the most enthusiastic advocates of cyclopropane.

The other obstetrical cases were all forceps deliveries and repairs. Cyclopropane gives such deep quiet safe anesthesia in these cases, that it has replaced chloroform and ether in my private obstetrical practice. I prefer it also to vinyl ether (vinethene) which seems to me more irritating to the mucous membranes. For late first stage and second stage analgesia we find nitrous oxid entirely satisfactory. During the last few months I have been using Brian

Sword's technique of continuous nitrous oxid-air analgesia, and my patients are quite enthusiastic about this new method. I believe Sword has made a real contribution to obstetrical anesthesia, and I am sorry we cannot now discuss this matter further. Uterine tone is well maintained during cyclopropane anesthesia and I am convinced there has been less post-partum bleeding in this series of cases than in any other similar series in my experience.

Postoperative complications

There has been no death following our administration of cyclopropane which could reasonably be attributed to the effect of the anesthetic. We have used it in all kinds of poor risk cases, and there has been no toxic effect which I could observe. Hyperthyroid, severe cardiac, arteriosclerotic, tuberculous and jaundiced patients have all seemed to do well following its administration. Nausea and vomiting is very uncommon. There has been about the same incidence of pulmonary atelectasis as has been observed following other types of gas-oxygen anesthesia. There has been no real case of postoperative pneumonia. Cyclopropane may be used in all ages of patients. The youngest patient in this series is a baby ten days old, to whom, without preliminary medication, I gave endotracheal cyclopropane through a small Magill tube for a hare lip operation. He was quiet during the operation, then woke up without any sign of irritation or congestion. The oldest patient was a woman of eighty-five. She is still in the hospital recovering uneventfully from a Whitman operation for fracture of the hip, for which I gave her also endotracheal cyclopropane using a 10 mm silk catheter and a Guedel plug. The combination of avertin with cyclopropane is especially satisfactory for most operations on children. Cyclopropane may be used in combination with ether, chloroform, vinethene, ethylene, nitrous oxid or evipan without any incompatibility that I have observed. The only danger with it seems to be in administering too high a concentration, which will cause respiratory paralysis, but there is no excuse for making this mistake.

Cost of Cyclopropane. The high cost of cyclopropane has taught us to use it cautiously. Waters has shown that deep anesthesia can be maintained in most patients by a 10 per cent to 15 per cent concentration of the gas in pure oxygen or oxygen and nitrogen. The small quantity necessary when efficient closed circuit apparatus is used, has made the actual cost per case within reasonable limits, although the cost of the gas per gallon is still high. In the Homeopathic Hospital of Montreal the total cost of all anesthetic supplies and equipment for the last four years has remained remarkably constant in spite of changing methods and new agents. The average yearly cost for the years 1931-33 was $2,688 while the cost in 1934, when cyclopropane was used in a large majority of cases, was $2,678. In 1933 the average cost of supplies for each anesthetic was $1.15 while in 1934 it was $1.13.

Explosibility of Cyclopropane. Cyclopropane, like ether, ethylene and ethyl chlorid, is explosive in certain proportions with oxygen and air. The danger of explosion is relatively slight, since the gas is always used in a closed circuit. However, adequate precautions against static should be maintained, and in my opinion the most efficient means to this end is proper humidification both inside the machine and in the operating rooms. We do not hesitate to use a cautery or an electric knife when cyclopropane is being administered.

Bleeding During Administration. Surgeons remark that some patients under cyclopropane bleed more than those under deep ether or spinal anesthesia. This observation perhaps is partly fallacious because of the bright color of the blood due to an excess of oxygen, but I am convinced that there is more tendency to capillary oozing than there is with ether. I do not believe that this is due to any chemical change in the blood affecting coagulability or viscosity, but is due to a vaso-motor effect on the smaller arteries. The oozing is more superficial than deep, and it will stop as soon as the tissue is left alone. We have had no trouble with hematomata or postoperative bleeding, and the surgeons who are accustomed to working with cyclopropane never complain of the bleeding. I have had little opportunity to use cyclopropane in brain or chest surgery, but others have reported that it provides very satisfactory anesthesia, especially when given endotracheally and combined with tribromethanol, and that there is no special trouble with bleeding.

Conclusions

We have concluded therefore, that cyclopropane is a safe, pleasant, powerful, controllable anesthetic agent, which can be used in almost every type of case, and which can almost entirely replace the unpleasantness of ether anesthesia. I feel that we owe a great debt of gratitude to Henderson and Lucas, to Waters and his associates, and to the chemists and manufacturers who have made possible the use of this gas.

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The management of complications arising during cyclopropane anesthesia

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Cyclopropane first came into clinical use in 1933, and since then it has been administered many thousand times by hundreds of anesthetists and with varying degrees of satisfaction. I have been asked to speak about the management of complications arising during or after cyclopropane anesthesia. Before I attempt to deal with this subject I believe I should try, in the legal sense of the term, to "qualify" myself as an expert witness. So with no intention of boasting but merely as a statement of fact, I wish to record a series of somewhat more than five thousand personal administrations of cyclopropane since October, 1933, with no death on the table, and no postoperative death which could be related to the anesthetic. This complete absence of mortality is to some extent merely good luck, because patients will die suddenly sometimes whether under anesthesia or not, and regardless of who may be caring for them. During the past five years in the hospital with which I am connected there have been 5 anesthetic deaths, but it happens that in each case some anesthetic other than cyclopropane was in use – one was with chloroform, one with ether, one with avertin, one with intravenous evipal, and one under spinal novocain. Because of these accidents I do not condemn these agents, nor do I uphold cyclopropane merely because of an absence of mortality. I do feel, however, that our record refutes the argument that cyclopropane is too dangerous a drug for use as an anesthetic agent. We have not picked our best risk cases for cyclopropane but have found it so satisfactory for so many types of operations, that during the past year 97 per cent of all my own anesthetics have been with cyclopropane. Our 5,000 cases include 2,256 abdominal operations, of which 340 were in the upper abdomen. There were 1,567 cases in which an endotracheal tube was used, 850 of these being tonsillectomies in both children and adults. There were 528 for obstetrical deliveries, of which 201 were cesarean sections. The patients have been of all ages from six days to ninety years, and included in the series are many patients with heart disease and acute or chronic respiratory infections. It is inevitable that in such a large number of cases complications should have arisen, and it is about some of these complications and their management that I wish to speak.

Respiratory Depression. A difficulty which I have experienced during cyclopropane anesthesia is a tendency in some patients to depression or temporary cessation of respiration. This is most frequently seen in patients who are somewhat resistant to the anesthetic and to whom the anesthetist is giving a high concentration of cyclopropane. The patient may suddenly become deeply anesthetized and stop breathing. The treatment here is obviously to give more oxygen, to give it quickly, and in an effective manner. It is usually necessary only to dilute the mixture in the breathing bag with oxygen and to use a little manual pressure on the bag to re-establish respiration; but in some cases on account of an obstructed airway this is ineffective, so an endotracheal tube should be introduced quickly in order to get oxygen into the lungs before the asphyxia becomes serious enough to affect the heart. I cannot speak too strongly of the life-saving value of endotracheal oxygen in all forms of respiratory depression during anesthesia, and I feel that it is a primary duty of everyone who calls himself an anesthetist to become expert in the introduction of endotracheal tubes. There is only one way to become efficient in this not too difficult technic, and that is to practice at every possible opportunity. In order to practice intubation one should have laryngoscope and tubes at hand at all times in the operating room, and frequently insert a tube during or after an operation. This can be done care-

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fully without damage to the patient, and avoids the danger of a failure at a critical moment by one who has had no experience except during the excitement of a crisis. As to methods of intubation, my personal preference is for a semirigid French silk catheter introduced through the mouth with a Guedel or other type of direct laryngoscope. Magill's method of blind nasal intubation with soft rubber tube is useful for normal anesthesia, but it is not always effective as a resuscitative measure in an emergency, and the anesthetist who is not accustomed to using a laryngoscope is then at a great disadvantage. *The most important single piece of advice for anesthetists contemplating the use of cyclopropane is to practice endotracheal intubation.*

With cyclopropane as with other anesthetic agents the maintenance of a free airway is a fundamental necessity. When there is obstruction to breathing from a tongue that is hard to control, the rubber Guedel airway may be introduced, or better still the "pharyngeal bulb gasway" designed by Dr Beverley Leech. I have used this simple device in hundreds of cases with great satisfaction, and it allows also the use of cyclopropane by closed circuit for teeth extractions and other operations where a mask would be in the way. Spasm of the larynx, with a resulting "crowing" type of obstructed breathing is occasionally observed, especially in patients who are resistant to anesthesia. This is not usually a serious sign, and may be relieved by diluting the patient's atmosphere with oxygen or helium. I have kept a cylinder of helium on our gas machines for several years, and I am of the opinion that it has definite value in relieving certain types of obstructed breathing in patients under anesthesia. However, none of these measures takes the place of oxygen by endotracheal tube in real cases of respiratory obstruction or asphyxia.

Pulmonary Atelectasis. Burford[1] has described several fatal cases of massive collapse of the lungs during or immediately after cyclopropane anesthesia, and he has suggested that these and also commoner and milder cases of postoperative atelectasis may be due to the rich oxygen atmosphere and shallow respiration which are usually associated with cyclopropane anesthesia. This hypothesis is interesting but I cannot subscribe to it as the sole or even the principal cause of atalectasis for the simple reason that in all our 5,000 cases of cyclopropane anesthesia we have had no single case of serious collapse, and the incidence of the milder forms of partial atelectasis is less than it used to be following ether or ethylene or nitrous oxide and ether. I believe, however, that the introduction of air into the anesthetic atmosphere is a good practice, and I am impressed by the simple device of a sphygmomanometer bulb attached to the breathing bag for this purpose as described by Colby.[2]

I believe that the factors which prevent atelectasis are: (a) open airways during and after anesthesia, (b) nonirritating anesthetic, and (c) adequate use of pharyngeal and tracheal suction after anesthesia.

If these factors are properly attended to one need not worry about the absorbability of the anesthetic atmosphere. Mild cases of atelectasis have occurred in our experience following cyclopropane but the symptoms have developed from one to six days after the anesthetic and could not possibly be due at that time to pockets of cyclopropane remaining in the patient's lungs. I have a theory, shared by Leech, of Regina (who has had a wide experience with cyclopropane) and probably also by others, that cyclopropane anesthesia is better without the addition of ether, vinethene, chloroform, or other volatile agents. In our experience the addition of ether causes increased secretion and obstructed air passages, and does not improve muscular relaxation. The objection will be raised that one needs ether to secure relaxation for upper abdominal surgery. Our answer is that in our hospitals (Regina General Hospital and Homeopathic Hospital of Montreal) for the past three years we have *never* added ether to any cyclopropane anesthetic in order to secure better relaxation, and we believe that cyclopropane alone will give as good relaxation in any patient as will ether. We admit that it is difficult to secure good relaxation in a few patients, but if cyclopropane will not do it, neither will ether. The cases of fatal pulmonary collapse which I have read about have all been cases in which some ether was added to the cyclopropane. Is it not possible that ether irritation played some part in the bronchial obstruction which must have preceded the collapse?

The other measure which I believe to be of great importance in the prevention of atelectasis is the proper use of suction. It is our practice to introduce a small fenestrated rubber catheter with suction into the mouth of every patient after anesthesia, and to pass this catheter down the trachea if there is any evidence of obstructing bronchial mucus. This is not traumatic, can do no harm, and I am sure has been the means of saving us much postoperative trouble. Suction in all our operating rooms is by water suction pumps such as are in common use in laboratories and which can be easily connected to the existing plumbing at very little expense. I don't believe enough emphasis has been placed upon the value of suction in the armamentarium of the anesthetist.

Acute Pulmonary Edema. I have reported elsewhere[3] a case of acute edema of the lungs occurring in an apparently healthy adult patient during the course of cyclopropane anesthesia for a herniotomy. The patient became cyanosed and it was found that the bronchi and trachea were filled with a large quantity of frothy serosanguineous fluid. An endotracheal tube was introduced at once and a large amount of this fluid removed by suction, then endotracheal oxygen was administered and the patient suffered

no serious after-effects. Dr Kenneth Heard, of Toronto, has told me that he recently had a similar case which he treated in the same manner, and with equal success.

I wish to record in more detail another case of acute pulmonary edema. An apparently healthy young woman went through a long and difficult labor ending in forceps delivery. She was given intermittent nitrous oxide and oxygen for one hour before delivery, then was anesthetized with cyclopropane for the actual delivery and repair, a period of about half an hour. During the cyclopropane anesthesia there was some trouble with mucus and the patient vomited fluids, but the condition was not regarded as unusual, and she was sent back to her room conscious, with a good color and a normal pulse rate. One hour later she suddenly developed dyspnea and became cyanosed. Oxygen was administered by mask without relief. I was called and found her semiconscious, with shallow rapid respiration, an extremely rapid feeble pulse and with many coarse rales throughout her chest. We made a tentative diagnosis of acute pulmonary edema, although she was not at that time spitting up any mucus; and in spite of her extremely serious condition I anesthetized her again with cyclopropane in order to introduce into her trachea a soft rubber suction tube. With this we withdrew several ounces of very tenacious mucus, and then kept up oxygen by the nasal catheter method. An x-ray of the chest at this time confirmed the diagnosis of widespread pulmonary edema. I was afraid to use suction again down the trachea on account of the extremely weak condition of her heart, so we contented ourselves with sucking from her pharynx what mucus was being coughed up, and continuing the oxygen. After three hours she showed some improvement, consciousness returned, and another x-ray showed that the edema was diminishing. Twelve hours later there was evidence of beginning consolidation in both bases, and soon she was again *in extremis* on account of bilateral bronchopneumonia. I attributed this complication to the very tenacious character of the mucus in her chest in contrast to the thin serous exudate we had seen in other cases of acute pulmonary edema. She was given sulfapyridine together with continuous nasal oxygen for eight days. Her respirations continued for days at the unbelievably high rate of sixty to eighty to the minute, but she made a good recovery and was discharged from the hospital perfectly well sixteen days after delivery.

After these experiences I might have believed that there was something peculiar to cyclopropane which tended to induce acute pulmonary edema in a few individuals, if it had not been for an almost identical experience with an obstetrical patient five years ago, when nitrous oxide and ether were used and not cyclopropane. In that case the patient did not develop pneumonia but she went through just the same pulmonary crisis an hour after delivery with a sudden filling of her lungs with frothy mucus. That was in our very early days of the use of cyclopropane and I remember being so thankful at the time that I had not used the new anesthetic in this case, for I never would have been able to convince myself or anyone else that the complication was not due to the "damned new-fangled gas!" We don't yet know what produces these attacks of acute pulmonary edema, but we do feel very strongly that immediate suction plus adequate oxygen is the proper treatment.

Cardiac Irregularities. In the reports on cyclopropane anesthesia, from both the laboratory and clinical points of view, there has been frequent mention of cardiac irregularity. I noted this effect in the sixth patient to whom I administered cyclopropane, and I have observed it in numerous patients since, but I can truthfully say that I have never seen any permanent or harmful result from the arrhythmia. I do not understand the underlying mechanism of these irregularities and I do not believe anyone else does in spite of extensive experimental and electrocardiographic studies, but I am going to be rash enough to say that from the clinical point of view, cardiac irregularities occurring in the human heart under surgical cyclopropane anesthesia may be disregarded. It is true that Meek[4] and others have pointed out to us the effect of cyclopropane on the automaticity of dogs' hearts, and have produced experimentally ventricular tachycardias which make the animals liable to the onset of ventricular fibrillation by the addition of adrenalin. Also, they have suggested that a similar condition might possibly be produced in the human heart. However, the clinical situation is simply this – hundreds of careful anesthetists have administered cyclopropane to many thousand patients and no one has recorded any permanently damaging effect on the heart. Patients will die of heart disease at times under cyclopropane anesthesia, just as they die in their beds or on the street, but my own feeling is that cyclopropane is the safest anesthetic agent we have at present for patients with heart disease who require major surgical operations. In view of this clinical evidence, to say that we should not use cyclopropane because it is too dangerous for the heart is, in my opinion, perfect nonsense.

Postanesthetic Encephalopathy. Gebauer and Coleman[5] have reported a case of so-called "post anesthetic encephalopathy" following cyclopropane, where at autopsy the brain showed evidence of severe degenerative changes. They believe that this condition might result from a localized cerebral anoxemia without any clinical evidence of cyanosis during the anesthesia. There are so many variable factors in different patients that we must admit that anything is possible, but at least we may comfort ourselves that such a complication is extremely rare. I have had no such case in my experience.

Postoperative Shock. When we are confronted with circulatory shock following a major operation it is often hard to decide how much of it is due to the surgery and how much to the anesthetic – it depends, perhaps, on whether one is a surgeon or an anesthetist. In any case, patients who have had cyclopropane anesthesia for any extensive abdominal operation or for some other type of operation in which there has been severe blood loss, do sometimes show evidence of more or less serious shock, and the anesthetist may be called upon to assist in supportive treatment. I have found that coramine in doses of at least 5 cc. hypodermatically is a useful stimulant and that oxygen is of value, but that our principal dependence should be upon intravenous injections of glucose saline, or early blood transfusions. The relative infrequency of serious shock, vomiting, or abdominal distention after cyclopropane anesthesia is indicated by a study recently made of 300 of our cases of cesarean section. In the 200 cyclopropane cases there was nausea and vomiting in only 5 per cent, and severe distention in only 2 per cent.

With reference to the use of cyclopropane in obstetrics, I have been told that some obstetricians and pediatricians have suggested a possible harmful effect on the baby. When we published our original report[6] on cyclopropane for cesarean section it never occurred to us to give statistics on this aspect of the subject, as we had never seen any such harmful effect. However, I have examined the records of our last 100 cases, and find that 5 babies did not live, of these, 4 were either too premature to be viable or were monstrosities. The other baby died when six days old, of peritonitis and pyloric stenosis. It was a small premature baby whose mother had been toxic. The other babies all left the hospital in healthy condition, so I do not see how anyone can logically consider cyclopropane as a factor in infant mortality.

Increased Bleeding During Operation. I suppose one should include in a paper such as this the controversial subject of the amount of bleeding during cyclopropane anesthesia. I have seen no convincing reports on this subject from laboratory or experimental workers, since it is a very difficult question to prove experimentally. I can definitely say, however, from the clinical standpoint, that fear of excessive bleeding need not enter into our estimation of the value of cyclopropane. There is, perhaps, in some patients a slightly increased capillary flow from the superficial tissues while they are being handled, but in my experience this has never led to serious hemorrhage either during or after the operation. The surgeons who use cyclopropane most frequently and like it best, do not complain about bleeding, whereas we sometimes hear remarks about it from new men. Some patients do bleed more readily than others, but these "bleeders" lose as much blood when they are switched to ether as they do with cyclopropane.

Conclusions

To administer cyclopropane properly, and to avoid and to treat these complications which I have mentioned, the anesthetist must be reasonably intelligent, properly trained, and above all, a qualified physician with the fundamental background of the basic medical sciences which only a physician can possess. I have heard some hospital administrators and some surgeons argue against the use of cyclopropane on the grounds that it is safe only in the hands of experts. Surely it is no valid argument against a useful new anesthetic agent to say that the anesthetists of one's hospital are not qualified to administer a drug which is being used safely in many other hospitals.

The whole subject of the relationship between surgeon, anesthetist, hospital, and patient, and their relative responsibility, has recently been ably reviewed by a learned French Canadian judge in the Superior Court of the Province of Quebec.[7] A few extracts from his remarks while rendering judgment are pertinent to this question. He says in part: "The following propositions are established, (a) that the administration of a general anesthetic is a dangerous thing even to the point of possibly causing the death of the person submitted to it, (b) that during the anesthetic surprises, complications, sudden and unforeseen situations, dangerous to the patient and capable of causing his death, may arise, (c) that with the presence of a physician specializing in anesthesia, and experienced in this branch of medicine, the life of the patient might almost always be saved when a complication arises during the anesthetic ... The administration of a general anesthetic is at the same time a science and an art; easy, this science and this art, when all goes well, that is to say when no complication or difficulty arises in the patient, difficult and exacting of skill and experience, when a sudden and dangerous complication arises (these complications vary with the patient and never present exactly the same aspect) being able to cause death very rapidly, if a competent anesthetist, experienced and knowing how to act quickly in this particular complication, is not ready to cope with it with the discretion, the precision, and the ability which can come only from the union of medical science with experience; during the operation the life of the patient rests in the hands of the anesthetist quite as much as in those of the surgeon himself, and any complication resulting from the anesthetic puts the life of the patient in the balance. ... It follows that ... one cannot be too careful in the choice of this man. ... An anesthetic agent is a drug, which shows its action by certain signs and produces definite effects; by these symptoms and these signs one knows what is happening to the patient; and to understand these signs and to judge what may arise, it is necessary to know medicine. ... A nurse has not the required medical preparation to be able to cope with an accident during anesthesia; the reflexes, the pulse, the

breathing, the color of the patient, these are the signs which would speak in a certain way to a specialist in anesthesia, and which by keeping him constantly informed of the condition of the patient, permit him not only to protect the patient by intervening at a critical moment, but also to foresee and prevent such a critical moment; that which constitutes the value of a medical anesthetist having a knowledge of physiology, is his ability to perceive quickly a sudden complication which may arise, to act quickly, to do what should be done and nothing else.... The claim of the defendants that, during the operation to guard against and to cope with anesthetic complications the patient has at the same time the anesthetist and the surgeon is not admissible; the surgeon cannot and should not supervise the anesthesia, that is not his business, all his attention and his faculties should be concentrated on the operation itself, which he should execute diligently, carefully, and without the preoccupation of accessory or extraneous things; the anaesthetist is, therefore, the only person who watches actually and completely the patient, he being ready to deal with complications which may arise with the anesthetic; when a critical situation does arise the surgeon, who should then suspend the operation, comes to assist the anesthetist, but it is still the latter who remains always the person in charge of the security of the patient."

In conclusion I would like to say simply that I believe cyclopropane to be the best and most widely applicable general anesthetic agent which we have available at the present time, and that the complications and dangers attendant upon its use should not frighten any experienced medical anesthetist.

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DAVID R BEVAN

Curare

Fifty years after the introduction of curare it is difficult to imagine anaesthesia without neuromuscular blocking drugs. Before the Second World War the available anaesthetic drugs and techniques were unable to meet all the needs of the surgical patient.[1,2] Sir Robert Macintosh's vivid memories of pre-curare days[3] were of the impossibility of relaxing the rigid abdominal wall of the man with a perforated gastric ulcer, and of delaying the start of an operation because of difficulties associated with passing an endotracheal tube. His impression of modern anaesthesia was the dramatic ease with which fundamental protective reflexes were abolished by muscle relaxants, and he quoted a colleague who divided the practice of anaesthesia into two eras: pre-Griffith and post-Griffith.

Anaesthesia before curare

The history of anaesthesia before the introduction of curare consisted of nearly a century of predominantly gases and vapours. Many were tried, some produced severe complications, and none was entirely satisfactory.

Ether remained popular in the United States since its introduction in Boston in 1846. Given in high concentrations, ether could provide muscle relaxation but this was associated with an overactive diaphragm, hypotension, and a prolonged recovery, often with nausea and vomiting, metabolic and respiratory acidosis, and impaired glucose metabolism. Chloroform was introduced in Scotland in 1847 and was used in the United Kingdom despite its ability to cause ventricular fibrillation and liver damage.

Nitrous oxide anaesthesia was first used in 1844. When used alone it did not produce adequate abdominal relaxation "unless accompanied by asphyxia"[2] or in the poor-risk patient with a lax abdominal wall. The anaesthetic properties of ethylene were reported in 1923.[4] It was slightly better than nitrous oxide but it seldom produced adequate relaxation unless it was supplemented with ether or cyclopropane. Cyclopropane, whose clinical use was reported in 1934,[5] produced muscle relaxation with a quiet abdomen, although the latter was evidence of respiratory depression, and arrhythmias were common at these levels of anaesthesia.

The intravenous barbiturates, especially thiopentone which was introduced in 1935,[6] were immediately popular because of the rapid, pleasant induction of anaesthesia. Thiopentone was also given by intermittent injection to produce brief periods of relaxation during the course of inhalational anaesthesia. Tracheal intubation was possible with thiopentone alone, although the large doses which were necessary were associated with cardiovascular depression, delayed recovery and, often, laryngospasm.

Regional anaesthesia, particularly spinal analgesia, was practised but it was not popular everywhere because of the toxicity of cocaine, and the short or unreliable effect of other local anaesthetics. High spinal analgesia provided excellent surgical conditions but at the risk of hypotension, which was exacerbated by hypovolaemia. The technique was unpopular with patients because of the unpleasant sensation produced by visceral traction, the discomfort of prolonged immobility, and by the frequent occurrence of headache.

Despite many attempts with general and regional anaesthetic techniques, none was able to provide ideal conditions for intra-abdominal surgery or tracheal intubation. Most of the methods were associated with the complications of prolonged deep anaesthesia or extensive neurological blockade.

Two papers in *Anesthesiology* in 1940 are of particular interest. Gillespie[7] suggested that muscle relaxation could only be achieved safely either by using ether in the middle of the fourth plane of anaesthesia with respiratory depression, or with high spinal anaesthesia. More prescient was the editorial by Haggard,[8] director of the Laboratory of Applied Physiology at Yale University, on the first page of the first issue of *Anesthesiology*. In discussing the lack of respect for anaesthetists, he suggested that true progress is

achieved only when two conditions are fulfilled: medical discovery and its application. The scene was set for change. Existing methods were inadequate for a very important function – the production of muscle relaxation during anaesthesia – and current research showed little originality. Two years later Harold Griffith and curare would enable both these goals to be achieved.

History and introduction of curare

Mankind has always feared paralysis. Tales of 'The Flying Death' brought back by 16th century explorers from the New World induced feelings of terror and fascination, even if some of the properties attributed to the poison were grossly exaggerated. Sufficient quantities of curare were brought back to Europe in the 19th century for physiologists to share the fascination. Brodie[9] showed that cats given curare could be kept alive by artificial respiration and Waterton demonstrated the same phenomenon in a donkey. Bernard[10] demonstrated that curare was only effective if given parenterally, and that its site of action was at the neuromuscular junction. Virchow and Munter[9] found that curare produced paralysis of voluntary but not involuntary muscle. Physicians had access to a powerful compound which had no obvious application, although several of them pursued their own ingenious ideas. Sibson tried to treat rabies with crude curare extract, Sayre sought to relieve the spasms of tetanus, and Tiercelin and Benedict attempted to control the convulsions of epilepsy. None of these attempts was successful, in part because different specimens of the drug had different potencies. The drug had to be given parenterally, it was relatively short acting, and supplies were limited. Sibson also pointed out that full control of tetanic convulsions required complete paralysis, and that this would necessitate artificial respiration. In 1912 Läwen,[11] a surgeon in Leipzig, described its use to provide muscle relaxation to facilitate abdominal closure. The Leipzig adventure, however, was one of several attempts to make use of the intriguing property of muscle relaxation by the curare arrow poison. De Caux,[12] an English anaesthetist, used it several times during anaesthesia in 1926 but he never published his findings.

The first controlled clinical investigations of curare were performed by West[13] in London in 1931-4, and Burman[14] in New York in 1935, who tried to treat paralytic rigidity and spastic paralysis. In 1939 Bennett,[15] a psychiatrist in Nebraska, controlled the convulsions induced by Metrazol (and later by electroshock) therapy with a preparation standardized by McIntyre in Nebraska and by ER Squibb and Sons. Bennett suggested later that he had thought, from the ease of performing a pelvic examination in a female psychotic patient given curare, that the drug may have a place in anaesthesia! By 1941 approximately 30,000 patients had been given curare. Two deaths were reported, probably as a result of airway obstruction. Bennett presented his work at the 91st Annual Session of the American Medical Association in New York. Lewis Wright, an associate of E.R. Squibb, was present and tried to interest two anaesthetists. He gave some curare to Rovenstine in New York, who passed it on to Papper, his resident, and to Stuart Cullen in Iowa. Papper and Cullen were not impressed by the bronchospasm produced in cats and the asphyxial convulsive movements seen in dogs. Papper also gave curare to two patients during ether anaesthesia; both developed prolonged apnoea and the clinical trial was abandoned. Wright also talked to Griffith about curare in 1940 but Griffith was "horrified at the poisonous reputation." They met again one year later and, as Intocostrin, curare arrived in Montreal.

Curare made its entry into anaesthetic practice on January 23, 1942 at the Montreal Homoeopathic Hospital. Harold Griffith and Enid Johnson[16] administered Intocostrin (1 ml ≡ 3 mg d-tubocurarine) to a 20 year old man during an appendectomy. The anaesthetist's record states:

> Intocostrin, Squibb (curare) 3.5 cc., given intravenously in 1 1/2 minutes as operation started – no appreciable effect upon pulse or respiration. After 5 minutes, another 1.5 cc. of Intocostrin given. Apparently complete relaxation of abdominal muscles resulted and continued for 20 minutes, during which time cyclopropane was lightened. At the end of this period, muscle tone returned, probably from wearing off of curare effect. Cyclopropane was then increased in concentration, and anesthesia continued in the usual way. There was no demonstrable change in pulse, blood pressure, or respiration.

The patient was anaesthetized with cyclopropane via a mask and airway. Griffith gave the drug under controlled conditions to 25 patients, and published his results in a simple two and a half page clinical report in the July 1942 issue of *Anesthesiology*.

The importance of the paper by Griffith and Johnson was soon recognized. Although supporting papers were slow to appear, two men were to have considerable influence in the use of curare: Cullen in the United States and Gray in England. In 1943 Cullen[17] published the results of his study of 131 patients to whom he had given curare to improve abdominal relaxation, and he soon had a series of more than 1,000 cases. In the United Kingdom, introduction was slower. During the war supplies of curare were difficult to obtain. Gray and Halton therefore turned to the crystalline extract prepared by Burroughs Wellcome and Co. In 1946 they presented their results at the Royal Society of Medicine[18] and concluded: "The road lies open before us and ... we venture to say that we have passed yet another milestone, and the distance to our goal is considerably shortened."

Griffith, and later Cullen, viewed curare as an adjunct to anaesthesia with other agents, only to be used when additional relaxation was necessary in difficult patients. Consequently only small doses were required, assisted ventilation was seldom necessary, and reversal drugs were rarely given. Cullen[19] appeared to fear the effects of neostigmine more than those of curare when he wrote in 1947: "indiscriminate use of prostigmine to overcome the effects of improper use of curare should be discouraged." Gray and Halton[20] initially eschewed the necessity for tracheal intubation: "Although endotracheal intubation under vision is simple when curarine is used it is considered necessary only where the site and nature of the operation preclude the use of a mask, in thoracic operations ... or in cases of intestinal obstruction ... occasionally in operations on the gallbladder and in the very obese."

From the beginning much larger doses of curare were used in Great Britain than in North America. Gray and Halton realized that curare could have an important role in 'balanced anaesthesia' – the triad of barbiturate hypnosis, light inhalational anaesthesia and muscle relaxation.[20] Anaesthesia was induced with thiopentone, maintained with nitrous oxide and oxygen using hyperventilation, and large doses of curare which frequently required reversal either with large doses of physostigmine or, preferably, with neostigmine. This became known as the 'Liverpool technique' which was recommended for patients of all ages and physical condition. It became a standard technique in England in the 1950s and 1960s.

For more than a decade following Griffith's introduction of curare doubts about its safety remained. For some anaesthetists the risk of respiratory paralysis was an additional burden to the practice of anaesthesia. Bronchospasm, apnoea, and postoperative complications were ascribed to its use, although the last of these appeared to be less common when the trachea was intubated.[21] Some anaesthetists believed that tubocurarine had some inherent toxicity, and these fears were strengthened by the report of Beecher and Todd[22] who analyzed the outcome of 599,548 anaesthetics administered in ten hospitals in the United States. They reported that the use of curare was associated with a six-fold increase in mortality. In the United States the paper had widespread support, and in some institutions the use of curare was abandoned. The authors held prestigious positions, and clinical investigation and epidemiological studies, particularly in anaesthesia, were poorly developed. However, their findings were not confirmed and curare was accepted enthusiastically in other countries. It is, nevertheless, obvious that induced muscle relaxation is not without risk, and that failure to ventilate the lungs of a patient with respiratory paralysis is rapidly fatal. Although deaths from this cause are now infrequent,[23] anaesthetists are well aware of the morbidity associated with incomplete reversal of neuromuscular blockade.[24]

The paper by Griffith and Johnson indicates that the philosophy of the use of neuromuscular blocking drugs in 1942 was quite different from what it is in 1992. They induced and maintained anaesthesia with cyclopropane using a facemask and spontaneous ventilation, and then gave Intocostrin in two small doses, equivalent to 10 mg and then 5 mg of d-tubocurarine, given five minutes apart. The trachea was not intubated, no changes in respiratory pattern were observed, ventilation was neither assisted nor controlled, and the relaxant was not reversed at the end of anaesthesia. This is a classical description of the use of Intocostrin as an adjuvant to anaesthesia.

The anaesthetic sequence, and also the monitoring, for the patient described by Griffith and Johnson would be very different in 1992. Muscle relaxant drugs are now used as part of a sequence of balanced anaesthesia. Larger doses are given which necessitate positive pressure ventilation, the trachea is intubated and, if a non-depolarizing agent is used, its action is reversed by an anticholinesterase (either neostigmine or edrophonium) at the end of surgery. In order to meet standards of practice guidelines[25] the anaesthetist now monitors physiological changes throughout the anaesthetic using an automated noninvasive blood pressure recorder, electrocardiogram, pulse oximeter, capnograph, peripheral nerve stimulator, and often a temperature probe. An oxygen analyzer indicates the oxygen percentage in the fresh gas flow, and alarm mechanisms on the ventilator and anaesthetic machine warn of any malfunction.

Progress since the introduction of curare

The introduction of curare had direct and indirect effects on the development of anaesthesia practice and research, and on the role of the specialist anaesthetist. For example, experience of long-term artificial ventilation during the 1952 Copenhagen poliomyelitis epidemic[26] led to the use of curare in the total paralysis regime for the treatment of severe tetanus.[27] Pharmacologists developed other muscle relaxant drugs and, since the drugs produced respiratory paralysis, anaesthetists became familiar with respiratory care, not only during anaesthesia but also in intensive care units which developed in the 1960s.

Respiratory physiology

With their ability to produce respiratory paralysis and to control ventilation, anaesthetists became more interested in respiratory physiology. Pulmonary effects of anaesthetic agents began to interest respiratory physiologists, and strong links were formed between basic science and clinical departments to their mutual benefit. The importance of changes in lung volumes, pulmonary vasculature, and gas

exchange were recognized, as were maintenance of adequate oxygenation and carbon dioxide removal during and after anaesthesia. The consequences of reversing intrapulmonary pressures during intermittent positive pressure ventilation were relevant to anaesthetized patients, and also to critically ill patients in intensive care units.

Anaesthetists were well placed to play a role in the growing specialty of critical care medicine. They became familiar with the clinical care of anaesthetized, paralyzed patients, and participated in the critical care of respiratory problems in children and adults. Their interests ranged from postoperative respiratory care to respiratory distress syndrome, tetanus, and respiratory failure. None of this would have occurred without the introduction of curare.

The introduction of curare encouraged anaesthesia to develop from a technical skill to an academic discipline, and the art of anaesthesia was supplemented by clinical measurement. Paralysis removed some of the signs which had helped the clinical anaesthetist. No longer could the depth of anesthesia be judged by observing movement, or changes in spontaneous respiration, in response to surgery. New signs were formulated, mainly related to the autonomic nervous system, which involved more intensive cardiovascular monitoring. Attempts were made to monitor the anaesthetic depth by electroencephalographic recording, although this never achieved widespread clinical use. Clinical testing of the extent of muscle paralysis was crude and imprecise until the peripheral nerve stimulator was introduced. The recent introduction of pulse oximetry and capnometry both resulted from the consequences of unrecognized pulmonary hypoventilation, usually from neuromuscular blockade. The methodological errors[28] of the Beecher and Todd report demonstrated the importance of well organized epidemiological studies and the current emphasis on anaesthesia outcome studies originated from such investigations.

Neuromuscular monitoring

Despite the changes in drugs and techniques that have occurred in the past 50 years, the principle of titration of the drug to achieve optimal operating conditions compatible with patient safety persists. For more than a decade after the introduction of curare, assessment of the extent of neuromuscular blockade was dependent upon motor responses to stimulation during light anaesthesia, surgical complaints of tight abdominal muscles, and crude tests of muscle strength in the postanaesthetic recovery room. The introduction of neuromuscular monitoring, by observation of the muscle response (usually the adductor pollicis) to stimulation of a peripheral nerve (usually the ulnar), either clinically or by recording the force of contraction or electromyogram, has allowed greater clinical control of relaxation. Neuromuscular blocking drugs can be titrated to the needs of the surgeon, and recovery characteristics can be predicted before the patient awakens. Several stimulation patterns have been suggested: single twitch, train-of-four, tetanus, double burst stimulation, and post-tetanic count. Train-of-four stimulation[29] is the standard both for clinical and research purposes.

The introduction of a new relaxant is now preceded by investigation of its pharmacological profile. This includes dose-response studies to determine doses which produce 50% (ED_{50}) and 90% (ED_{90}) paralysis under several anaesthetic conditions and with young and old patients. Onset of block, recovery, and reversal following administration of multiples of the ED_{90} dose will also be included. Thus, the administration of these agents is more predictable than was possible when curare was introduced. It is interesting that dose-response curves for succinylcholine in man have only been determined in the last few years[30] – 35 years after the first report of its use in clinical practice.[31]

Pharmacokinetics

The development of a sensitive assay for d-tubocurarine allowed the relationship between plasma concentration and neuromuscular blockade to be established.[32] With the exception of succinylcholine, sensitive assays are now available for all neuromuscular blocking drugs which are in current use or are undergoing evaluation, and for their metabolites. Consequently, pharmacokinetic variables (volumes of distribution Vd, clearance Cp, half-lives [$t_{1/2}$ α and β], and the relationship between plasma concentration and effect [Cpss50]) are now obtained before the introduction of a new drug. Such information allows the pharmacological behaviour to be predicted for normal individuals and for those in whom the common routes of metabolism and excretion, via the liver and kidney, are impaired.

All neuromuscular blocking drugs are ionized, quaternary ammonium compounds. This structure ensures that they are distributed mainly in the extracellular fluid and that they do not cross lipid biological membranes such as the blood-brain barrier, placental barrier, or renal tubular lumen. Consequently, if these membranes are intact, the neuromuscular blocking drugs have no direct central nervous system action, they do not cross the placenta, and they are not reabsorbed from the renal tubular lumen. Variable tissue binding may modify the rate of plasma clearance, and metabolism may occur in plasma or liver. Although sensitive assays and pharmacokinetic analysis help the clinician to understand and anticipate pharmacological activity, they have not, per se, modified clinical use of these compounds.

Muscle relaxants 1942–92

Since 1942 many neuromuscular blocking drugs have been

TABLE Neuromuscular blocking drugs – past and present

Amidonium	Dipyrandium	N-methyl tubocurarine
Anatruxonium	Dipyronium	Nubitanium
Alcuronium	*Doxacurium*	*Pancuronium*
Alloferin	Duador	*Pipecuronium*
Atracurium	*Fazadinium*	Quilidium
Bensoquinonium	*Gallamine*	Rocuronium
C-toxiferin	Laudexium	Stercuronium
Chandonium	Maluetin	*Succinylcholine*
Cyclobutonium	Mebutanum	Toxiferine
Dacuronium	*Metocurine*	Tercuronium
Decadonium	Mivacurium*	*d-tubocurarine*
Decamethonium	*Myanesin*	*Vecuronium*
Diadonium	Mytolon	

Italics = Used in clinical practice. *Under investigation

investigated (Table). The initial stimulus for pharmaceutical companies was the possibility of profit. Most of these drugs are now part of history – rejected, forgotten, or superseded by ones with fewer undesirable side effects. Only a few have enjoyed as much popularity as curare did – succinylcholine, pancuronium, atracurium and vecuronium.

D-tubocurarine had two major disadvantages. Its onset and recovery were slow, and histamine release caused hypotension and, occasionally, bronchospasm. Of the many drugs that have been tried as replacements only four have overcome one or both of these problems.

The first depolarizing muscle relaxant, decamethonium,[33] had an onset time which was not appreciably shorter than that of curare. Although recovery was quicker, reversal was not possible, and it was discarded by all but a few anaesthetists.

Succinylcholine was the second depolarizer to undergo clinical investigation.[34] Its onset time of 1 to 2 minutes, and recovery time of 10 to 12 minutes, are shorter than those of any other neuromuscular blocking drug. It soon became more popular than curare to facilitate tracheal intubation, to relieve laryngospasm, and to provide relaxation for electroconvulsive therapy. It was given in repeated doses or by infusion to maintain neuromuscular blockade for periods up to one hour. The rapid recovery from succinylcholine, and probably the rapid onset, are a result of its metabolism by plasma cholinesterase.

The most important dangers of succinylcholine are its ability to induce malignant hyperthermia in susceptible individuals, and to cause fatal hyperkalaemia in severely burned or traumatized patients. Postoperative neck and shoulder muscle pains are common, increase in gastric and intraocular pressure may occur, and approximately one patient in 3,000 possesses an abnormal pseudocholinesterase which prolongs the effect of succinylcholine to 3 to 4 hours. Nevertheless, because of its unique profile, succinylcholine is still widely used throughout the world.

Pancuronium[35] was the first of a new generation of quaternary ammonium steroid compounds with neuromuscular blocking properties. It was also the first nondepolarizing neuromuscular blocking agent which did not cause either the histamine release and ganglionic blockade associated with d-tubocurarine, or the marked tachycardia of gallamine. Indeed, it was not immediately recognized that pancuronium caused both tachycardia and hypertension.[36] Its pharmacological and pharmacokinetic profiles are similar to those of d-tubocurarine. Its release in Great Britain in 1968 was important because anaesthetists there used it as they used curare. Therefore, when it was released in North America in 1972, full paralyzing doses of 0.08–0.1 $mg \cdot kg^{-1}$ were recommended rather than doses equivalent to the 9 to 15 mg adjuvant doses of curare which were still commonly given in many centres. During the 1970s pancuronium replaced curare in most parts of the world.

Atracurium and vecuronium were released in the mid-1980s. Atracurium was the first of a series of benzylisoquinolines to be evaluated.[37] It is unique because its clearance is dependent upon spontaneous degradation in plasma, mainly as a result of Hofmann degradation and, in part, by nonspecific plasma esterases. Vecuronium is a monoquaternary ammonium steroid.[38] Recovery from neuromuscular blockade is much more rapid following the use of these drugs than after pancuronium or d-tubocurarine (recovery index, 75–25% block, of 10 to 15 minutes vs 30 to 50 minutes). Onset of neuromuscular blockade is not quicker than after pancuronium or d-tubocurarine but the more rapid recovery results in fewer patients demonstrating persistent neuromuscular blockade at the termination of anaesthesia.[39] They are almost free of cardiovascular effect although some hypotension, probably a result of histamine release, may follow the use of large doses of atracurium.

Future developments

Neuromuscular blocking drugs are required in several situations. To facilitate tracheal intubation, they should produce paralysis which is rapid in onset, intense and brief. Surgical relaxation need not be so intense but recovery should be rapid to ensure restoration of respiration after anaesthesia. Prolonged paralysis is occasionally necessary to allow intermittent positive pressure ventilation in the intensive care unit. All agents should be devoid of side effects, particularly histamine release and cardiovascular depression. They should also be water-soluble, and should be excreted unchanged or metabolized to inactive compounds.

Succinylcholine remains the only agent which produces rapid paralysis of brief duration. Several compounds of the steroid and benzylisoquinoline groups are being investigated in an attempt to produce a succinylcholine replacement but, so far, none is satisfactory. Related cardioneutral compounds are also being studied as alternatives to pancuronium and d-tubocurarine. Doxacurium[40] (benzylisoquinoline) and pipecuronium[41] (steroid) appear to be promising although, since the advantages of the rapid recovery from atracurium and vecuronium have been appreciated, they are likely to have only a small place in clinical practice. For the maintenance of surgical relaxation, pancuronium and d-tubocurarine are gradually being replaced by atracurium and vecuronium which are shorter acting and are devoid of cardiovascular side effects.

Conclusion

Griffith was in an unique position to play his vital role. He was medical superintendent and chief anaesthetist at the Montreal Homoeopathic Hospital, he was inquisitive, and he enjoyed learning new techniques. He learned from his international friendships, and he was much influenced by Ralph Waters in Madison. Griffith introduced cyclopropane anaesthesia into Canada in 1933, and he was aware not only of its advantages but also of its problems. When deep anaesthesia was induced in an attempt to augment muscle relaxation respiratory inadequacy occurred. Indeed, in 1929 he had written of endotracheal anaesthesia using ethylene,[42] and in 1940 he wrote: "The most important single piece of advice for anaesthetists contemplating the use of cyclopropane is to practice endotracheal intubation."[43] Consequently, Griffith had long been skilled in the arts of tracheal intubation and assisted respiration when he was asked to conduct a clinical trial of curare, and he was well equipped to deal with its major complication – respiratory paralysis.

Harold Griffith was a careful record keeper who enjoyed talking and writing about his experiences. His introduction of curare into anaesthetic practice did more than provide surgeons with a quiet, relaxed abdomen. It set in train a series of changes which were to alter the approach to anaesthetic care. Anaesthesia became a clinical science.

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The use of curare in general anesthesia

Every anesthetist has wished at times that he might be able to produce rapid and complete muscular relaxation in resistant patients under general anesthesia. This is a preliminary report on the clinical use of a drug which will give this kind of relaxation, temporarily and apparently quite harmlessly.

The physiological action of curare as an interrupter of the neuromuscular mechanism has long been recognized, and its best known practical applications have been by South American Indians as an arrow poison and in the physiological laboratory. The crude curare of the South American forests contains numerous toxic substances, but it has been possible so to refine the drug that the elements of cardiac and respiratory depression are removed and only the "pure" curare effect remains.

For several years this purified curare has been used experimentally in psychiatric hospitals to prevent traumatic complications in convulsive shock therapy. Bennett [1], Gray[2] and others have reported on the efficiency and harmlessness of curare when used for this purpose in quite a large number of patients.

In January, 1942, at the suggestion of Dr LH Wright, we began using Intocostrin (Extract of Unauthenticated Curare, Squibb) in order to increase skeletal muscular relaxation in patients under general anesthesia. So far, we have given it to 25 patients, and in each case there has been rapid and complete muscular relaxation, which develops within one minute after intravenous injection of the drug and gradually disappears in from ten to fifteen minutes. In none of our patients has there been any serious depressing effect on respiration, pulse or blood pressure, and there was no demonstrable postoperative effect of any kind. Apparently the drug is very rapidly broken down and excreted almost as rapidly as it acts, although there is some evidence from the psychiatric experience that patients who are given a second injection on the same day require a smaller dose to produce the physiological effect.

We administer the Intocostrin intravenously with a dosage of 10 to 20 mg. of the active curare per 20 lbs. of body weight. Intocostrin is prepared in solution containing 20 mg. of the active curare substance per cubic centimeter, so that an average adult dose is 4 to 5 cc. We have not given to any one patient more than 5 cc., and we make the injection rather rapidly, in less than a minute.

It has not been necessary to administer artificial respiration or stimulants in any of our cases. As our patients are all under gas anesthesia, with means of resuscitation by oxygen immediately available, we do not fear this complication. Since prostigmine is used as an antidote to curare, an ampule of this drug should always be available.

The operations during which curare was given have been as follows:

Appendicectomy	12
Cholecystectomy	4
Laparotomy	3
Curettage of Uterus	2
Hemorrhoidectomy	2
Colostomy	1
Nephrectomy	1
Total	25

All the patients were under cyclopropane anesthesia, and ranged in age from 18 to 70 years. Since we do not ordinarily have difficulty due to inadequate relaxation during cyclopropane anesthesia, in many of these cases the anesthesia was purposely lightened to the point of abdominal straining in order to test the effect of the curare. Several cases, however, have illustrated the possible real usefulness of this drug to the surgeon.

One case was that of a man weighing 250 lbs. who

*From the Department of Anesthesia, Homeopathic Hospital of Montreal
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insisted on general anesthesia for hemorrhoidectomy. Under cyclopropane anesthesia, relaxation of the anal sphincter was unsatisfactory. Immediately after the administration of 5 cc. of Intocostrin, complete relaxation was obtained, and the operation was easily performed.

Several of the cases of appendicectomy were in healthy young adults undergoing operation for an acute infection, and who were particularly resistant to anesthesia. When the surgeon began to close the peritoneum the abdominal muscles became tense, a situation which arises at times in the experience of every anesthetist. We administered 5 cc. of Intocostrin, and within one minute the abdomen was "soft as dough," and the surgeon was able to finish the operation without any difficulty.

In one case of curettage the Intocostrin was given to see if there would be any effect on the muscular tone of the uterus or cervix, and no effect was observed. The other case of curettage was an extremely obese woman on whom the surgeon found it difficult to make a satisfactory bimanual examination. The Intocostrin gave such complete relaxation of the abdominal musculature that he was able to feel the pelvic organs without difficulty.

It seems to us, as the result of these preliminary clinical investigations, that curare may prove to be a drug which will occasionally be of great value, and will give us a means of providing the surgeon rapidly with excellent muscular relaxation at critical times during certain operations.

Its scope of usefulness is limited because of its somewhat fleeting action, and because it is in no sense an anesthetic agent. It is potentially a dangerous poison, and should be used only by experienced anesthetists in well-equipped operating rooms; but we have been so much impressed by the dramatic effect produced in every one of our patients that we believe this investigation should be continued.

The Intocostrin used has been supplied through the courtesy of E. R. Squibb & Sons, to whom we are grateful also for friendly assistance.

Summary

A purified extract of curare (Intocostrin) has been administered intravenously to 25 patients under light general anesthesia. In each case temporary but complete muscular relaxation was rapidly produced with apparently no harmful effect.

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HAROLD R GRIFFITH MD

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The use of curare in anaesthesia and for other clinical purposes*

If anyone had suggested a few years ago that I should present a paper on the clinical use of curare I would have been inclined to laugh, for to most of us curare has always been a fabulous poison vaguely connected with South American Indians and detective novels, useful in the physiological laboratory, but far removed from the realm of practical therapeutics. Nevertheless I have now to report its administration to 90 patients under general anaesthesia, and others have used it hundreds of times in various conditions.

Curare has long been known to science; in fact, the earliest reference to its use is in Hakluyt's description of Sir Walter Raleigh's voyage up the Orinoco in 1595, when even then the Indians were using it as an arrow poison. In 1814 Wheatermen [sic] and Brodie observed that asphyxia from respiratory paralysis was the cause of death in curare poisoning, and in 1840 Claude Bernard[1] confirmed this observation in a series of physiological experiments which have become famous. But the modern history of curare, or what one might call the "civilization" of the drug, dates only from 1938 when Richard C. Gill, an American who had lived for many years on the edge of the upper Amazonian jungle of Ecuador, and who had himself just recovered from an attack of spastic paralysis, led an expedition into this South American wilderness in the hope that he might obtain a sufficient quantity of curare and knowledge of its manufacture to make possible its use in scientific medicine as a treatment for spastic disease.

In his book "White Water and Black Magic", Gill[2] tells most interestingly of the difficulties, dangers, and final success of his quest. Curare, which among the Indians is known as "the flying death", is the most sacred and mystifying of all the strange drugs in the primitive pharmacopoeia. Its secrets have been for centuries carefully guarded by the witch doctors who make it, and for this reason any accurate information about its origin and its ingredients has been most difficult to obtain. Nevertheless, Gill returned to civilization with a large supply of the crude drug, a detailed history of its manufacture, and with botanical samples of over forty plants which the Indians use in making various kinds of crude curare. Through the cooperation of the Research Laboratories of E. R. Squibb & Sons, and Professor AR McIntyre, of the University of Nebraska, this crude curare was subjected to its first really thorough pharmacological study. The so-called "true curare substance" was separated from various other toxic ingredients which are present in the Indians' arrow-poison, and after extensive animal experimentation a product was obtained which seemed safe for human trial. This substance was offered to the medical profession for experimental study under the name of "Intocostrin", (Extract of Curare, Squibb).

Professor AE Bennett, of the University of Nebraska, began using intocostrin in order to minimize the traumatic effects of the violent muscular contraction in patients undergoing metrazol shock therapy for various psychiatric disorders. He[3] and others[4] have reported after many hundred injections that this preparation of curare is harmless to the patient, and extremely valuable in preventing the fractures which formerly resulted rather frequently from shock therapy. A recent report by Dr JA Cummins[5] tells of his experience with curare at the Ontario Hospital, Hamilton; and at the Verdun Protestant Hospital, Montreal, curare is being used to modify the effects of electric shock convulsions.

In June, 1940, Dr LH Wright, of E. R. Squibb & Sons of New York, told me of this new work with curare and remarked how nice it would be if we could use some of it in anaesthesia to relax the muscles of our patients when

*Read before the Montreal Medico-Chirurgical Society, April 2, 1943.
From the Department of Anaesthesia, Homoeopathic Hospital of Montreal.
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they got a little too tense. I agreed that such an effect is often to be desired but was too horrified at the old poisonous reputation of curare to be seriously interested. I met Dr Wright again in October, 1941, and asked him how he was getting on with curare in anaesthesia. He said he still thought the idea was sound, but that so far as he knew no one had tried it. I thought I had better not pass up a good thing any longer, so Dr Wright kindly sent me some ampoules of intocostrin and in January, 1942, we began using it in the operating room of the Homoeopathic Hospital of Montreal. We administered the drug intravenously to patients under general anaesthesia, and found that it acts quickly, producing in less than a minute a dramatic and complete relaxation of the skeletal muscles. Even under the most favourable circumstances, and with every general anaesthetic agent, occasions do arise when it seems impossible to get the patient sufficiently relaxed to make an upper abdominal exploration or to close a friable peritoneum. To have a drug at hand which will give the patient at these critical moments complete relaxation, uniformly, quickly and harmlessly, has seemed to us a blessing to both surgeon and anaesthetist.

Action of curare

The typical curare action consists essentially of an interruption of nervous impulses to muscle, this interruption taking place at the termination of the nerve fibres at the muscle cells, and probably consists in a neutralization of the acetylcholine reaction which is the fundamental neuromuscular stimulation mechanism. When a drug having a pure curare action is introduced intravenously it very rapidly produces a paralysis involving skeletal muscles, of which in practice the diaphragm and intercostals are the last to be affected. In moderate doses there is apparently no effect on cardiac or involuntary muscle. The drug is excreted almost as rapidly as it acts, so that the duration of action is transient. In our experience the effect is usually observed within a few seconds; attains its maximum in about five minutes, and does not last longer than fifteen or twenty minutes. There is a good deal of individual variation in patients as to the duration of effect, and this depends also to some extent on the depth of anaesthesia present.

Curare affects only the neuro-muscular junction and it is in no sense an anaesthetic agent. Therefore, we do not recommend its use to prolong the effect of spinal anaesthesia unless the patient is heavily sedated or a general anaesthetic is used in combination with the spinal. In two patients we repeated the injection during the same operation and obtained relaxation after each injection without harmful effect. There is some evidence, however, from animal experimentation that the drug may have some cumulative action, so we feel that in anaesthesia it should not be repeated indiscriminately but should be used only to overcome some critical situation, and subsequent muscular relaxation should be maintained by the use of the anaesthetic agent itself.

Use during anaesthesia

Intocostrin is marketed in 5 cc. vials of a sterile aqueous solution which contains 20 mgm. of the pure curare substance to each cc. We have found that 5 cc. (or 100 mgm. of curare substance) is an adequate dose for the average adult. We make the injection intravenously, and quite rapidly, and have had no case of thrombosis or other local reaction. This dose is rather larger than that usually used by psychiatrists, but we feel that the conditions under which we work with curare in surgery are much safer than those of most psychiatric institutions. In the operating room we have the patient already asleep under the care of an experienced anaesthetist, with adequate oxygenation, a free airway, and every facility at hand for the proper control of respiration. In none of our patients have we observed any appreciable effect on the pulse or blood pressure. Respiratory depression and even cessation of respiration occurred in a few cases, but we are so accustomed to artificial control of the respiration in patients under modern anaesthesia technique that such an effect does not worry us at all, and there has never been any harmful postoperative disturbance. Almost all our patients have been under cyclopropane anaesthesia, but a few received nitrous oxide and ether. One young man undergoing cholecystostomy for a very severe acute haemorrhagic pancreatitis was given open ether with most unsatisfactory abdominal relaxation. He was given 5 cc. of intocostrin and immediate relaxation ensued but there was also cessation of respiration. An endotracheal tube was introduced and anaesthesia continued with controlled respiration and cyclopropane and oxygen. I am glad to say that in spite of the ether, the curare and the pancreatitis, he subsequently recovered.

The drug prostigmin, which is allied chemically to physostigmine, apparently bears the closest resemblance to a true physiological antidote of curare. In patients with myasthenia gravis it acts to inhibit the choline esterase and to restore the acetylcholine preponderance at the myoneural junction.[6] Since curare action is very similar to the effect of myasthenia gravis, prostigmin should quickly counteract the curare effect. For this reason an ampoule of prostigmin should always be available when curare is given, although in our cases we have not had to use it.

After 25 cases we were so greatly impressed with the uniform results obtained when an adequate dose of curare was given that in July, 1942, Dr Enid Johnson and I published a preliminary report on "The use of curare in general anaesthesia".[7] This has led to further clinical trial by anaesthetists in the United States and Canada, and many have written me that they believe this to be an important

new approach to the problem of muscular relaxation in anaesthesia. Dr SC Cullen, of the University of Iowa, has recently published[8] a report on the use of curare in 250 patients under inhalation anaesthesia. It is gratifying to learn that his work has confirmed our findings, and he says that surgeons with whom he works are enthusiastic about the results obtained. His technique of administration has been somewhat similar to ours, except that he gives the curare now more or less as a routine before the peritoneum is opened in patients with whom he expects to have difficulty in securing relaxation. He has administered the drug in fractionally repeated doses to a number of patients with a satisfactory result in prolonging the period of complete muscular relaxation. He feels that curare is much more depressing to the respiration in patients under ether than under cyclopropane, but in every case artificial respiration by manual compression of the breathing bag was all that was necessary to restore the patient to normal breathing.

During recent months we have not used curare very frequently, and our total series has grown only to 90 cases simply because we were satisfied with its efficacy and wished to keep it for cases in which it was really needed. Inadequate relaxation is not a frequent complication with modern anaesthesia technique and the good anaesthetist should not need curare every day or even every week. It is still a potentially dangerous drug, and I would not like to see it used indiscriminately by unskilled anaesthetists simply because they were too inefficient to obtain muscular relaxation by ordinary anaesthetic procedures. Also, one should not expect too much of the drug. According to our present knowledge, curare is simply a powerful but short acting adjuvant to anaesthetic agents, to be used in an unconscious patient to tide one over an emergency situation where complete relaxation is demanded. We have found it to be required most frequently in strong, young adults who may be just as resistant to any anaesthetic agent as are some men to the effects of whisky. I do not recommend it as an aid during the excitement of a difficult induction, or for a short procedure such as the reduction of a dislocation, because in these cases such an agent as intravenous pentothal may do the work perfectly satisfactorily, and probably more safely.

So much for curare in anaesthesia and in psychiatry. One might speculate upon other possible fields for clinical use. Perhaps we may find it of value in the treatment of conditions in which there is too violent muscular contraction or too persistent muscular spasm. Gill had hoped that it would prove an effective treatment for the various forms of spastic paralysis. This dream has come true to a certain degree, and Burman[9] and others are now advocating the use of curare and erythroidine hydrochloride for spastic and dystonic states. An obstacle to the effective use of curare in the treatment of these conditions is that its action is fleeting and cannot be long maintained. However, since the treatment of spastic paralysis is concerned largely with the re-education of muscles and nerves, a drug such as curare, which will give even temporary relaxation to those who are in a state of constant spasm, has proved to be a great help in bolstering the patients' morale and giving them confidence and hope. Cullen[10] reports a case of tetanus successfully controlled by repeated curare injections; and it might be used for the control of eclamptic and other forms of convulsions in unconscious patients, providing that oxygen and means of artificial respiration were always at hand.

This, then, is the story of the transformation of a drug from the kettles and gourds of Indian witch doctors to the biological standardization and sterile ampoules of modern medicine. What chapters of the story remain to be told only time will show, but I think that enough has already been revealed to assure for curare a definitely useful place in our pharmacopoeia.

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Résumé

Le curare du commerce s'appelle "intocostrin" (Squibb). Il fut d'abord utilisé pour diminuer la violence des convulsions thérapeutiques produites par le métrazol, puis par l'electrochoc, puis, depuis janvier 1942, comme adjuvant de l'anesthésie générale, pour favoriser le relâchement des muscles abdominaux. Son mode d'action, on le sait, est son

effet inhibant au niveau de la jonction myo-neurale, par neutralisation de l'acétylcholine. Son antidote est la prostigmine. Le curare ne doit pas être employé de façon routinière, mais dans les seuls cas ou le relâchement musculaire ne peut s'obtenir autrement. Les états spasmodiques et les dystonies en profiteront peut-être.

HAROLD R GRIFFITH MD

Editorial

As I read over the paper on "The Use of Curare in General Anesthesia," which has been reprinted in this issue, I am awed by the realization of all that has happened in the field of muscle relaxation since Enid Johnson and I first administered Intocostrin in the operating room on January 23, 1942. Even then I felt that this might develop into a useful tool because it did seem to meet a need, but I could not foresee either the revolutionary effect of curare upon operating room practice or the surprising influence of this contribution upon my own professional career. I am glad to note that in 1942 we did not make any statement regarding curare which in 1957 we would like to withdraw. A medical author does not always have this satisfaction regarding his earlier brain children!

It would be impossible for me here to mention all those in many countries who have contributed to our present knowledge of muscle relaxants. Among the pioneer anesthesiologists are Stuart Cullen, Gray, Hudon, Whitacre, Scott, Smith, and Baird and Knight – all of them my good friends and trusted colleagues. Hundreds of others – physiologists, pharmacologists, pharmaceutical manufacturers, as well as anesthesiologists and neurologists – have joined in the search for new relaxants and the study of the action of these drugs. So we now know a great deal more about the whole subject than we did in 1942. However, certain fundamental considerations in regard to the safe clinical use of these drugs remain unchanged, whether we are dealing with tubocurarine, decamethonium, gallamine, succinylcholine, or any of a dozen other agents.

(1) All muscle relaxants depress respiration, and whenever they are used some means of supporting respiration must be instantly available.

(2) No one should use muscle relaxants unless he has the ability and the equipment for the rapid introduction of an endotracheal tube.

(3) The dosage of relaxant drugs should be carefully assessed on the basis of the tolerance of each individual patient, taking into consideration the anesthetic agents and other drugs which are being used.

(4) All muscle relaxant drugs are potential poisons and should be administered only by experienced anesthesiologists in well-equipped operating rooms.

Subject to the above-mentioned limitations, I believe curare and other muscle relaxants may and should be used in order to provide ideal operating conditions for the surgeon. They should be used only when muscle relaxation is really needed. They should never be used routinely or without careful, intelligent appraisal of their probable effect on the individual patient.

There is still much to be learned about curare and similar drugs. The unsolved problems in anesthesiology are many and baffling. Clinical and laboratory research must continue. There may be many young anesthesiologists who would like to make some contribution to the advance of knowledge, who yet feel frustrated because they must make their living in a small hospital not directly connected with a medical school. My advice to these young doctors is to not be discouraged. Such an environment may be ideal for careful observation under personally controlled conditions. My own work with curare, cyclopropane, and other agents was done in just such a small hospital. My academic connection and my teaching responsibility came rather unexpectedly in recent years, and were the result rather than the cause of my enthusiasm for research. Now as I come near the end of my active career as a teacher I can think of no greater reward than the satisfaction of seeing my students, wherever they may be located, imbued with determination "to strive, to seek, to find, and not to yield."

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C RONALD STEPHEN

Balanced anaesthesia

The first independent department of anaesthesia in Canada was established at McGill University in Montreal in 1945. This department status had been earned. Years of preparation, of proving the value of this upstart specialty, of showing the importance of the anaesthetic centre in Montreal in the world community, had preceded the establishment of the department.

Back in 1929, John S Lundy, Chief of Anesthesiology at the Mayo Clinic, had formed the Anesthetists' Travel Club. He believed that by gathering together once a year leading anaesthetists in the United States and Canada for formal and informal interchanges of thought, mutual advantages would accrue to all concerned. The group was purposefully kept small, numbering about 12 to 15, so as to foster better communication among members. It was to be intimate enough that all could squeeze into an elevator together!

At the first meeting in Rochester, Minnesota the attendees from Canada were Jack Blezard from London, Ontario; Easson Brown, Charles Robson and Harry Shields from Toronto; and Charles Stewart from Montreal. At the 1930 meeting, hosted by Ralph Waters and held in Madison, Wisconsin, Harold Griffith was invited and at the third meeting in 1931, held in Toronto, Wesley Bourne also attended.

The 1933 meeting was held jointly in Rochester, Minnesota and Madison, Wisconsin. It was established custom at these gatherings that the mornings would be spent in the operating rooms and the afternoons in the lecture theatre, with free discussions following each presentation. Of particular interest in Madison was an operating room demonstration of cyclopropane by Waters. Griffith was impressed with Waters' demonstration of cyclopropane, as he recognized in his article[1] which was published the following year.

In 1937 the meeting was held jointly in Montreal and Toronto. Bourne, Griffith and Stewart hosted the Montreal section, and Brown, Robson and Shields the Toronto section. The gatherings were interrupted by the Second World War, but resumed in 1952 in an organization called the Academy of Anesthesiology, in which Griffith was an active member. The breadth of knowledge and perspective gained by the participants in the Travel Club cannot be underestimated as they struggled to improve the image of the fledgling specialty in their own environments.

Griffith and Johnson's introduction of curare as an anaesthetic adjunct in 1942[2] went a long way toward placing Montreal on the anaesthetic map. If the authorities at McGill University had any lingering doubts about the feasibility of a department of anaesthesia, these were nullified as the importance and value of the curare story became manifest.

It was in this setting of an established, active, and progressive teaching programme, staffed by dynamic personnel, that Griffith wrote his paper on balanced anaesthesia.[3] The concept was not entirely new because Lundy is recognized as having coined the term in 1926.[4] Earlier still, in 1910 Crile[5,6] had introduced the concept of anoci-association, in which general anaesthesia was combined with the use of local anaesthetic drugs. It is not known why Griffith published his paper in a little-known journal. Perhaps he had been invited to speak before a group of urologic surgeons and his paper was 'captured' by them for one of its journals. It is a coincidence that both Lundy's and Griffith's papers were published in journals that were not widely read.

Several years later David M Little Jr, and I expressed our beliefs regarding balanced anaesthesia.[7] Little had spent several weeks at McGill in the early postwar years on a rotation from the residency programme in Hartford, Connecticut. During this time he had been thoroughly exposed to the concepts of Griffith, Bourne and others.

Griffith realized that by using a combination of cyclopropane and curare and other anaesthetics then in use, each

with its own attributes and dangers, the net result could be to the advantage of the patient. He wrote that "the tendency among thoughtful anesthesiologists today is not to look for the 'ideal' anesthetic agent but to learn to use in varying combinations the agents and methods we have, in order to anesthetize safely and comfortably a particular patient."

Griffith recorded that 90% of the anaesthetics in his hospital in 1941 were given with cyclopropane alone, whereas in 1945-46, a scant five years later, 32 different combinations and techniques were used in a total of 2,000 patients. One may conjecture how much this variety reflected the fact that his anaesthesia administration was moving in a different direction. Endotracheal intubation was employed in 586 of these patients, and curare in 410. In 1929 Griffith[8] was among the first to recommend this protection of the airway under what must have been rather difficult circumstances.

Griffith's rationale for balanced anaesthesia was that "the toxicity of many drugs is often in geometrical progression to the size of the dose – small doses are comparatively harmless, but double such a dose may be more than twice as toxic." Echoing these sentiments, Little[9] stated several years later: "In combined anaesthesia, minimal amounts of a hypnotic (Pentothal), an analgesic (nitrous oxide, ethylene or light cyclopropane), and a muscle relaxant (curare, or one of its numerous analogues) are used in combination to produce adequate conditions for surgery without recourse to deep general anaesthesia and its attendant physiological disturbances." Griffith pointed out the advantages of combining regional analgesia with a light general anaesthetic as was championed in later years by that bastion of regional analgesia at the Virginia Mason Clinic in Seattle. He wrote that "the removal of fear and discomfort by sleep is often of great physiological advantage to the patient."

Finally, there is a discourse on the importance of training adequately qualified anaesthetists to render safe anaesthesia in the changing nature of the specialty: "if we are to use intelligently and safely the many combinations of drugs and methods which make up "balanced anesthesia," the administration must be in the hands of qualified physician anesthesiologists." He went on to emphasize that the anaesthetist of 1947 not only "gives the anesthetic," but is responsible for "intravenous supportive procedures, oxygen therapy, blood banks, recovery rooms," and is proficient in being a consultant "on all matters in connection with pain relief." One wonders how many anaesthetists in 1947 in North America were assuming all these responsibilities. The recovery room, for example, was a recent innovation in the postoperative care of patients. It was only in 1943, after he learned of Lundy's `postanaesthesia recovery room', that Griffith instituted the first recovery room in Canada[10,11] at a cost of $2,000, not exactly a paltry sum in those days. However, having the dual role of medical superintendent and chief of anaesthesia of the hospital no doubt was an advantage! As one looks back at Griffith's papers, it is amazing that what he had to say is still so applicable to today's practice.

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Balanced anesthesia – a modern trend

This year it is fitting that we should be honoring the memory of Morton, who gave to the world the great blessing of ether anesthesia. There are some who say that ether is still the safest and most generally useful anesthetic agent. Opinions differ on such a point. There is, however, no argument about the fact that during the hundred years since the introduction of ether many other useful anesthetic agents have become available. Today we have a choice which is sometimes bewildering. Chloroform was for a while heralded as the "ideal anesthetic," then the gases nitrous-oxide and ethylene, and later cyclopropane, pentothal and various drugs for regional injection. The search for new anesthetic drugs still goes on, and our present list, large as it may be, is certainly by no means complete. The tendency among thoughtful anesthesiologists today is not to look for the "ideal" anesthetic agent but to learn to use in varying combinations the agents and methods we have, in order to anesthetize safely and comfortably a particular patient.

A few years ago many of us were doing a very large proportion of our work with one particular agent or method for which we happened to have an individual preference. In 1941 I reported, for instance,[1] that 90% of the operations in our hospital were being done with cyclopropane alone. By contrast, in a series of 2000 consecutive cases in 1945-46, I find we have used 32 different combinations of agents and methods as follows:

AGENTS AND METHODS†	NUMBER OF CASES
Cyclopropane (alone)	795
Cyclopropane & curare	292
Avertin & cyclopropane	140
Avertin, cyclopropane, & curare	36
Pentothal & cyclopropane	202
Pentothal, cyclopropane & curare	39
Pentothal, cyclopropane & ethylene	8
Pentothal, cyclopropane, avertin & curare	1
Pentothal, cyclopropane, ethylene & curare	4
Ethylene & cyclopropane	24
Ethylene, cyclopropane & curare	21
Avertin, ethylene, cyclopropane & curare	2
Nitrous-oxide & cyclopropane	5
Nitrous-oxide, cyclopropane & pentothal	1
Nitrous-oxide	12
Pentothal	167
Pentothal & nitrous-oxide	9
Pentothal, nitrous-oxide & ethylene	2
Pentothal & ethylene	2
Spinal (various agents)	86
Spinal & cyclopropane	46
Spinal & ethylene	1
Spinal & pentothal	56
Spinal & nitrous-oxide	8
Spinal, cyclopropane & curare	9
Spinal, pentothal & cyclopropane	10
Spinal, pentothal, cyclopropane & curare	4
Ether	6
Local anesthesia & curare (bronchoscopy)	6
Refrigeration	4
Total	2000‡

†Combinations total 30. – Eds.

‡Numbers in this table total 1998. – Eds.

Endotracheal anesthesia in 586 of these cases.

Curare given in 20.5% of all cases.

This trend toward using several agents and different methods during the conduct of one operation is what we mean when we speak of "balanced" anesthesia. It is not done just to show off our skill, but is based, I believe, on sound reasoning. The toxicity of many drugs is often in

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geometrical progression to the size of the dose – small doses are comparatively harmless, but double such a dose may be more than twice as toxic. Wiggin[2] and others pointed this out years ago when they demonstrated clinically how a combination of small doses of procaine and pontocaine was more effective and less toxic for spinal anesthesia than was twice the dose of either drug alone. In other words, they were able to obtain a summation of the anesthetic effect of the drugs without a summation of toxicity. The concentration of a drug used in anesthesia appears also to have an important relation to toxicity. This is undoubtedly one of the reasons for the clinical success and the absence of toxic effects in the use of continuous spinal anesthesia for prolonged abdominal surgery; and it is nowhere better demonstrated than in the current use of dilute procaine intravenously. In obstetrics, spinal anesthesia was looked upon with suspicion by most careful observers until Fraser[3] and others demonstrated that a dose as small as 5 cc. of 1% procaine will produce anesthesia in the parturient woman comparable to that obtained from double this dose in an ordinary surgical case. Lund[4] has also shown the efficacy and comparative safety of dilute solutions of hypobaric pontocaine. For these reasons we are now using spinal anesthesia for nearly half of our obstetrical deliveries, with a great deal of satisfaction to the mothers.

Similarly, with agents for general anesthesia, we have found that frequently a combination is better than the use of one agent pushed to its full potency. For example, in thyroid surgery we frequently administer a combination of cyclopropane and ethylene because this mixture seems to protect the automaticity of the heart against a tachycardia which may develop in toxic cases when cyclopropane is used alone. Nitrous-oxide may be mixed with cyclopropane or ethylene, or with ether vapor in a wide variety of combinations.

It is frequently a good practice to combine light general with regional or spinal anesthesia. Properly administered cyclopropane, nitrous-oxide or ethylene in a "sleeping dose," or small doses of pentothal do not increase the operative risk to a patient under spinal or regional anesthesia. In fact, the removal of fear and discomfort by sleep is often of great physiological advantage to the patient. In operations where it is necessary to have the patient postured in uncomfortable positions or where there is embarrassing exposure most patients prefer to be asleep, even though pain may be entirely controlled by regional block. With the means available today for non-toxic "balanced" anesthesia there is no longer any justification for making the patient endure this kind of psychic shock.

Curare, which I had the good fortune to introduce into anesthesia in 1942,[5] has had the effect of infinitely widening our choice of anesthetic procedures. Muscle relaxation is one of the fundamental requirements for good abdominal surgery. In order to obtain adequate relaxation it has often seemed necessary to administer maximum doses of potent anesthetic drugs. Since there is a wide individual variation among human beings in reaction and tolerance to all such drugs, the result of maximum doses has been that inevitably certain patients suffered from overdosage. Curare, which in recommended dosage has the sole effect of producing muscle relaxation, has made it unnecessary for us to depend on maximum doses of anesthetic agents for this purpose.

We can now give moderate and safe doses of anesthetic drugs to produce sleep, insensibility to pain, and ordinary muscle relaxation. Whenever more relaxation is required, curare can be given, and its action appears to be dependable and controllable. Knight,[6] of Minnesota, has recommended a routine anesthesia procedure with definite proportions of nitrous-oxide for analgesia, pentothal for hypnosis, and curare for muscle relaxation. His technique is efficient and widely applicable although I do not believe it will ever be possible to set definite rules of dosage and method in clinical anesthesiology. There are too many variable factors in our patients. However, Knight's work is an excellent example of modern "balanced anesthesia," and I heartily recommend this or some similar combination of drugs.

I believe it is apparent in this discussion that if we are to use intelligently and safely the many combinations of drugs and methods which make up "balanced anesthesia," the administration must be in the hands of qualified physician anesthesiologists. We speak of safe drugs and harmless methods – these agents are safe and harmless only when they are used properly. Most of our drugs are deadly poisons when used improperly. Patients today have a right to good anesthesia, just as in our hospitals they expect to find good urology, good surgery, good obstetrics, and good medicine. The anesthesiologist not only "gives the anesthetic" but he looks after any features of the pre-operative and post-operative care of patients. He supervises intravenous supportive procedures, oxygen therapy, blood banks, recovery rooms, and acts as a consultant on all matters in connection with pain relief. The day is past when the surgeon or obstetrician can himself administer a spinal anesthetic, leave the patient without proper supervision, and feel satisfied that he is giving all the protection which the public has a right to demand. We teach our students that, for a patient under spinal anesthesia, oxygen and supportive measures should not be in another room but at arm's length. Only thus can we have assurance that disasters which occur with terrifying suddenness may be avoided. It is argued that there are not enough trained anesthesiologists to provide this kind of service in all American hospitals. At present there is some truth in this argument, but improvement of the situation can never be brought about by a complacent acceptance of the present policy of widespread employment

of non-medical anesthetists. For the protection of their patients, surgeons and hospital administrators should demand the best in anesthesiology as they do in surgery. When economic conditions are so adjusted that anesthesiology will be placed on a basis comparable with other specialties, the best type of young doctors will be induced to seek qualification in this important field in sufficient numbers to provide really good anesthesia for even the smallest hospitals. This has been done in Canada and in Great Britain, and should not prove too difficult a goal for the United States.

Summary

The present-day trend toward the use of various combinations of anesthetic drugs and methods to provide safe anesthesia is described. The introduction of curare into clinical anesthesiology has made possible the employment of smaller doses of toxic anesthetic agents. The judgment, skill and experience of the anesthesiologist is considered more important for the safety and comfort of the patient than is the use of any particular agent or method.

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Recovery room

The immediate post-operative period is a time when surgical patients should receive continuous skilful nursing care. For some patients the kind of attention received during this critical period may tip the balance between death or recovery. In order to be sure that all the advantages of modern specialized knowledge and equipment would be available for such patients, in 1943 we organized a Post-Operative Recovery Room at the Homoeopathic Hospital of Montreal. Since that time nearly 15,000 patients have passed through this department and we can say without hesitation that this is one of the best investments ever made. The advantages of a recovery room from the point of view of nursing efficiency and economy are fully and fairly covered in Miss Honey's excellent article which was published in the June, 1950, issue. I need only say that we agree entirely with her observations and that equally valuable advantages are apparent to anesthetists, surgeons, and to the patients themselves.

To set up a recovery room in an already over-crowded hospital may seem impossible. However, once we decided such a department was necessary, we gave it first priority, improvised space in what had been a partly enclosed solarium, and "sold" the idea to our Women's Auxiliary who raised the money needed for special equipment. The shape of our room is not ideal. It is too small for comfort but it has accomplished its purpose. A makeshift arrangement of some kind is possible in almost every hospital, because "where there's a will there's a way." It is wrong to feel that one must always wait for a new building or a new wing to provide such a valuable and satisfying addition.

The following are some practical points which, in the light of seven years' experience, we believe to be of importance to anyone who may be contemplating starting a recovery room in either an old or a new hospital. We realize that special circumstances may necessitate the modification of some of these suggestions.

Average reading time – 5 min. 36 sec.

Genial Dr. Griffith is medical superintendent and anesthetist-in-chief of the Homoeopathic Hospital, Montreal.

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Direction

Medical direction of the recovery room is best undertaken by the anesthesia department. The modern anesthetist is well qualified to look after restorative procedures, oxygen therapy, blood transfusions, parenteral fluid service, and the handling of unconscious patients. With us, there has been no conflict between the authority of anesthetist and surgeon. For as long as the patient must remain in the recovery room the anesthetist assumes responsibility and the surgeon acts in a consulting capacity. Since there is confidence in the anesthesia staff, the surgeons are glad to be free of this responsibility and they know that their patients are receiving the benefit of the best in medical knowledge and nursing skill.

Nursing staff

Just as important as good medical direction is the proper selection and training of the nursing staff for a recovery room. An alert, intelligent graduate nurse should be selected and specially trained, then given this department as her full-time job. Since the work is interesting, stimulating, and satisfying, there should be no difficulty in finding suitable nurses. We have been singularly fortunate in this regard and the only reason we have had to change our recovery room nurses is because they seem to be prone to the infection of matrimony. The number of nurses required will depend on the amount of surgery being done. In our small hospital, with an average of seven operations a day, we have always on duty one graduate and one student nurse. For a hospital with a school of nursing it is most important that students get an opportunity for this specialized and highly valuable training.

Size and location

An adequate recovery room should have space for as many patients as there are active operating rooms. In our hospital patients are brought from the O. R. on their own beds. This is an ideal arrangement since it obviates the extra dangers of frequent changes of position for anesthetized patients but we realize it is not possible in every hospital. We bring practically all post-operative patients to the recovery room – not only those who are in serious condition. For a patient with spinal anesthesia it is just as important to have constant attention until the anesthetic has worn off as it is for the patient recovering from ether or cyclopropane. Children are brought there after tonsillectomy so that they can get their often noisy awakening over in seclusion and so not upset their mothers or other patients in a ward. It is not necessary to have separate rooms for male and female patients – a curtain that may be pulled across between beds provides sufficient privacy.

It is important that the recovery room should be adjacent to or in proximity with the operating room. This permits closer liaison between anesthetists and recovery room nursing staff and minimizes transportation difficulties.

Duration of patient's stay

Whether the recovery room is organized for day-time only or for 24-hour service will depend on the number of cases to be handled, the nature of the operations, and the space available. In our recovery room the patients stay only until they are awake and do not need constant nursing attention. However, if we were planning a new hospital, I would recommend an arrangement whereby patients could be cared for as long as two or three days in the recovery room so that the occasional complications which arise in cardiac, thoracic, and abdominal cases might be handled expeditiously and efficiently. The average patient would still be out of the recovery room in an hour or two but, if it were possible to keep complicated cases there much longer, there should be less difficulty in maintaining routine nursing care for the less demanding patients in the surgical wards. This is in line with the modern idea of "graded nursing care."

Financing the recovery room

We have made no charge to the patient for recovery room nursing care, although the usual service charges for blood transfusions, intravenous therapy, and other drug administrations are made. For purposes of convenience, we have combined our Blood Bank with the recovery room, under the same medical and nursing supervision. This arrangement might not be suitable for another hospital. With us, it has run so smoothly that we have not yet joined the Red Cross Blood Transfusion Service. The service charges from 800 blood transfusions given annually have covered the whole cost of the recovery room. However, even if this source of revenue was not available, we would still recommend the installation of a recovery room as a good investment.

Other uses

A hospital department which is set up with readily available equipment for all kinds of supportive treatment may well be used for other than post-operative patients. Any patient who needs to be intubated for respiratory obstruction, or to have tracheal aspiration performed for atelectasis or increased secretions, may be handled most expeditiously in the recovery room. It is used for poisoning cases and for comatose patients who are being investigated.

PHILIP R BROMAGE

Regional anaesthesia

In 1955 I had the good fortune to have a paper accepted for the joint meeting of the British and Canadian Medical Associations in Toronto. This provided the opportunity to tour Canada, the United States and parts of South America. At that time there was an apparent shortage of anaesthetists in North America, and any likely passer-by was apt to find himself being recruited and many tempting offers were made in the course of my tour.

Montréal was my last port of call before returning home. The city was different from any other place I had visited in North America. True, it was bitterly cold and ice-bound for half the year, but it was a safe, open, vibrant city, with none of the tragic social decay of so much of the United States conurbia. Here the social contract had not yet been broken. The citizens paid their taxes, and in return they lived in an orderly society and were safe from street violence. The mountain park rising in the middle of the island city was a haven for recreation and for wild life of all sorts, including pheasants, raccoons, skunks and hawks. And with McGill University perched on one flank of the mountain and the Université de Montréal on the other, the ambivalent dichotomy of two very divergent cultures enjoying a close liaison was proudly proclaimed. The blend of French and English, with bilingual signs everywhere, gave a uniquely European flavour to the city, and the Gallic flare of the French Canadians gave it an *élan* unknown to the rest of North America.

The chairman of the Department of Anaesthesia at McGill University, Harold Griffith, who was known affectionately as 'Uncle Harold', had two firm goals for his specialty. The first was to raise the standards and productivity of his department so that it might attain world stature in anaesthesia. The second was to unite the French and English groups of anaesthetists by regular academic interchange and by bonds of mutual respect, friendship, and professional exchange that would make the Montréal anaesthetic scene a true cosmopolitan Mecca for French-speaking and English-speaking anaesthetists all over the world.

The times were exciting, and Griffith was succeeding in his ambitions for anaesthesia in Montréal. He had drawn world attention to his department, not only from the results of his own work on curare, but through his wider ecumenical efforts to organize the World Federation of Societies of Anaesthesiologists.

It was suggested that my interests in regional anaesthesia could find fertile opportunities for future developments in surgery, obstetrics and chronic pain management. By January 1956, after a warm and friendly invitation from Alan Noble, Chief of Anaesthesia at the Royal Victoria Hospital, I found myself happily installed with the rank of Assistant Professor of Anaesthesia at McGill University.

The place seemed unique and the timing perfect. Here was an opportunity to become part of an enterprise led by far-seeing men, committed to licensed iconoclasm, challenging old ideas but breaking new ground and expanding horizons in a fiercely traditional university. Regular anaesthetic meetings were held by the French and English departments, presided over by Griffith and his counterpart Louis Lamoureaux from the Université de Montréal, and a deep mutual respect and affection existed between the two professional language groups.

Through the generosity of The Wellcome Foundation Griffith had formed the McGill Department of Anaesthesia Research in 1956. Gordon (later Sir Gordon) Robson was appointed as the first Wellcome Research Professor of Anaesthesia. In May 1956 he arrived from Edinburgh and set to work with a will to create his new department. Several other newcomers were also being recruited with the objective of combining clinical and basic research in anaesthesia.

I arrived in Montréal 14 years after Griffith's use of curare had burst upon the anaesthetic scene like a magic

bullet that made general anaesthesia technically easy and apparently very safe. Yet those of us with experience in both general and regional anaesthesia had more than a hunch that regional anaesthesia offered something valuable and uniquely different. This was most obvious in the dreadful days of thoracoplasty which under general anaesthesia was a bloody operation. Careful monitoring of blood loss was required during surgery, and close supervision of the patient during the difficult and painful early postoperative phase. Under good regional anaesthesia with generous quantities of dilute lidocaine and epinephrine the picture was entirely different. In skilled surgical hands the operation was virtually bloodless and the patients were comfortable throughout the procedure. Postoperative management was easy with the patients pain-free and able to cough and clear their own secretions effectively while analgesia lasted for several hours after returning to their ward. This particular surgical procedure provided a perfect example, clear for all to see, of the dramatic difference between anaesthetic techniques that relied upon neuromuscular blockade, de-efferentation, and those that sought to block sensory impulses by de-afferentation at the periphery.

Montréal provided an ideal field for playing out the forthcoming struggles of anaesthetic philosophy and clinical outcome that were bound to emerge between the 'de-afferenters' and 'de-efferenters'. De-afferenters saw anaesthesia as a shield to protect the central nervous system and its humoral agents from inappropriate reflex responses to noxious afferent input, while de-efferenters focused their skills on providing perfect muscle relaxation through neuromuscular blockade, and sought to suppress inappropriate cardiovascular responses with systemic vasoactive agents acting on autonomic efferent pathways.

The de-afferenting stage was already set, albeit tenuously, by Wesley Bourne's work with high subarachnoid anaesthesia for thoracic surgery, while Griffith was encouraging wider and safer use of spinal anaesthesia in obstetrics, and the Department of Psychiatry was exploring the effects of de-afferentation on mental behaviour. But curare had made Montréal the champion of light general anaesthesia and de-efferentation, and the balance needed to be redressed by adding greater credibility to the long-term advantages of regional anaesthesia. My contribution lay in helping to establish that balance by enlisting collaborative support from the extraordinary constellation of skills in other disciplines, especially in pulmonary medicine and physiology, that abounded at McGill in order to provide all the collaborative support that would be needed for such an undertaking. The powerful Section of Pulmonary Medicine, directed by Ronald Christie, and backed by David Bates and Margot Becklake, and later by Milic-Emili, were to play an important role in those endeavours.

Robson's close friendship and collaboration with Professor Ben Burns in the Department of Physiology also gave the Department of Anaesthesia an entry into the sophisticated world of central respiratory control. After Robson's return to England in 1964, Professor Kris Krnjevic was recruited to take over the directorship of anaesthesia research. Krnjevic's primary interests also lay in central neural communication systems and micro-electrode technology. His unrelenting insistence on scrupulously rigorous experimental method paved the way for a disciplined approach to clinical experimental anaesthesia. This was destined to lead to seminal work in the early discoveries of the action of morphine on the spinal cord by one of our talented residents, Octavio Calvillo, working for his doctorate of philosophy under Krnjevic's direction. These ideas in turn would call for their therapeutic justification upon earlier foundations laid down by Melzack and Wall, a few years before, in their classical hypothesis of pain modulation by small cell networks in the dorsal horn of the spinal cord.[1]

And so, on many intellectual fronts of the Faculty of Medicine, the signs were set fair for a programme of anaesthesia research that might pursue Crile's[2] First World War concept of a protective anaesthetic shield to guard the central nervous system from noxious afferent input, even at a time when such old fashioned notions were eclipsed by the glamour of curare.

The two articles on spinal anaesthesia for obstetrics in this section, one by Cullen and Griffith in 1947[3] and the other by Griffith in 1952,[4] illustrate the hazardous nature of obstetrical anaesthesia when general anaesthesia with an unguarded airway was administered for forceps deliveries. Mendelson's classic paper on aspiration of stomach contents during delivery had been published in 1946,[5] a year earlier than the article by Cullen and Griffith.[3] It would take another 15 years before Hodges and Tunstall stated the issues clearly enough to insist that a cuffed endotracheal tube and a watertight tracheobronchial tree were mandatory for every general anaesthetic given to any parturient.[6] Meanwhile, regional anaesthesia proved to be the safer choice for vaginal and abdominal delivery, and de-afferentation won the day in the obstetrical field.

Cullen and Griffith's 1947 article is remarkable for two incisive observations on post-dural puncture headache that were steadfastly ignored by other researchers in the same field during the succeeding 30 to 40 years. First, they compared carefully collected data on the incidence of headache after vaginal delivery under nitrous oxide analgesia ($n = 200$), or subarachnoid analgesia with a 22-gauge needle ($n = 200$). They found an overall incidence of 20% in both groups, thus showing that not all postoperative headaches can be blamed on spinal anaesthesia. However, severe headaches requiring aggressive analgesic treatment

were more frequent in the spinal group (14%) than in the nitrous oxide group (5%).

They went on to make a second and even more cogent observation related to the prevention of spinal headache. At that time, and indeed until very recently, enforced recumbency for 24 hours was considered to be the obvious first line of defence against excessive cerebrospinal fluid loss after spinal anaesthesia. Cullen and Griffith challenged this entrenched concept and compared the outcome of recumbency with freedom of movement and position of choice in 200 patients. Their figures showed that the enforced recumbent posture made no difference – the incidence and intensity of headache were the same in both groups. Sadly, this innovative study has received no recognition in the voluminous literature on post-dural puncture headache. It has taken nearly 40 years and innumerable recumbent patients for their findings to be rediscovered and accepted by the medical profession.

As time went by it became clear that continuous epidural anaesthesia provided the key for both painless labour and delivery. Selective analgesia could be made to last as long as needed and it could be converted to provide more intense analgesic blockade if Caesarean section became necessary, and subarachnoid analgesia was gradually eclipsed. In retrospect, we were slow to see the obvious. It took a long time for the focus on de-afferentation to become sharpened to provide pain-free labour with preservation of motor function as has been achieved in recent years. We wondered why second stage labour was often prolonged with continuous epidural analgesia although we knew, or should have known, that bupivacaine 0.25%, or even higher in some institutions, was powerful enough to produce a significant degree of motor block (de-efferentation), not only in the lower limbs but in the all-important levator ani muscles whose tone controlled proper rotation and flexion of the descending fetal head. And so it was commonplace for some conservative obstetricians to insist that the epidural be allowed to wear off to ensure that pain and adequate expulsion efforts returned, just at a time when pain relief was most needed by the labouring mother. Today, with greater appreciation of the additive effects of epidural opiates acting on the dorsal horn, and local anaesthetics acting on axons, combinations of very dilute solutions of bupivacaine (<0.1%), together with small doses of lipid-soluble epidural opiates, are sufficient to walk the narrow line between pain relief and preservation of function in the muscular passageway of the birth canal. There is now no need to discontinue analgesia to establish a functionally normal birth process.

The rest of the story is a partial fulfillment of Griffith's earlier ambitions. We did make obstetrical anaesthesia safe at McGill, and in 1961 we published the first paper on placental transfer of local anaesthetics during epidural analgesia for labour.[7] A number of papers followed on clinical research in technical and pharmacologic aspects of regional and general anaesthesia for obstetrics.

In 1963 we made the fundamental observation that the dura mater is not an effective barrier to local anaesthetics and that epidural anaesthetics act upon the periphery of the spinal cord as well as on the spinal roots, thus opening the door for future work on the spinal effects of epidural opiates. Moreover, and contrary to earlier beliefs, we showed that epidural local anaesthetics can reach intracranial parts of the neuraxis, an observation that would later rationalize the concept of delayed respiratory depression from rostral spread of epidural opiates to midbrain structures.[8,9]

We went on to establish a form of post-surgical management service and, with the help and encouragement of Professor Ronald Melzack, founded a Pain Management Clinic for chronic painful ailments. Thus, research that had sprung from Griffith's farsighted plans in the 1940s saw practical clinical expression through these facilities 20 years later.

Best of all, in terms of Griffith's dreams of Anglo-French entente, was the creation of a formal France-Québec exchange agreement in 1968. The seeds of the agreement went back to 1952 when Bourne, Griffith's predecessor, had been invited by the World Health Organization to spend 15 months in France setting up postgraduate training courses in anaesthesia, modelled on the courses which he had initiated at McGill. My predecessor, Professor Richard Gilbert, continued this tradition through his personal friendships with anaesthetic leaders in France. During my term of office as chairman, arrangements became formalized so that we in Québec received French residents for periods of one, or sometime two years of postgraduate training, while members of Quebec university faculties were invited to give lecture courses and hands-on clinical instruction to university anaesthesia departments in France. This exchange proved fruitful to both parties. We in Québec received keen, cultured residents who were eager to learn all aspects of anaesthesia, pulmonary physiology and critical care, while France received a series of experts from Québec as well as from other parts of North America, who toured the major university centres delivering short condensed courses in their own particular areas of expertise. The fruits of this interchange are now highly visible in France where the gains have been consolidated through generous government funding of medical research. It is particularly gratifying to see former French residents from our exchange programme returning to attend the American Society of Anesthesiologists' annual meetings and delivering their papers in open competition with their former North American colleagues and teachers.

The changing political scene that took place during the late 1960s in the province of Québec effected deep changes

upon the medical community at large and upon the Department of Anaesthesia at McGill in particular. Morale deteriorated and staff drifted away to more congenial pastures, while research projects languished and it became increasingly difficult to recruit newcomers to fill the gaps.

The year 1969 brought disquieting changes to the provincial political scene that would distract us from our prime medical functions and eventually undo much of the hard work that Bourne and Griffith had contributed towards their goal of cementing strong Anglo-French bonds of collaboration, friendship and mutual academic encouragement.

In July 1970 a series of Provincial Bills were passed that placed all health resources under the control of the provincial government and outlawed all forms of health insurance except for that of the province's health plan. Doctors were obliged to become members of the Union of General Practitioners or of the Union of Specialists, and Bill 41 threatened medical strikers with heavy fines and possible imprisonment.

These political distractions had very deleterious effects upon academic output because much time was taken up in futile acts of rearguard resistance to governmental control. Global hospital budgets did not provide for financial overruns and increasing amounts of time and effort were spent in reorganizing our services to remain fiscally solvent.

There was a debt to be paid because so much effort was concentrated on these clinical pressures and administrative adventures that there was less time to maintain close liaison between clinical research and our basic science colleagues. While Krnjevic and his team forged ahead with their marvellous work on single-cell recordings in the brain and spinal cord, our minds were elsewhere. In 1974 Calvillo eventually defined the role of morphine in the dorsal horn of the spinal cord.[10] We noted this with interest and respect but utterly failed to pick up the baton and run with it to the logical clinical conclusion of subarachnoid and epidural opiates for pain relief. That laurel would have to wait another five years before it was won by Wang at the Mayo Clinic in 1979.[11]

What would Griffith have done? Would his intellectual toughness have kept all the balls in the air simultaneously? And would he have summoned up the time and energy to make that creative jump between the brilliant bench work undertaken with spinal morphine and its clinical application to new and revolutionary methods of segmental pain relief in humans? The obstetrical field was an obvious place where intraspinal mixtures of very dilute local anaesthetics and powerful lipid-soluble opiates would enable the anaesthetist to come very close to the elusive ideal of satisfactory pain relief without appreciable impairment of motor tone in the muscular birth passages and without causing delay in the normal process of natural childbirth.

What a crowning triumph that would have been, to close a fundamental intellectual loop at the end of such a long and distinguished career, and to travel backwards through the reflex arc from a clinical first in de-efferentation with curare and then to be first in the clinical field of de-afferentation, with the intraspinal opiates closing entry to the arc in the dorsal horn. He might have done it because he was not the kind to be distracted by the excitements of catastrophic change in the medico-political world around us at that time. For he was made of the stuff that TS Eliot honoured when he wrote in *The Dry Salvages*:

> Who are only undefeated
> Because we have gone on trying;
> We, content at the last
> If our temporal reversion nourish
> (Not too far from the yew-tree)
> The life of significant soil.

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Postpartum results of spinal anesthesia in obstetrics*

The value of any procedure in the practice of medicine is probably best measured or assessed by the results.

Anesthesia in obstetrics is a problem that is receiving more attention and study in recent years than ever before, and rightly so. There are still ample opportunities for improvement, not only in the development of new techniques based on a more accurate understanding of the physiology of labor, but also, and of even greater importance, in the development and training of anesthetists. The latter should have some experience in obstetrics and psychology and thus be qualified to direct the whole problem of anesthesia in obstetrics.

There are four individuals involved in this problem and to reach a successful conclusion they must work together harmoniously; (1) the mother, (2) the child, (3) the obstetrician, and (4) the anesthetist. Let us call them the "foursome." In the past, the mother has had little or no opportunity to have much to say in the matter, but today and even more so in the near future, she is asking and at times, demanding more consideration for pain relief with safety to herself and her child.

The child has been and probably always will be helpless and at the mercy of the other three involved in the problem.

The obstetrician has, in many cases, left the anesthesia in the hands of the senior nurse or junior interne. In other cases, he has assumed the dual role of anesthetist and obstetrician. But, as in the past the surgeon-anesthetist has gladly welcomed the services of the physician anesthetist, so the obstetrician anesthetist is welcoming the cooperation of the qualified medical anesthetist.

*Presented during the Twenty-First Annual Congress of Anesthetists, Joint Session of the International Anesthesia Research Society and the International College of Anesthetists, Hotel McAlpin, New York, N.Y., September 9-13, 1946.
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The anesthetist in many places seems to avoid the problem of obstetrics or has been discouraged for economic or other reasons and thus confines his efforts to anesthesia in other fields. However, the anesthetist who becomes interested in this problem in obstetrics will find no more gratifying experience in all his work than being able to relieve safely the excruciating and agonizing pains of a woman in childbirth, and later to hear the spontaneous clear cry of her newborn child. This must be seen and heard to be appreciated.

It is now sixty years since spinal anesthesia was first used in obstetrics by Corning.[1] A few years later others tried it, but they used cocaine and had so many immediate and late accidents that the method was abandoned.

The method then remained obscure for over twenty-five years when in 1928 Pitkin[2] described his "controllable spinal anesthesia" in obstetrics using a procaine solution. In 1934, Franken[3] reported the successful use of spinal anesthesia for cesarean section but also warned of the dangers of that method, mentioning especially the fact that hard labor pains or excessive movement of the patient might send the anesthetic agent to dangerously high levels. Delee and Greenhill[5] have stated that spinal anesthesia is the most dangerous anesthetic for the pregnant woman. Their theory is that, during labor contractions, the cerebrospinal fluid in the lower spinal canal is forced up toward the medulla, thereby carrying the anesthetic agent to the vital centers, with resultant respiratory paralysis. Heard pointed out the fact that the rhythmic contractions of the uterus were not interrupted unless the anesthesia reached the ninth dorsal segment. Recently Cosgrove[7] has accumulated a large series of deliveries under spinal anesthesia. Mallinson[4] discussed the physiologic changes associated with pregnancy and concluded that spinal anesthesia is contraindicated in pregnancy. Percy Malpas[10] of Liverpool, described the pattern of the contractions of the pregnant uterus under spinal anesthesia and the attendant changes in

TABLE 1 Incidence of Headache

	Grade I		Grade II		Grade III		All Grades	
	No. of cases	%	No of Cases	%	No. of cases	%	No. of cases	%
In 200 spinal cases	12	6	28	14	0	0	40	20
In 200 gas cases	30	15	10	5	0	0	40	20

TABLE 2 Incidence of Headache in Spinal Anesthesia Cases

Total	Grade I Cases	Grade II Cases	%	Grade III Cases	%	All grades Cases	%	Time periods Cases	%
From Nov /44 to July/45--9 mos.	67	2	3	11	17	0	0	13	20
From Aug /45 to June/46--11 mos.	133	10	7	17	13	0	0	27	20

TABLE 3 Incidence of Resuscitation

	No Resuscitation		Easy Resuscitation		Difficult Resuscitation		Stillborn Cer. Hem.	Neonatal Deaths
200 cases spinal anesthesia	173	86.5%	20	10%	5	2.5%	2 (a. long (labour b. 5 mos. (fetus	1 lived 6 hrs., congenital heart disease 2 –
200 cases gas anesthesia	126	63%	54	27%	20	10%	0	a. lived 9 hrs. (cer. hem. (b. lived 6 hrs. (prematurity

the reactivity of the myometrium. Hingson[8] described how spinal anesthesia, when properly administered, absolutely protects the baby from transplacental intoxication. Weaver[17] reported last year the use of spinal anesthesia in over 1500 vaginal deliveries with good results.

In this study at the Homeopathic Hospital of Montreal an analysis has been made of the results of two hundred consecutive cases of spinal anaesthesia for vaginal delivery. For comparison, the results of two hundred consecutive cases of gas anesthesia for vaginal delivery have also been studied. All anesthetics were given by qualified physician anesthetists during a twenty month period ending June 30, 1946 and any necessary resuscitation of the newborn was done by the anesthetist.

The technique for all the spinal cases in this group was very similar. With the patient in the usual lateral decubitus position, either left or right, she is curled up as much as her enlarged abdomen will permit. Then a 22 gauge needle is inserted through the third or fourth lumbar interspace into the subarachnoid space and 5 or 6 cc. of 1 per cent procaine in saline solution (50 to 60 mg.) at room temperature is injected, without barbotage. Specific gravity of this solution is 1.007. The patient is carefully lifted (and not allowed to move herself) into the supine position and kept thus for five minutes before being placed in the lithotomy position for delivery. Prior to and during the delivery, the mother is given oxygen by face mask, and if she is at all nervous or wishes to be asleep, we do not hesitate to add small amounts of cyclopropane during the actual delivery. This patient is awake for the repair of the episiotomy and enjoys watching her baby. Cyclopropane was added in this way in 85 cases or 42 per cent of this spinal group.

The technique for the gas cases was either nitrous oxide and air, in the modified Sword technique, followed by cyclopropane and oxygen for the actual delivery, episiotomy and repair, or straight cyclopropane and oxygen for delivery, episiotomy and repair. No ether, chloroform, vinethene or pentothal was used in these cases.

Selection of Cases

The cases for spinal anesthesia are selected after consultation and after carefully considering the advantages and disadvantages to each of the "foursome." Best results are obtained if the mother is of normal intelligence and has no language difficulty. The mother's mental attitude is important and interesting.

As she approaches the delivery room the first stage of her labor is either completed if she is a primipara, or well advanced, if she is a multipara.

There should be no discussion by the nurse, doctor or patient about the spinal anesthesia.

I heartily agree with Fraser[18] in suggesting that the word "spinal" should be avoided. He prefers the term "lumbar anesthesia," but any other innocently sounding term is satisfactory. Thus many times the patient will never know that she has had spinal anesthesia.

In no case should any member of our "foursome" be deprived of the benefits of spinal anesthesia simply because the mother does not wish to be awake. The anesthetist can readily supplement or balance the spinal anesthesia with light cyclopropane, nitrous oxide or pentothal anesthesia.

The cases for gas anesthesia are also carefully selected with reference to the "foursome." It is employed when labor is progressing very rapidly, when internal version or other intra-uterine manipulation are contemplated, and when the obstetrician desires spontaneous delivery.

1. The Mother

Let us consider our results in detail primarily as they affect each of the "foursome."

One of the commonest sequelae observed in the postpartum period was headache. Every headache in this series, was recorded even if it was a minor distress requiring only five grains of acetylsalicylic acid for relief and did not recur. Headaches were arbitrarily classified, as follows:

Grade I, called minor headache, was usually a dull frontal distress, readily controlled with five grains of acetylsalicylic acid or an aspirin-phenacetin-caffeine tablet and did not recur more than three times during the first ten days.

Grade II, called notable headache, was quite disturbing to the patient and required aspirin-phenacetin-caffeine with codeine on several occasions for control. These headaches usually appeared twenty-four to seventy-two hours postpartum. They recurred intermittently for from one to four days with decreasing severity and then cleared up completely.

Grade III, called severe headache, included the so-called "spinal headache" and all other cases of severe headache.

It is of considerable interest to note that headaches occurred just as frequently after gas anesthesia as after spinal anesthesia. After spinal anesthesia the incidence of grade II headache was higher than after gas anesthesia. It is also notable that there were no cases of severe headache. It may be coincident that many of the headaches that appeared about the third day were in patients with engorged breasts.

During the first nine months period all spinal anesthesia patients were kept "flat in bed" for twenty-four hours after delivery. During the latter eleven month period there was no "flat in bed" order and patients moved freely in bed as soon as they desired to do so. The total incidence of headache was equal in each group and actually the percentage of grade II headaches was lower when all patients were allowed freedom of movement and position after delivery.

Nausea and vomiting is an important factor in obstetrics because these women are prone to be nauseated in the second stage of labor as well as in the first stage, when their abdominal organs are all under pressure from within and without. Besides, many women with full stomachs come to the delivery room as emergency cases.

Spaid[15] emphasizes that the greatest number of complications from aspiration occurs in obstetric patients. Aspiration of vomitus is a real danger and the resultant condition, aspiration pneumonitis, which Hall[14] calls an obstetric hazard, must not be minimized at any time. In Hall's fifteen collected cases, five women died. Thus it is imperative that every delivery room be equipped with an efficient suction apparatus, ready for instant use. Its prompt use may often mean the difference between life and death of the mother.

In the 200 gas cases, some degree of nausea and vomiting occurred in 40 cases, that is 20 per cent; but it always occurred before the patient left the delivery room. Thus it was soon controlled with suction by the anesthetist. If the vomitus contained solid food it was even more important to maintain a clear airway by removing vomitus with the index finger protected by gauze. Patients reacted from cyclopropane quickly and soon regained control of their reflexes. The duration of vomiting was almost always less than five or ten minutes. Nausea and vomiting in the spinal anesthesia group was rare and slight, and never a hazard in the conscious patient. In the whole study there was no cases of aspiration pneumonitis or any other respiratory complication. There was no cases of infection or distress at the site of lumbar puncture, no involvement of the meninges, and no injuries to the spine or damage to the nervous system. There was little change in blood pressure in the spinal anesthesia cases and no evidence of actual circulatory depression.

However, the following case developed rather alarming symptoms postpartum:

Spinal anesthesia case No. 84. This patient was a young,

healthy primipara. For a normal spontaneous delivery, she was given a spinal anesthetic at 10:00 p.m., apparently satisfactory for each of the "foursome." However, six hours postpartum she developed a mild headache in the frontal area and complained of blurred vision. Slowly the headache became more pronounced, but was considerably relieved with aspirin and codeine. Eleven hours postpartum she complained of blurred and poor vision, equal in both eyes, and could not recognize by sight persons who stood beside her bed. The headache was moderate and not unbearable. Fifteen hours postpartum vision began to clear. Twenty-four hours postpartum vision was almost normal and headache was only a minor distress. Forty-eight hours postpartum, her vision was perfectly normal and headache had cleared completely.

She had no recurrence of symptoms and before she left the hospital on her tenth day she voluntarily requested another spinal anesthetic for her next baby. Physical examination at all times was normal.

2. The Child

In 1940 Heard[6] carefully appraised the effect of anesthesia on the child born by cesarean section and rightly emphasized the importance of respiration in the newborn. Most of his comments and conclusions in "Anesthesia in Cesarean Section" could be applied to anesthesia for vaginal deliveries.

All the cases here reported were grouped together in regard to the health of the mother and child. Those listed as easy resuscitation are babies who breathed spontaneously and readily, but required some oxygen to facilitate a strong cry and to make the body pink. Oxygen is given until hands and feet are pink, and baby crying well.

Thus 96.5 per cent of the babies delivered with the use of spinal anesthesia breathed spontaneously and required little or no resuscitation. In the gas anesthesia cases, the corresponding incidence was 90 per cent. However, 10 per cent of the babies in the gas anesthesia group required considerable resuscitation, whereas, only 2.5 per cent in the spinal anesthesia group were at all difficult to resuscitate.

Henderson[11] emphasizes that 98 per cent of all babies normally born of unnarcotized mothers breathe immediately, whereas, 30 to 60 per cent of babies born of narcotized mothers require resuscitation, the frequency depending upon the narcotic used. Cyclopropane anesthesia has also a very good record and runs a close second to spinal anesthesia for harmlessness to the newborn. Clifford[12] states, "that spinal anesthesia theoretically should be satisfactory for the babe, but actually the fall in maternal blood pressure that occasionally occurs has produced severe fetal asphyxia." However, in none of the cases in this report was there a notable fall in blood pressure resulting in circulatory depression. Nevertheless, it is vitally important to administer to the mother prior to delivery, and also the newborn, a high concentration of oxygen.

3. The Obstetrician

Almost all of the deliveries in the spinal anesthesia group were conducted by specialists in obstetrics and also the incidence of primiparous patients was considerably higher in this group. In the gas anesthesia cases, the large majority were also conducted by specialists. In the spinal anaesthesia group there were 9 breech deliveries and 191 vertex cases. Ninety-three per cent of the latter were forceps deliveries as prophylactic low forceps is almost a routine procedure. The remaining 7 per cent were spontaneous deliveries. In the gas anesthesia group, there were more multiparous cases and more cases by obstetricians who preferred spontaneous deliveries. There were 5 breech cases and 22 per cent of the vertex cases were spontaneous deliveries, leaving 78 per cent as forceps deliveries. The increased relaxation in the lower uterine segment, as well as in the vaginal and perineal tissues under spinal anesthesia is a definite help to the obstetrician but he must also remember that these cases are more susceptible to lacerations and that additional care must be exercised.

The minimal amount of uterine bleeding in the spinal anesthesia cases was almost phenomenal. The blood loss is largely from the perineum. In comparing the blood loss, as estimated by our obstetricians, it is readily apparent that they cannot be truly accurate. However, the percentage error will be about equal in both groups. In 60 per cent of our spinal cases the blood loss was not over 150 cc. The average amount was 170 cc. In 37 per cent of our gas cases the blood loss was not over 150 cc., but the average was 280 cc. However, even such figures as these do not give a comparison between the actual blood lost from the uterus in these two groups.

In a few cases spinal anesthesia seemed to weaken somewhat the uterine contractions and thus result in prolonged labor. Such a condition may on occasion have necessitated the higher application of forceps. However, such observations were very difficult to evaluate when other obstetric factors were always present.

4. The Anesthetist

The last member of the "foursome" is especially concerned with the technique of anesthesia. Two secrets of success in our series are the use of relatively small doses of the anesthetic agent and the use of very dilute solutions of such drug.

The dangers of spinal anesthesia in obstetrics have all been recognized and never belittled by the anesthetist.

Modified technique and constant care have provided a means of avoiding the many hazards often referred to, and have made spinal anesthesia safe for vaginal deliveries. To obtain the best results, the anesthetist must have the full confidence of the mother. Constant reassurance, care and vigilance on his part are essential.

Recently pontocaine also has been used in dilute aqueous solution, 5 or 6 mg. in either 0.10 or 0.075 per cent solution. Cyclopropane anesthesia in obstetrics is satisfactory to the anesthetist and in spite of the disadvantages aforementioned, we have been obtaining consistently good results. About 70 per cent of our vaginal deliveries are conducted under cyclopropane anesthesia and the remaining 30 per cent under spinal anesthesia.

In any anesthetic, one of the best methods of evaluating the anesthetist is the degree of oxygenation of his patient, and this is literally doubly true in obstetrics, as it affects both mother and child. Good results in anesthesia for vaginal delivery are readily obtainable when a qualified medical anesthetist cooperates with a qualified obstetrician for the common good of the mother and child.

Summary

The postpartum results of 200 consecutive cases of spinal anesthesia for vaginal delivery have been carefully studied and compared with a similar series of 200 consecutive cases of gas anesthesia (cyclopropane or nitrous oxide followed by cyclopropane).

The techniques used in each group have been described.

The incidence of headache of various grades in severity is reported, as well as other sequelae which are found in both groups.

The importance of qualified medical anesthetists with some clinical experience in obstetrics and psychology, is stressed.

All results are classified according to their value to the mother, the child, the obstetrician and the anesthetist.

Conclusions

1 Almost immediate pain relief can be safely obtained for vaginal delivery by use of spinal anesthesia.
2 Best results are obtained if the dose of spinal anesthetic agent is small and given in dilute solution.
3 The incidence of spontaneous respiration and optimum oxygenation of the newborn is greatly increased.
4 Uterine blood loss during labor is greatly reduced by use of spinal anesthesia.
5 Cyclopropane anesthesia for vaginal delivery produces good results.
6 Headache does not occur more frequently after spinal anesthesia than after gas anesthesia, but it may be somewhat more distressing.
7 Mother and newborn babe share equally with the obstetrician and anesthetist in their approval of spinal anesthesia.
8 The services of a qualified anesthetist are just as essential in obstetrics as in surgery.

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(Editors' note: reference No. 1 above does not correspond to reference No. 1 in the text; reference Nos. 9, 13, 16 do not appear in the text.)

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Safety factors in spinal anaesthesia*

Recently there has been much discussion among anaesthetists and surgeons regarding the dangers of spinal anaesthesia. An eminent neurologist, Foster Kennedy of New York, says in an article in *Surgery, Gynecology and Obstetrics* for October 1950, that "paralysis below the waist is too large a price for a patient to pay in order that the surgeon should have a fine relaxed field of operation." Such a statement created a sensation in both the medical and lay press of Britain and America, and has led to much controversy. I do not wish here to take sides in this argument, but I cannot refrain from pointing out that no anaesthetic agent or method is entirely safe. Deaths and disablement occur in every country following administration of ether, chloroform, cyclopropane, intravenous barbiturates and everything else which has ever been tried in anaesthesia. Even water may kill a patient under certain circumstances. The possible neurologic sequelae make me shudder every time I give a spinal anaesthetic, and I certainly do not want to minimize real dangers. I firmly believe, however, that if certain safety factors are followed, spinal anaesthesia can be made relatively safe, and should be the method of choice in a variety of cases. Elucidation of these safety factors is the purpose of this paper, and I shall list them as follows:

1 Meticulous attention to aseptic technique
2 Use of fine atraumatic needles
3 Use of minimum doses of drugs of least possible toxicity
4 Use of dilute solutions
5 Attention to water balance
6. Intelligent combination with other drugs which are to be used for sleep or for stimulation
7 Instantly available oxygenation
8 Proper psychological approach to the patient before, during and after operation
9 Common sense
10 Vigilance

No two people are exactly alike even when it comes to the effect of spinal anaesthesia, and we should be just as careful in the individualization of this procedure as we are about selecting a wife or a suit of clothes. Professional judgment is even more important than technical skill – that's what makes our work interesting and study worthwhile.

1 *Aseptic technique.* No one questions the importance of asepsis in spinal anaesthesia, yet carelessness does exist and disasters result from inadequate sterilization of skin, ampuls, or needles. Sufficient time should be allowed to ensure skin sterilization by whatever antiseptic is used, the anaesthetist should always wear sterile gloves, and be careful about what he touches. Everything that is required for spinal anaesthesia including towels, gloves, needles and ampuls of drugs, may be done up in a tray and the whole tray autoclaved. This obviates the necessity for chemical sterilization of needles and of the outside of ampules, and in our Hospital over a period of years has proved to be a practical and safe method of preparation.

2 *Use of fine needles.* Many neurologists believe that leakage of cerebrospinal fluid is at least one of the causes for headache after lumbar puncture. For this and other reasons, it is advisable to minimize trauma to the meninges by the use of fine sharp needles, introduced gently and with careful attention to direction. The lumbar puncture needle we use for most cases is 22 gage. Careful anaesthetists quickly acquire skill in the introduction of this rather flexible needle even in obese patients, and in parturient women who find it difficult to bend their backs. The still finer 24 needle recently advocated has the disadvantage that it must be introduced through a larger director needle,

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and this makes the puncture of the dura sometimes difficult to keep under control.

I do not wish to decry the whole practice of continuous spinal anaesthesia, but I feel I must record my own view that the method is seldom really necessary, and that it seems reasonable to believe that there is more danger of trauma and permanent neurologic damage from an indwelling needle or catheter than there is from a single careful lumbar puncture made with a fine sharp needle.

3 *Minimum dosage.* From the point of view of immediate cardiovascular-respiratory depression, the size of the dose of the anaesthetic drugs is the most important factor in spinal anaesthesia. I am convinced that the proper dose of any drug for any purpose is the smallest amount which will accomplish that purpose. There is a wide variation in individual patient tolerance to spinal anaesthetic drugs, as there is to drugs administered in other ways. This individual tolerance is difficult to estimate preoperatively, so it is common practice always to give a large dose in order to reduce the chance of failure in a resistant patient. I am sure that in sensitive patients this leads to disastrous overdosage and so I have taken the opposite course, that is always to give the smallest dose which I think will accomplish the purpose. This may lead in resistant patients to insufficient anaesthesia, but since the anaesthetist now has so many arrows in his quiver he can safely change his tactics to meet such a situation.

I am not going to tabulate specific recommendations about the exact doses to be used, but I do want to call attention to the necessity for altering the basis for dosage in accordance with the operative procedure, or the posture of the patient. For safe spinal anaesthesia in obstetrics one should use not more than half the dose which might be considered normal in a routine surgical operation. For instance, I do cesarean sections with 6 mg. of pontocaine, and forceps deliveries with 50 mg. of procaine. Since procaine is probably the least toxic drug for spinal anesthesia I use it wherever I feel it is applicable, and reserve the use of a more toxic drug such as nupercaine for those situations in which it is particularly indicated.

4 *Dilute solutions.* On general principles, dilute solutions are less irritating and less disturbing than concentrated solutions, so I prefer to use dilute solutions whenever they can be employed effectively in spinal anaesthesia. Lund's 1:1000 pontocaine for hysterectomies, and Fraser's 1 per cent procaine for vaginal deliveries are favorite procedures in our hospital. I prefer hypobaric or isobaric solutions to those weighted with dextrose, since I feel that the large volume and the diffusability of such solutions is a safeguard against subarachnoid irritation. Sometimes addition of a vasoconstrictor drug such as neo-synephrin in an attempt to prolong duration seems to do no harm.

5 *Water balance.* In order to minimize effects of leakage of cerebrospinal fluid in dehydrated patients it is wise to restore the extracellular fluid balance as rapidly as possible during and after spinal anaesthesia. After observing the effects of spinal anaesthesia in several thousand obstetric patients I have come to the conclusion that headache occurs more frequently in exhausted dehydrated women than in those who have a short normal labour. The incidence of headache may be somewhat reduced by administering an adequate quantity of dextrose and water intravenously during or immediately after delivery to patients who show evidence of dehydration. Hingson has stated that severe postoperative spinal headache may be effectively treated by the injection of a sufficient quantity of normal saline into the peridural space to raise the pressure above that of the cerebrospinal fluid and thus stop leakage. This may be effective treatment for a severe and alarming headache but in my opinion such a heroic measure is not advisable for the ordinary minor headaches in which there is at least an element of psychic suggestion. The most severe postpartum headache I have had reported during the past year occurred in a woman who thought she had had a spinal anaesthetic but in whom, on account of technical difficulties, the spinal needle was not passed beyond the subcutaneous tissues.

6 *Combination of drugs.* The wise anaesthetist avoids the pitfalls of routine, and no matter how much he comes to like a drug, he is ready to alter his practice in accordance with the requirements of an individual patient. In spinal anaesthesia this leads occasionally to the use of certain combination of drugs, such as light and heavy nupercaine, or light procaine and heavy nupercaine in the same patient in order to meet a special need. We should not hesitate frequently to combine spinal anaesthesia with light general anaesthesia. Indeed, I believe it is a physiologic safeguard to produce light sleep in patients undergoing spinal anaesthesia for major surgical procedures, and thus to remove the poisonous effects of psychic stress. A "sleeping dose" of 1:500 pentothal intravenous drip or light nitrous oxide or cyclopropane by mask is given in the majority of our abdominal operations under spinal anaesthesia, and I believe this is an important factor in enabling us to use extremely small doses and dilute solutions of the spinal agents.

In regard to vasopressor and stimulating drugs, these also should be used in accordance with individual requirements and never routinely. No drug can be given to anyone anytime without some interference with an enzyme system, so why should we ever give drugs unnecessarily? By using small doses of spinal agents, and by quickly replacing fluid and blood losses, we seldom see alarming hypotension, and therefore have little need for analeptic drugs. When we do want to whip up a patient's blood pressure we prefer to use methoxamine (vasoxyl), as this

drug produces no cerebral stimulation and has no cardiac effect. It is stupid to obnubilate a spinal anaesthesia patient and then to wake him up during the operation by using some drug with pronounced cerebral stimulation.

7 *Emergency oxygenation.* Spinal anaesthesia seems so simple and easy that once the technical procedure of the lumbar puncture is accomplished there is a temptation for some anaesthetists to feel the patient needs little further attention. I once heard a hospital administrator express the opinion that anaesthetists should be efficiently employed by expecting them to supervise five or six spinal anaesthetics at the same time. Nothing could be a greater fallacy or more easily lead to disaster. When a patient under spinal anaesthesia collapses he may do so with dramatic suddenness and without much warning. The first thing such a patient needs is oxygen delivered to his lungs in an adequate manner, and this should be attended to before running for analeptic or intravenous fluids. I have heard of cases where patients died because the gas machine was down the corridor or in use in another theatre. We make it an invariable rule that no spinal anaesthetic shall be administered unless there is an oxygen apparatus with masks and endotracheal tubes at arm's length from the anaesthetist. Emergency use of such equipment is not often required when all our other safety factors are observed, but I am nevertheless convinced that it is an imperative precaution even with the most experienced anaesthetists.

8 *Psychologic approach to the patient.* There is a widespread fear of spinal anaesthesia among the lay public. If it is desired to give a spinal anaesthetic to such a person fear can often be allayed by a friendly preoperative visit, an explanation of the reason for this choice of anaesthetic, and assurance that during the actual operation the patient will be asleep as well as free from pain. In our hospital about 60 per cent of all our normal vaginal deliveries are done under spinal anaesthesia, and I believe the fact that this percentage has remained constant over the last four years is fairly good evidence of patient satisfaction with the method. Intelligent cooperation between obstetricians, anaesthetists and nurses has done much to reassure our patients as to the safety and comfort of this procedure. Nevertheless there are some patients, both in obstetrics and in surgery, who simply do not want a spinal anaesthetic under any circumstances. For these patients, unless there is some vital reason for choosing spinal anaesthesia it is foolish for the anaesthetist to insist. Let us sensibly choose some other method. A nervous patient who has been persuaded against his will to undergo spinal anaesthesia will have a tendency to blame all his aches and pains for years afterwards to this procedure, whether or not there is any logical connection. It is equally foolish for an anaesthetist to persist in unsuccessful attempts at lumbar puncture when a patient is becoming disgruntled and tense. This brings us to the last point in my enumeration of safety factors – that is the display of uncommon, but vitally important "Common Sense." I do not need to elaborate this point, but what I mean to emphasize is that in one's judgment regarding spinal anaesthesia, as in every other professional decision, we should have the capacity and the sense to cut through all the silly nonsense of red tape and routine, and meet each emergency as common sense dictates of the physician-patient relationship may require. We, at McGill University, are conducting a three year postgraduate course for training of anaesthetists. We pour into this period instruction in the basic sciences, technical training in all sorts of anaesthetic procedures, laboratory demonstrations, seminars, lectures, and years of repetitive practice under many teachers. Yet, when our students graduate we think we have failed if they emerge just as replicas of me, or Wesley Bourne, or any other teacher. We want them to be themselves, sure in their own soundly based professional judgments, and able to meet whatever situation may arise, whether in spinal anaesthesia or anywhere else, with common sense. In order to have safer spinal anaesthesia we need more good anaesthetists. The factors I have outlined will only be safety factors in the hands of competent thoughtful anaesthetists. For such men it is not necessary to add that vigilance is the price of safety.

JOHN SM ZORAB

The World Federation of Societies of Anaesthesiologists

Ideas that eventually led to the foundation of the World Federation of Societies of Anaesthesiologists (WFSA) in 1955 were first formulated nearly two decades earlier. In 1936 (personal communication from J. Boureau, 1990) two French surgeons, Desmarest and Le Mee, joined the annual meeting of the International Anesthesia Research Society (IARS) in Philadelphia. Frank McMechan, the first editor of Current Researches in Anesthesia and Analgesia, was present at that meeting and urged the French to organize an international congress of anaesthesia. It was this occasion that was, perhaps, the moment of conception for the congresses in London and Paris in 1951 which subsequently led to the foundation of the WFSA. Cornelius Ritsema van Eck[1] records that a "body of Frenchmen, most of them surgeons, had already, in 1937, conceived the idea of a world society of anaesthesiologists. The war in 1939 put a stop to their efforts."

Geoffrey Organe[2] noted that in the five years following the centennial of ether in 1946, "there was a tremendous upsurge of interest in anaesthesia among doctors, ... and there was a general desire for an international organization which would help in the spread of knowledge and in the development of the specialty in countries which were emerging from the dark ages of surgical control."

Jacques Boureau sheds further light on these early days. During the autumn of 1949, a few members of the Syndicat National des Anesthésiologistes-Réanimateurs Française held a meeting at which Robert Hingson, honorary vice-president of the IARS, was a guest. At the time, two French societies existed:

1 The Societé Française d'Anesthésie et d'Analgésie (SFAA), which was founded in 1934, essentially by surgeons, when anaesthetists were not very numerous in France.
2 Syndicat National des Anesthésiologistes-Réanimateurs Française (Syndicat) which was founded in 1946 and whose first aim was the defence of professional interests and the organization of the specialty.

Nearly all members of the Syndicat were members of the SFAA but they were not members of its council which was still under surgical direction. Hingson knew that the IARS was planning to visit London in 1951 and he wished to encourage a follow-on meeting in Paris. Boureau, president of the Syndicat and a member of the SFAA, reported Hingson's wish to the General Assembly of the SFAA which gave it a very enthusiastic welcome. In fact, it was looking again at the idea which had been suggested before the Second World War intervened. The SFAA's main idea in organizing an international congress was to propose to all delegates the creation of an international society of anaesthesia. This enthusiasm led to the organization of the Paris congress, which immediately followed the London IARS congress, and thus played its part in setting the stage for subsequent events.

At its London congress, the IARS itself was not thought to be a suitable international body as its membership was largely North American. However, it was sympathetic to the idea of a world federation and, under Harold Griffith's leadership, it provided financial as well as moral support. At the Paris congress the SFAA proposed the formation of an international organization based in Paris, but this did not find favour because both the president and the treasurer of the French society were surgeons. Nevertheless, Griffith[3] credited two Paris surgeons, Professor Robert Monod and Dr Marcel Thalheimer, with the original suggestion which they made in 1951 in both London and Paris. Thalheimer, on behalf of the SFAA, presented a paper in Paris, 'Creation of an International Movement for the Study of Anaesthesia and the Formation of an International Society of Anaesthesiology.' This paper was presented complete with draft statutes for the proposed society before a plenary session of 350 representatives from 32 nations. Views expressed were generally supportive. The main objection

TABLE I Members of the Interim Committee (Comité Intérimaire)

Initial members (1951)

HR Griffith (Canada), Chairman
A Goldblat (Belgium), Secretary
J Boureau (France)
J Gillies (Gt Britain and Ireland)
T Gordh (Sweden)

Additional members (1953)

Wesley Bourne (Canada and WHO)
E Ciocatto (Italy)
GSW Organe (Gt Britain and Ireland)
H Reinholdt (Belgium)
CR Ritsema van Eck (Netherlands)
RPW Shackleton (Gt Britain and Ireland)
J van de Walle (Belgium)
AW Friend (IARS)
TH Seldon (IARS)
RJ Whitacre (IARS)
JF Delafresnaye (CIOMS)

Additional members (1954)

L Boeré (Netherlands)
CJ Durshordwe (USA)
FF Foldes (USA)
R Frey (Germany)
E Gillespie (Australia)
WA Low (Gt Britain and Ireland)

was by those members who preferred a federation of national societies rather than one international society. An Interim Committee (Comité Intérimaire) was appointed to explore the matter.

After exchanging ideas by correspondence, the Interim Committee held its first meeting in Brussels on June 18-20, 1953. The committee was enlarged[4] by invited representatives from the IARS, five national societies of anaesthetists, and the Council for International Organizations of Medical Sciences (CIOMS) (Table I). Outstanding assistance was given by J. F. Delafresnaye of the CIOMS. It was agreed to establish an international organization to be known as the World Federation of Societies of Anaesthesiologists. The committee had received reports from organized societies of anaesthetists in 21 countries, and societies were known to exist in 6 additional countries. According to the WFSA constitution the 21 national societies were eligible for charter membership, and others could be admitted by vote of the General Assembly at the World Congress in 1955.[4,5]

Griffith's final comment[4] on the Brussels meeting, "An international organization . . . will also inhibit the development of the kind of self-seeking promotion which has plagued other specialties, and which has recently been attempted in anesthesiology," makes one wonder to what he was referring. He also mentioned that anaesthesia societies in certain countries, where the specialty had been dominated by surgeons and others, were rapidly coming under the control of anaesthetists. He had observed this at first hand in France where anaesthetists in the SFAA were now in the majority. Organe[2] also observed that "this attitude of suspicion towards surgeons was widespread and strongly felt," although he added that "on the other hand, it must be remembered that without the active encouragement of influential surgeons, the establishment of anaesthesiology as a major specialty would have been more difficult in some countries."

The first World Congress of Anaesthesiologists was held September 5-10, 1955, in Scheveningen, Netherlands having been organized by a committee under the chairmanship of Ritsema van Eck. Organe[6] records that "here, on 9 September 1955, the World Federation of Societies of Anaesthesiologists was founded. ... As a matter of course Griffith was elected the first President, and Ritsema van Eck the second, for there could be no doubt of their joint contribution to the birth of the Federation." Griffith's outstanding chairing of the Interim Committee brought it to a successful conclusion,[7] and Ritsema van Eck was one of the most active members of the committee.[8] Organe was elected as the first secretary-treasurer. In Ritsema van Eck's full and fascinating account of the congress,[1] there is a photograph of the General Assembly in which Griffith and the other officers can be clearly seen, while in the *Proceedings of the World Congress of Anaesthesiologists* there is a photograph of all the participants.

Following its foundation in 1955, the WFSA developed relatively slowly. The 26 founder-member societies did not enjoy high incomes, and for the first decade the income to the WFSA from its dues was inadequate to permit much beyond simple administrative activities. A brief account of the first 20 years of its development was published by this author,[9] and the following sections update that account.

International congresses

The next important event was the Second World Congress in 1960 in Toronto under the presidency of Griffith. At the General Assembly, Ritsema van Eck (Netherlands) was confirmed as the second president, Organe (Great Britain and Ireland) continued as secretary without the additional burden of finances, and Henning Poulsen (Denmark) was elected treasurer. Principal officers of the WFSA from 1955-1992 are listed in Table II, and venues of the world congresses, which are held at four-yearly intervals, are shown in Table III.

TABLE II Principal officers of the WFSA

	President	Secretary	Treasurer	Exec Cttee Chairman
55-60	HR Griffith Canada	GSW Organe GB & Ireland	GSW Organe GB & Ireland	A Goldblat Belgium
60-64	CR Ritsema van Eck Netherlands	GSW Organe GB & Ireland	H Poulsen Denmark	RA Gordon Canada
64-68	GSW Organe GB & Ireland	O Mayrhofer Austria	H Poulsen Denmark	R Sappenfield USA
68-72	FF Foldes USA	O Mayrhofer Austria	Q Gomez Philippines	H Poulsen Denmark
72-76	O Mayrhofer Austria	JJ Bonica USA	Q Gomez Philippines	H Poulsen Denmark
76-80	Q Gomez Philippines	JJ Bonica USA	C Rivas Venezuela	DDC Howat GB & Ireland
80-84	JJ Bonica USA	JSM Zorab GB & Ireland	C Rivas Venezuela	ES Siker USA
84-88	C Parsloe Brazil	JSM Zorab GB & Ireland	R Ament USA	SW Lim Malaysia
88-92	JSM Zorab GB & Ireland	SW Lim Malaysia	R Ament USA	MD Vickers GB & Ireland

TABLE III World and regional congresses of anaesthesiologists

World	European	Asian/Australasian	Latin-American	
1st 1955 Scheveningen	1st 1962 Vienna	1st 1962 Manila	1st 1949 Buenos Aires	13th 1975 Quito
2nd 1960 Toronto	2nd 1966 Copenhagen	2nd 1966 Tokyo	2nd 1954 São Paulo	14th 1977 Guadalajara
3rd 1964 São Paulo	3rd 1970 Prague	3rd 1970 Canberra	3rd 1956 Bogotá	15th 1979 Guatemala City
4th 1968 London	4th 1974 Madrid	4th 1974 Singapore	4th 1958 Santiago	16th 1981 Panama City
5th 1972 Kyoto	5th 1978 Paris	5th 1978 New Delhi	5th 1960 Mexico City	17th 1983 Lima
6th 1976 Mexico City	6th 1982 London	6th 1982 Auckland	6th 1962 Lima	18th 1985 Montevideo
7th 1980 Hamburg	7th 1986 Vienna	7th 1986 Hong Kong	7th 1964 Montevideo	19th 1987 Caracas
8th 1984 Manila	8th 1990 Warsaw	8th 1990 Seoul	8th 1966 Caracas	20th 1989 Buenos Aires
9th 1988 Washington D.C.	9th 1994 Jerusalem	9th 1994 Bangkok	9th 1967 Buenos Aires	21st 1991 Rio de Janeiro
10th 1992 The Hague			10th 1969 La Paz	
11th 1996 Sydney			11th 1971 Rio de Janeiro	
12th 2000 Montreal			12th 1973 Bogotá	

It was not long before there was a widespread feeling that four years was too long between these major international congresses. As a result, and under the influence of Otto Mayrhofer of Austria, the third president, European and Asian/Australasian sections of the WFSA were set up with the primary task of organizing regional congresses in the intervening even years. The first European and Asian/Australasian congresses were held in 1962 in Vienna and Manila and they both continue to be held every four years (Table III).

The WFSA was not the first international federation of anaesthesia societies. In 1949 the Latin-American

Congresses Protocol was signed by five Latin-American national societies in Buenos Aires, and six of these societies became founder members of the WFSA. During the Sixth Latin American Congress in Lima in 1962, the same year as the regional sections of the WFSA were founded, the Confederación Latinoamericana de Sociedades Anestesiologia (CLASA) was founded. CLASA itself remained an independent organization until 1988 when, at the Ninth World Congress in Washington D.C., it was formally admitted as a regional section similar to the European and Asian/Australasian regional sections.

Not only do these congresses provide a forum for the presentation of scientific papers and opportunities for scientific discussion, they also foster a very real fellowship among anaesthetists from various countries. This fellowship has grown over the years, both through the organization of congresses and by the increase in the number of member societies. In 1958 Griffith[10] described the importance of personal friendships in the growth and development of our specialty, and expressed his regret that the American Society of Anesthesiologists (ASA) was not a member of the WFSA. He emphasized the need of the new organization for the "friendship, the wise counsel and the moral support of the great American Society." Evidently his words were heeded, because the ASA became a member at the Second World Congress in 1960 and has remained a stalwart supporter ever since. It was, thus, entirely appropriate that the first Harold Griffith Symposium[11] should have been held in Washington D.C. during the Ninth World Congress in 1988.

Anaesthetic training centres

In 1950 the World Health Organization (WHO) organized an anaesthetic training course based on the University Hospital in Copenhagen. This was a one-year course and attracted trainee anaesthetists from various parts of the world. Clearly, during those decades there was a great need for such training courses. In 1966 the WFSA set up a Training Centre in Caracas, Venezuela under the direction of the late Carlos Rivas, with outstanding help from Robert Hingson and the Anesthesia Education and Research Foundation. In the early stages the Caracas WFSA Training Centre provided training opportunities for trainee anaesthetists from many parts of South America. However, in later years the trainees were drawn exclusively from Venezuela.

A similar training centre was set up in Manila in 1970 under the direction of Prof. Quintin Gomez to provide training opportunities in the Philippines and the Western Pacific Region. Once again, although in the early stages the trainees were drawn from a wide area, latterly the trainees came largely from the Philippines.

Visiting educational teams

In 1978 at the European Congress in Paris, Quintin Gomez, President of the WFSA, presented the concept of the WFSA Educational Team as another means of educational aid. The following year the Education Committee began organizing lecture tours for pairs of lecturers. For these tours, the WFSA met international travel expenses and the host societies met in-country costs. This scheme met with some success but was limited by a somewhat rigid framework. During the past few years the scheme has become more flexible so that funds can be made available for individuals or small groups provided they meet the new criteria. This system has made possible a highly successful innovation to develop short WFSA Refresher Courses in various parts of the developing world.

WFSA publications

Another important activity of the WFSA has been to produce a number of low-cost manuals, particularly for anaesthetists working where educational material is difficult to obtain. The first of these was Safar's 1968 manual on cardiopulmonary resuscitation which has been translated into fifteen languages and is now in its third, expanded edition.[12] Bonica's manual on obstetric analgesia and anaesthesia is in its second edition[13] and has also been translated into several languages. The most recent is Scott's manual on techniques of nerve blockade, published in 1989.[14] A manual on paediatric anaesthesia is in preparation.

In addition, a four-language Newsletter was published by Springer-Verlag from 1965 until 1974 when it ceased publication because of cost. In 1980 a small leaflet-style Newsletter was introduced on a twice-yearly basis and this continues. From 1984 until 1988 collections of published lectures appeared under the title Lectures in Anaesthesiology but these, regrettably, were also insufficiently profitable for the publishers to continue the series.

Following several years of discussion, the WHO decided to publish a series of manuals for those working in the developing world. The first of these, Anaesthesia at the District Hospital by Dobson,[15] was published in 1988 as a joint venture between the WFSA and the WHO.

In order to assist national societies to overcome the recurring problem of recruitment, especially in the developing world, the WFSA has published a career guide[16] in English, French, Spanish, Chinese and Russian for distribution to senior medical students and newly qualified doctors.

The future

Membership of the WFSA has grown from the 26 founder societies in 1955 to 82 societies by 1988 (Table IV). The society from the last of the large countries, the People's

TABLE IV WFSA member societies with year of election by General Assembly

1955	Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Cuba, Denmark, Finland, France, Germany (FRG), Great Britain and Ireland, Israel, Italy, Mexico, Netherlands, Norway, Philippines, Portugal, Spain, Sweden, Switzerland, Uruguay, Venezuela
1960	Czechoslovakia, Egypt, Greece, Hong Kong, India, Japan, Korea, New Zealand, Sri Lanka, South Africa, United States of America
1964	Bolivia, Bulgaria, China (Taipei), Ecuador, Lebanon, Peru, Turkey, Yugoslavia
1968	Hungary, Indonesia, Kuwait, Malaysia, Poland, Romania, Singapore, Syria, West Africa (Anglo)
1972	Costa Rica, Dominican Rep., East Africa, Germany (GDR), Guatemala, Haiti, Honduras, Iceland, Iran, Iraq, Nicaragua, Panama, Thailand, USSR, Zambia
1976	Pakistan, Zimbabwe
1980	Bangladesh, Malta, Tunisia, Vietnam
1984	Jordan, Sudan, Trinidad and Tobago
1988	Algeria, China (PRC), Nepal, West Africa (Franco)
1992	Jamaica, Papua New Guinea

Republic of China, was admitted in 1988. Societies from Jamaica and Papua New Guinea expect to be admitted in 1992 still leaving a number of smaller countries to be recruited. An application from the Albanian Society has recently been received.

Although the educational activities of the WFSA have grown ever since its foundation, and particularly during the past decade, there is still much to be done. A healthy spirit of cooperation has developed among societies and organizations working in the same field and this can only lead to an increase in the overall educational activity.

It can truthfully be said that the WFSA has grown in stature and influence since its foundation, and it is to be hoped that Griffith would not be entirely dissatisfied with its progress. He would also doubtless approve of the Tenth World Congress being held in the Netherlands, the birthplace of the WFSA, marking at the same time the 50th anniversary of his own historic contribution to the specialty.

Harold Griffith ended his 1958 editorial[10] with the words, "Friendship can not only obliterate the wounds of war, but may bring us to a new era of cooperation, of understanding, and of mutual assistance. God knows the world needs a great outpouring of friendship everywhere." Those words are as true today as they were in 1958.

Acknowedgement

The author is greatly indebted to Dr Maarten Mauve (Netherlands) for much of the early history of the foundation of WFSA. Dr Mauve's first-hand knowledge of the events as they occurred was invaluable to the author's researches.

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HAROLD R GRIFFITH MD

Plans for a world federation of anaesthesiologists

On June 15, 1953, Rolland Whitacre of Cleveland, T. Harry Seldon of Rochester, Minn., A. William Friend of Akron, and I left Montreal, via B.O.A.C. Stratocruiser, for a two week "tour" of France, Belgium, England and Scotland. The immediate purpose of the trip was to attend a meeting of the Interim Committee on the Establishment of an International Organization of Anaesthetists, which was appointed at the Anaesthesiology Congress in Paris, in 1951, and of which I am Chairman. Since Whitacre and Seldon had never been abroad, before, I thought we should see as much as possible, so every minute of our time was filled with professional contacts, entertainment and sightseeing, as well as the sessions of the Committee.

We had a pleasant flight over the Atlantic, missed our connections in London, but managed to arrive in Paris later in the afternoon, via a Brazilian plane, in time for a magnificent reception and dinner by Parisian anaesthetists at "Le Doyen" in Champs Elysees. We were delighted to find Wesley and Sara Bourne well and happy after a year in Paris. Doctor Bourne has been able to accomplish much in stimulating interest in better anaesthesia among surgeons, basic science teachers, and the anaesthetists themselves. In medicine, the French are just as individualistic as they are in politics, and it is not easy to get united opinion. Nevertheless, I found a much better spirit among the French anaesthetists than was apparent when we were there two years ago, and I am sure Doctor Bourne's presence has been responsible for some of this change. Anaesthetists are now in the majority in the French Société d'Anesthésiologie, and are taking over control from surgeons. It was a great pleasure for me to meet again many French colleagues.

The next morning at Hopital Vaugirard we saw Doctor Huguenard conduct "hibernation" anaesthesia with a combination of drugs plus refrigeration, and we visited and admired Doctor Genevieve Delahaye's department at the ultra-modern Clinique Marie Lannelongue.

The next morning we flew to Brussels via "Sabena", the Belgian Air Line, and were comfortably housed in the Hotel Metropole. The first meeting of our Committee convened at 2:30 p.m. at the "Domus Medicorum" rue de Ten Bosch. Doctors Goldblat, Reinhold and Van de Walle, our Belgian hosts, had made most satisfactory local arrangements for the sessions, with a commodious meeting room, good secretarial assistance and a large supply of coffee. We were welcomed, officially, by Doctor Nokerman of the Belgian Ministry of Health, and, in reply, I was able to assure him that our present visit to Belgium was in much happier circumstances than my last one in 1915-1916. After these preliminary formalities, which were in French, the work of the Committee proceeded in English, as this was the only language common to everyone present, and our Belgian hosts were perfectly trilingual. Roll call and introductions showed the following anaesthetists present:

1 The original Interim Committee consisting of John Gillies of Edinburgh; Torsten Gordh of Stockholm; Jacques Boureau of Paris; A Goldblat of Brussels, as Secretary; and myself, as Chairman.
2 Others invited in order to make the proceedings more representative:
Doctors Whitmore, Seldon and Friend, representing the International Anaesthesia Research Society; Doctors WA Low, Geoffrey Organe and RPW Shackleton of London, representing the Association of Anaesthetists of Great Britain and Ireland:
Doctor Ritsema Van Eck of Groningen, representing the Netherlands Society of Anaesthesiologists:
Doctor Ellis Gillespie of Melbourne, representing the Australian Society of Anaesthetists:
Doctor Wesley Bourne of Montreal, representing the Canadian Anaesthetists' Society:

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Doctor E Ciocatto of Turin, representing the Italian Society of Anaesthesiology.

3 Doctor JF Delafresnaye of Paris, Secretary of the Council for International Organization of Medical Sciences, attended and was most helpful with suggestions and advice. The C.I.O.M.S., which is sponsored by UNESCO and W.H.O., also assisted financially toward travelling expenses of some of the delegates.

The first item on our Agenda was the report of a survey of all known societies of anaesthesiologists in the various countries of the world. We had reports of organized societies in Argentine, Austria, Australia, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Great Britain and Ireland, Italy, Netherlands, New Zealand, Norway, Philippines, South Africa, Spain, Sweden, Switzerland, and the United States of America. We know, also, that there are societies in several other countries, such as Cuba, Mexico, Chili, Israel, India and Portugal. In all, there were reports of over 7,000 members in these national societies. It was noted that 5,719* of these members are in the six English-speaking countries, as follows:

United States	4,000 (approx.)
Canada	490
Great Britain & Ireland	883
Australia	172
New Zealand	95
South Africa	74

*Numbers total 5714. – Eds.

The sessions went on for two and a half days. Discussion was frank but harmonious, and all decisions were arrived at by unanimous agreement. I have never attended a meeting where there was so sympathetic an understanding of each others problems, and where there was such a determination to arrive at a mutually helpful policy. After discussion, the following facts became clear:

1 There is a rapidly increasing interest in Anaesthesiology throughout the world.
2 Anaesthesiologists organized into national societies are rapidly increasing in numbers.
3 Anaesthesiology societies in certain countries where the specialty has been dominated by surgeons and others are rapidly coming under the control of anaesthesiologists themselves.
4 There is need for a representative international organization, which should be a federation of national societies.

So it was decided to recommend to the various national societies that a "World Federation of Societies of Anaesthesiologists" should be organized, and a draft constitution was prepared, which will be submitted for suggestions and later approval. The Interim Committee will continue its work, and if the draft constitution is approved by at least ten national societies, a Constituent Assembly for the organization of the World Federation will be held in Amsterdam in 1955. The draft Constitution states that the purposes and functions of the Federation are, as follows:

"The object of the Federation is to make available better anaesthesia to more people throughout the world. In pursuit of this aim, the functions of the Federation shall include the following:

(a) To assist and encourage the formation of national Societies of anaesthesiologists.
(b) To promote the dissemination of scientific information.
(c) To recommend desirable standards of training for anaesthesiologists.
(d) To provide information regarding opportunities for post-graduate training and research.
(e) To encourage research into all aspects of anaesthesiology.
(f) To encourage the establishment of safety measures including the standardization of equipment.
(g) To advise upon request national and international organizations."

Only one organization per country shall be admitted to membership of the Federation. The Federation will be controlled by a General Assembly to which the various member Societies will send delegates on the following basis:

> "Each member organization shall be entitled to one delegate if the number of its members is 250 or less. It will be entitled to two delegates if it numbers from 250 to 500 members; to three if it numbers from 500 to 1,000 members, and to one extra delegate per 1,000 members over 1,000."

There will be an Executive Committee elected by the General Assembly, and general meetings of the Federation will be held on the occasion of international congresses, presumably every three or four years. An international congress will be held in Amsterdam in 1955 at the same time as the Constituent Assembly, with the Nederlandse Anesthesisten Vereeniging as the host Society.

The American and Canadian delegates came away from the Brussels meeting convinced that there is real need for the new Federation, and feeling that here is an opportunity for us to make some slight contribution toward better international relations.

Our business session adjourned on Saturday afternoon in time for us to attend a meeting of the Section of Anaesthesia of the Belgian Society of Surgery, which was held in one of the large hospitals. The program was a symposium on the anaesthetic problems of thoracic surgery, and we were all impressed by the enthusiastic participation of more than fifty young Belgian anaesthetists. This speaks well for the progress of the specialty in a country where a few years ago it was almost neglected. There are three medical schools in Belgium, and each one of them has a fairly satisfactory teaching program in anaesthesiology.

The social part of our visit to Brussels was well taken care of by our gracious hosts.

Our American party then flew to London, where we had reservations at the Cumberland Hotel. We arrived there three weeks after the Coronation, but London was still in its gala dress, and we enjoyed the decorations by day and the illuminations at night. Doctor Ivan Magill entertained us to dinner at the Connaught Hotel, where we had the privilege of meeting many of the famous men of English anaesthesia – Langton Hewer, Bernard Johnson, Featherstone, Macrae, Nosworthy, Rowbotham, Jarman, Low and others. The next day we visited Westminster Hospital, and were dined again as guests of Doctors Low and Rowbotham at the Savoy.

For the following week we travelled by private limousine to Oxford, Liverpool, Newcastle and Edinburgh. I can think of no more delightful way to see Britain and no lovelier time in which to see it than the month of June. Roses and every kind of flower lined the roads, and the beautiful countryside filled our hearts with peace and joy. Our chauffeur took us up through lovely Shropshire, and through the incomparable Lake District, over the Pennine Hills, into byways of Durham and Northumberland, and over the sheep-strewn moors of the Border Country. We were thrilled to see even in the most remote tiny villages buntings and flags, and the prayer "God Bless Our Queen".

Oxford was "on parade" the morning we arrived, for it was the day of the "Encaenia", the ceremony for granting honorary degrees, held in the old Sheldonian Theatre. Professor Macintosh had secured tickets for us, and we were really impressed by the colourful and dignified ceremony – even though most of the speeches were in Latin. We had rooms at the Mitre Hotel, one of the quaintest and most historic inns of England. A guide showed us over the colleges in the afternoon, then we were guests of Professor and Mrs Macintosh for cocktails at their home in Pembroke College, and later had dinner with the Professor and his colleague, Doctor Allsop. Doctor Macintosh had just returned from an anaesthetizing tour to India and Indonesia, and he was bubbling over with enthusiasm for better anaesthesia for the whole world. His achievements in the Nuffield Department of Anaesthetics at Oxford are justly famous, and before we left Oxford we had an opportunity to see for ourselves all that is being done there in clinical teaching and research. One new device which interested us was a simplified ether vaporizer to which a hand bellows is attached, and which together with an endotracheal tube could provide complete anaesthesia service even in the most primitive surroundings.

We left Oxford late in the morning, drove on through Shakespeare's country, lingered in the quaint streets of Chester, hurried under the Mersey in the amazing tunnel which connects Birkenhead with Liverpool, and found Cecil Gray and his colleagues anxiously awaiting us for a full scale party at the Liverpool University Club. That was another pleasant evening during which I had an opportunity to become acquainted with another of the senior men of British anaesthesia, Dr RJ Minnitt, author, editor and inventor.

The Liverpool group of anaesthetists is one of the most active in England, and the teaching department at the University, under the leadership of Doctor Cecil Gray, can hold its own with any such department anywhere, in both research and clinical work. I lectured next morning to the group of twenty postgraduate students in anaesthesia, and I was interested in seeing among them representatives of many countries. Included among them was a little Burmese girl, whom I had met the year before in Hartford. We drove to Aintree Hospital (near the famous race track) where we saw several thoracic operations in which the patient was under completely controlled breathing, using a new type of respirator designed by Doctor JR Esplen. Then after a delightful luncheon with the hospital staff, we were on our way to Newcastle – by a circuitous but most interesting route, which covered all the extremes of English countryside from the cotton towns of Lancashire to the wild and beautiful hills of the Lake District, the Pennines, and the upper reaches of the River Tyne. We arrived in the great city of Newcastle upon Tyne about 10.30 p.m. and even then, it is light enough to drive without headlights in that northern latitude in June. Doctor EA Pask, Professor of Anaesthetics at the Medical School of Durham University, was our host. He is so well-known to so many Canadians, particularly Montrealers, that I do not need to say that we were cordially welcomed and graciously entertained. We were, also, tremendously impressed by the excellence of his Department. I think that in many ways "Gar" Pask has one of the best all-round anaesthesia teaching organizations to be found anywhere in the world. He is surrounded by a group of competent and enthusiastic associates, he has the co-operation of university and hospital authorities, he has adequate financial support for a program of research closely coordinated with clinical problems, and he has his own inimitable clear-thinking brain and absolute intellectual honesty.

On Sunday, we drove over the moors to Edinburgh and were received with open arms by Doctor and Mrs. John Gillies and all their family. We enjoyed a dinner at their home that evening, with Sir James Learmonth, the only other guest. The next morning, Sir James did a lumbar sympathectomy for us, in order that we might see John Gillies' technique of "total sympathetic paralysis", using procaine spinal anaesthesia, plus pentothal and endotracheal oxygen. We were much impressed by the apparently good condition of the patient, in spite of extreme hypotension. For the rest of the day, we drove through the Trossachs, to Lochearnhead, to Loch Lomond, Greenock and Glasgow, returning to Edinburgh in time to bring the tour to a fitting climax with a glimpse of our beloved Queen, as she and her husband were leaving the city after their busy week in Scotland. We drove eighty miles through Burns' country to Prestwick; said good-bye to our faithful chauffeur, Mr Brown, and boarded our plane for home.

It was a memorable tour for all of us, and we hope that our deliberations in Brussels may ultimately be of some value to anaesthetists everywhere.

HAROLD R GRIFFITH MD

EDITORIAL
A world federation of anesthesiologists

Interest in better anesthesia, which has been so marked in the United States during the past few years, has now spread to many other parts of the world. In some countries where, until recently, there has been very little conception of the role of anesthesiology in modern medicine, there is now a great upsurge of enthusiasm. For example, a few months ago we were privileged to attend a scientific session in Brussels where more than 55 young Belgian anesthesiologists entered into a discussion of the anesthetic problems of thoracic surgery, and in Paris we witnessed an impressive demonstration of "hibernation" conducted by anesthesiologists. New societies have been formed in most of the countries of Europe, in Latin America, and in some parts of the East.

At the Congresses held in London and in Paris in 1951 it was decided that an attempt should be made to explore the advisability of organizing an international association of anesthesiologists, and for this purpose an Interim Committee was appointed. Dr Harold R Griffith, of McGill University, Montreal, Canada, was elected chairman, and other members of the Committee were Dr. John Gillies of Edinburgh, Dr Torsten Gordh of Stockholm, Dr Jacques Boureau of Paris, and Dr A Goldblat of Brussels. The first meeting of this Committee was held in Brussels, Belgium, June 18 to 20, 1953. In order that the deliberations might be more representative the following additional anesthesiologists attended by invitation:

Dr RJ Whitacre, of Cleveland; Dr TH Seldon, of Rochester, Minnesota, and Dr A. W Friend, of Akron, all representing the International Anesthesia Research Society.

Dr WA Low, Dr Geoffrey Organe, and Dr P Shackelton, of London, representing the Association of Anaesthetists of Great Britain and Ireland.

Dr Ritsema Van Eck, of Groningen, representing the Netherlands Society of Anesthesiologists.

Dr E Ciocatto, of Turin, representing the Italian Society of Anesthesiology.

Dr Ellis Gillespie, of Melbourne, representing the Australian Society of Anesthetists.

Dr Wesley Bourne, of Montreal, representing the Canadian Anaesthetists' Society and the World Health Organization.

Dr J. Van de Walle and Dr. Henri Reinhold, of Brussels, representing the Professional Association of Specialists in Anesthesia of Belgium.

Dr JF Delafresnaye, of Paris, Secretary of the Council for International Organizations of Medical Sciences, also attended and contributed most valuable suggestions and advice.

The Committee first studied replies to a questionnaire which had been sent out to all known national societies of anesthesiologists. From this study the following facts became clearly established:

1 There is a rapidly increasing interest in anesthesiology throughout the world.
2 Anesthesiologists organized into national societies are increasing in numbers. Definite reports were made of 7,067 members in 18 countries (of which approximately 5,700 are in six English speaking countries). It is known that there are also small groups of anesthesiologists in many countries, for which no figures were available.
3 Anesthesiology societies in certain countries, where the specialty has been dominated by surgeons and others, are rapidly coming under the control of anesthesiologists themselves.

After two days of friendly, frank and harmonious discussion the delegates were unanimously agreed that steps should be taken to organize a "World Federation of Soci-

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eties of Anesthesiologists." It was thought that a federation of national societies would be much more useful than a new "international society" with individual memberships, and that membership should be limited to one recognized national society from each country. A constitution was drafted, which will be submitted to the various national societies for their suggestions and approval.

The purpose of the new Federation, as outlined in the constitution is "to make available better anesthesia to more people throughout the world." The functions of the Federation, in pursuit of this aim, shall include the following:

"a) To assist and encourage the formation of national Societies of anesthesiologists.
"b) To promote the dissemination of scientific information.
"c) To recommend desirable standards of training for anesthesiologists.
"d) To provide information regarding opportunities for postgraduate training and research.
"e) To encourage research into all aspects of anesthesiology.
"f) To encourage the establishment of safety measures including the standardization of equipment.
"g) To advise upon request national and international organizations."

Societies of anesthesiologists in 21 countries have been designated as eligible for charter membership, and others may be admitted by vote of the Constituent Assembly. The Interim Committee is continuing its work in preparation for this Constituent Assembly which it is proposed to hold in Amsterdam in 1955. The new Federation will work in cooperation with such international bodies as the World Health Organization, but it will be quite independent of any government. Until it is established and has proved its value, its expenditures should be on a very modest scale, and its resources will originate mainly from annual contributions paid by member organizations. The International Anesthesia Research Society will not become a member of the Federation, because it is not a national society, but its Board of Trustees has already assisted in the promotion of the Federation and will continue to do so. The world brotherhood idea of this new development is very much in the spirit of the founder of the I.A.R.S., the late Dr. Frank McMechan.

The delegates from the United States and Canada to the Brussels meeting were at first skeptical as to the possible advantages to our two countries of such a World Federation, and also as to whether this might not be just one more new organization for the upkeep of which our taxpayers would be expected to "shell out." After serious study of the facts of the situation, our delegates all became convinced that the new Federation would meet a real need, and that it should not become a financial burden. The Federation could be of assistance to small groups of anesthesiologists in many countries in Europe, the Middle East, Africa, Asia and Latin America, very much in the same way as the parent American Society of Anesthesiologists has been of assistance to small groups in various American states. An international organization set up on a really representative basis will also inhibit the development of the kind of self-seeking promotion which has plagued other specialties, and which has recently been attempted in anesthesiology.

JOHN G WADE

The profession of anaesthesia

Harold Griffith will always be remembered as the anaesthetist who introduced curare into the practice of anaesthesia. His vision of the specialty of anaesthesia and his leadership in implementing that vision have received less attention.

The environment in which Griffith practised has been well described by Shephard[1] who divided the evolution of anaesthesia as a specialty in Canada into six phases. Griffith was involved in at least three of them. The third phase (1920-1929) marked the beginning of professional satisfaction in anaesthesia and the founding of the short-lived Canadian Society of Anaesthetists. The fourth phase (1930-1943) included the growth of the Royal College of Physicians and Surgeons of Canada, the introduction of certification in anaesthesia, and the founding in 1943 of the present-day Canadian Anaesthetists' Society. The fifth phase (1944-1971) saw the resolution of problems affecting the status of anaesthesia. The first autonomous department of anaesthesia in a Canadian university was founded at McGill in 1945, fellowship in anaesthesia of the Royal College was approved in 1951, and the Canadian Anaesthetists' Society Journal was launched in 1954.

Between 1937 and 1955 Griffith wrote several articles that reveal his views on what an anaesthetist should be.[2-4] He himself devoted a large part of his time to clinical anaesthesia and it is clear that he was a superb clinical anaesthetist. Early in his career he developed the clinical skills in the operating room to provide safe care for his patients. He cared about people, and he felt that every hospital and department should have the motto "this hospital exists for the benefit of the patient."

Griffith was convinced that a sound scientific foundation was necessary for a specialty to advance. His own research record is evidence of his commitment to that view. Because of his clinical capabilities, his sound basis in science, his continual stimulation from teaching and his medical administration responsibilities, Griffith developed a vision of anaesthesia that far outstripped his time. He was a keen supporter of obstetrical anaesthesia, he developed one of the early recovery rooms, promoted the blood bank, respiratory therapy, an intravenous fluid and caloric therapy team, and he set the stage for the early development of respiratory and critical care units. He was also involved in diagnostic and therapeutic nerve blocks and this, together with his knowledge of analgesics, led him into the area of palliative care. He stated that a major role of a physician was "to help people to die."

Griffith was a strong supporter of teaching and it is important to realize that for most of his career he worked in a community hospital. He felt that in order to teach, and to teach well, one did not necessarily require a university affiliation. Teaching could occur among colleagues, with members of other specialties, and with nurses and many of the allied health professionals.

McGill University was becoming one of the centres of academic anaesthesia in Canada and the world. This achievement was crowned in 1945 by the appointment of Wesley Bourne as the first professor and chairman of an autonomous department of anaesthesia in Canada. This was a significant advance because at that time in North America, both in hospitals and universities, anaesthesia was organized as a section within the department of surgery. Griffith strongly supported autonomous anaesthesia departments. He believed this was the only way that anaesthesia could fulfill its true potential and achieve the respect and credibility of the medical profession as a whole, particularly in relationships with surgery.

Griffith himself became chief of anaesthesia and also served as the medical director of his hospital for more than 20 years. His position as medical director provided a hospital overview which prompted him to move into areas other than the anaesthetist's traditional operating room role. He was an active leader in the development of Canadian

and American anaesthesia and in organizing professional societies in the United States and Canada.

In 1949 Griffith described his concept of the ideal position of the anaesthetist on the hospital staff.[3]

i He should be a member of an established separate hospital department of anaesthesia and not, as was predominant then, of anaesthesia as a sub-department of surgery.
ii The director of the department should be a certified anaesthetist.
iii Appointments to the anaesthesia staff should be made in the same manner as for all other attending staff. All anaesthetists should be active members of the medical staff, and the director of the department should be a member of the executive committee of the medical staff.
iv The income of anaesthetists should be comparable to that of other specialists with equal qualifications and responsibility.
v His professional relationship with surgeons and other members of the hospital staff should be on the basis of mutual respect and understanding of one another's duties and problems. To influence those around us he believed that, above all else, we must be superb physicians, credible to our colleagues, and respectful of surgeons, nurses and others with whom we work.
vi Teaching of anaesthesia should be carried on constantly. In order to enhance the stature of anaesthetists, we should also play an active role in the medical staff organizations of hospitals, of medical associations and specialist societies, and should participate fully in the university.

His consistent theme that much of the advancement of anaesthesia depended on economics is still relevant today. While he was a strong advocate of economic equality, he was flexible as to whether the manner of remuneration should be fee-for-service, salary, or partnership.

He had great concerns about the commonly observed practice in the United States where a physician supervised multiple nurse anaesthetists or even multiple residents. Griffith believed that only a well-trained physician with a solid anaesthesia background should accept the responsibility for an anaesthetized patient. Although he had a high regard for nurses, he felt strongly that nurse anaesthesia should not be developed in Canada. He viewed the delegation of anaesthesia to lesser-trained or lesser-educated personnel as unethical.

Griffith's writings between 1937 and 1955 provided a vision of the future of anaesthesia that, to a large extent, has been fulfilled. In today's climate his opinions would be interesting. Anaesthetists in North America receive a fair economic reward, based on training, experience, and the risks and responsibility of the specialty. The role of anaesthetists outside of operating rooms has expanded into critical care units, obstetrical analgesia and acute pain services, palliative care, and other areas of patient care. Commitment to education and research as part of our professional responsibility requires constant emphasis to maintain our credibility and status in the hospital as well as in the university. We also have a reasonable lifestyle, with time for regular holidays and participation in non-medical activities – Griffith felt that anaesthetists should become involved in the community and provide service to the community.

Griffith urged us to accept leadership roles in hospitals, universities, professional organizations, and in society as a whole. We must also search for new knowledge, and pass it on to future generations. Nevertheless, I cannot help but finish with what seems to me was Griffith's favourite quote 'katheudontas parateroumen' – 'we watch closely those who sleep' – because in the end our credibility and status depend on our fulfillment of this obligation.

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Anaesthesia from the patient's point of view*

How often we have heard the remark, "It's not the operation I dread, doctor, but the anaesthetic!"

Many of us can remember personal impressions of the operating table where the anaesthetic seemed like a nightmare. In recent years such a change has come over our methods that there should no longer be any such experiences. The purpose of this paper is to bring to our attention as anaesthetists those factors and conditions which make for good anaesthesia from the patient's point of view. This aspect of our specialty is not new, and I have nothing original to report, so experienced anaesthetists must forgive me if I offer to young men who hope to make their living from anaesthesia some suggestions regarding their attitude toward the patient. My remarks are addressed particularly to those who have had their training in large public hospitals where often the patient has no more individuality than that of a name on the list of the work for the day. Personal contact between anaesthetist and patient should be fostered in order to promote confidence. A brief physical examination by the anaesthetist is usually advisable.

An interesting chapter could be written on the stethoscope in anaesthesia – not as an instrument for precise diagnosis but as a means of gaining the confidence of the patient. We know that in cases of doubtful cardiac function mere stethoscope examination is not sufficient to satisfy the requirements of scientific medicine, but in the average normal case there is nothing which gives more encouragement to the patient than to have the anaesthetist apply the stethoscope and then pass some such remark as "Well there's nothing wrong with your heart", or "That heart sounds as if it is good for another fifty years!" So, whether you hear anything or not, my advice is, use your stethoscope.

The choice of the anaesthetic and the method to be used must depend on the nature of the operation and the condition of the patient, and, of course, the wishes of the surgeon should be taken into consideration. However, more and more surgeons who have confidence in their anaesthetists are leaving the choice to us. So anaesthetists must be prepared to exercise their own judgment in this matter. Our first consideration should, of course, be safety, but in most cases the preference of the patient may be consulted. From my own observation I have concluded that most patients prefer a general to a local anaesthetic, providing we can make general anaesthesia comparatively comfortable. At those hospitals with a reputation for good general anaesthesias we find a decreasing demand for local, regional and spinal methods. The introduction of avertin and the barbiturates, and the replacement of ether by cyclopropane and the other gases has entirely altered the patient's attitude toward general anaesthesia. Now many patients return for a second or third operation without any apprehension regarding the anaesthetic, knowing that they will go to sleep almost imperceptibly, and will wake up more or less comfortably without having to face days of nausea from ether saturation. My personal opinion is that local and spinal anaesthesia are almost always accompanied by a certain amount of nervous strain which may lead in a few cases to serious and persistent mental shock. In order to see what a patient feels like under spinal anaesthesia I did what many good anaesthetists have been afraid to do, had a spinal anaesthetic administered to myself for a herniotomy. I felt no pain and I was not really afraid, but even in the familiar surroundings of our own operating room, and in spite of nembutal and morphine, I was under considerable nervous tension, and my conclusion afterward was that it was an interesting but distinctly uncomfortable experi-

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From the Department of Anaesthesia, Homoeopathic Hospital of Montreal.

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ence. Of course, if one gives very large doses of barbiturates and morphine and hyoscine so that the patient is really asleep before the spinal anaesthetic is administered the nervous tension is removed, but I cannot make myself believe that such polypharmacy is good for the patient. So we use spinal and local anaesthesia only when we believe these methods are specially indicated for a particular case, and I am an enthusiastic advocate of avertin or the barbiturates in moderate doses as a preliminary to gas anaesthesia. I prefer avertin to nembutal for abdominal operations because patients like it better, and I believe its effect is somewhat more predictable.

If the patient is to have avertin the anaesthetist should administer the injection himself, for although this requires no particular skill it is often the only time the patient sees the anaesthetist, and to the patient this injection is regarded as the anaesthetic, no matter what may be given to him later in the operating room. A patient pays a bill more cheerfully to a doctor he has seen than to one of whom he has no recollection!

When avertin is being given to a child I see no reason why the parents should not be allowed to remain in the room if they wish. It often gives a child confidence to have his mother beside him when a strange procedure is being undertaken, and it certainly gives the parents confidence in the anaesthetist to watch their child drop peacefully off to sleep. The more we can understand the ignorance and the fears of the laity, the more the public will respect our profession.

I am very much opposed to the practice of putting a patient on an uncomfortable stretcher half an hour before the time for operation and wheeling him in this embarrassing position through the corridors, only to wait in some anteroom until the omnipotent surgeon is ready to give him his attention. I believe the pre-operative order which is routine in some hospitals, of "hypo on stretcher", should be discarded. Preliminary hypnotic medication, whether it is to be avertin, nembutal, or morphine, or something else should be given in the patient's own room, and when the operating room is ready the patient taken there in his bed with as little commotion as possible.

Patients are sensitive about such things as false teeth and the state of their hair or complexion. If it keeps up their morale to come to the operating room with painted lips and blackened eyelashes, I say, let them. They never know how bedraggled their faces may look after an hour or two of anaesthesia, and no harm is done. Many times I have removed a toupee or wig after the patient is asleep and carefully readjusted it to keep up the illusion before the patient awakes. Scrupulous care should be taken of religious medals, rosaries, and such good luck tokens as the patient may wish to take to the operating room. When rings do not actually interfere with the operative procedure I like to leave them on if the patient wishes, for who knows what sentimental values and what depths of emotion may be stored up in these little bits of gold. It is sometimes terrifying to have one's hands tied down before the anaesthesia begins, so I believe such preparation should be left until the patient is unconscious.

From the patient's point of view the induction is the most important period of anaesthesia, for it is then when lasting impressions are sustained. The use of avertin and the barbiturates has spoiled to some extent the "art" of anaesthesia, and yet with any patient who comes to the operating room in a conscious condition there is scope for the anaesthetist to display his skill during induction. When I started to give anaesthetics we had in our hospital only open ether, and there is no better way to learn the art of a smooth induction than to discard all the new paraphernalia of pleasant anaesthesia and to go back to the open ether mask. However, I do not let our interns do this, since I do not think it fair to our patients.

Quietness in the anaesthetizing room during the induction period is essential, but this fundamental principle is all too often forgotten by busy nurses and laughing, talking surgeons and interns. I believe that the anaesthetist should usually talk to the patient during the induction period. Even the most banal remarks sometimes give great comfort at this time, as I can remember in my personal experience. We, for whom the operating room is a means of livelihood, must never forget that for each patient the operation is a tremendous adventure, and that the moment above all others when the emotional upset may be greatest is just as consciousness is going. Don't let us ever get frivolous about our work in the sight or hearing of the patient.

Many patients have a dread of waking up before the operation is over. It is often wise for the anaesthetist to explain that he is present throughout the operation and continues to administer the anaesthetic during that time according to the patient's requirements.

The conduct of anaesthesia during the operation is really the most important part of the anaesthetist's work, but since from the patient's point of view this period is all a blank, we will not discuss it in this paper. I just want to say, be careful with airways and mouth gags and suction tubes, for sore throats and lips and broken teeth are often misunderstood and resented.

The anaesthetist should visit all his patients before they leave the hospital. A discussion of incidents in connection with the anaesthetic will be appreciated by most patients, and forms a personal relationship between anaesthetist and patient which may be of value on some future occasion.

Obstetrics is a branch of medicine where the question of anaesthesia is of the greatest importance to the patient. A difficulty some of us have encountered in this field is the unwillingness of many obstetricians to avail themselves of

an experienced anaesthetist's service. There are still a few obstetricians who seem to believe that pain during childbirth is a God-given accompaniment of this maternal ordeal, to be borne with fortitude, and good for the soul. When I see such a man standing beside a woman in labour I wish that some miracle might happen whereby he and his poor patient would change places. However, the principal reason for inadequate obstetrical anaesthesia is, I am sure, the economic argument. Patients are inclined to bargain so about the cost of confinement that the obstetrician is unwilling to add an anaesthetist's fee. The patient goes into labour without any provision having been made for anaesthesia, and at the last minute an intern is called to administer whatever he or the obstetrician may happen to know something about. The trouble with this arrangement is that really satisfactory obstetrical anaesthesia demands a higher degree of skill than almost anything we may be called upon to do in the operating room, and should be a matter for complete cooperation between obstetrician and experienced anaesthetist. I have observed that very few patients object to paying a reasonable fee to the anaesthetist who has really helped them through the terrifying ordeal of childbirth. Some obstetricians, with whom I have the privilege of working, make a practice of explaining to the patient before she comes to the hospital that it will be to their mutual advantage to have a specialist administer the anaesthetic, and tell her that this will mean a small extra fee. The women are almost always grateful for this advance information regarding the importance of anaesthesia, and they make a point of asking for this service at subsequent confinements.

The method of obstetrical anaesthesia which I have found to be most successful for the average case is a combination of nembutal or heroin for the first stage, Sword's technique of nitrous oxide-air analgesia for the second stage, and cyclopropane for delivery and repair. During the nitrous oxide analgesia period the patient should remain awake and cooperative, and the anaesthetist then has an opportunity to exercise his knowledge of psychology by tactful encouragement. At this period patients particularly resent hearing doctors and nurses in the case room discussing the affairs of the day as if the ordeal of childbirth were not the most important subject in the world just at that moment. Many women have told us that all they remembered of their experience in the case room was that someone with a very kind voice was giving them encouragement.

It seems to me, therefore, that the anaesthetist, whose work touches so many aspects of the practice of medicine, is in a particularly favourable position to understand the patient's point of view. We can do much to bring this point of view to the attention of surgeons and hospital administrators. During the past generation many hospitals have been built around the surgeon as the all important element in the organization, and everything seems to have been designed primarily for his convenience. The motto which should be carried by every department of every hospital is that "This hospital exists for the benefit of the patient". The interests of nursing staff, of interns, of physicians, surgeons and anaesthetists are subsidiary to those of the patient. Conversely, what benefits the patients benefits us, and whatever we as anaesthetists can do to make the patient's stay in hospital safe, comfortable, and pleasant will more than repay us for the thought and effort involved.

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Position of the anesthesiologist on the hospital staff*

The penetrating survey into the profession of anesthesiology recently made by DC Lortie[1] has revealed aspects of the relationship between anesthesiology and other specialties which should warrant serious study. He has pointed out that in many American hospitals the prestige of anesthesiology and those who administer anesthetics is definitely lower than that of some other branches of the medical profession. This fact we know to be true, but often prefer to ignore. We should thank Mr Lortie for bringing this situation into the open, and should firmly resolve to discover a remedy. Low status for anesthesiology in the hospital hierarchy is mainly due, as Mr Lortie has shown, to the still widely held concept that anesthesia is "nurses' work," and to subordination of anesthesia staffs to hospital administrators and profit-seeking hospital policy. Another factor is undoubtedly the dominant position of the surgeon on hospital staffs. For more than a generation surgeons have dominated medical boards, have set up scales of financial remuneration greatly in their own favor, and have dictated to professional colleagues in other branches not only how much these colleagues should be paid, but oftentimes how they should carry on their work. Only now is there appearing on the medical horizon a glimmer of light that makes us hope for more equality between various recognized branches of the medical profession. Another factor in the subservient status of hospital anesthesia departments has been the excessively timid approach to the daily problems of hospital life by many anesthesiologists, both men and women. I certainly do not advocate going around with a chip on the shoulder, but there should be a happy medium between that and "Mr Milquetoast." I suppose the very fact of subservient status tends to set up a vicious circle when it comes to recruitment for anesthesiology. Forceful, ambitious young doctors steer away from such a situation.

Is it possible, then, for us to find ideal conditions and satisfactory professional standing in the field of anesthesiology? You know that my answer will be, "Not only is such a goal possible, but for many this has actually been achieved; and it is the bounden duty of all of us to work toward that end for all of our professional colleagues." My conception of the ideal position of the anesthesiologist on the hospital staff may be outlined briefly as follows:

1 Anesthesiology should be established as a separate hospital department, and not as a subdepartment of surgery.
2 The director of the department and his or her principal assistants should be certified specialists in anesthesiology.
3 Appointments to the staff should be made in the same manner as is the custom for other members of the attending staff, and all anesthesiologists should be active members of the Medical Staff. The director of the department should be a member of the Medical Board, or Executive Committee of the Medical Staff, and should have the same status as the chiefs of other departments.
4 The income of anesthesiologists should be comparable to that of other specialists with equal qualifications and seniority. Whether remuneration is by salary or by fee for service will depend on conditions in individual hospitals, but it should be arranged that anesthesiologists have knowledge of the exact revenue and expenses of their department. The Department of Anesthesiology should aim to be self-supporting, but should not be expected to make a greater contribution toward the hospital deficit than is made by the doctors of other departments. A system of anesthesia practice which is

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proving to be most satisfactory is the partnership or group plan. In this way income is shared between the partners in a mutually agreeable manner, and it is possible to distribute the work in a way which not only tends to more efficient patient care, but which also permits the anesthesiologist to maintain reasonable hours of work and a normal social life. Partnerships may be of all sizes from the two-man arrangement by which the anesthesia service is covered in the small hospital, such as the one in which I work, to the fourteen men and women who are partners in the large Vancouver General Hospital.

5 Professional relationship with surgeons and other members of the hospital staff should be on the basis of mutual respect and understanding of one anothers' duties and problems. The anesthesiologists should assume responsibility for preoperative preparation of the patient, for the maintenance, so far as is possible, of normal physiologic function during operation, and for the immediate postoperative recovery period. Such comprehensive duties demand closest cooperation among anesthesiologist, surgeon, obstetrician, and others. But many of us have been able to demonstrate that such cooperation is not impossible, provided confidence in the ability of anesthesiologists has been established.

6 Teaching of anesthesiology should be carried on constantly, and this can be done even in small hospitals far removed from university centers. If there are no residents or interns to teach, the anesthesiologist should strive to educate other doctors, lay members of the hospital staff, and even the general public regarding advantages of professional anesthesia. So much ignorance exists everywhere regrading the specialty that I sometimes feel that teaching will be the most important duty of anesthesiologists for many years to come.

Having thus outlined what we feel to be an ideal relationship of the anesthesiologist to the hospital staff, let us consider some practical suggestions concerning how such a happy situation may be achieved, or at least approached. I do not know all the answers, but I do know one cause of failure, and that is for a young man to be overconfident, aggressive, combative and mercenary. Those who have been successful in anesthesiology have shown qualities of firmness, but combined with a large measure of tact, enthusiasm, tolerance, wisdom, and Christian charity.

The first requisite for success is ability and determination to provide high quality of anesthesia service. To establish prestige for a new specialty we must demonstrate not only that our work is useful, but that it is far better and more acceptable than any other previous system. It is much easier for a mediocre surgeon to succeed than for a mediocre anesthesiologist. The anesthesiologist with confidence in himself, who quietly and without boasting demonstrates superior ability will almost always gain recognition and acceptance by hospital colleagues. I know there are many examples of injustice where good men have been held down and need to be helped, but what I am trying to emphasize is that the prime requisite for advancement is willingness and ability to provide good anesthesia.

There are other fields beside the routine administration of anesthetics whereby the anesthesiologist can legitimately make his presence felt in the hospital. By readiness to serve on committee jobs, by meticulous attendance at meetings, and by voluntary acceptance of unpopular assignments of all kinds, the anesthesiologist can exert influence out of all proportion to the number or size of his group. As I have visited successful anesthetists in all parts of North America I have endeavored to discover the determining factors of their success, over and above the prime requisite of providing good anesthesia. Almost always there is discernible a personality factor which fosters friendly relationship with other people. A good anesthetist knows how to be friendly not only with his patients and with his surgeons, but with the administration staff, with interns, nurses, cooks, maids, orderlies, telephone operators and all the many workers who make up a hospital family. To be known and well-liked throughout a hospital is half the battle for prestige and respect. The anesthesiologist may occupy himself with many activities around the hospital which can legitimately be brought within his field or specialized knowledge. Such comparatively recent additions to medical activities as oxygen therapy, blood transfusion and intravenous therapy, bronchoscopy, emergency treatment for poisoning and coma, diagnostic and therapeutic nerve blocks are in many hospitals neglected just because there is no physician on the staff with the interest and skill needed for proper supervision over such a variety of services. The anesthesiologist may be just the one who is specially qualified to take over any or all of these "odd jobs." Such work will not bring in much money, but it can add immensely to one's usefulness in any hospital. In the field of hospital administration, some anesthesiologists may also employ any extra time available. It has become increasingly the custom to designate one member of the attending staff as Medical Director or some such title. He has general supervision over the medical activities of the hospital, and acts as liaison between lay administrator and the medical board. In smaller hospitals this need be only part-time work, and for such duty the anesthesiologist is often ideally suited. In my own case, I inherited a good many years ago the honorary position of Medical Superintendent. I must confess that this has given me a good many headaches, but it certainly has not done anything to impair my status, either within our specialty or with the general public. I know of at least three other hospitals in the Province of Quebec where such an arrangement is working satisfactorily for all

concerned. The gist of my argument, therefore, is that an anesthesiologist should in every way possible make himself an indispensable member of the hospital staff. His success, from the point of view of both prestige and financial security, will depend largely on his value to the hospital.

When we turn our eyes upon the community both inside and outside the hospital we see many things which the wise anesthesiologist can do to improve his prestige. Boyd Stewart, in his presidential address at the American Society of Anesthesiology meeting at St. Louis in November, 1948,[2] has very wisely summarized the situation in this regard. Dr Stewart says:

> Active participation and interest in the affairs of the hospital and county medical society committees keep an anesthesiologist in a position of prominence, more or less, within the ranks of the profession. Accepting appointments cheerfully and doing a thorough job of any assignment, tends to generate a kindly feeling and helpful attitude on the part of the general membership. It is comparatively easy to obtain staff support for your own department when you justify your position by such activity. The greatest reward for your efforts is the charitable feeling exhibited by other hospital departments, who often are jealous, because they feel anesthesiology is on the receiving end of referred work and puts out little or nothing in return.

Dr Stewart urged active participation in civic clubs and chambers of commerce. Taking part in the annual community fund drive, the anesthesiologist "will introduce himself and his specialty to many community leaders who are worth while knowing." Local politics, public school affairs are also mentioned, along with the country club which "offers the chance of developing a large acquaintance among business and professional people, who learn to know you as a regular fellow as well as a prominent physician and specialist of the town."

The concluding words of this remarkable address are:

> I believe very strongly that, if we are to be eminently successful in our specialty of anesthesiology, we must pay some attention to the art of the practice, as well as to the actual scientific rendition of anesthesia. As practitioners, we must accomplish the degree of development outside the hospital that we have attained in the operating room. It behooves us as department heads to lead the way and to set the pattern. Our instructions to those whom we train, and to those who are our subordinates, should include this second front. Anesthesiology surely deserves equal recognition with other specialties from the home town public. In some places it already occupies such a position, but in far too many localities we are scarcely known, seldom seen, and never heard. We must exercise our ingenuity to keep out of the shadow which clouded the specialty when we took over from the technicians. We have the credentials and the professional equality but as a young specialty we are not 'catching up' as fast as we might. We just are not getting our story over to the patient and the public. Let's round out our program and make anesthesiology a part of the practice of medicine – not limit it to the operating room."

So far we have concerned ourselves with what the anesthesiologist may do as an individual both within and without the hospital. Let us also consider some aspects of advantageous group action by both our own specialists organizations and by the medical profession as a whole. The words of the report of the Hess Committee on Hospitals and the Practice of Medicine of the American Medical Association[3] came as sweet music to many of us who for years have dreamed about recognition by organized medicine of the claims of the anesthesiologist for united professional support. It is now the official policy of the American Medical Association "that it is illegal ... and unethical for any lay corporation to practice medicine and to furnish medical services for a professional fee which shall be so divided as to produce profit for a lay employer, either individual or institutional, including the hospitals and medical schools." The American Medical Association may withdraw its recognition from hospitals which continue to exploit doctors, including anesthesiologists. However, the report states that--"There can be no exploitation of the doctor or of the hospital if everyone concerned in both management and on the professional staff will work together to supply the greatest possible good quality medical and hospital services to the public, and that most matters in dispute can be settled at a local level by joint action. The medical profession should be dominant in the physician-hospital relationship in all circumstances, but since the physician and hospital are interdependent, it is incumbent on both to be completely interested in all phases of their scientific and financial relationships ... The finances of an institution in which a physician does his professional work are definitely of importance to him and the professional staff, and the proper consideration must be given to these finances if the hospital is to work efficiently and remain the workshop of the physician. ... Unfortunately, in many instances the financial matters of the lay hospital management have been no affair of the staff or of its professional executive committee. This is wrong and probably the cause of most of the differences of opinion. Every professional man on the appointed staff should have a voice in the professional management of the institution. The pathologist, roentgenologist, anesthesiologist and physiatrist should have equal standing with other staff members as active members of the staff."

All this adds up to the fact that at last the forces of

organized medicine are aligned to come to the assistance of professional colleagues in our specialty who may be the victims of unfair economic discrimination. Our battle with hospital administration in many parts of the United States and Canada for fair working conditions is by no means won, but certainly such assistance as is now available should be of great value. I still believe, however, that the united, well-planned and tactful but firm action of local groups of anesthesiologists can be most effective in improving local conditions. Advice and help can come from state and national anesthesia organizations, and from county and state medical societies, but the initiation of action must come from a local group of anesthesiologists. Since our services are vital to hospitals, to surgeons, and to the public, and the demand is far greater than the supply, we are in a stronger bargaining position than we realize, provided we will only stand together. Let each one of us, therefore, go back to his own locality with determination to initiate action for the remedy of situations which prevent the establishing of ideal conditions for the anesthesiologist on the hospital staff. Different methods must be used to meet varying circumstances, but provided we are honest with ourselves and true to the high principles of our profession, I think we can look forward to better days for anesthesiology.

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EDITORIAL
A plea for the "art of anesthesia"*

There seems to be an irresistible urge for everyone who has practised medicine for a quarter of a century to reminisce about the "good old days," and how the young doctors are not the kind of men they used to be. So far as I am concerned, the "good old days" of thirty years ago in anesthesia are gone without regret. We had none of the tools or the drugs which we look upon today as essentials, and I shudder when I think of the battles through which our patients often passed. Yet even in those days I was attracted into anesthesia because there seemed to be an opportunity and a need to practise an art which would give scope for high qualities of wisdom and judgment. One had only to watch some of the old masters of anesthesia at work – men like Ralph Waters, Art Guedel, Tom Buchanan, Sir Francis Shipway, El McKesson, or Wesley Bourne – to realize that good anesthesia involved more than technical skill. What consummate art is involved, for instance, in guiding a nervous patient safely through an induction with open ether and no preoperative sedation! So forceful were the personalities of some of these early anesthetists, so confidence-inspiring, so hypnotic, that patients seemed to be gently lulled to sleep by their mere presence. Today, with drugs to obtund the senses and with instantly acting intravenous anesthetics, we are in danger of losing the "art of induction" – this is probably fortunate for our patients because the art was not always practised successfully. With our increased knowledge of all that now comprises the basic sciences and the technics of anesthesia, however, I seem to discern a tendency on the part of modern anesthesiologists to neglect at least some aspects of the honorable art of anesthesia. Induction has become too easy, operating schedules are too crowded, examining boards seem to be concerned only with knowledge of science, patients are all to often just so many "cases." I believe that if one is to be a successful practitioner of anesthesiology now and in the future one should pay as much attention to the "art of anesthesia" as did the leaders of the past generation.

How can a young anesthesiologist go about acquiring the art of anesthesia? Observant experience is the best teacher, and for this there is, as with all forms of art, no substitute for the apprenticeship system. At least part of the required years of residency should be spent in close daily association with an older man who is actually administering anesthetics. I strongly condemn the type of anesthesia training centre wherein too few practising anesthesiologists attempt to supervise too many residents. It is impossible, in a few of these centres, for the residents ever to enjoy the intimate hour by hour contact with experienced anesthesiologists which is so necessary to the acquisition of an art. A strong case can be made for a rotation system of residency training, wherein six months of the required period should be spent in a small hospital under the personal supervision of a successful, enthusiastic, wise anesthesiologist. Provision for this type of training we believe to be one of the strongest and most fruitful features of our Diploma Course in the Department of Anaesthesia of McGill University. We believe, also, that a few years spent in general practice provide a good background for the acquisition of the art of anesthesia. The general practitioner has unexcelled opportunities for learning how to get along with people, and that is what anesthesiologists must know. So we prefer our students to be men or women, with experience in the practice of medicine, for the art which is acquired in general practice is the art which is needed in anesthesia.

What, then, is involved in the modern art of anesthesia? Like all forms of art, it is hard to define, but one might say it includes all that comprises the practice of the science of anesthesia. This means all the factors which influence the relationship of the anesthesiologist to his patient, to his colleagues, to surgeons, nurses, hospitals and to the community.

An anesthesiologist should have sufficient imagination

*Read at the Annual Meeting of The American Society of Anesthesiologists, Houston, Texas, November 9, 1950.
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to see things from the patient's point of view. In our familiarity with the operating room we must never forget what a terrific adventure anesthesia is for most patients. All our skill should be concentrated before the operation on making the ordeal easier. The methods to be used are different with different patients, because no two human beings are alike. Some need encouragement, some reassurance, some want intelligent explanations and some need firm guidance. A good personal understanding, therefore, between patient and anesthesiologist, before anesthesia, is part of the art of anesthesia.

As the anaesthesia proceeds, artistic skill should accompany scientific technic, and here are a few pointers which I think are important:

1. Never strap the face mask on a conscious patient unless the procedure is fully explained beforehand. Most people have a great fear of suffocation, and straps around the head certainly can be terrifying. I would like to see more attention paid by young anesthesiologists to the art of holding a mask firmly and comfortably on a face throughout a long operation. Head straps can never take the place of skillful hands.

2. It is generally wrong to apply restraining straps of any kind to the conscious patient. Straps are seldom necessary in these days of smooth, rapid induction, and tend to stir up resistance.

3. The careful anesthesiologist pays particular attention to such seemingly minor details as comfortable fit of a face mask, possibility of trauma to lips, teeth, tongue or pharynx, from mouth gags, airways and laryngoscopes. A cut lip will often give more postoperative discomfort than an abdominal incision, and for such unnecessary damage the anesthetist may be entirely to blame. The patient is not responsible for his own actions once we have given him an anesthetic drug, and we must guard him against doing damage to himself.

4. Anesthesiologists and others in the operating room often talk too much and too carelessly in the hearing of conscious patients. The patient expects to be, and should be, the cynosure of all operating room interest. We should at least wait until he is sound asleep before recounting golf scores or other such scientific reports. It is our duty to remind the surgeons and nurses of the patient's conscious state if they start to talk about things which might prove disturbing.

5. Light shining in a patient's face may seem a small thing to be concerned about, but it can be so distressing that this was one of the Nazis' favorite methods of torture. We should think of such little things when we are using spinal or regional anesthesia.

6. We all know that many patients are prejudiced against spinal anesthesia. It may take considerable diplomacy to persuade a skeptical patient to accept this method. If after such persuasion the anesthesiologist has difficulty in making a lumbar puncture he should not persist, as I have seen some do, in poking at a patient's back for half an hour. It is usually good judgment to switch to some other method before the patient becomes utterly disgusted. By bullheaded persistence in such a situation we may be building up a tale about the horrors of spinal anesthesia which will circulate for years among the bridge clubs. In these matters judgment is needed, and common sense – and that is all included in the "art of anesthesia."

Postoperative visits to our patients build goodwill, and yet I find that many of our students simply will not be bothered to make this a routine practice. They seem to think these visits are a waste of time unless there is some complication to be scientifically measured and investigated. Nothing could be a greater fallacy.

The anesthesiologist should assiduously cultivate the art of getting along with other people. Operating room conflicts may often be avoided if there is a basis of mutual confidence, tolerance and understanding between anesthesia staff, surgeons, nurses and hospital employees. Such good relations are essential for a happy and satisfying professional career, but they do not "just happen." I have noticed, as I travel about the country, that those anesthesiologists who have been most successful are men and women who have made themselves important cogs in the whole life of their hospitals and communities. They are interested in all that goes on in their hospitals, they take an intelligent interest in administrative problems, they serve on medical staff committees, they know and are friendly with all the hospital workers, even the porters, cooks and laundry staff. This is all part of the "art of anesthesia." The first duty of an anesthesiologist is to give good anesthesias, but if our economic and social problems are ever to be solved we must not feel that our whole duty ends there. We must make ourselves indispensable members of the hospital family. The more actively we interest ourselves in hospital administration and finance the more likely are we to be able to make local economic adjustments which are ethical and satisfactory to all concerned.

The anesthesiologist should cultivate also a proper status as an important citizen in his community. This may mean taking a part in parent-teacher associations, in service clubs, in fraternal societies, in the church, and in various charitable organizations. I advocate this kind of activity not from any selfish motives of pecuniary gain or even of prestige, but simply because such social responsibilities of our citizenship call forth what is best in all of us. Our democratic way of life comprises more than scientific knowledge and technical ability. It demands of anesthesiologists, as of other citizens, goodwill, co-operation, patience, tolerance and mercy. All of these things make up the "Art of Anesthesia."

DAVID AE SHEPHARD

Eminent anaesthetists

Harold Griffith's ennobling quality of generous respect for his predecessors and his contemporaries is evident in his tributes to early leaders of anaesthesia. For Griffith these pioneers were to be admired for their insistence on high professional standards, which smoothed the way for those who came after them. As a young anaesthetist in Montreal, he developed the art of anaesthesia by absorbing their wisdom born of experience. Canadian pioneers to whom he paid tribute[1] included Horace Nelson of Montreal, who experimented by using ether on himself before administering it to a patient; William Webster of Winnipeg, who remains the only Canadian to have written a definitive textbook of anaesthesia;[2] Samuel Johnston of Toronto who, like Webster, was one of the first in Canada to devote all his time to anaesthesia; Bev Leech of Regina, who fought the long fight during the Depression for recognition of professional standards for anaesthetists; and Charles LaRoque of Montreal, of whom it was said that he had worked too much and too well. All of them set an example of professionalism that was valued by Griffith as he matured in the 1920s and the 1930s – and that example still has value today, even though the circumstances of practice have changed over the years.

Griffith observed that "those who have been successful in anesthesiology have shown qualities of firmness, but combined with a large measure of tact, enthusiasm, tolerance, wisdom, and Christian charity."[3] As he too became a leader in anaesthesia, not only in Canada but around the world, he was inspired and influenced by three remarkable leaders about whom he wrote – John Snow[4] of England, Frank McMechan[5] of the United States, and Wesley Bourne[6] of Canada.

John Snow (1813-58) was the first physician to specialize in anaesthesia and possessed two attributes essential to professionalism.[7] One is the desire to expand and develop new knowledge for the sake of knowledge itself; the other is the desire to transmit that knowledge to others. Snow influenced other physicians through his clinical practice, research and education. Many other qualities, of course, made him a professional,[4] but Griffith noted in particular how Snow worked "incessantly" to promote and maintain a high standard for the nascent specialty. Griffith illustrated this by quoting a parable that Snow himself used. Snow suggested that in surgery, "there would be a great uproar if a student were to undertake on the operating table to tie the femoral artery, and were to open the femoral vein"; whereas in anaesthesia mismanagement of a similar order would be unlikely to occasion a similar uproar. He continued, "at some of our hospitals, the administration of chloroform has been entrusted to the porter, who would only grin in ignorance if informed that each time his services were required, he performed the grand act of suspending for a time the oxidation of the whole body, and of inducing a temporary death; and who would tell you, if you asked him the composition of chloroform, that it was smelling stuff."[8] Snow's ethic of practice, allied with his scientific knowledge, constituted the basis of his professionalism. It was this quality that enabled him to initiate the evolution from what was originally an empirically based craft into a scientifically based medical discipline practised by professionals.

Snow is a worthy model for every anaesthetist. Griffith emphasized those qualities that made Snow a paragon of professionalism: a sense of humanity, integrity and sincerity, industry, sound scientific training, a broad outlook that embraced the whole of medicine, and insistence on the maintenance of high ethical and professional standards. Such qualities cannot be taught; they can only be fostered through the awareness of their infinite value, as manifest in acknowledged leaders of the specialty.

Francis Hoeffer McMechan (1879-1939) exemplified the importance of persons, professional organizations and publications in the development of a specialty.[9] Though increasingly disabled by rheumatoid disease, his genius for

organization and administration[10] led him to found the Associated Anesthetists of the United States and Canada, the National (later, the International) Anesthesia Research Society, and the journal *Current Researches in Anesthesia and Analgesia* (later renamed *Anesthesia and Analgesia*). All of these contributions facilitated the growth of the specialty of anaesthesia. He also had a remarkable talent for cultivating friendships around the world and inspiring younger anaesthetists to practise state-of-the-art anaesthesia. Griffith, who met McMechan in 1922, recalled that "in a few friendly words he made me believe that anaesthesia was worth doing well," and that "the foundation of cooperation, enthusiasm, and friendship ... [was] present ... strongly in the specialty of anesthesiology." Griffith prized the gift of friendship,[11] and his own friendship with anaesthetists around the world also made him a world leader.

McMechan's professionalism was characterized by "study with consequent progress, the teaching and recruitment of others, interaction with other branches of medicine, and devotion to the kind of investigation that solves its own problems."[12] Teaching, recruitment, interaction, devotion – these were the qualities that inspired so many of his colleagues. Griffith observed that McMechan's untiring efforts helped anaesthesia to develop, as it did in the second quarter of the 20th century, with well-organized anaesthesia departments in most hospitals, and active teaching departments and research programmes. So strongly did Griffith feel about McMechan's example that he made it his goal to ensure that all his trainees would know about McMechan; he wanted "to have them progress in their work with the spirit which he instilled into us."

In Wesley Bourne (1886-1965) Griffith saw yet another dimension of professionalism.[6] Graduated from McGill in 1911, he was appointed lecturer in pharmacology in 1921, and McGill's first professor of anaesthesia in 1945. His productive academic career included contributions in clinical practice, laboratory research, writing and teaching. His professionalism also extended to the organizational aspects, for he was one of the founders of the Canadian Society of Anaesthetists in 1920.

Bourne's professionalism, like that of Snow and McMechan, was rooted in wholehearted commitment to work. Griffith believed that Bourne's greatest contribution to the medical profession and to the specialty of anaesthesia was "the flame of passionate idealism" that illuminated his own life and "ignited in his students a spirit of devotion to duty, to truth, and to the welfare of humanity." Educated in the classicist tradition as well as the scientific, Bourne could say that "art and science are not disparate," and that "the science of morals, namely ethics, and science, whether natural or physical, belong to one another [and that] ... they are at their best when thought of together." His knowledge of the classics was responsible for his formulating the Greek motto of the Canadian Anaesthetists' Society – 'Katheudontas Parateroumen', which means 'We watch closely those who sleep' – while his pursuit of scientific knowledge led him to produce sterling research on the pharmacology of numerous anaesthetic agents. Bourne was also a fine human being and a well-rounded individual who brought all of his humanity to bear on his service in the healing art. In Bourne professionalism reached a new height. His ingrained sense of humanity, cultivated by education and motivated by a moral imperative to serve others, was integrated and refined to benefit patients and colleagues.

Griffith's individuality and medical education influenced his practice as an anaesthetist. He was inspired and influenced by others who had recognized the dictates of professionalism, and he himself became a leader. Moreover, we can appreciate his professionalism in relation to that of the many others who preceded him and from whom he learned. In thinking about practice in our own day we can ponder the examples of professionalism – from Snow, through Bourne and McMechan, to Griffith himself.

"Let us all," wrote Griffith, "thank God for these men and women who by their wisdom, vision, persistence, dedication, and integrity have brought the specialty of anaesthesiology to its present respected status."[1] Griffith was one of them. He, in his turn, should be thanked for exemplifying those same qualities that enabled him to advance the status of the specialty.

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John Snow, pioneer specialist in anesthesia*

There is not much credit in the mere acts of living and dying! in being driven by unavoidable fate through the common journey – in doing nothing save the drudgery of existence. But, in the face of all the struggles incidental to existence, so to have managed as to have stolen out of time hours which other men knew not in their calendar – so to have defied the inexorable taskmaster as to perform more than is included in his demands: so to have willed and acted as to live on when death has done his worst – to prove that there is something more in life than labor lost – in this there is achieved the grand "attainment"; the perpetual life.

The immortality of John Snow

"He whom I, with poor biographer's pencil, put forward now in brief sketch, is one amongst the few who have thus realized the ideality of death. It were but little matter, therefore, though no biography should appear at all: it is of but little count that such biography as the recollections of friends shall call forth, be scanty in its details: it is of but little count that the life of him who is shadowed forth is destitute of incident fitted for the taste of wonder-loving, passion-courting, romance-devouring readers. Biographies for these are common. Good men are scarce."

It is with these words that Dr Benjamin Richardson begins his "Memoir" of his friend John Snow, written a few months after Snow's untimely death in 1858. The prophecy has come true. John Snow's work has been immortal, and now seventy-five years later we are gathered here from all the ends of the earth to do honor to his memory. John Snow, a London physician, was the first scientifically trained man to specialize in the administration of anesthetics, and he wrote the first modern textbook on "Anesthesia". But it is not because of mere priority that he has been selected as the "patron saint" of our Congress in this "Century of Progress" year. His title to our reverence rests rather on the sound, scientific, ethical basis which he established for the practice of our art.

Snow's early life and career

The physical details of John Snow's life are unexciting and quickly told. He was born at York, England, in 1813, the eldest son of a gentleman farmer. His early education was at a private school in York. At the age of fourteen he went to Newcastle-on-Tyne, as an apprentice to Mr William Hardcastle, surgeon, of that place. Thus began his medical experience, in the hard school of practice. When he was eighteen, a terribly fatal epidemic of cholera visited Newcastle, and the young apprentice worked indefatigably among the sufferers in the collieries. He left Newcastle in 1833 and spent three more years as assistant to country surgeons. In 1836 after nine years of practical experience, he trudged on foot to London, and enrolled himself in the "Hunterian School of Medicine" in Windmill Street; a school long since closed.

Snow was an enthusiastic and persevering student, although not a specially brilliant scholar. He was much interested in what we now call the "basic sciences" in medicine. It is said of him that "the object of this steady pursuit was always truth; the naked truth, for its own sake, was what he sought and loved. No consideration of honor or profit seemed to have power to bias his opinion on any subject." He was at that time a vegetarian by conviction, and what seemed to his contemporaries stranger still, an ardent and life long teetotaller.

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On May second, 1838, he passed his examination and was entered duly as a member of the Royal College of Surgeons of England. He later passed the examinations of the Apothecaries Company, and with this double qualification began the practice of medicine in London. The first years brought few private patients, but Snow was not idle. He attended the out-patient departments of Charing Cross and Westminster Hospitals, and was a constant reader at the Library of the College of Surgeons. He was firmly convinced of the external origin of disease as opposed to the prevailing theories, and this led him to a special interest in hygiene and its relation to the spread of epidemics. He later became involved in a violent controversy over the cause of cholera. His contention that the disease was water borne we now know to have been true, but it exposed him to much ridicule.

He was interested in chemistry, in experimental pharmacology, and in physiology. He sought to establish his fame on the basis of a sound and rational medicine, and for this reason he did not advance rapidly in favor at the bedsides of "dowagers of the pillmania dynasty." In view of his later achievements it is significant that his first published paper (in the *London Medical Gazette*, 1841) was on the subject of "Asphyxia and the Resuscitation of Newborn Children." Pushing on in the higher branches of his profession, in 1844 "Mr" Snow became "Dr" Snow by passing the MD examination of the University of London. Thus he was equipped for the turn of fortune which came with the eventful medical year of 1846. In this year news came over from America that operations could be performed without pain under the influence of sulphuric ether.

Snow and anesthesia

The fact was just such a one as would at once attract the attention of Dr Snow. It was a physiological as well as a practical fact – rational in its meaning, and marvellously humane in its application. His previous experimental studies on respiration and asphyxia had prepared him for this new inquiry. The first inhalations of ether in England were not so successful as to astonish all the surgeons, or to recommend etherization as a common practice. The distrust arose from the manner in which the agent was administered. Dr Snow at once detected this circumstance, and remedied the mistake by making an improved inhaler. He next carried out many experiments on animals and on himself, and brought the administration to great perfection.

One day on coming out of one of the hospitals, he met a druggist whom he knew, bustling along with a large ether apparatus under his arm. "Good morning!" said Dr Snow. "Good morning to you, doctor," said the friend; "but don't detain me, I am giving ether here, there and everywhere, and am getting quite into an ether practice. Good morning doctor!" "Rather peculiar!" said the doctor to himself: "rather peculiar, certainly! for the man has not the remotest chemical or physiological idea on the subject. An ether practice! If he can get an ether practice, perchance some scraps of the same thing might fall to a scientific unfortunate."

Consequently, with his improved inhaler, Dr Snow lost no time in asking to be allowed to give ether at St George's Hospital. He got permission to give it there to the out-patients, in cases of tooth-drawing. One of the surgeons, standing by, was surprised to see the happy effects of ether when administered properly. As a result Dr Snow was asked to give it on operating days, and he did so with great success. This was on the twenty-eighth of January, 1847, just six weeks after the first use of ether in England. He then administered it at University College with the same success. Liston, then the leading operator, stuck with the new man who came before him in such an able and unaffected way, took him by the hand; and from that time the best ether practice of London came almost exclusively to him.

Snow continued his experimental and practical studies, and in September, 1847 he published his first book, entitled "The Inhalation of the Vapor of Ether in Surgical Operations." Two months later Dr James Y Simpson in Edinburgh began his first experiments with chloroform as an anesthetic, and on November fifteenth published his first pamphlet on the subject. Chloroform was immediately used everywhere to a greater extent than ether had been. Ether was practically abandoned, and it was many years before it was again used to any extent in England. Dr Snow soon became convinced of the greater practicability of chloroform although he was the first to point out its dangerous nature. Nevertheless, as anesthetists still often have to do, he bowed to the wishes of the surgeons, and during the remaining ten years of his life he administered chloroform over four thousand times and ether only twelve times. However he never quite lost his preference for ether.

He says, "I prefer the flavor of ether vapor to that of chloroform; and the sensations I experience from the inhalation of ether are more pleasurable than those from chloroform. I believe that ether is altogether incapable of causing the sudden death by paralysis of the heart, which has caused the accidents which have happened during the administration of chloroform. I hold it to be almost impossible that a death from this agent can occur in the hands of a medical man who is applying it with ordinary intelligence and attention." He pointed out the dangers of mixtures of chloroform and ether many years before such popular combinations as "ACE" were ever heard of. He says: "When the two liquids are mixed, although they then evaporate together, the ether is converted into vapor much more rapidly: and in whatever proportions they are combined, before the whole is evaporated the last portion is nearly all chloroform: the consequence is that at the

commencement of the inhalation the vapor inspired is chiefly ether, and towards the end nearly all chloroform: the patient experiencing the stronger pungency of ether when it is most objectionable, and inhaling the more powerful vapor at the conclusion, when there is the most need to proceed cautiously."

During the years which followed the introduction of chloroform Dr Snow's reputation in relation to his knowledge of the effect of anesthetics, spread far and wide. It is fortunate, indeed, for the subsequent development of anesthesia that there was such a man in England so eminently fitted for leadership in the new science. He made exact pharmacological studies, he pointed out dangers, he devised a comparatively safe inhaler for chloroform, he was constantly on the lookout for new anesthetic agents for either local or general use, and at the same time in spite of his rather reserved manner, he attended and spoke at medical society meetings, and was a prolific and extremely lucid writer. He worked incessantly to promote and maintain a high professional standard for the new specialty of anesthesia. "There would be a great uproar," he remarked on one occasion, "if a student were to undertake on the operating table to tie the femoral artery, and were to open the femoral vein. Yet at some of our hospitals, the administration of chloroform has been entrusted to the porter, who would only grin in ignorance if informed that each time his services were required, he performed the grand act of suspending for a time the oxidation of the whole body, and of inducing a temporary death; and who would tell you, if you asked him the composition of chloroform, that it was smelling stuff." He felt that in this way many patients had been led to their destruction.

"Chloroform à la reine"

In 1853 and again four years later, Dr Snow administered chloroform to Queen Victoria for childbirth. It is well known what a great influence this royal patient exerted in silencing religious critics of the use of chloroform. "Inquisitive folk often burden Snow, after these events, with a multitude of questions. He answered them all with good-natured reserve. "Her Majesty is a model patient," was his usual reply. One lady of an inquiring mind, to whom he was administering chloroform, got very loquacious during the period of excitement, and declared she would inhale no more of the vapor unless she were told what the Queen said, word for word, when she was taking it. "Her Majesty," replied the doctor, "asked no questions until she had breathed very much longer than you have; and if you will only go on in loyal imitation, I will tell you everything." The patient could not but follow the invitation held out to her. In a few seconds she forgot all about the Queen, Lords and Commons; and when the time came for a renewal of hostilities, found that her clever witness had gone home to his dinner, leaving her with the thirst for knowledge still on her tongue."

In spite of Dr Snow's fashionable practice his income never exceeded one thousand pounds a year, and his average fee is said to have been two or three guineas. He lived modestly, found little time for social recreation, although he had many intimate professional friends, and he never married. His health was apparently good, but on June 9, 1858, he suffered a sudden paralytic stroke, gradually sank into unconsciousness, and passed away seven days later, just two days after his forty-fifth birthday. The post-mortem examination revealed slight cerebral softening, fatty degeneration of the minute cerebral vessels, and contracted cystic kidneys. It is probable that his untimely death was to some extent the result of his continued inhalation of chloroform and many other poisonous vapors with which he was constantly experimenting.

During the last two years of his life Dr Snow wrote his textbook "On Chloroform and Other Anaesthetics." In the act of writing the last sentence of this book he was seized with his fatal illness. For us, the book is not only a valuable scientific treatise, but it presents an intensely interesting picture of those exciting years in medical history when pre-antiseptic surgery was suddenly confronted with all the opportunities for advancement afforded by the new anesthetic drugs. Speed was still the most essential attribute of a good surgeon. Postoperative sepsis was so prevalent that only emergency surgery was ever undertaken. Amputations, lithotomy, ligature of arteries, herniotomy, and the removal of external tumors comprise the principal operations for which Dr Snow administered chloroform. He records only ten cases of true abdominal operations, mostly for the removal of ovarian cysts, and all of these patients died. Some of his descriptions throw an interesting light on the surgical procedures of that time.

For example, he says, "On March 10, 1852, I administered chloroform in St Mary's Hospital to a woman, apparently about thirty-five, who had suffered from an ovarian cyst about eighteen years. Mr Isaac Baker Brown made an incision, about six inches in length, into the peritoneal cavity, drew out a portion of the cyst, tapped it, and removed several pints of clear serum. He then cut away a piece of the anterior wall of the cyst, about as large as the hand, and allowed the rest of the cyst to remain loose in the abdomen. The wound in the parietes of the abdomen was stitched up. If I remember rightly, the patient died."

He says: "I have notes of only nineteen cases of operations for strangulated hernia in which I have administered chloroform since the end of 1849. This operation is, I believe, often performed without the use of this agent. In one of the cases there was a complication in addition to the hernia. The surgeon had directed the application of ice and salt. The patient was a scientific man, and applied

the ice and salt most effectually for about four hours. When we arrived, a portion of the integuments around the umbilicus, larger than the palm of the hand, was as hard as a board, and of a dull white color. The part thawed whilst the patient was inhaling chloroform, and when the incisions were made some fluid blood of a light crimson color flowed. Iced water was applied to the part immediately after the operation. The integuments which had been frozen sloughed two days later, the patient had peritonitis and died on the fifth day."

Snow's experimental work

In the first part of his work, Snow describes his physical, chemical, and pharmacological investigation of chloroform and ether. Considering the means at his disposal his experiments were amazingly accurate and complete. The quantity of vapor of chloroform that the air will hold in solution at different temperatures he determined with great accuracy, and he always emphasized the importance of temperature in relation to the administration of volatile drugs. He describes forty-two experiments in which he anesthetized small animals and birds. These were, I believe, the first true pharmacological experiments in the action of anesthetics.

Here is a typical example. "Experiment No. 3. – A guinea pig was placed in a jar holding 3000 cubic inches of air, and thirty grains of chloroform were introduced by a tube in the lid of the jar which was closed immediately by a screw. The chloroform fell on some blotting paper suspended in the jar, and in three minutes it had evaporated and diffused itself through the air in the jar. In two minutes afterward the guinea pig lay down, but stirred when the jar was moved. It was allowed to remain in the jar for half an hour, being asleep except when disturbed. When taken out it awoke and endeavored to walk, but was unable to support itself at first. It flinched on being pricked. Recovered in three or four minutes. This shows, that one grain of chloroform to each hundred cubic inches of air suffices to induce the second degree of narcotism, or that state in which consciousness and voluntary motion are disturbed, but not entirely abolished. Now one grain of chloroform produces 0.767 of a cubic inch of vapor at 60° when its specific gravity is 4.2." Then by an elaborate mathematical calculation he determines that one part in 16,285 is the average proportion of chloroform by measure in the blood in the second degree of narcotism.

As a result of these experiments, and before there were human fatalities to confirm his findings, Snow pointed out that the principal danger in chloroform lies in a paralysis of the heart produced by the rapid inhalation of a highly concentrated vapor. In order to prevent this kind of an accident, he devised an inhaler which made it almost impossible for the patient to receive more than a 5 per cent chloroform mixture with the inspired air. This inhaler was widely adopted and used for many years until Clover made a better one. Snow's inhaler contained blotting paper, and required careful adjustment before each administration. It was safe in Snow's hands, as is proved by the fact that he had no fatality, but others were not so skilful in its use. However, the usual method of administering chloroform was from a handkerchief or a sponge, and it was not long before fatal accidents were recorded.

In his book, Snow gives complete details of fifty such cases. The first case described is as follows: "The first death from chloroform was that of Hannah Greener, which occurred at Winlaton, near Newcastle, on the twenty-eighth of January, 1848. The patient was a girl of fifteen, who required to have the nail of the great toe removed. The following is the account of the accident by Dr Meggison, who administered the chloroform: 'She appeared to dread the operation, and fretted a good deal; in fact she commenced sobbing on our entering the house, and continued so until seated in the operating chair, and commencing the inhalation, which was done from a handkerchief on which a teaspoonful of chloroform had been poured. After drawing her breath twice she pulled my hand from her mouth. I told her to breathe quietly and put her hands on her knees, which she did. In about half a minute, seeing no change in breathing, or alteration of the pulse, I lifted her arm, which I found rigid. I looked at the pupil and pinched her cheek, and finding her insensible, requested Mr Lloyd to begin the operation. At the termination of the semilunar incision she gave a kick or twitch, which caused me to think the chloroform had not sufficient effect. I was proceeding to apply more to the handkerchief, when her lips, which had been previously of a good color, became suddenly blanched, and she spluttered at the mouth as if in epilepsy. I threw down the handkerchief, dashed cold water in her face, and gave her some internally, followed by brandy, without, however, the least effect, not the slightest attempt at a rally being made. We laid her on the floor, opened a vein in her arm, and the jugular vein, but no blood flowed. The whole process of inhalation, operation, venesection, and death, could not, I should say, have occupied more than two minutes.'"

Note the futile restorative measure then in use. Snow was one of the first to emphasize the importance of an open airway during anesthesia and he advocated rational methods of artificial resuscitation.

He was not familiar with the late chloroform poisoning which we now know to be due principally to damage to the liver. Because the operations were all done in a hurry, the period of anesthesia was hardly ever more than a few minutes and the total amount of chloroform absorbed was usually very small. Probably cases of delayed poisoning did occur but the mortality rate in major operations was so

high that such deaths were ascribed to the usual septic poisoning.

Tonsillectomy was unknown, but the following description gives a pretty good idea of what an operation in the mouth was like in those days. This operation was performed in St George's Hospital, in May, 1848. The patient was a man, aged twenty-five; the tumor was of nearly six years duration. For some time previous to the operation, he had suffered occasionally from hemorrhage from the affected nostril, to an extent which had reduced him considerably. The vapor was given to him rather slowly, with the apparatus I commonly employ, and he became gradually insensible, without previous excitement or struggling. In about three minutes, the inhalation was discontinued, the narcotism having reached the third degree. The patient was passive, but the muscles were not relaxed. The breathing was not stertorous. Some teeth were now extracted without causing any sign of pain. A little more chloroform was then given to him, he was in the same state as before the teeth were drawn. The operation was immediately commenced. The superior maxillary and malar bones of the left side were removed. During the first part of the operation, whilst the flaps were made, the patient was perfectly quiet and silent; but afterwards he began to groan and move his limbs, and he was not again rendered altogether insensible; for although a few minims of chloroform were from time to time sprinkled over a sponge, which was, now and then, held near his face, yet, owing to the hands of the operator and his assistants being in the way, and the cavity of the mouth and nostril being laid widely open, he got very little of the vapor, and the only effect of it was partially to quiet him on one or two occasions. After the first two or three minutes of the operation, the effect of the chloroform never exceeded the second degree. The patient executed voluntary movements of his arms and legs; sometimes it was necessary to hold his hands, and at one time he appeared conscious, for he folded his arms as if making an effort not to raise his hands to the seat of pain. He coughed now and then, and seemed somewhat embarrassed with the blood in his throat. He was seated in a chair, but as there was no window in the operating theatre except the skylight, his head was obliged to be inclined rather backwards. He was leaned forwards once or twice to allow him to get rid of the blood, and it appeared that he vomited some on one of these occasions. Towards the conclusion of the operation, and at a time when he was very little under the influence of chloroform, he fainted. He was laid down, and brandy was given to him. No more chloroform was administered after this time. He partially rallied from the syncope, but again became faint. The actual cautery was applied, but oozing of blood continued until the moment of death, – about half hour after his removal into another room. During this interval he was much exhausted; his pulse was small, and difficult to feel. He was tossing himself about in a restless manner, but there was no difficulty of breathing. He seemed quite conscious, doing as he was told, but, of course, could not speak, from the nature of the operation. I left a few minutes before the patient's death. When he ceased to breathe laryngotomy was performed, and artificial respiration exercised by the opening, with no beneficial result. In my opinion, this measure was not indicated, but of course it could do no harm."

I think we can feel thankful that surgery, as well as anesthesia has progressed since 1848!

Conclusions

From this brief outline of John Snow's life and work, I believe we may conclude that he should rightly be regarded as the "father" of our specialty.

He is worthy of our emulation for the following reasons:

1 His absolute integrity, and sense of humanity.
2 His sound scientific training, his industry, and sincerity.
3 His wise original observations derived both from laboratory experiments and practical experience, and seasoned with a generous measure of common sense.
4 His broad outlook, which embraced the whole of medicine, and never became restricted to the one little branch at which he spent so much of his time.
5 His insistence, in the interest of his patients, on the maintenance of high ethical and professional standards in the practice of anesthesia.

We could have chosen no more worthy name to honor, and to bring us inspiration at this most important "Congress of Anesthetists".

HAROLD R GRIFFITH MD FICA

Montreal, Canada

A tribute to Dr FH McMechan*

Recently I came across the following quotation in the "Lincoln Reader," – it was the recollection of a young American immigrant after his first meeting with Abraham Lincoln. I quote it from the Lincoln Reader.

> When, in a tone of perfect ingenuousness, he asked me – a young beginner – what I thought about this and that, I should have felt myself very much honored by his confidence, had he permitted me to regard him as a great man. But he talked in so simple and familiar a strain, and his manner and homely phrase were so absolutely free from any semblance of self-consciousness or pretension to superiority, that I soon felt as if I had known him all my life and we had long been close friends.

These words might have been said with equal truth about Dr FH McMechan. I shall never forget my own first meeting with him, twenty-five years ago. He was visiting Montreal for a meeting of anesthetists, and a friend brought me, a young beginner in medicine, up to Dr McMechan in his wheel chair and introduced us. In a few friendly words he made me believe that anesthesia was worth doing well and spoke as though I could be an important new addition to the workers. Five years later, when I first felt that I had something worth presenting at an anesthetists' meeting, I was welcomed and encouraged, and received the kind of help from him which he was always ready to give freely to young men. Friendliness was the keynote of all his activities. He built up the foundation of cooperation, enthusiasm, and friendship, which is present more strongly in the specialty of anesthesiology than in any other medical group.

During the War it was my privilege to assist in the training of a large number of medical officers in the Canadian Armed Forces. In Montreal we had a cooperative program, embracing French and English anesthetists in our various hospitals. We met on Monday evenings for a general discussion of the previous week's work. At one of these sessions I remember entertaining, as a visitor, the Director of Medical Services. In his remarks he stated that he had chanced to meet with a "Missionary Society" rather than a group of ordinary physicians. He thought it a joke, but I accepted the remark as a compliment. It was pleasant to hear that in our own group McMechan's "soul goes marching on."

In Canada, McMechan was a friend to anesthetists from the earliest day of the specialty. He attended our meetings whenever he was able to travel, and many times when he was really too sick to travel. His last visit was in 1932, when he came to Montreal to unveil in the operating room of the old Hotel Dieu Hospital a tablet in memory of Charles Larocque, beloved French-Canadian anesthetist. Out of this visit there has grown a unique cooperation between the French and English anesthetists of the Province of Quebec. Today anesthesiology throughout Canada is on a high level, with recognized professional status of the specialty. There exist active teaching departments and research programs in the medical colleges, and well-organized departments of anesthesia in most of the hospitals. It seems that these things are the culmination of the work which McMechan began almost single handed, and for which he fought so bravely for many years.

I cannot end this tribute to Dr McMechan without a word about his wife. No man was ever more blessed by a helpmate than he. She was his hands and his feet, his ambassador to all the world, his *alter ego*. How valiantly she has carried on, continuing to do the work which he

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began, keeping together this great world-wide circle of friends, making us all respect each other more because of friendship to her. It shall be my aim to see that all young men who come to me for training in anesthesia shall know about Dr McMechan, and I shall endeavor to have them progress in their work with the spirit which he instilled into us.

HAROLD R GRIFFITH

Wesley Bourne

Eminent Anaesthetists, No. 6

I welcome the opportunity to write about one of the great anaesthetists. I do not wish my words to sound just like a eulogy – and much less an epitaph or an elegy – but I cannot claim to be entirely dispassionate because the subject of these biographical notes is not only my mentor, my teacher and my academic predecessor; he is also my closest and dearest friend.

Wesley Bourne was born in Barbados, British West Indies, on April 24, 1886, the son of James Thomas Bourne and Mary Elizabeth Harding (all good old English names.) He and his three brothers and one sister grew up in the pleasant, devout and cultured atmosphere of a tropical plantation home. Wesley learned to love the sea, the green fields, the trees and flowers, and the open sky. The whole of his formal education before coming to medical school was obtained at the little "Lodge School" in Barbados. Here he came under the influence of teachers who were all Oxonian scholars; and who, with the assistance of two very salutary canings, instilled into Wesley a deep love for the classics. Fortunately for the literature of anaesthesia, his mind has remained impregnated with much that he learned as a boy.

In 1907 Wesley Bourne came via New York to Montreal, saw his first maple leaves and snow, and other Canadian wonders; and plunged immediately into the study of medicine at McGill University. Shepherd, Mills, Adami, Armstrong, Lafleur, Chipman, Martin, Blackadar, were among McGill teachers of that day who had succeeded to the mantle of the great Osler. Young Bourne's college career was uneventful except for a long bout with mumps, and the winning of first place in Anatomy. He graduated in 1911, as Doctor of Medicine and Master of Surgery, spent the next year attending to the medical needs of a railway construction gang in Western Canada; and then returned to the Royal Victoria Hospital in Montreal to learn to be a surgeon. He was the bright protegé of Edward Archibald, who later became McGill's cultured, wise and much beloved Professor and achieved world renown as the "father" of thoracic surgery. To Archibald, whose warm friendship was always an inspiring and steadying influence, Bourne attributes much of his professional success. Anaesthesia at the Royal Victoria Hospital was at that time administered single handed by Dr FW Nagle, one of the very few Canadian specialists in this field. He needed help, and Archibald asked young Bourne to try his hand at "dropping ether". Thus the die was cast – from that day on, surgery was superseded by the gradually developing and all-engrossing realm of anaesthesia. When, a few years later, Nagle met a tragic death, Bourne was offered his post. But the idea of a full-time hospital appointment did not appeal to the rising young anaesthetist, and he wisely chose to remain in private practice.

Bourne's connection with the teaching staff of McGill University dates from 1921, when he was appointed Lecturer in Pharmacology, a position which he occupied for nearly twenty-five years until the Department of Anaesthesia was established. Thus he began the research and the scientific writing which have made his name known throughout the world. He somehow found time to combine this activity with his busy, prosperous clinical practice; and to travel to countless professional meetings and conferences throughout North America, Great Britain and other parts of the world.

In 1913 Wesley Bourne had the good fortune to marry lovely Sara McGillis of Montreal. Their happy home throughout the years has been blessed by the arrival of three sons and one daughter, and now several grandchildren. Douglas, the eldest, served as a major with the Royal Canadian Corps of Signals in Iceland, and is now an electrical engineer in Montreal. John, the second son, became at twenty-five a Lieutenant-Colonel in the First Special Service Force, that super-commando American-

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Canadian combined regiment which was the brainchild of Winston Churchill, and which was used for specially hazardous ventures. John Bourne commanded the first tank which clattered into the streets of Rome, after the bitter fighting of Anzio. Robert, the youngest, graduated in medicine at McGill in 1949, and is preparing himself for a career in internal medicine. Barbara, the only daughter, is to be married this autumn, and so Wesley and Sara will be alone at home – but with what happy memories, and with their children and grandchildren still near by.

Wesley Bourne's contributions to anaesthesia have been in the four fields of clinical practice, laboratory research, writing and teaching. So outstanding has been his eminence in each field that it is quite impossible to pick out any one achievement as his greatest. In clinical anaesthesia he is a master of the art, with an almost hypnotic approach to his patients. He loves people; he is interested in their problems; he sees things from their point of view; and he inspires confidence. He has been a pioneer, although never quite the first, in the clinical use of almost all the new agents which have been introduced into anaesthesia in the last generation. He is alert to what others are doing, he has good judgment in sorting the good things from the impractical ones, and he is a critical observer. In his clinical work he has been successful because he knows that fear, anxiety, apprehension, may be just as harmful to the patient as physical blows or chemical poisons. Much of his work towards the popularization of new agents and new methods has been prompted by the need to make anaesthesia and recovery less distressing and more comfortable. In this regard I am reminded of Dr Bourne's love for unusual words (which he always uses properly) – he tells our students that the purpose of pre-operative medication is "to obtund, to obfuscate, and to obnubilate!"

On appointment to the teaching staff at McGill, Wesley Bourne plunged at once into the laboratory investigation of anaesthetics and of the effect of anaesthetic drugs upon human physiology. His first paper was on "The Anaesthetic Properties of Pure Ether", and then there was a rapid succession of studies on acidosis, on the excretion of phosphoric acid, on heat regulation, and on water exchange. In collaboration with Barbour, Stehle, Raginsky, Melville and other pharmacologists he published reports on liver and kidney function which have become classics in the literature of anaesthesia. Much of his laboratory work was done at night because his days were filled with clinical practice, and all of his reports are written in precise and faultless style. In 1924 he was awarded the Master of Science degree by McGill University, and in 1935 he became the first Hickman Medallist of the Royal Society of Medicine. As each new anaesthetic agent came into use, it was subjected to the critical analysis of Bourne's laboratory study, and we have from his pen many reports about Avertin, vinyl ether, cyclopropane, Amytal, Pentothal, Nupercaine and Pitressin. The total number of his contributions to medical literature is now more than one hundred articles. As the years went by he allowed his writing to become not less scientific but more philosophical, and he gave rein to his erudition and his love for the classics. This is reflected in the titles of some of his more recent contributions, for example – "De Officiis in Anaesthesia", "The Perfecting of Anaesthesia", "Anaesthesia for the Republic of Plato", "Wise Indifference of the Wise in Anaesthesia", "On Learning Anaesthesia", "At the Head of the Table", "Anaesthesia, Pursuit of Learning", "Fors Clavigera in Anaesthesia", and "Measure and Order in a School of Anaesthesia". The following quotations, limited as they must be, will give come impression of his style, his breadth of interest, and his rich form of expression.

> It seems not too much to assume that customarily not nearly enough attention is paid to fear, which is perhaps the most fundamental of animal emotions. Anyone contemplating a surgical operation is subject to some degree of fear ... out of it may come excruciating phantasmagoria during the period of going under an anaesthetic, and such spectres are so realistic that severe shock may ensue, the end-result of which nobody can foretell. Suffice it to say that tremendous dissipation of nervous energy is very likely to occur. It is our duty, therefore, to allay fear. ... The physician should adopt metaphysical (in the broader sense) principles, apply them himself, and solicit the co-operation of all attending the patient ... these principles, in general, belong to the cultivation of a psychological approach as well as to the carrying out of some psychological ritual through the affectation of voice and gesture, gentle and persuasive, in order to inspire confidence, gain reliance, and induce harmonious contentment.
>
> From a consideration of the effects of anaesthetics on the liver, two aphorisms may be engendered, namely, that chloroform is to be eschewed, and that oxygen should be used with all general anaesthetics. ... We do well to remember that oxygen is virtually a food; indeed in anaesthesia it might be considered an ambrosial food.
>
> In olden times the liver was thought to be the seat of love or lust and in this manner the father of Euphuism, the Oxonian, John Lyly, of Elizabethan days, made mention of it in his *Endymion* as: 'It tickleth not my liver!' Whether or no it be true that such passion saps vitality, we must now behold the liver with other than amatory eye. The liver is a prodigious organ, possessed of multiform activities, assimilatory and secretory, diurnal and rhythmical. However, despite its magnitude and physiologic importance, its cells are exceedingly susceptible to injury, so that in the very performance of their duties they are apt easily to succumb."
>
> The perfect anaesthetic is far to seek, and, vague-looming, may remain in the realm of the ideal. It is difficult to conceive

of a chemical entity capable of producing narcosis without untoward action and at the same time suitable for all manner and conditions of men. Rather is it better to believe that our end and aim in ease will be attained the sooner by using such anaesthetics as are least harmful, by improving the methods of their administration, and by being prepared to offset or lessen deleterious effects.

It stands to reason that he who learns from many masters, all else being equal, will these outdo, as time goes on, in knowledge and action. It stands to reason that he will be more capable, more Jeffersonian, more perspicacious than he who abides too long with one set of categories. ... Let us avoid becoming too fond of any one idea or thing, any one drug or method, even be it method of teaching. Let us, rather ... do all in our power to bring it about that the anaesthetist of tomorrow will be more accomplished than are we. Shall we not thus be attempting the altruistic?

Throughout his whole professional life Wesley Bourne has been active in the group activities of anaesthetists. Stimulated by Frank McMechan in 1920, he became the organizer and secretary of the original Canadian Society of Anaesthetists, which was ten years later merged with the Canadian Medical Association. He designed the crest of the Society, which shows the Greek God Hypnos pouring from his horn the poppy juice, and he chose the motto which I think is still the best description of the anaesthetist's duty, *Katheudontas Parateroumen*, "We watch closely those who sleep." In 1932 he was Vice-President of the Section of Anaesthesia of the British Medical Association. He served as President of the International Anesthesia Research Society in 1925, and again in 1940. He was Chairman of the Section of Anaesthesia of the Canadian Medical Association from 1932 to 1936, and in 1942 he was elected President of the American Society of Anesthesiologists – the only foreigner to be so honoured. He represented Canada and the United States at the Anaesthesia Centenary celebrations in England in 1946, and was an official delegate to the First Latin-American Congress of Anesthesiology at Buenos Aires in 1949. In 1950 the Congress of Anesthetists at Miami, Florida, was held in honour of Wesley Bourne, and on that occasion the anaesthetists of the Province of Quebec presented to him his portrait painted by A. Sherriff Scott, R.C.A., which is reproduced as the frontispiece of this journal. This gesture which was fostered by his French-speaking colleagues was particularly touching to Dr Bourne, because the promotion of good relations between the two language groups in Quebec has long been one of his fondest aims.

As a teacher, Wesley Bourne has stimulated and inspired countless young anaesthetists. However, post-graduate teaching was informal and unorganized until 1941 when he and Digby Leigh, and some others in the Montreal group, offered their services to the armed forces for the systematic training of medical officers to be anaesthetists. A four months' course was organized, and from that time until the end of the war a succession of doctors from all three services were given intensive teaching in both the clinical and basic science aspects of anaesthesiology. Dr Bourne became Consultant to the Royal Canadian Army Medical Corps with the rank of Lieutenant-Colonel, Dr Leigh was Consultant for the Royal Canadian Navy, and I for the Royal Canadian Air Force. The whole programme was designed and directed by Dr Bourne as a patriotic duty, and without any personal remuneration. In 1945 the pattern of this course was followed in the organization of the Department of Anaesthesia of McGill University. The Principal and Governors of the University decided to establish anaesthesia as an independent Department in the Faculty of Medicine, and Wesley Bourne was appointed the first Professor. With characteristic energy he proceeded to organize systematic teaching in anaesthesia for graduates as well as undergraduates. A three-year Diploma Course for specialist training was started, with the unique advantage that students rotate as residents every six months between various co-operating hospitals, and come together frequently and regularly for seminar discussions, basic science courses and other lectures. The curriculum of the Department was so wisely planned that it has continued almost unchanged in spite of inevitable changes among teachers, and wide variations in the numbers and qualifications of the students. The "Monday evening forums" of this group have become famous, attracting French and English-speaking anaesthetists, and visitors in large numbers. Although Dr Bourne has delegated the active direction of these colloquia to others, no "Monday evening" is ever complete without his friendly, stimulating presence.

The Chairmanship of the McGill Department of Anaesthesia has now, through the inevitable passage of the years, been passed on to other hands. However, if nothing else remained of all the work of Wesley Bourne for anaesthesia, this Diploma Course alone would be a worthy and lasting memorial. Already, dozens of its graduates have gone to many places throughout the world to assume leading positions in hospitals, in practice, and in other medical schools. Each one has left McGill with the words of his great teacher ringing in his ears: "Although it is not given to us to know the whole truth, we do know that the secret of all learning lies in the passion for the search, and we shall do well to remember the warning of Horace, `Life grants no boon to man without much toil ...' The anaesthetists of tomorrow, having fulfilled these requirements, should become inured with the spirit of rational effort, with a zeal for measuring; should become imbued with an urge for inquiry, governed by sense of order."

Wesley Bourne has been more than just an able teacher,

a brilliant scientist and a good clinician. His greatest contribution to our profession and to the specialty of Anaesthesiology is the flame of passionate idealism which has illuminated his own life, and with which he has ignited in his students a spirit of devotion to duty, to truth, and to the welfare of humanity. He claims that he is not a "religious" man, but actually he is full of a deep faith in God, and his mind is brimming over with the richest fruits of the great essayists, poets and philosophers. He has inspired many young men to "preach the Gospel" – not only the gospel of better anaesthesia, but the gospel of better Christian citizenship. On May 21, 1950, Dr Bourne preached a sermon entitled "Cultivate your Gardens" in Christ Church Cathedral in Montreal on the occasion of "Hospital Sunday". I wish that all the wise and good things he said at that time might be recorded here in just the inimitable way in which they were delivered. I shall have to content myself with the following quotations:

Despite the beneficient inroads of science, art will little wane nor long lag in medicine. This is not art for art's sake, nor art for relaxation, it is rather art as technique implying purpose with the ideal of such perfect adequacy that 'art conceals art. ...' Let us call medicine an art and a science. Let us call it both or neither. ... Edwin Grant Conklin has written: 'The ethic of the great scientists is essentially similar to that taught by great religious leaders. ... The Decalogue of Moses might be accepted as the Decalogue of Science if the word "Truth" were substituted for the word "God". ...' As scientists we are inheritors of a noble ethical tradition: we are the successors of men who loved truth and justice and their fellowmen more than fame or fortune or life itself. ... 'To us the inestimable privilege is given to add to the store of knowledge, to seek truth not only for truth's sake but for humanity's sake, and to have a part in the greatest work of all time, namely – the further progress of the human race through the advancement of both science and ethics ... 'In this mood I could go on to quote many more excellent authorities. But I must forbid myself the pleasure. Only, let us realize that art and science are not disparate. Let us understand that the science of morals, namely ethics, and science, whether natural or physical, belong to one another. Indeed, they are at their best when thought of together. ... Utterly to interfuse one with another seems as natural as the essential unity of hue and form and odour of a blossom. ... Let us remember the three sister words of love – *philosophia, philanthropia, philotechnia*. The Father of Medicine, Hippocrates, used these words together. ... In a delightful little book called *The Two Villages*, Lord Elton writes that `there can in fact be no collectively good people unless there be many separate good men.' Then he goes on: '*Cultivez votre jardin* – for the average citizen there could hardly be more salutary advice. Cultivate your gardens! A great many tidy and fertile plots make a prosperous country. Cultivate your gardens!' Let us cultivate the garden of youth, so to tend the coming generations.

The idea of `Hospital Sunday' ... arouses devotion to human interests, and lends fervour as it reminds us that Jesus said, 'Ye have the poor with you always, and whensoever ye will ye do them good.' And again, 'Inasmuch as ye have done it unto one of the least of these my brethren, ye have done it unto me.'

This, then, is the measure of the stature of Wesley Bourne.

DAVID AE SHEPHARD

The legacy of Harold Griffith

Harold Griffith first gave an anaesthetic in 1916, when he served with No. 6 Canadian Field Ambulance as a humble corporal in France. He retired in 1967 as professor at McGill University in Montreal, renowned throughout the world for his contributions to anaesthesia in clinical practice, research, education and organized medicine. Because his experience of anaesthesia covered five of the twelve decades since Morton had demonstrated the efficacy of ether in 1846, he could speak to his younger colleagues about the "fantastic" changes in anaesthesia from his unparalleled experience. His knowledge and understanding of both the art and the science of anaesthesia were profound. Griffith died in 1985, and in this volume we honour his legacy of "good work" – the fruits of his career, his influence on anaesthesia, and his belief that, while the *science* of anaesthesia will continue to change, the *art* of anaesthesia in the relationship between physician and patient does not change.

In his valedictory address in 1967, Griffith looked back at the great changes in anaesthesia that he had seen during his long career.[1] When he closed his address with the couplet, "Lives of great men remind us / We can make our lives sublime," he was thinking of predecessors and colleagues like William Webster, Samuel Johnston and Wesley Bourne in Canada, and Ralph Waters and Frank McMechan in the United States. Now we can think about him and his career – his example as a practising anaesthetist, his scientific contributions, his international vision, and his knowledge and wisdom – and ask ourselves how we may incorporate the essence of this great man's legacy into our own work.

In 1948 Griffith addressed the topic 'Anesthesiology Today and Tomorrow'[2] at the 23rd Annual Congress of Anesthetists at a joint session of the International Anesthesia Research Society and the College of Anesthetists. He honoured those who inspired him, and from whose wisdom he learned the art of anaesthesia. He suggested that to be true to them, while mourning their absence, he could best honour their memory by looking forward rather than by dwelling on the past. Now, in honouring Griffith's memory, we might do the same. We can observe how he used his knowledge and understanding of progress in anaesthesia during his career to give us his perspective of the future.

Many of his comments pertained to organizational rather than scientific matters. He noted the importance of "a universal recognition by hospital staffs and the medical profession that the anesthesiologist is a specialist of equal status with internists, surgeons, obstetricians, and other specialists." Today, though those considerations are raised periodically they are not of overriding concern, for Griffith and others paved a path that has made anaesthesia easier for us. He held that "the best way to overcome this inferior status is not by legislation or battle, but for every individual anesthesiologist tactfully to do such good work that gradually even the most tradition-bound hospital staff will become convinced of his value." The scientific content of anaesthesia has changed a great deal in the past half-century, but Griffith's observations on relationships among health professionals remain valid. He was emphasizing that, whatever the changes in anaesthesia, it will remain of fundamental importance that individual anaesthetists continue to do "such good work" that the role of the anaesthetist will always be valued by others. Part of the legacy of Griffith, then, lies in the role he modelled as a respected physician and anaesthetist who understood the essence of the practice of anaesthesia.

Griffith identified five recent trends in the progress of anaesthesia: the wide variety of techniques resulting from the multiplicity of available anaesthetic agents, the diminution of doses of anaesthetic agents made possible by the introduction of drugs like curare, the ability to adapt techniques to the needs of each individual patient, the expansion of anaesthesia into numerous fields outside the

operating room, and the improved teaching of the basic sciences. These trends seem commonplace today for they have become part of the practice of anaesthesia, but in 1948 they were novel enough to warrant mention. He also observed that "progress in anesthesiology has not reached its zenith, it is just starting."

Griffith spoke of the past and the future again in 1951.[3] The principal changes that he emphasized were the rational use of intravenous anaesthetics, the introduction of curare and other relaxants, an increased appreciation of the value of gaseous anaesthetics, a renewal of the appreciation of the place of spinal anaesthesia, better obstetric anaesthesia, and improved training in anaesthesia. He noted especially the steady improvement in the training of anaesthetists over the years. This was a common thread in the tapestry of his vision of anaesthesia the world over, and he spoke of it frequently. He emphasized that "safe and satisfactory anaesthesia requires the attention of physicians with special knowledge and skill." In 1951 university departments of anaesthesia were of recent origin; the first in Canada had been established at McGill University in 1945 – a full century after the birth of anaesthesia. Many of the changes of that first century had taken place in Griffith's own lifetime. He poignantly recalled that "oftentimes it was just as bad for one's peace of mind to be the administrator as the recipient of an anaesthetic." Neither he nor his patients could forget the discomfort or even the anguish associated with ether and chloroform. But these experiences had matured him and, while he sought always to smooth the course of anaesthesia for his patients, he also smoothed the path of the anaesthetists who followed him.

Griffith also discussed the "mutual confidence and co-operation" that underlies the relationship between anaesthetists and the hospitals in which they practise. As a hospital administrator himself, he knew the value of this relationship. Today this relationship is greatly valued by anaesthetists who can go about their business knowing that such a relationship makes for the good of patients as well as their anaesthetic care. Part of his legacy is, again, rooted in the role he played in times more difficult than those of today.

In 1955 Griffith addressed a joint meeting of the British, Canadian and Ontario Medical Associations in Montreal.[4] In this address, entitled 'Whither Now in Anaesthesia,' he hazarded specific 'guesses' about the future. His predictions are stimulating, but most interesting is the breadth of his vision. He again emphasized the importance of training in anaesthesia, but this time he looked beyond the confines of his own country and continent. He identified the needs for well-trained anaesthetists, pointing out that these needs still had not been fulfilled. He knew this very well, for he was the first president of the World Federation of Societies of Anaesthesiologists (WFSA) which had been formed, in part, "to make available the highest standards of anaesthesia to all people throughout the world." In looking at the future from his position as an international figure, he concluded that "the great need of the world as far as anaesthesia is concerned is for more and better clinicians." This concern had long been on Griffith's mind. In 1948 he wrote[2] that "outside of the English speaking countries, and a few isolated centers in Latin America, there is little application of the knowledge and safeguards which comprise our present specialty," and that "in most of the world anesthesiology is practised with nineteenth century methods." His vision was of better anaesthesia in the less developed countries, thinking of it as "a missionary project worthy of the best efforts of the best men and women in our younger generation." To what extent have his hopes been realized? Through the efforts of the WFSA, compassionate groups and individuals some progress has been made, but there is still a vast amount of work to be done. In considering how Griffith's legacy might inspire us, we must ask whether we, as individuals and as a speciality, could do more to help realize Griffith's hopes in this regard.

But Griffith also recognized that there was a need for well-trained anaesthetists closer to home. In his Montreal presentation he predicted that "it will gradually be recognized that expert anaesthetists are needed in small hospitals where so-called 'routine' surgery is done, and not only in the large teaching hospitals and specialized hospitals." This was an accurate prediction, and in his own country a welcome trend for specialist anaesthetists to locate in small hospitals has been observed.

One of his scientific topics, the relative advantages and disadvantages of inhalational and intravenous anaesthesia, is still of interest. He thought that the use of intravenous agents would decrease. None of the barbiturates was ideal and other drugs such as steroidal compounds had drawbacks, though he did suggest that out of research "quite possibly something really good [might] turn up" – something, one can add today, like etomidate or propofol. Griffith's preference, however, was for inhalational agents, and he guessed that there would be "an increasing appreciation of the advantages of the anaesthetic gases." Their advantages were relative lack of toxicity and metabolic upset, good analgesia, and rapid uptake and elimination and Griffith's model was cyclopropane. The age of the fluorinated compounds was dawning as he spoke and doubtless, with time, he would have welcomed the introduction of halothane, enflurane, isoflurane and most recently desflurane because they, like cyclopropane, manifest desirable qualities of an inhalational agent.

Griffith was also accurate in his predictions that cardiac arrest would become "an extremely rare accident," spinal anaesthesia would continue to hold its own, and increasing attention would be given to pulmonary ventilation – es-

pecially to the elimination of carbon dioxide. He was only "rather reluctantly" reaching the conclusion that mechanical ventilation was superior to "the tired hand of an anaesthetist squeezing a breathing bag." He was, however, capable of moving with the times, always ready to use modern methods. His prediction that relaxants would continue to hold an important place in anaesthesia is not at all surprising.

His final prediction in his 1955 paper was the one that he thought was the most valid: the anaesthetist of the future would acquire the status of a physician consultant. Together with many others, he had worked hard to lay the groundwork, and the anaesthetist's status today is in large measure due to their work. This achievement is now forgotten because it has been incorporated into the daily pattern of practice. Nevertheless, it constitutes part of Griffith's legacy.

In 1959 in Toronto he chose the title 'The Boundless Realm of Anaesthesiology' for the first Dr. Harry Shields Lecture in Anaesthesia.[5] He took the opportunity "to emphasize not only the way in which the interest and responsibility of the anaesthetist have expanded, but also the bewildering and apparently limitless way in which the field is still expanding." Although he gave this address more than 30 years ago, it is not anachronistic today, and we may be sure that the realm of anaesthesia will continue to expand. He provided an interesting account of the remarkable transformation that anaesthesia had undergone in just one anaesthetist's career, but the lecture is particularly interesting for its vision of what anaesthesia had indeed become – a boundless realm. Griffith also touched on those aspects of both the art and the science of anaesthesia that the anaesthetist must master in order to guard the "mysterious waters" of the body during anaesthesia.[6]

Griffith discussed two aspects of the science of anaesthesia and one aspect of the art. He emphasized the first two because "the anaesthetist must deal with a patient who is handicapped not only by disease but also by drugs and by the assault of the surgeon." Anaesthesia in 1959 had changed a great deal from the state in which he had found it in 1916: "we watch the patient more closely than ever, but now we try to exercise our art in evaluating pulse and blood pressure changes, the electrocardiographic pattern, blood and biochemical requirements, oxygenation, carbon dioxide elimination, peripheral circulation and many other matters." No wonder Griffith saw anaesthesia as a boundless realm that had expanded immeasurably since he began his career.

However exciting this realm, Griffith was moved, rather wistfully, to "sometimes wonder just where the limit should be to such an expansion of our realm." Was Griffith at heart more the artist than the scientist? Was he perhaps most fulfilled when he could exercise his skill in direct contact with his patient, giving anaesthesia at its simplest, sitting at the head of the table administering cyclopropane and oxygen with just a touch of curare, and knowing he was a master of the *art* rather than of the science of anaesthesia? He said that the anaesthetist, besides being a clinical pharmacologist, a biochemist and a physiologist, should be a practical psychologist and have the wisdom of a physician. He urged the anaesthetist to "be humble in relations with his professional colleagues, gentle, courteous and kind to all with whom he works in the hospital." He concluded his lecture not with an observation about the degree of sophistication of modern anaesthesia but with a disarmingly simple and heartfelt verity, "the quality of kindness is more important than any drug or technique." We would do well to hold this in our minds and hearts as we ourselves ponder the future.

For Griffith the art of anaesthesia was fundamental, because he was an individual who treated his own patients as individuals "with sympathy as well as with science." Science progresses and techniques come and go but what does *not* change is the relationship between two individuals – the patient and the anaesthetist. As medicine becomes increasingly technical, this is where Griffith's legacy touches each of us most deeply as we try to practise anaesthesia according to our ethical principles.

The legacy of Harold Griffith is indeed one that should be commemorated and incorporated into our own daily work, because our task, at bottom, is the same as his. It is fitting, therefore, to conclude by simply letting him speak for himself:

> Finally, our patients, who are to be treated as individuals, should be treated with sympathy as well as with science. It is so easy to be kind to people if we just make it a habit, and it means so much to the patient. Nothing does more harm to the medical profession than a reputation for being hard-boiled, indifferent, unapproachable, or hard to find. These qualities are not typical, but they are sufficiently prevalent to make us take stock of ourselves. The anaesthetist knows how the smoothness of preoperative care, the operation itself, and the period of recovery can be influenced by such intangibles as mental distress, worry, fear, and anger on the one hand, and by calmness, courage and faith on the other. The quality of kindness is more important than any drug or technique. Let us all – anaesthetist, surgeon, physician, and nurse – cultivate a spirit of kindness as our most important duty.

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Montreal

Whither now in anaesthesia?*

To have taken part in the development of anaesthesia over the past 35 years has been an exciting and satisfying experience. One has only to compare the drugs and methods of 1920 with what we have today to realize that vast changes have taken place – it may not all have been "progress", but it certainly has been fun for the anaesthetist. At the age of 60, one has a right to look back over the milestones which mark a professional career, and to take some pride in a variegated accumulation of knowledge. But I am not going to fall into the enticing temptations of reminiscence. What I want to do for a few minutes, from the vantage point of experience, is to turn my eyes the other way, and to peer into the road which lies ahead. Of course, I don't really know what lies around even the next bend, but I am going to make a few guesses. Here they are.

1. The present trend toward better training in anaesthesia will continue. Organized teaching of anaesthesiology is a very recent development. A few years ago one learned by apprenticeship to one of the masters, or, as I did, by trial and error. The teaching departments in British, Canadian, and American medical schools, the examining specialty boards and hospital accreditation programs were almost entirely non-existent 15 years ago. There has been some criticism that requirements for certification as a specialist are now too exacting and are unrealistic. Perhaps there will be changes in the regulations and even relaxation of the number of years required for training, but I am perfectly certain that systematic teaching of anaesthesiology will continue and become even more important than it is now in every civilized country. The reason for this is that specially qualified anaesthetists render better service to the public than do unqualified anaesthetists. Surgeons and other hospital personnel who see how smoothly and safely anaesthesia is conducted by qualified anaesthetists, and how difficult even the simplest procedures can appear in untrained hands, will continue to demand good training. It will gradually be recognized that expert anaesthetists are needed in small hospitals where so-called "routine" surgery is done, and not only in the large teaching hospitals and in specialized hospitals. A patient can die just as rapidly, just as permanently, and just as unnecessarily during a tonsillectomy or an obstetrical delivery as during a pneumonectomy. The only protection against such tragedies is to have better anaesthetists in a more even distribution throughout small and large cities, and wherever surgery is being done. I predict, therefore, that systematic teaching of anaesthesia will continue on an even larger scale than at present. In the best teaching centres the main emphasis will be on training good clinical anaesthetists rather than specialists in laboratory research. Research, investigation, the elucidation of basic physiological and biochemical mechanisms will continue to be important, but the *great need* of the world as far as anaesthesia is concerned is for more and better clinicians. This fact is recognized by the formation this year of the World Federation of Societies of Anaesthesiologists, which has as its purpose "to make available the highest standards of anaesthesia to all people throughout the world."

2. My next guess is that there will be *increasing attention to problems of pulmonary ventilation and adequate carbon dioxide elimination.* Oxygenation of the patient is not really a problem, but carbon dioxide removal is, especially when natural respiration is interfered with as seriously as occurs with so many of our currently used anaesthetic drugs. I shall not enter here into a discussion of the deleterious effects of excess carbon dioxide, but many thoughtful anaesthetists are becoming increasingly aware of both the harmfulness and the insidious method of onset of this pathological state. Studies with the Liston Becker

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CO_2 analyzer show that adequate pulmonary ventilation is essential for the maintenance of normal CO_2 levels in patients under prolonged anaesthesia. "Adequate" ventilation usually means more vigorous ventilation than the anaesthetized patient may carry on by his own semi-paralyzed efforts, and it usually means better ventilation than is produced by the tired hand of an anaesthetist squeezing a breathing bag. For this reason many forms of mechanical respirators have been invented, and I am coming rather reluctantly to the conclusion that some such mechanical device will be used in the future for the maintenance of respiration in long operations. I shall not attempt here to list all the ventilators now on the market, or to predict which one will be most widely accepted. Our own limited experience leads us to feel that a simple device such as has been recommended by Pask and others, and which has a negative as well as a positive phase, is most efficient. The so-called "Jefferson Ventilator" is an apparatus of this type, and it has the advantage that it can be instantly switched from automatic to manual control.

Actually automatic or mechanical respirators are not essential to provide good ventilation. A good example of an efficient, simple, portable, manually controlled ventilator is the little Oxford Ventilator which Sir Robert Macintosh has demonstrated for use in even the most primitive operating rooms, and which makes efficient use of "God's oxygen" which is all around us in 20% concentration rather than the 100% variety which comes only in compressed cylinders.

Our studies in CO_2 levels have clearly shown the importance of fresh soda lime in closed circuit or semi-closed circuit anaesthesia. I am convinced that many anaesthetists are much too careless about changing soda lime, and that there is need for a simple method of detecting CO_2 build-up on the inhaling side of the circuit. Such a device already is in existence (Draper's Hi-Co Detector). It can be attached to any gas machine, and should be much more commonly used.

3. My next guess is that there will be *an increasing appreciation of the advantages of the anaesthetic gases, cyclopropane in particular*. Of all anaesthetic drugs the gases alone can be breathed out by the lungs just about as rapidly as they can be breathed in. This property tends to make more controllable the levels of anaesthesia, and controllability is perhaps the most important aspect of expert administration. Nitrous oxide, ethylene and cyclopropane when given with adequate oxygen are relatively non-toxic, do not upset metabolic processes, have good analgesic properties, and are very rapidly eliminated. When used in combination with proper doses of muscle-relaxing agents, one or other of the gases can be used for every type of operation. Cyclopropane has an added advantage of potency, which makes it perhaps the most versatile of all anaesthetic agents. I believe that in the future more thoughtful anaesthetists who believe in the virtues of simplicity will turn to cyclopropane with great satisfaction. Few anaesthetists have had as much experience with this drug as I have had. I began using it in 1933, and I have tried to be critical in my attempts at evaluation, but it still seems to me to be by far the most useful anaesthetic drug. Beecher has preached simplicity in anaesthesia, but his idea of simplicity is to use nothing but ether. In my judgment, from all three aspects of safety, efficiency, and patients' preference, cyclopropane is a much better drug.

Recently Hingson has demonstrated with his "Reserve Midget Portable Anaesthesia Apparatus" how rapidly cyclopropane anaesthesia can be induced in all types of patients, and how small and convenient can be the apparatus for its administration in short operations. This inhaler, or some similar type of machine, will probably make cyclopropane the agent of choice in minor surgery such as simple tooth extraction, reduction of dislocations, paracentesis auri, or incision of abscesses.

I would not be surprised to see a revival of interest in ethylene, because it is a gas which has an impressive record of safety from a pharmacological point of view. Goodman and Gilman in their 1955 edition of "The Pharmacological Basis of Therapeutics" have this to say about ethylene:

> Ethylene-oxygen mixtures produce satisfactory anaesthesia with practically no untoward effects on vital function. The innocuousness of ethylene is its outstanding advantage. ...The myocardium is not 'sensitized' to epinephrine. Respiratory and vasomotor depression and metabolic disturbances are not encountered. Pulmonary and renal irritation are absent and salivary and bronchial secretions are not stimulated. Sweating is not produced ... it is one of the preferred agents for 'poor risk' patients.

In view of these advantages, and because adequate muscle relaxation is no longer a problem, I believe ethylene should be, and will be, much more generally used in cardiac surgery – a field which will undoubtedly be greatly extended in the next few years.

4. As a corollary to the increased use of gas anaesthetics there probably will be *a decrease in the use of intravenous agents, particularly the barbiturates*. Thiopentone and similar drugs have been wonderfully effective in abolishing the fear of anaesthesia, but they are really safe only when used in small doses for the sole purpose of putting patients to sleep. Deep or prolonged anaesthesia with a barbiturate is depressing, uncontrollable, and unnecessarily hazardous. No one knows exactly where the drug goes, how it is broken down, or how and when it leaves the body. Some people who are particularly sensitive to barbiturates may become seriously poisoned. Because none of the

barbiturates is ideal as an anaesthetic agent, the search for some better intravenous anaesthetic is continuing, and quite possibly something really good may turn up. I do not believe that the answer lies in drugs like chlorpromazine, reserpine, or Miltown, which certainly have profound pharmacological effects, but which do not seem to offer any particular advantages in anaesthesiology over better understood drugs now in use.

Two new drugs have recently been used as anaesthetic agents, and may have an interesting future. One called Viadril is a steroid compound, and its clinical use has recently been reported by Murphy, Guadagni, and DeBon of the University of California. Viadril may have some advantages over thiopentone and other barbiturates, but is not quite the wonder drug which was proclaimed in recent newspaper reports. It appears to be a good "basal anaesthetic," does not depress respiration or interfere with ventilation when given in reasonable dosage, is compatible with gas anaesthetic agents, and has some analgesic property. The other drug, Dolitrone, is used as a substitute for thiopentone. Lundy reports that he is very favourably impressed by the high degree of analgesia produced by small doses, and the lack of toxic effects. We have used these two drugs in a small series of cases, but I am not prepared to render any judgment as to their value.

For a drug to be widely accepted in clinical anaesthesia it must have properties which make it significantly better than drugs already in use. It must meet some real need, and not be just different or the product of a rival manufacturer. During the next ten years probably hundreds of new drugs will be produced, under thousands of names, and each one will have some enthusiastic proponents. It will be a waste of time to try them clinically if the only difference from satisfactory present drugs is a slight change in chemical formula or some inconsequential variation in the effect on laboratory animals. How much time has been wasted, for instance, in trying to evaluate local anaesthetic agents. As far as I am concerned, the old original ones are still the best – cocaine for topical anaesthesia and procaine for nearly everything else. Before we dabble in clinical experiments we should ask ourselves – what need is this drug likely to meet, and how much better will it be met than with a known agent already at hand?

5. Next I would like to hazard a guess as to *the future of muscle relaxing drugs*. The report last year of Beecher and Todd entitled "A Study of the Deaths Associated with Anesthesia and Surgery" led many surgeons to the conclusion that muscle relaxants have greatly increased the dangers of anaesthesia and that such drugs are all really too toxic for clinical use. I have not found any competent anaesthesiologist who subscribes to this view. Anaesthesiologists realize that all drugs may be toxic when improperly used, and that the intelligent use of muscle relaxants has made many operative procedures both safer and more practicable. People often ask me which is the best muscle relaxant of all the drugs now available. I answer that all the commonly used agents – tubocurarine, Metubine, decamethonium, Flaxedil, succinylcholine, etc. – are equally effective and are equally dangerous. Some anaesthetists prefer one drug or another, but the dangers of respiratory depression, apnoea and anoxia are common to them all. Safety lies in administration by a skilled, intelligent anaesthetist who knows how to control respiration and how to adjust the dosage to the needs of a particular patient in a particular situation. I am certain that fatalities and morbidity after administration of relaxant drugs have been almost entirely due to their improper or careless use.

I have been particularly interested in succinylcholine because I feel that its property of short action due to rapid hydrolysis represents the first important change in muscle relaxants since curare was introduced. Short action makes for controllability, and controllability in anaesthesia should tend toward safety. Generally speaking, in our hands, succinylcholine has been both safe and satisfactory, but it is not ideal and I will not be surprised to see a better drug appear. Dr. Rudolf Frey, Director of Anaesthesiology at Heidelberg University, Germany, has told me of a new short-acting muscle-relaxing drug called Prestonal, which may be of value. It differs from succinylcholine in that it acts like curare by polarization of the end plates, and its action is antagonized by prostigmine. Frey has used Prestonal in over a thousand clinical cases with excellent results.

I believe, therefore, that muscle-relaxing drugs of some kind will continue to have an important place in anaesthesiology. We should reassure our surgical friends on this point.

6. *Cardiac arrest in patients under anaesthesia* has been a disturbing complication frequently reported in recent years. Will this continue in the future? I think it will to some extent, primarily because we are all mortals and no heart goes on forever, and because surgeons are with increasing frequency invading areas in the thorax, the abdomen, and the brain where the reflexes are located which control the heart. Stimulation of these areas is bound occasionally to cause cardiac arrest. However, much can and will be done by anaesthetists to *prevent* cardiac arrest, and I think it should become an extremely rare accident. I read an article recently which reported an incidence of one cardiac arrest in every 858 cases in a general hospital. Such a figure is horrifying, and I am sure is quite avoidable. In my own hospital the incidence is about one case in 10,000. Individualization of the patient's requirements, gentleness in all manipulation, intelligent use of atropine and other autonomic blocking agents, sensible choice of anaesthetic agents, and absolute avoidance of anoxia or

excess carbon dioxide should remove the fear of cardiac arrest.

7. *Conduction or Regional Anaesthesia.* I think that in spite of possible neurological sequelae and legal complications, spinal anaesthesia will continue to have a place in our practice. This is because it is a simple technique, with definite advantages for certain operations and certain types of patients. I believe that spinal anaesthesia will be safer as we learn to pay more attention to the advantages of minimal dosage, dilute solutions and the less toxic drugs.

I do not agree with the opinion that local and regional anaesthesia will be the favourite method for future major surgery. Wherever general anaesthesia has improved in quality there has been a tendency to use fewer regional blocks. The hazards of procedure such as brachial blocks are becoming widely recognized, and toxic reactions from local anaesthetics often outweigh their advantage in routine operations.

8. *Hypothermia.* As soon as a reasonably safe and practicable method is devised for lowering the body temperature, this will become a more common practice in operations which require shutting off of cerebral circulation. There is no doubt that cold brain cells can live longer without oxygen than those in a normal physiological state. However, hypothermia will be reserved for open cardiac surgery, and I can see no reason to believe that it will be advisable for the treatment of patients in shock or for other conditions. The so-called "artificial hibernation" produced by drugs will probably have no important place in future anaesthesiology.

9. My final and perhaps most valid prediction is that *the anaesthetist of future years will acquire the status of a physician consultant* – one who is specially qualified in pharmacology and physiology as well as in the mysteries of electronic recording apparatus and other gadgets. He will be available to his hospital colleagues for advice on problems of respiration, circulation, drug poisoning, gas therapy, postoperative complications and prognosis, as well as for the actual administration of anaesthetics. There is no danger that we will be unemployed in the years ahead.

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The boundless realm of anaesthesiology*

I feel very highly honoured indeed to be invited to deliver the first Dr Harry Shields Lecture in Anaesthesia. The University of Toronto and the Toronto General Hospital have become world-recognized centres for the teaching of anaesthesiology – and Harry Shields, more than anyone else, has been the originator, the planner, the director of this teaching program. Dr Shields has been associated with the Toronto General Hospital ever since he started in anaesthesia (except for the years during the First World War when he was one of the few qualified anaesthetists in the Canadian Army Overseas) and during all these years, in addition to his teaching responsibilities, he has taken a major part in the administration of the anaesthesia service of the hospital; he has personally cared for many thousands of patients; and he has made friends of all those he has served – patients, medical colleagues, students, and others. A great outpouring of sympathy, understanding and friendship has been perhaps his most lasting contribution to the development of anaesthesia in Canada.

As a title for this lecture I have chosen "The Boundless Realm of Anaesthesiology" in order to emphasize not only the way in which the interest and responsibility of the anaesthetist have expanded, but also the bewildering and apparently limitless way in which the field is still expanding. I shall try not to succumb to the temptation of reminiscence, but I cannot help but recall that when I started to administer anaesthetics 40 years ago, the attitude of the medical profession generally was that this was a rather boring technical procedure which could be carried out by students, interns, or broken-down doctors who had failed at the really important aspects of the practice of medicine. It was a way to put in time while one was learning to be a surgeon, and I must confess that my first interest was prompted by the opportunity to earn a few $5.00 fees while I was working my way through medical school. The hospital in which I gave my first anaesthetics (and where I have remained ever since) was typical of that day in that there was no regular anaesthetist, no oxygen, no suction, gas machines, airways or endotracheal tubes, and the complete anaesthesia equipment consisted of a bottle of chloroform, a few cans of ether, and a gauze-covered wire mask.

Fortunately for the progress of anaesthesiology in Canada there were even then a few men who had caught the vision of better service to the patient in this field. Samuel Johnston, Charles Robson, William Easson Brown and Harry Shields in Toronto; Wesley Bourne and Charles Larocque in Montreal, and William Webster in Winnipeg were far ahead of the times in their work in anaesthesia. For this reason some Canadian hospitals, and notably the Toronto General Hospital, have for many years been in a leading position in both the technique and the teaching of anaesthesia. Anaesthesia in Canada has always been considered a part of the practice of medicine, requiring the services of physicians, so that we were never involved to any serious extent in the controversy which still goes on in the United States and in some other countries regarding the administration of anaesthetics by nurses and technicians.

A dawning realization that the role of the anaesthetist could be more than that of a technician came relatively early in Canada. Back in 1920, when the original Canadian Society of Anaesthetists was being formed, the founders chose as its motto the Greek words *Katheudontas parateroumen* (We watch closely those who sleep). It was then a revolutionary concept that the anaesthetist's responsibility rested primarily in watching the condition of the patient rather than the rate of ether drops from the bottle, or the expression on the surgeon's face. That motto has continued right up to the present as the guiding prin-

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ciple of our Canadian Society, although today it might be amplified into "We watch closely those who are going to sleep, those who sleep, and those who have slept." This expansion of the anaesthetist's realm of interest has come about gradually as, over the years, more and more thoughtful, intelligent doctors have begun to realize the comprehensive nature of medical problems posed by surgery and concomitant anaesthesia, and the imperative need, in the patient's interest, for finding a solution to most of these problems.

So, I propose now briefly to relate how anaesthesiology today, in contrast to 40 years ago, has become the most comprehensive of all specialties. The anaesthetist, in addition to his technical skill, must have the wisdom of the physician, and an appreciation of the problems of surgeons and obstetricians. He must be familiar with the extraordinary conditions involved in all the surgical specialties. He must be a clinical pharmacologist, because he deals with all kinds of drugs; a biochemist and physiologist of sorts because he is responsible for the maintenance of vital function under widely varying conditions: and he must be a practical psychologist because he deals with patients at times of peculiar strain and stress. He should also be humble in relations with his professional colleagues, gentle, courteous and kind to all with whom he works in the hospital. In spite of these formidable requirements, the anaesthetists of Canada have grown into a veritable host. In fact, we are now the largest group of certified specialists outside the ranks of internal medicine and general surgery. There are nearly 700 certified anaesthetists in Canada, and more than 1000 members of the Canadian Anaesthetists' Society.

How has this transformation from the old days come about? Probably the most important factor has been more and better teaching. When I started we picked up what we know just by ourselves on a trial-and-error basis. My early years were not even an apprenticeship, because there was no one to be apprenticed to. I did have the good fortune, however, to work in the same city with Wesley Bourne, who was an inspiration to me to do good work, as he has been to so many young anaesthetists. As the years went by, the challenge of better anaesthesia began to interest more young doctors, and many who are now leaders in our specialty got into practice after a year or two of residency in Montreal or Toronto, or in some English or American hospital. At the University of Wisconsin, Dr Ralph Waters established the first really comprehensive program for the training of anaesthetists. He was able to demonstrate how there could be an effective integration of clinical teaching on anaesthesiology with specialized instruction in the basic sciences, and he provided the inspiring leadership which stimulated the interest of pharmacologists, physiologists, physicians and surgeons, as well as a very distinguished group of students. Waters at Madison, and to some extent John Lundy at the Mayo Clinic, were the gardeners who planted the seeds from which have grown the present departments of anaesthesiology in most of the American medical schools.

In Canada, even before Waters' time, Easson Brown at Toronto, and Wesley Bourne at McGill, were demonstrating, through long hours of personal work in the laboratories, that anaesthesia and pharmacology are inseparable partners and that some knowledge of biochemistry is a fundamental requirement for an anaesthetist. Brown, in co-operation with Professors Velyan Henderson and George Lucas, discovered the anaesthetic properties of ethylene, cyclopropane, and ethyl-N-propyl ether; but co-ordination between clinicians and laboratory workers had not then developed sufficiently at the University of Toronto to get these important discoveries into the hospital operating rooms. At McGill, Wesley Bourne worked in the department of pharmacology for many years, in his so-called "leisure time", and was one of the first of modern anaesthetists to investigate basic physiological problems concerned with the administration of anaesthetics, and the effects of anaesthetic agents on the vital metabolic processes. Dr Bourne became so concerned with the biochemical basis of anaesthesia that many years later when he published a volume of his essays he gave it the intriguing title "Mysterious Waters to Guard," borrowing the words of Shelley when he says –

> "O stream!
> Whose source is inaccessibly profound,
> Whither do thy mysterious waters tend?
> Thou imagest my life."

The human body is indeed made up of mysterious waters, and it is the anaesthetist's duty to guard these waters through some of the most turbulent moments of life.

So new concepts for the anaesthetist gradually became apparent. The leaders of the rapidly developing specialty found themselves concerned with three parallel problems:

1. The development of new drugs and techniques of administration that would keep pace with and enhance the progress of surgery.
2. A better understanding of the basic sciences in relation to anaesthesia – an imperative need if new drugs and techniques were to be used safely.
3. Better provisions for the teaching of anaesthesiology.

All these phases of the development of anaesthesiology have progressed in a simultaneous and parallel fashion. It is difficult, and perhaps futile, to speculate as to which is the most important.

I. Drugs and techniques

Work in regard to drugs and apparatus has been exciting,

and good fun. When one sees the formidable and expensive anaesthesia machines of today, one must admit that this is at least a change from the old "rag and bottle" days. Some of these changes have been more significant than others. In my opinion the two most important are the development and popularization of *endotracheal tubes* with their emphasis on clear airways; and secondly and more recently, the great extension of interest in *adequate pulmonary ventilation*.

Endotracheal tubes are now such an indispensable part of the anaesthetist's equipment that it is hard to believe that a few years ago they were almost unknown. The first paper I ever read at a medical meeting was in 1928 in Boston, entitled "Intratracheal Ethylene Anaesthesia." It was received by most of the audience with great skepticism because 90% of the anaesthetists of the United States at that time had never intubated a patient. Fortunately for me, Dr Ralph Waters happened to be in the audience, and recognized a new young advocate of the doctrine which he and Guedel had been preaching – the supreme importance of a clear airway. Dr Waters introduced himself, and this led to a friendship which over the years has meant much to me. In Canada, for years before that, we had been administering ether by intratracheal insufflation, and Hargraves in Toronto, and Stewart in Montreal, had developed large tubes for nitrous oxide. A great variety of tubes were tried, and now we have all come to using some variation of the endotracheal tubes designed by Magill of London, to which has been added Guedel-Waters' inflatable cuff. Today, the endotracheal tube is indeed a "life line" for the patient under anaesthesia.

So far as anaesthetic apparatus is concerned, I still believe there is virtue in simplicity, and the most complex machine is not always the best. In some operating rooms the surgeon and patient are squeezed into a small corner to make room for the apparatus which counts and records innumerable body functions as well as delivering the anaesthetic. Up to the present the ultimate in automation is probably the machine developed by Bickford, Faulconer and their associates at the Mayo Clinic, which automatically maintains the level of anaesthesia by turning valves on or off in accordance with the electroencephalographic pattern of the patient. This is fine for experiment and investigation, but in my opinion it is utter nonsense to try to make such a device applicable to regular clinical anaesthesia. Variations of electroencephalographic curves are only one of the infinite number of variable factors in a human being, and I cannot conceive of any machine which could instantly take into account all of these factors more effectively than the human intelligence of an anaesthetist. Perhaps such a machine might be devised, but it would certainly be a complicated and expensive way of carrying out a procedure which we can now do simply and quickly by using our own brains. So I continue to be an advocate of simple gas machines with dependable easily-read flow meters; accurate vapourizers; efficient CO_2 absorbers; and not too many tricky valves or by-passes.

Sir Robert Macintosh of Oxford, who has, perhaps, done more than anyone else to spread the gospel of good anaesthesia throughout the world, is a consistent advocate of simplicity in techniques and equipment. I visited him one year when he had just returned from a trip to Indonesia, where he had been demonstrating anaesthesia in a country of seventy million people and three anaesthesiologists. His essential equipment consisted of an ether vapourizer, hand-operated bellows, and some endotracheal tubes. He expressed the unorthodox view that "no life is ever saved by oxygen that could not have been saved by air. Why use oxygen from a tank when we have God's oxygen all about us in 20% concentration?" Even if one does not entirely agree with this doctrine, one must admit that there is much to be said in favour of simplicity.

The fundamental equipment necessary for administration, therefore, consists of a laryngoscope, endotracheal tubes, vapourizer or flow meters, and some kind of ventilator. We realize now, much more than we did twenty-five years ago, that carbon dioxide elimination is just as vital as oxygenation. With present-day drugs, when one respiratory depressant is often piled on top of another, we cannot just depend on the patient's doing his own pulmonary ventilation (as in the days of open-drop ether). Dr Shields was one of the first to point out the importance of assisted or controlled ventilation as a concomitant of modern anaesthesia. Then, for some years we believed that the so-called "educated hand" of the anaesthetist squeezing the breathing bag was more efficient than any mechanical device. Now, I am not so sure. Studies with infra-red CO_2 analyzers set up under conditions of clinical anaesthesia have proved to us that a good mechanical ventilator is a most efficient device for removing alveolar CO_2, particularly in long operations. There are now a number of such ventilators available and in my opinion one must be included as essential equipment of a modern anaesthesiology department. So much, then, for equipment.

The development of new drugs has been even more revolutionary. It is unnecessary for me to enumerate all the drugs we now have on our shelves in addition to the old originals – ether and chloroform, and nitrous oxide. Many of the anaesthetic agents which have appeared have been hailed as the ideal, their use boomed into popularity and then they faded away or settled into a particular niche of special usefulness. We have seen this happen with ethyl chloride, ethylene, tribromoethanol, sodium amobarbital, hexobarbital, thiopental, divinylether, cyclopropane, cocaine, procaine, nupercaine, xylocaine, halothane and countless others. It seems to me that the criterion as to the

speed of acceptance of a new drug is whether the drug does meet a real need, and the criterion as to whether the new drug finds a permanent and important place in clinical medicine is whether this drug meets this need more effectively and with greater safety than similar drugs presently available. In all branches of medicine new drugs are now being introduced in bewildering profusion, and many are simply variations of previously accepted drugs, whose only title to fame is that they are more expensive or have shown slightly different side effects in laboratory animals. I need not elaborate this point because every doctor knows it to be true, in spite of our admiration and friendship for the pharmaceutical manufacturers. To turn to the other side of the picture, I would like to speak of two drugs in which I have had much interest over many years, and which met the criteria for final and wide acceptance. I refer to cyclopropane and curare.

When the anaesthetic properties of cyclopropane were announced here at the University of Toronto in 1929, Dr Ralph Waters was one of the few forward-looking anaesthesiologists who immediately visualized the possibilities of the new agent. Here at last was a potent anaesthetic, non-toxic in its metabolic effects, permitting high oxygenation and with all the advantages of controllability which go with an inhalation gas. In other words, here was something to meet a long-felt need. The clinical trials which followed confirmed Professor Waters' hopes, and the era of cyclopropane anaesthesia soon dawned. After a visit to Madison, I had the privilege of administering the first clinical cyclopropane anaesthesia in Canada in October 1933. I could spend a long time expounding the advantages of cyclopropane and explaining why after twenty-six years we still use it more often than any other agent, but will resist the temptation. I just cite cyclopropane as an example of a drug which met a need.

One could say the same thing about curare. The need for better muscle relaxation during anaesthesia was recognized by every anaesthetist who ever sat shivering under the glowering eyes and blistering tongue of the surgeons of the "good old days". It happens that, in 1942, I had the good fortune, or temerity, or foolhardiness, to introduce into clinical anaesthesia a new preparation of the fabulous drug curare, which certainly met that need. This has had a surprising effect on my subsequent professional career and led to many new adventures, but I think really that I have been given much more credit than I deserve. All that my colleague, Enid Johnson, and I did was to carry out a suggestion which was made to us, and which others had turned down.

Dr Lewis Wright, of New York, told me of the work being done by Bennett in Nebraska with a new preparation of curare used for the purpose of softening convulsions in shock therapy for psychiatric patients. He thought this "Intocostrin" might be used safely for muscle relaxation in anaesthesia, but everyone had laughed at him. I reasoned that if this curare preparation did not kill the psychiatric patients it should be even safer in the operating room, because anaesthetists are dealing every day with respiratory paralysis. So on January 23, 1942, at the Homoeopathic Hospital of Montreal (now the Queen Elizabeth Hospital) we gave the curare to a young man undergoing appendicectomy with cyclopropane anaesthesia. The drug worked, there was no untoward effect, and we used it cautiously in other cases. We published our first report in "Anesthesiology" (August 1942), and others took up the work.

The use of curare in anaesthesia soon spread around the world, and led in some years to the introduction of other muscle relaxing agents; and indirectly to the ganglionic blocking drugs, to the phenothiazine derivatives and all the tranquillizers which now flood the drug stores. I shall leave this subject here with the comment that in spite of doubts and questionings in high scientific circles, and in spite of a period of opposition by some well-known anaesthesiologists, curare or similar drugs are now being used every day in almost every operating room in the world. This seems to me to be a prime example of the rapid acceptance of a new drug when it safely meets a real need.

II. Problems of physiology and biochemistry

During recent years all medical men have become more interested in how the body works, and how to maintain normal function in the vital organs. When I was a medical student the functions of the liver, for instance, were even more of a mystery than they are today. We did not even know enough to realize how little we did know. We knew nothing of fluid and electrolyte balance, or the problems of blood transfusion, and little about vitamins. No clinician was concerned with enzymology or the intricacies of cellular metabolism, and endocrinology was almost a blank. Today there are many of these problems about which we still do not know much, but we know that they do concern the clinician. There is no branch of clinical medicine where there is greater need for an understanding of basic sciences than there is in anaesthesiology, and no one has a better opportunity to study basic problems than the anaesthetist. The anaesthetist must deal with a patient who is handicapped not only by disease, but also by drugs and by the assault of the surgeon. Take, for example, the problems of respiration. Physicians who have made a specialty of this field have learned a great deal about such things as the metabolic effects of emphysema, of depressed and obstructed respiration, of chronic cough, etc. The anaesthetist must know not only all about these matters, but also about the effects and the management of complete respiratory paralysis produced often by his own drugs, and

in a patient existing temporarily in a completely artificial atmosphere.

As a result of thinking along such lines, and because of the advent of new drugs, new apparatus and new operations, our concept of how to conduct anaesthesia has undergone a gradual transformation. We used to feel that anaesthetic sleep should closely simulate natural sleep. Now we realize that this is impossible, partly because we do not yet know enough basically about natural sleep to be able to stimulate it, but mainly because we must in anaesthesia do things to the patient which produce conditions far removed from natural sleep and in which the basic metabolic responses are very different indeed. In 1951, Dr John Gillies, of Edinburgh, coined the term "physiological trespass" to describe some of the things which the anaesthetist is now purposely and almost nonchalantly doing to the patient, in order to obtain conditions which make modern surgery feasible and safe. Gillies' trespasses included hypotension, apnoea, and muscle paralysis. This sort of trespass every anaesthetist accepts as the inevitable concomitant of certain surgical operations. Besides these trespasses there are others due to posture, sudden haemorrhage, and surgical trauma: so the anaesthetist today has abandoned any attempt to waft the patient into natural sleep and bends all his efforts to protecting vital functions under these grossly abnormal conditions, and to restoring the patient to comfortable normality after the period of trespass is over. We watch the patient more closely than ever, but now we try to exercise our art in evaluating pulse and blood pressure changes, the electrocardiographic pattern, blood and biochemical requirements, oxygenation, carbon dioxide elimination, peripheral circulation, and many other matters. I believe the usual rapid and fairly comfortable recovery of patients from operations which were in the old days either formidable adventures or unheard of, has justified this expansion of the interest of the anaesthetist. It has, however, brought problems regarding the supply of such omniscient people. Simultaneously with the development of new drugs and methods, and of new conceptions, there has been a revolutionary development in the education of the anaesthetist.

III. Educational developments

I have often been asked where I received my training in anaesthesiology. My answer must be the same as that of many others of the senior men in this room – I just picked up what I could, however I could, as I engaged in general practice. Until fifteen years ago there was no formal or organized specialist anaesthesia training in Canada. Those who were interested either taught themselves or served an apprenticeship in one of the larger hospitals. During the war we had the opportunity in Montreal to organize intensive three- or four-month courses for medical officers in all three services. This led to the recognition by McGill that there was need for better teaching facilities, and in 1946, the Department of Anaesthesia was established within the Faculty of Medicine, with Dr Wesley Bourne the first Professor and Chairman. There was soon a parallel development at the University of Toronto under the leadership of Dr Harry Shields, and since that time these two great Canadian medical schools, in friendly rivalry but close cooperation, have built up teaching programs which have set a standard widely copied throughout Canada and in other countries. The curriculum of these postgraduate specialty training courses includes clinical residency at selected hospitals on a rotation basis, and also basic science lectures, seminars, colloquia and various reading and discussion group meetings. The program for the current year's work at McGill lists 195 of these sessions for students of anaesthesia. We think our type of training is perhaps the most comprehensive of any medical school, but development along the same general lines has been widespread throughout the English-speaking countries, and is now becoming established in Europe and South America. There are now at least eleven journals of anaesthesiology published regularly in various countries. With all these opportunities for education there is now no need for a serious student to remain in ignorance. The demand for qualified anaesthetists is still far ahead of the supply in every country, for anaesthetists are now being recognized as a very useful kind of doctor.

The comprehensiveness of our interests and of our technical skills has resulted in increasing our responsibilities in the modern hospital care of patients. We are called upon to do many things which seem fantastically far removed from the traditional anaesthetist's role. We may supervise oxygen therapy, recovery rooms, blood banks, and emergency departments. We are called for difficult intravenous injections, for lumbar punctures, for tracheal intubations and bronchial suction therapy, for the control of convulsions and barbiturate poisonings, for diagnostic and therapeutic nerve blocks, for emergency bronchoscopies and tracheostomies – in other words, we are just handy people to have around. We anaesthetists welcome this recognition of our duty as physicians, although we sometimes wonder just where the limit should be to such an expansion of our realm. There is, however, one field in which I am sure the anaesthetist is better qualified than other consultants who are often asked for, that is in the preoperative assessment of the risk of operation and the preparation of the patient. The cardiologist understands hearts, but he does not know much about the techniques and stresses of either surgery or anaesthesiology, and not much about the behaviour of hearts under the influence of anaesthetic drugs. All of these are things the anaesthetist must deal with every day, and I believe the anaesthetist

should be the one to decide the kind of anaesthetic to be used and the way in which the patient is to be prepared for it. The same is true to some extent of immediate postoperative care. Not many surgeons are alert to the problems of postoperative respiration, to the causes of postoperative restlessness, to the differentiation between delirium of drugs and that produced by toxic states. It is often to the patient's advantage if the anaesthetist assumes responsibility in the recovery room, and sometimes for much longer periods. The question of responsibility for postoperative care should be a matter for consultation and co-operation between anaesthetist and surgeon. Indeed, it is a matter which I view with some alarm. For years we have fought for the recognition of our knowledge; and now many surgeons would like to let us go on looking after their patients for days postoperatively, and let us treat all the complications which are not directly related to the area of operation. This is a tendency shown by some general surgeons, as well as by obstetricians, ophthalmologists, otolaryngologists and other specialists. The anaesthetists are conveniently available day or night, and in my hospital at least, many times in recent years they have been in constant attendance for a week or more conducting treatment and making decisions which I believe should really be the responsibility of the surgeon.

We may have to get round to treating problem cases by committee. In many hospitals, plans are being made to establish intensive care areas for the concentrated medical and nursing care of the very sick patient. At the new Queen Elizabeth Hospital of Montreal, now under construction, we will have 38 beds (15% of our total capacity) allotted to this type of intensive care. Anaesthetists do not want to assume all the responsibility for seeing that things run smoothly in this area, but I can foresee that much will be expected of us. At present we have a committee studying the problem – an internist, a surgeon, an obstetrician, and some other specialists, as well as a general practitioner, and with an anaesthetist as chairman.

Because anaesthetists have infiltrated so deeply into fundamental medical and hospital problems, I believe we are in a position to enunciate certain principles which may help to get other specialists back into more effective thinking regarding the over-all care of the patient. These principles I shall enumerate briefly:

1. The patient is a whole individual who cannot be divided up into compartments. I know this is a truism, but from my observation I am amazed at how often this seems to be forgotten by those who are concerned with an eye, or an ear, or a stomach or a uterus. Even the radiologist in his enthusiasm for diagnosis often forgets that the patient he is prodding, or purging, or standing on his head is a sick individual.

2. A knowledge of and an application of basic sciences is essential to the good practice of medicine and surgery. Physiology, pharmacology, biochemistry and pathology are not subjects we learn during our training years and then put away forever in the dusty cupboards of our brains. I am distressed when I see young surgeons who have obtained their FRCS act as if this basic science knowledge was acquired only to pass examinations and need not be used in practice. The older surgeons depended on intuition and experience to steer their patients through the hazards of operations. Today, surgeons need just as much wisdom and common sense, but they also have at hand the tools of biochemistry, of fluid and electrolyte estimation, and many other tests which can be life-saving if they will take the trouble to sit down and think intelligently in regard to the needs of each patient individually. Anaesthetists are aware of these tools and know how to use them, but we do not think surgeons should just hand over the patient to us.

3. Drugs can be dangerous. This is another truism, but we are in an era of an extravagant use of drugs. New drugs are coming upon us every day, far too rapidly for any doctor to become familiar with the proper use of all of them. Many drugs have so-called side effects which, in our enthusiasm for specific therapy, we often forget or ignore. Anaesthetists know that adrenaline in the eye affects the heart; that pontocaine used for a bronchogram may be so rapidly absorbed as to cause convulsions; that antibiotics, especially when introduced intraperitoneally, may have profound and disastrous effects on respiration; and that sedatives may mask anoxia. We plead with our medical and surgical colleagues to take a second look and give a second thought before they burden a patient who is already handicapped by disease with an unnecessary load of drugs. I often think of the wisdom of the old homoeopathic principles on which I was reared – that the *proper* dose of any drug is the *smallest* dose which will effect a cure, and that one drug at a time is better than a mixture.

4. The next item of advice from anaesthetists is a reminder that technical skill in an emergency may be lifesaving. This advice is directed perhaps particularly to the medical specialists. We think every doctor should be able to pass an endotracheal tube, or at least be able to clear an airway and re-establish respiration. The carrying out of lumbar punctures, thoracentesis, intravenous administrations and cut-downs, sternal punctures and other simple procedures is shunned by hospital physicians. It is so easy to write an order to have such things performed by an intern or resident, or to send for the anaesthetic department. We do not object to being called in to do these things, particularly in an emergency, but we think that it would be good for some of the practising physicians to continue to be skilled at such procedures themselves.

5. The next reminder from the wisdom of the anaesthesiologist is that there were never two people born

exactly alike. Even in such simple laboratory animals as mice or guinea pigs there are individual differences and the reactions to drugs or to stress show wide variations. How much more important are these sometimes unpredictable and inexplicable variations of human patients. Anaesthetists have learned to prepare their patients individually, but also to be prepared for the unexpected. We believe that there is no excuse in modern hospitals for preoperative or postoperative "routine orders". The very term makes me shudder. No surgeon should ever think that he is too busy to give orders personally for his patient as an individual.

6. Finally, our patients, who are to be treated as individuals, should be treated with sympathy as well as with science. It is so easy to be kind to people if we just make it a habit, and it means so much to the patient. Nothing does more harm to the medical profession than a reputation for being hard-boiled, indifferent, unapproachable, or hard to find. These qualities are not typical, but they are sufficiently prevalent to make us take stock of ourselves. The anaesthetist knows how the smoothness of preoperative care, the operation itself, and the period of recovery can be influenced by such intangibles as mental distress, worry, fear, and anger on the one hand, and by calmness, courage and faith on the other. The quality of kindness is more important than any drug or technique. Let us all – anaesthetist, surgeon, physician and nurse – cultivate a spirit of kindness as our most important duty.

I have said enough, perhaps too much, about all the virtues of the anaesthetist. I have tried to show how the realm of anaesthesiology is indeed becoming boundless. We really do not want it to be boundless, if only the rest of the hospital team will reoccupy some of the fields over which we willy-nilly have recently spread ourselves. So much remains to be learned in our own narrower and traditional sphere. There is need for basic laboratory research and careful clinical study into hundreds of problems which still confront us.

Résumé

L'anesthésiologie a parcouru beaucoup de chemin depuis l'époque, dont l'auteur se souvient très bien, où le matériel d'anesthésie de tout hôpital se limitait à un masque ouaté, une bouteille de chloroforme et une bouteille d'éther. En effet cette spécialité est maintenant devenue une de celles qui exigent le plus de connaissances puisque l'anesthésiste doit posséder la sagesse du médecin et pour une bonne part l'expérience clinique du chirurgien et de l'obstétricien. Il doit aussi avoir des connaissances étendues en pharmacologie, biochimie et bio-logie sans compter qu'il lui faut souvent avoir recours à la psychologie pratique. Pour les pionniers dans ce domaine les débuts n'ont pas été faciles puisqu'il y avait tout à faire. Aujourd'hui l'enseignement de l'anesthésie est bien organisé et sa pratique bien règlementée. Parmi les grands noms de l'anesthésiologie canadienne citons ceux de Easson Brown de Toronto et Wesley Bourne de McGill. L'évolution de la spécialité s'est déroulée dans les trois sphères d'activité suivantes: le développement de nouveaux médicaments et de nouvelles techniques d'administration; l'approfondissement des sciences de base en relation avec l'anesthésie et la fondation d'un enseignement de l'anesthésie.

Les deux plus grandes réalisations techniques semblent avoir été l'adoption du tubage intratrachéal et l'étude de la ventilation pulmonaire. Ces deux innovations sont intimement liées et, contrairement à ce que pourrait laisser supposer leur usage courant, ne datent que de quelques années. L'auteur accorde sa faveur à l'appareil le plus simple. Selon lui l'automation telle que représentée par cet instrument récent dont les circuits sont ouverts ou fermés selon les variations de l'électroencé-phalogramme n'a pas sa place dans la salle d'operation. L'appareillage fondamental de l'anesthésie consiste en un laryngoscope, des tubes intratrachéaux, des manometres et débimètres et un appareil pour assurer la ventilation pulmonaire. Les médicaments dont les propriétés anesthesiques ont été employés sont légion. Plusieurs d'entre eux ont été abandonnés et un certain nombre d'autres ne servent qu'a des fins spécialisées. L'auteur choisit de s'étendre sur deux d'entre eux au developpement desquels il a contribué personnellement: le cyclopropane et le curare.

L'anesthésiste qui surveille un malade assailli par la maladie, par les médicaments et par l'intervention chirurgicale doit plus que tout posséder une bonne connaissance des sciences de base. L'état dans lequel le malade subit la chirurgie est loin d'être la reproduction du sommeil physiologique; il s'apparente plutôt a ce que le docteur John Gillies appelle "le trépas physiologique". Cet état comprend souvent de l'hypotension, de l'apnee et de la paralysie musculaire. La recouvrance facile et confortable que l'on prend maintenant pour acquise differe considerablement des réveils orageux de jadis et justifie l'expansion des intérêts de l'anesthésiste.

L'enseignement de l'anesthésie au Canada date à peine de 15 ans. La guerre a souligné la pénurie de ces spécialistes et a donne l'erre d'aller à la formation de medecins dans ce domaine. L'élève en anesthésie doit maintenant suivre quelques années de cours post-universitaires et de résidence dans plusieurs hôpitaux. Il existe maintenant au moins 11 revues d'anesthésiologie publiées regulièrement dans différents pays Les responsabilités attribuées a l'anesthésiste se sont accrues à mesure que ses connaissances augmentaient. On attend de lui aujourd'hui qu'il surveille l'oxygénotherapie, qu'il soit en charge des salles de recouvrance, qu'il fasse partie des banques de sang et des departements d'urgence. On se fie à lui dans les cas difficiles pour les injections intraveineuses, les ponctions lombaires, les intubations intratrachéales, les aspirations bronchiques, le

contrôle des convulsions, la désintoxication des empoisonnements aux barbituriques, les blocs nerveux diagnostiques et thérapeutiques, les bronchoscopies d'urgence et les trachéotomies. On a même tendance dans certains milieux à le charger de responsabilites au cours de la période post-opératoire qui devraient etre partagées avec le chirurgien traitant. L'auteur termine en énoncant une série de principes généraux tirés de son expérience de l'anesthésie et qui peuvent ètre appliques a tous les domaines de la médecine.

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Annotated bibliography of Harold Randall Griffith

This bibliography is believed to be a complete collection of Harold Griffith's writings from 1922 through 1967. Most of these were reprinted in 1963 in *The Boundless Realm of Anaesthesiology: A Collection of the Works of Harold Randall Griffith* which was published by ER Squibb & Sons Ltd to mark the 21st anniversary of Griffith's introduction of curare into clinical anaesthesia. Footnotes on some of his papers indicate the wide variety of regional, national and international audiences that he was invited to address. A brief summary has been added to the title of each paper. Griffith's writings provide vignettes of the development of clinical anaesthesia and the growth of our specialty in the 50 years following the First World War.

**Griffith HR.* Some practical observations on general anaesthesia. (Written 1922, reprinted in: *The Boundless Realm of Anaesthesiology: A Collection of the Works of Harold Randall Griffith.* Montreal: ER Squibb & Sons Ltd, 1963)
Griffith's observations from his experience of 400 general anaesthetics given as a medical student in the Montreal Homoeopathic Hospital and in private homes won second place in McGill Medical Society's Senior Prize Competition in 1922. Ether, chloroform and nitrous oxide-oxygen were the anaesthetic agents. A mouth gag and wooden wedge were available to open clenched teeth, and a clear airway was maintained by holding up the chin and jaw and inserting a curved metal airway. Endotracheal tubes are not mentioned. The patient's colour should always be pink and oxygen could be added under the mask. Warm water gastric lavage at the conclusion of anaesthesia was used to reduce postoperative nausea. A ward temperature chart was modified to make an anaesthetic record.

Titles preceded by an asterisk (*) are reprinted in this volume.

**Griffith HR.* Intratracheal ethylene-oxygen anaesthesia. Canadian Medical Association Journal 1929; 21: 294-6.
Griffith's first published paper described the use of intratracheal ethylene anaesthesia for ear, nose, throat, thyroid and brain operations. The usual adult premedication was hypodermic morphine 15 mg with hyoscine 0.4 mg 1 hour before operation, followed by morphine 10 mg 1/2 hour later. Induction with nitrous oxide and oxygen was followed by ethylene and a few breaths of ether. A Jackson speculum was used for laryngoscopy and the risk of damage to the pharynx or upper teeth from leverage instead of lifting was recognized. Tracheal catheters were available from size F16 for infants to F32 for adults; in adults the catheter was passed 22 cm from the teeth. A manometer was incorporated into the circuit to blow off at 20 mm mercury to prevent dangerously high intrathoracic pressure. Drops of water were added to the rubber tubing and rebreathing bag to humidify the circuit to reduce the risk of explosion.

Griffith HR. Intratracheal gas-oxygen anesthesia. Current Researches in Anesthesia and Analgesia 1929; 8: 387-9.
Griffith had expanded his use of intratracheal anaesthesia to include 60 abdominal operations: appendectomy, hysterectomy, hernia repair, cholecystectomy and gastro-enterostomy. Patients ranged in age from 10 months to 80 years, and tracheal catheters from size F12 to F34. Advantages of the method included a clear airway with quieter breathing and large bore tubes prevented inhalation of foreign material. In head surgery the anaesthetist was out of the surgeon's way. Disadvantages were the skill and experience required (an argument for properly trained anaesthetists), and the danger of trauma to teeth, lips, epiglottis and vocal cords.

Griffith HR. The field of homeopathic remedies in scientific medicine. Journal of the American Institute of Homeopathy 1930: August.
Griffith was interested in both homoeopathy and modern

medical thought. He castigated clearly foolish statements by some homoeopaths but he also claimed success for homoeopathic treatment given by his father and himself to patients who had failed to respond to orthodox measures prescribed by respected Montreal physicians.

Griffith HR. Operating room explosions. Current Researches in Anesthesia and Analgesia 1931; 10: 281-5.
Griffith was no more afraid of explosion with ethylene than others were of using gasoline in their cars. Either agent could be used safely provided the precautions governing its use were understood. He gave the explosive ranges of ethylene in air and oxygen. Moisture inside the machine (water in the breathing bag and rubber tubing) and outside the machine (45-55% room humidification by commercial humidifier) were more effective in preventing explosions caused by static electricity than merely grounding the machine. Cautery was safe in the abdomen, but not in the face area, during ethylene anaesthesia. Many more deaths resulted from respiratory complications and shock from poorly administered anaesthetics than from explosions.

**Griffith HR.* Further experiences with endotracheal gas-oxygen anesthesia. Current Researches in Anesthesia and Analgesia 1932; 11: 206-9.
Griffith's series of endotracheal anaesthetics had grown to 1,500 administrations for almost every kind of operation: head and neck surgery and poor risk, fat, and upper abdominal cases in which spinal anaesthesia was not indicated. Endotracheal intubation made such a difference in the recovery of patients that Griffith wondered why it was still looked upon as almost a curiosity in many American clinics. Waters' carbon dioxide absorption technique was added to technical details described in earlier papers.

Griffith HR. Recent advances in anaesthesia. Canadian Medical Association Journal 1933; 29: 634-9.
Better trained anaesthetists were the principal reason that anaesthesia had improved over the previous 15 years. Nitrous oxide-oxygen apparatus, ethylene, endotracheal and endobronchial intubation, suction apparatus, closed circuit and soda lime absorption, rectal premedication with tribromethanol, and intravenous sodium amytal and pentobarbital had also contributed. Cyclopropane and divinyl ether showed promise in clinical studies. Spinal and regional anaesthesia had come within the province of the anaesthetist. The anaesthetist also dealt with metabolism, physiology, pharmacology, biochemistry and pathology, and only a properly trained medical graduate could possess these qualifications. Griffith was critical of many American hospitals which employed nurse anaesthetists principally for mercenary reasons.

**Griffith HR.* John Snow, pioneer specialist in anesthesia. Current Researches in Anesthesia and Analgesia 1934; 13: 45-51.
Griffith described Snow's important contribution in the early years of anaesthesia. He drew attention to Snow's clinical practice, precise pharmacological studies, willingness to speak at meetings, promotion and maintenance of a high professional standard, and criticism of hospitals which entrusted administration of chloroform to the hospital porter.

Griffith HR. Cyclopropane anaesthesia: a clinical record of 350 administrations. Canadian Medical Association Journal 1934; 31: 157-60.
Lucas and Henderson's work in animals was reviewed, followed by Waters' results in 600 clinical cases. Griffith's own patients ranged in age from 16 months to 78 years, strong and weak, fat and thin, good and poor risk. Surgical anaesthesia was obtained with 10-15% cyclopropane in oxygen. Good relaxation was present in 266 abdominal cases, including 13 Caesarean sections, and ether was added in <5% of cases. Carbon dioxide absorption was used with a Guedel-Waters inflatable balloon around the endotracheal tube to maintain a completely closed circuit. Cyclopropane had a pleasant odour, it was not irritating, and induction was as rapid as with nitrous oxide or ethylene. Rectal avertin (tribromethanol) premedication was very helpful. The range of explosibility of cyclopropane was less than that of ethylene or nitrous oxide-oxygen-ether mixtures.

**Griffith HR.* Cyclopropane anesthesia. Current Researches in Anesthesia and Analgesia 1935; 14: 253-6.
This expanded report of 1,108 cases provided fuller details of premedication, endotracheal administration and the carbon dioxide absorption technique. Age ranged from 10 days to 85 years. Griffith considered cyclopropane to be a powerful, controllable agent and its only danger was respiratory paralysis from too high a concentration. The high cost was countered by the small quantity required for closed circuit anaesthesia. Proper humidification was maintained inside the anaesthetic machine and in the operating room. Cautery was used in the abdomen.

Morgan GS, Eaman SG, Griffith HR. Cyclopropane anesthesia for cesarean section: a comparative analysis of two hundred cases. Current Researches in Anesthesia and Analgesia 1937; 16: 113-5.
This retrospective study compared 100 cyclopropane anaesthetics with 100 ethylene-ether anaesthetics for Caesarean section. Postoperative condition and convalescence were better with cyclopropane. There was less vomiting, abdominal distension, and haemorrhage. The mean time until patients were out of bed was 14.3 days for cyclopropane and 17.4 days for ethylene-ether. Griffith attributed the improve-

ment to less disturbance of bowel function and less uterine haemorrhage.

Griffith HR. Cyclopropane: a revolutionary anaesthetic agent. Canadian Medical Association Journal 1937; 36: 496-500.
The unpleasantness of ether, dangers of chloroform, lack of potency of nitrous oxide, and disadvantages of ethyl chloride, ethylene and other agents were discussed, followed by a review of the manufacture and clinical properties of cyclopropane and its use in animals and humans. In Griffith's opinion, cyclopropane was no more explosive than nitrous oxide-oxygen-ether. It was just as difficult to cause an explosion with electric cautery in the abdomen as it would be to light one's kitchen stove by striking a match on the opposite side of the room. Spinal anaesthesia, intravenous barbiturates, divinyl ether and nitrous oxide were all useful but cyclopropane most nearly approached the ideal agent.

**Griffith HR.* Anaesthesia from the patient's point of view. Canadian Medical Association Journal 1937; 37: 361-3.
Griffith emphasized the value of personal contact, a brief physical examination, and reassuring words after auscultation of the heart and lungs. Although safety was paramount, the patient's preference for the type of anaesthesia should be considered. Local and spinal anaesthesia should only be used when specially indicated. If it helped patients' morale, they were allowed to keep false teeth, painted lips, blackened eyelashes or toupee until after induction of anaesthesia. There should be quietness during induction, except for the anaesthetist's conversation with the patient. Postoperative visits were valuable because "whatever we can do to make the patient's stay in the hospital safe, comfortable and pleasant will more than repay us for the thought and effort involved."

Griffith HR. The recent revolution in anesthesia. Journal of the Connecticut State Medical Society 1937; 1: 509-14.
In 17 years from 1920 to 1937 at the Montreal Homoeopathic Hospital drugs and equipment had progressed from ether and chloroform and a few masks to 8 anaesthesia machines, suction, oxygen and helium, 15 different agents and much technical equipment. Although spinal and regional anaesthesia were suitable for some cases, better general anaesthetic agents were needed. Ethylene had been an improvement but it gave inadequate relaxation. Next came rectal tribromethanol; intravenous sodium amytal, nembutal, evipal and pentothal; and the inhaled agents divinyl ether and cyclopropane. New apparatus and techniques included closed circuit anaesthesia with carbon dioxide absorption by soda lime, endotracheal anaesthesia, Leech's pharyngeal bulb gasway, and suction pumps run from the water system. Therapeutic uses of oxygen, helium, and carbon dioxide were discussed.

Griffith HR. Two unusual complications in patients under cyclopropane anesthesia. Current Researches in Anesthesia and Analgesia 1938; 17: 298-9.
The first was a case of acute pulmonary oedema in a healthy 40 year old male during inguinal hernia repair. Uneventful recovery followed endotracheal intubation, suction and oxygen. In the second case a healthy 14 year old boy developed convulsions during submucous resection of the nasal septum. Twitching commenced 40 minutes after each nostril had been packed with nupercain 2%, and convulsions occurred at the end of the operation. The convulsions were controlled by intravenous sodium amytal 0.5 gm, and endotracheal oxygen for 2 hours. Convalescence was uneventful. In both cases Griffith emphasized the lifesaving value of endotracheal oxygen.

**Griffith HR.* The management of complications arising during cyclopropane anesthesia. New York State Journal of Medicine 1940; 40: 209-14.
Since October 1933 Griffith had accumulated more than 5,000 personal administrations of cyclopropane. He had had no death on the table and no postoperative death which could be attributed to cyclopropane. During the same period at his hospital there had been 5 anaesthetic deaths with other agents. His series included 528 obstetric cases, of which 201 were Caesarean section. Respiratory depression was treated by decreasing the concentration of cyclopropane and giving endotracheal oxygen with positive pressure ventilation. He emphasized the fundamental importance of a clear airway and endotracheal intubation. Pulmonary atelectasis was minimized by maintaining a clear airway, using a non-irritating anaesthetic, and performing pharyngeal and tracheal suction at the end of the case. He described 2 cases of pulmonary oedema, the second of which resembled Mendelson's syndrome and both patients recovered. The aetiology of cardiac arrhythmias was not understood but they caused no permanent damage to the heart. Postoperative shock was treated with intravenous glucose-saline or blood transfusion.

Leech BC, Griffith HR. Cyclopropane – unmixed. Canadian Medical Association Journal 1940; 42: 434-8.
Leech in Regina and Griffith in Montreal combined their experience of 8,661 cases. Criticism of cyclopropane had come from laboratory workers rather than from clinical anaesthetists. The authors wanted to clear away unjustified prejudice and misunderstanding. Ninety per cent (8,270) of their patients received cyclopropane and oxygen alone, whereas other anaesthetists often mixed nitrous oxide, ether, or vinethene. Three operative deaths had occurred, all in patients in extremis preoperatively. Postoperative death rate from cardiac or respiratory causes was 0.21% with cyclopropane and 0.33% with other anaesthetics. The authors emphasized that cyclopropane was very dangerous in the hands of unskilled or non-

medical anaesthetists, but valuable for skilled, experienced physician-anaesthetists with a good knowledge of basic medical sciences. Addition of other agents was unnecessary; it confused warning signs and added to postoperative morbidity.

Griffith HR. The prevention and treatment of complications during cyclopropane anesthesia. Current Researches in Anesthesia and Analgesia 1940; 19: 141-4.
This paper is very similar to 'The management of complications arising during cyclopropane anesthesia' above.

Griffith HR, Goodall JR. Analgesia and anaesthesia in obstetrics. Journal of Obstetrics and Gynaecology of the British Empire 1941; 48: 323-33.
Griffith's co-author was an obstetrician. This paper represents their combined experience. They believed that complete analgesia in the first stage of labour could mask danger signs because there was no infallible method for measuring uterine effort. Opium derivatives were ideal analgesics because they reduced but did not obliterate pain. Risk of fetal depression was balanced by better uterine action. For the second stage ether or chloroform was recommended, the popularity of spinal, caudal and local anaesthesia having been shortlived. Causes of fetal death were reviewed, and the effect of general anaesthetics on uterine contraction and retraction, uterine stimulants, placental separation and expulsion, and intrapartum and postpartum haemorrhage. Nitrous oxide was recommended for pain relief, and cyclopropane for delivery. For Caesarean section cyclopropane was first choice and spinal second choice. If an infant failed to breathe adequately within 2 minutes of delivery the anaesthetist gave oxygen by mouth, or by endotracheal catheter with artificial respiration. The authors concluded that good results in obstetrics came from cooperation between obstetrician and anaesthetist. They criticized obstetricians and hospital authorities who delegated obstetrical anaesthesia to junior interns or nurses.

Griffith HR. Pneumotherapy: the therapeutic use of oxygen and other gases. Canadian Medical Association Journal 1941; 45: 439-42.
Griffith criticized those physicians who overrated the danger of oxygen therapy. It was of proven value for pneumonia, gas poisoning, various forms of heart disease, acute coronary thrombosis and postoperative shock. He recommended humidified oxygen via nasopharyngeal catheter which gave 40-50% oxygen with a flow rate of 4-6 litres per minute. Oxygen tents were only used by special request from patients. Helium 70-80% in oxygen was given for respiratory obstruction including laryngospasm and it was also beneficial in aero-otitis media in aviators. Therapeutic value of carbon oxide was very limited, cyclopropane had been used for the prevention or treatment of anaphylaxis to antitoxins, and ether for intractable asthma.

**Griffith HR, Johnson GE.* The use of curare in general anesthesia. Anesthesiology 1942; 3: 418-20.
This preliminary report on the clinical use of curare was destined to change the practice of anaesthesia. It contained a very brief description of the physiological action of curare and its previous use in convulsive shock therapy. At the suggestion of Dr LH Wright, Griffith and Johnson had given the drug to 25 patients during surgical anaesthesia. Small doses were given, mostly for abdominal cases, and artificial respiration was not necessary. The authors concluded that curare would occasionally be of great value. It would provide surgeons with excellent muscular relaxation at critical times during certain operations, but it should be used only by experienced anaesthetists in well-equipped operating rooms.

Griffith HR. Anesthesia service for small hospitals. Anesthesiology 1942; 3: 553-9.
Griffith believed that patients in small hospitals of less than 150 beds were entitled to as safe anaesthesia as in the largest teaching hospitals. In Canada and the United States there were only 2,000 full-time physician-anaesthetists for 7,000 hospitals. To make anaesthesia attractive the income must be comparable with other specialties. Too often hospitals charged high fees for, and made a profit from, nurse-anaesthesia to offset other budget deficits. The physician could be paid by salary or private fee but must not be used for hospital profit. In Griffith's hospital separate charges were made for "anaesthetic supplies" and "anaesthetist's fee." A hospital of less than 150 beds could not offer full-time work in anaesthesia. The anaesthetist should therefore involve himself in general practice, hospital administration, and nursing education. Advantages of working in a small hospital included close teamwork and clinical research. The Montreal Homoeopathic Hospital's anaesthesia staff consisted of himself and one 3rd year resident. Details of 4,873 anaesthetics in the previous 2 years were presented and analysed.

**Griffith HR.* The use of curare in anaesthesia and for other clinical purposes. Canadian Medical Association Journal 1944; 50: 144-7.
Griffith presented a concise history of curare from the time of Sir Walter Raleigh to its introduction into clinical anaesthesia, described its physiological action at the neuromuscular junction, and mentioned that the diaphragm and intercostals were the last muscles to be affected. Maximum effect was seen in about 5 minutes and duration of action was 15 to 20 minutes. When curare was used in anaesthesia the patient was already asleep under the care of an experienced anaesthetist, with adequate oxygenation, free airway, and every facility at hand for proper control of respiration. Griffith did not fear respiratory depression or apnoea because he was so accustomed to artificial control of respiration in patients under anaesthesia. Prostigmine should always be available when

curare was given although in Griffith's 90 cases to date he had never used it. Curare was not used routinely because inadequate relaxation was not a frequent problem. The good anaesthetist should not need it every day or even every week. Its use in psychiatry during convulsive therapy and its potential for use in spastic paralysis were discussed.

Griffith HR. Curare in anesthesia. Journal of the American Medical Association 1945; 127: 642-4.
The content of this paper is similar to that of the previous one. In 1,000 consecutive operations Griffith used curare in 8.6% of cases. Even in abdominal surgery he only used it in 16.5% of cases (45.2% of gall bladder and stomach operations), and in only 1.3% of extra-abdominal operations. Griffith predicted that the use of curare would lower the use of spinal anaesthesia, and increase the use of pure cyclopropane or thiopentone for abdominal surgery without the addition of ether.

Griffith HR. Curare: a new tool for the anaesthetist. Canadian Medical Association Journal 1945; 52: 391-4.
This paper is very similar to the previous one and includes the same statistics.

Griffith HR. Curare as an aid to the anaesthetist. Lancet 1945; 2: 74-5.
This paper is similar to the previous three. Opinions about curare varied from the anaesthetist who stated that curare would promptly replace a great deal of deep ether anaesthesia and also spinal anaesthesia to one who wrote, "Why not learn to give an effective anaesthetic?" Griffith believed that curare should remain "just one more good thing in the modern anaesthetist's bag of tricks. It is not a play thing for the inexperienced." With more than 3 years clinical experience of curare, he believed it would probably have a permanent place in anaesthesia.

Griffith HR, MacMillan M. A post-operative recovery room and blood bank. The Canadian Hospital 1946; April.
This well illustrated paper described the first postoperative recovery room in Canada, following Lundy's example at the Mayo Clinic. In Griffith's hospital the recovery room and blood bank were both housed in a sun porch on the same floor as the operating room. Funding was obtained from the Women's Auxiliary of the hospital. It was the unanimous opinion of surgeons, nurses, patients, visitors, and hospital administration that this was one of the best investments in a special service that a hospital could make.

Griffith HR. Physiological and clinical action of curare. Current Researches in Anesthesia and Analgesia 1946; 25: 45-51.
Griffith's indication for the use of curare continued to be profound muscular relaxation for the surgeon. He did not believe it was necessary to use curare routinely for every operation and he protested against such use.

Griffith HR. The problem of muscle relaxation in surgery. Canadian Medical Association Journal 1947; 56: 281-3.
The responsibility of the modern anaesthetist was for the safety and comfort of the patient before, during and after operation, and to provide the best possible working conditions for the surgeon. Muscle relaxation could be provided by deep general anaesthesia; local, regional block and spinal anaesthesia; and by interruption of the myoneural junction. The best way was a judicious combination of nitrous oxide, ethylene, thiopentone or light cyclopropane supplemented when necessary with curare. Spinal anaesthesia was used particularly for major gynaecology and in obstetrics.

**Griffith HR.* Balanced anaesthesia – a modern trend. Urologic and Cutaneous Review 1947; 51: 132-4.
Griffith presented the same data as in the previous paper. The current trend was towards the use of various combinations of anaesthetic drugs and methods to provide safe anaesthesia. The judgment, skill and experience of the anaesthetist were considered even more important.

**Cullen WG, Griffith HR.* Postpartum results of spinal anesthesia in obstetrics. Current Researches in Anesthesia and Analgesia 1947; 26: 114-21.
The results of 200 consecutive cases of spinal anaesthesia were compared with 200 consecutive cases of cyclopropane anaesthesia for vaginal delivery. The advantages of spinal anaesthesia were almost immediate pain relief, reduced uterine blood loss, and a higher incidence of spontaneous respiration and optimum oxygenation in the newborn. Cyclopropane also produced good results. Headache did not occur more frequently after spinal anaesthesia than after cyclopropane but it could be more distressing. Services of a qualified anaesthetist were as essential in obstetrics as in surgery.

Griffith HR, MacLeod EJ. Ethyl-normal-propyl ether: a satisfactory general anesthetic agent for intranasal surgery. Anesthesiology 1947; 8: 615-8.
Most intranasal surgical procedures were performed under local anaesthesia, although for some patients general anaesthesia was preferable. This clinical report of ethyl-n-propyl ether for 25 intranasal surgical procedures showed that it was safe, and that it produced a remarkable absence of congestion of the nasal mucous membrane.

**Griffith HR.* A tribute to Dr FH McMechan. (Presented 1947, reprinted in: *The Boundless Realm of Anaesthesiology: A Collection of the Works of Harold Randall Griffith.* Montreal: ER Squibb & Sons Ltd, 1963)

Griffith recalled McMechan's personal friendship and encouragement to himself and to Canadian anaesthetists from the earliest days of the specialty. Despite rheumatoid arthritis McMechan travelled to promote anaesthesia organizations, active teaching departments, research programmes, and hospital departments of anaesthesia. McMechan's wife was his alter ego and valiantly carried on his work when he was unable to do so.

Griffith HR, Cullen WG. Myanesin as a muscle relaxant. Current Researches in Anesthesia and Analgesia 1948; 27: 232-5.
Reports from Britain suggested that advantages of Myanesin over curare included a selective action on the abdominal muscles, a high therapeutic ratio and an absence of side effects. Having used it in 120 cases, the authors concluded that it was effective and non-toxic but local irritation sometimes occurred at injection site. It had no advantage over curare.

Griffith HR, Stephen CR, Cullen WG, Bourne W. Myanesin as a muscle relaxant. Anesthesiology 1949; 10: 61-5.
This paper is very similar to the previous one. Irritation at the site of injection and haemoglobinuria made the continued clinical use of Myanesin inadvisable.

Griffith HR. Anesthesiology today and tomorrow. Current Researches in Anesthesia and Analgesia 1949; 28: 105-10.
Current practice used combinations of the many anaesthetic agents and methods available. Anaesthesia was branching out into fields which included parenteral fluid and protein therapy, bronchoscopy, diagnostic and therapeutic nerve blocks and therapeutic use of gases. The most important trend was towards better teaching in the basic sciences and clinical practice. Griffith looked forward to better and larger training facilities; recognition that the anaesthetist was a specialist of equal status with internists, surgeons and obstetricians; and adequate financial remuneration with some measure of security. Looking beyond his own country Griffith believed the World Health Organization should have a section to spread the benefits of modern anaesthesia throughout the world.

Griffith HR. New freedom of choice in anesthetic agents. Connecticut State Medical Journal 1949; 13: 1119-22.
Curare enabled anaesthetists to evaluate anaesthetic agents according to their analgesic or hypnotic action without having to consider their muscle relaxant properties. The toxicity of a combination of small doses of several drugs was less than that of a large dose of one drug used to produce a similar effect. Spinal anaesthesia was used in 30% of surgical and obstetrical cases, up from 11% in 1945 and only 2% in 1941. With the increased variety and potency of anaesthetic agents the quality of training of anaesthetists was more important than ever.

Griffith HR, Bourne W. Muscle relaxants. Montreal Medical Society 1949; 385-91.
Erythroidine and B-erythroidine hydrobromide, Metubine, Myanesin, Flaxedil and Decamethonium had been used clinically. Griffith believed that claims for superiority of these drugs over curare had been made without sufficient substantiating evidence.

**Griffith HR.* Position of the anesthesiologist on the hospital staff. Current Researches in Anesthesia and Analgesia 1950; 29: 189-94.
Griffith believed that the anaesthetist must have the ability and determination to provide a high quality of anaesthesia service. Being overconfident, aggressive, combative and mercenary would lead to failure. Anaesthesia should be a separate hospital department and at least the director should be a certified specialist in anaesthesia. Anaesthetists should be appointed to the medical staff in the same way as other specialists, their professional relationships should be based on mutual respect, and their income should be comparable with that of other specialists. They should strive to educate other members of hospital staff, serve on committees, and attend meetings.

**Griffith HR.* Recovery room. The Canadian Nurse 1950; 46: 791-2.
This short paper described the organization, construction and function of the recovery room.

Griffith HR. New anaesthetic drugs. Canadian Medical Association Journal 1950; 63: 533-6.
Nitrous oxide, ethylene and cyclopropane were the inhaled anaesthetics, thiopentone was the most popular intravenous agent, xylocaine was a promising new local anaesthetic and pharmacologists were searching for curare substitutes. Intravenous procaine was used to protect the heart from cyclopropane-induced arrhythmias, to facilitate manipulation by the physiotherapist and to control the pain of burns. Many synthetic analgesic drugs had been reported although none was entirely free from the disadvantages of morphine.

Griffith HR. Cyclopropane – a clinical evaluation. Anesthesiology 1951; 12: 109-13.
Griffith had personally administered 20,000 cyclopropane anaesthetics without an operative death. His principles for its safe use were a clear airway, if necessary by endotracheal intubation, adequate oxygenation and carbon dioxide elimination, and smooth but not too deep anaesthesia. Postoperative cyclopropane shock was due to inadequate pulmonary ventilation during anaesthesia. Slight pulse irregularity was not a concern, but if persistent the anaesthetic should be lightened and curare given for relaxation.

**Griffith HR.* A plea for the "Art of Anesthesia." Anesthesiology 1951; 12: 500-3.
Griffith welcomed new drugs and equipment although he believed that good anaesthesia involved more than technical skill. The art of anaesthesia included wisdom, judgment, kindness, and careful attention to detail. Operating room conflicts could be avoided if there was mutual confidence, tolerance and understanding between anaesthetists, surgeons, nurses and hospital employees. Intelligent interest in administrative problems and committees, and friendliness with all levels of hospital staff were all part of the art of anaesthesia.

**Griffith HR.* Eminent anaesthetists No. 6. Wesley Bourne. British Journal of Anaesthesia 1951; 23: 186-95.
Bourne was Griffith's mentor, teacher, academic predecessor and also his closest friend. Griffith reviewed Bourne's many contributions to clinical, academic and organized anaesthesia. Bourne was more than just an able teacher, a brilliant scientist and a good clinician; his passionate idealism had ignited in his students a spirit of devotion to duty, truth, and the welfare of humanity.

Griffith HR. Aspects of anaesthesia. Canadian Medical Association Journal 1951; 65: 523-31.
Griffith discussed the rational use of intravenous anaesthetic agents, curare and other muscle relaxants, the value of anaesthetic gases, the recurrent spinal-versus-general anaesthesia controversy, better obstetrical anaesthesia, better training for anaesthetists, and the outlook for the future.

Griffith HR. The evolution of the use of curare in anesthesiology. Annals of the New York Academy of Sciences 1951; 54: 493-7.
Griffith described the modern history and development of curare, including his own contribution. He had used all the subsequent synthetic relaxants and was unable to decide whether any one was safer or better than others. He did not decry attempts at comparative evaluation of relaxant drugs, but he firmly believed that their safe use depended on competent anaesthetists.

**Griffith HR.* Safety factors in spinal anaesthesia. Current Researches in Anesthesia and Analgesia 1952; 31: 367-71.
In response to Foster Kennedy's statement that "paralysis below the waist is too large a price for a patient to pay in order that the surgeon should have a fine relaxed field of operation" Griffith pointed out that no anaesthetic agent or method was entirely safe. The safety factors for spinal anaesthesia which he discussed were aseptic technique, fine needles, minimum dosage and dilute solutions, intravenous fluids, use of sedatives or stimulants, oxygen availability, proper psychological approach, common sense and vigilance.

Griffith HR. The clinical use of muscles relaxants. Anesthésie et Analgésie (Paris) 1952; 8: 1-4.
This paper was presented in Paris in 1951. Prevention and treatment of complications depended on combining the use of muscle relaxant drugs with anaesthetic agents, using just enough relaxant to obtain the desired effect, having means of supporting respiration immediately available and knowing how to use neostigmine. The ability to pass an endotracheal tube and to support the patient's respiration with oxygen were vital.

Griffith HR. How to stay out of trouble while using cyclopropane. Current Researches in Anesthesia and Analgesia 1953; 32: 23-6.
The advantages of cyclopropane in skilled hands far outweighed its dangers. Cardinal principles were to respect its potency, never to give it unless an endotracheal tube was available, to keep an even level of anaesthesia with adequate pulmonary ventilation and not to remove the tube too soon. Tachycardia should cause more concern than arrhythmias. Supplementary intravenous or inhalation agents, regional anaesthesia or muscle relaxants should be used when necessary. Risk of explosion was minimized by providing adequate humidity, use of conductive materials and allowing cautery only in the abdomen but not around the head.

Griffith HR. The abuse of drugs in anesthesiology. Hartford Hospital Bulletin 1953; 8: 4-12.
Griffith discussed overuse, underuse, and misuse of anaesthetic agents. Examples included hypoxia with nitrous oxide, respiratory acidosis with cyclopropane, arterial injection of thiopentone, overdosage of curare and spinal anaesthetics, too little pre-anaesthetic medication and the controversial use of hypotensive drugs.

**Griffith HR.* Plans for a world federation of anaesthesiologists. (Unidentified source 1953, reprinted in: *The Boundless Realm of Anaesthesiology: A Collection of the Works of Harold Randall Griffith.* Montreal: ER Squibb & Sons Ltd, 1963)
Griffith, with Whitacre of Cleveland, Seldon of Rochester, Minn. and Friend of Akron, attended the meeting of the Interim Committee on the Establishment of an International Organization of Anaesthetists in Brussels in June 1953. The committee recommended to various national societies that a "World Federation of Societies of Anaesthesiologists" should be organized, and a draft constitution was prepared. After the meeting Griffith and his American colleagues combined visits to anaesthesia centres in France, Belgium, England and Scotland with a limousine tour of Britain.

Griffith HR. Anesthetic accidents. (c. 1953, reprinted in: *The Boundless Realm of Anaesthesiology: A Collection of the Works of Harold Randall Griffith.* Montreal: ER Squibb & Sons Ltd, 1963)
This was a typed list of personal mistakes in 30 years of anaesthetic practice. It included: wrong patient, ran out of oxygen, ran out of gas, no light for laryngoscope, damaged teeth, subcutaneous emphysema, broken spinal needle, and aspiration of food.

Griffith HR. Internship in a small hospital. Canadian Association of Medical Students and Interns Journal 1953; 12: 15-6.
Larger hospitals were sometimes so departmentalized that internship in a well-organized small hospital of 100 to 300 beds could give the intern better insight into how medicine was actually practised. Essentials for a good intern teaching service in any hospital included properly organized medical staff with regular and frequent conferences, good medical records, and good library, laboratory and radiology facilities.

Griffith HR. Anesthesiology in medical practice. North Carolina Medical Journal 1954; 15: 63-6.
Developments during the previous 30 years had brought new methods and new drugs which made anaesthesia relatively safe and almost pleasant. Griffith reviewed advances in apparatus, anaesthetic agents, spinal and regional blocks, prevention and treatment of cardiac arrest and operating room explosions, but the greatest safety factor was the intelligence, ability, and experience of the anaesthetist.

**Griffith HR.* A world federation of anesthesiologists. Anesthesiology 1954; 15: 202-4.
This is a brief, detailed report of the Brussels meeting in June 1953 which led to the organization of the World Federation of Societies of Anaesthesiologists.

Gillies DM, Cullen WG, Griffith HR. Succinylcholine as a relaxant in abdominal surgery. Current Researches in Anesthesia and Analgesia 1954; 33: 251-7.
The authors presented the history, chemistry and pharmacology of a new, nondepolarizing neuromuscular blocking agent. They had given the drug to 602 patients by bolus injection of 20-60 mg or by 0.1% infusion. They concluded that succinylcholine represented the first really significant advance in relaxant drugs since curare because its ultra-short action brought controllability.

Griffith HR. Succinylcholine – a controllable muscle relaxant. Canadian Medical Association Journal 1954; 71: 28-31.
Griffith had extended his study to more than 1,000 administrations of succinylcholine of which more than 600 were 0.1% infusions for abdominal surgery. Its controllability and extremely short action were emphasized.

Griffith HR. Anaesthetics. The Hospital Pharmacist 1954; 7: 142-5.
This was a brief account of general and local anaesthetics which produce insensibility to pain, and their methods of administration.

Hosein EA, Denstedt OF, Griffith HR. Comments on benzimidazole: illustrating a method of approach to the introduction of new drugs. Anesthesiology 1955; 16: 142-4.
The authors investigated the effect of this muscle relaxant on various enzyme systems in animals to measure oxygen consumed or carbon dioxide produced. This was a measure of its toxicity and the technique could be applied to other anaesthetic drugs.

Griffith HR. Zur Gründung des Weltbundes der Anaesthesie-Gesellschaften. Der Anaesthesist 1955; 4: 97.
This article in German described the formation of the World Federation of Societies of Anaesthesiologists.

**Griffith HR.* Whither now in anaesthesia? Canadian Medical Association Journal 1956; 74: 601-4.
With 35 years experience Griffith predicted future trends in anaesthesia. These included better training in anaesthesia, increased attention to pulmonary ventilation, increased appreciation of the advantages of anaesthetic gases compared with volatile agents, and decreased use of intravenous agents. Despite the Beecher and Todd report Griffith believed that muscle-relaxant drugs would continue to have an important place and despite possible neurological sequelae spinal anaesthesia would continue to be used. Hypothermia would be reserved for open cardiac surgery. The anaesthetist of the future would be a consultant on problems of respiration, circulation, drug poisoning and postoperative complications.

Cullen WG, Brindle GF, Griffith HR. Observations of carbon dioxide in conscious and anaesthetized subjects using the Liston-Becker infra-red analyser. Canadian Anaesthetists Society Journal 1956; 3: 81-96.
Fifty carbon dioxide patterns were obtained on anaesthetized patients and conscious volunteers. Samples were taken on the expiratory side of the Y-connector, and at the inspiratory valve next to a "Hico" carbon dioxide detector. Levels of carbon dioxide at which the "Hico" detector changed colour were recorded. Many capnograph tracings were shown. The authors emphasized the need for a simple device for detecting carbon dioxide during anaesthesia, and the importance of alveolar ventilation in addition to oxygenation.

Griffith HR. Die Lehre der Anaesthesiologie. Der Anaesthesist 1956; 5: 33-5.
This paper in German discussed the teaching of anaesthesia.

Griffith HR. The anesthesiologist as a physician. Current Researches in Anesthesia and Analgesia 1956; 35: 304-12.
Griffith again emphasized that the anaesthetist is a physician. In Canada anaesthetists were separate from surgeons and became Fellows of the Royal College of Physicians of Canada. In addition to giving good anaesthetics, anaesthetists should have good personal relations with surgeons, nurses, and other hospital colleagues. They should also make preoperative and postoperative visits to show interest in patients as individuals, use their clinical abilities outside the operating rooms and sit on committees. Research would only appeal to some anaesthetists but all should keep abreast of recent advances. Clinical research was possible in small hospitals such as Griffith's. He had already published many papers when he "hit the jack-pot" with curare in 1942. At that time he was still four years away from his connection with a medical school, basic science laboratory, or any formal teaching programme. He encouraged anaesthetists to take holidays, have a relaxing hobby and involve themselves in community activity.

Griffith HR. President's message. Proceedings of the World Congress of Anesthesiologists. Minneapolis: Burgess, 1956; 1: i-ii.
Griffith described events leading up to the first World Congress and named those who made it possible. The congress brought together men and women from many nations and languages who were united in a common friendship and devotion towards better anaesthesia throughout the world.

Griffith HR. The teaching of anesthesiology. Proceedings of the World Congress of Anesthesiologists. Minneapolis: Burgess, 1956; 1: 313-5.
Griffith described the 3 year programme at McGill University in Montreal and discussed the advantages and disadvantages of shorter courses. Three years was optimal for complete specialist training. Well organized courses of 6 months to 1 year could produce anaesthetists who were relatively harmless and much better than physicians with no special training.

Griffith HR, Cullen WG, Welt P. Clinical study of prestonal as a muscle relaxant in anaesthesia: a preliminary report. Canadian Anaesthetists Society Journal 1956; 3: 346-56.
This muscle relaxant had been used on 26 patients. Duration of relaxation was 6-8 minutes, the block appeared to be of the mixed type and no serious undesirable side effects were reported.

**Griffith HR.* Editorial. Survey of Anesthesiology 1957; 1: 73-4.
Griffith had no need to withdraw any of the statements concerning curare that he made 15 years earlier. Anaesthetists, neurologists, physiologists, pharmacologists and pharmaceutical manufacturers had contributed to the knowledge of muscle relaxants. Because curare and all the newer muscle relaxants caused respiratory depression, they should only be used by experienced anaesthetists who could intubate the trachea. Dosage should be assessed for each patient and should only be used when muscle relaxation was really needed.

Griffith HR. On friendship. Anesthesiology 1958; 19: 88-9.
Friendship was as important in professional life as it was in personal, political or international relations. That thought had led a number of anaesthetists to work towards the organization of the World Federation of Societies of Anaesthesiologists. The next World Congress was scheduled for Toronto in September 1960.

Griffith HR, Robson JG, Cullen WG, Gillies DMM. Fluothane a modern substitute for chloroform. Anesthesia and Analgesia ... Current Researches 1958; 37: 316-21.
The authors were interested in Fluothane (halothane) because it was non-combustible. It had many desirable features but it lowered blood pressure, sometimes alarmingly. It might slow the heart, had been known to cause cardiac arrest and sensitized the heart to adrenalin. Although it was less toxic than chloroform it was not the harmless, foolproof drug to replace all explosive agents. The authors concluded that it might be a most useful agent in the future.

Griffith HR. Fifty years of progress in surgery and anesthesia. The Canadian Nurse 1958; 54: 541-43.
Developments which had made modern surgery possible were clinical application of better knowledge of biochemistry and physiology, blood transfusion, sulfa drugs and antibiotics, and better anaesthesia that included the use of muscle relaxant drugs.

Robson JG, Gillies DM, Cullen WG, Griffith HR. Fluothane (halothane) in closed circuit anaesthesia. Anesthesiology 1959; 20: 251-60.
A safe closed circuit absorption technique using halothane was evolved as a result of measurements using a Liston-Becker infra-red analyser sensitive to halothane. The analyser in the closed circuit gave a continuous reading under varying conditions with an oxygen flow rate of 500 ml per minute.

Griffith HR. Present day concepts of muscle relaxants. Wisconsin Medical Journal 1959; 58: 255-7.
Curare filled the need for good muscle relaxation in abdominal

surgery. It also led pharmaceutical manufacturers and research pharmacologists to look for curare substitutes. The only one which Griffith considered significantly better was succinylcholine because of its very short action and use by intravenous drip. Attempts to find a drug which would relax skeletal muscles and not affect respiration did not make physiological sense and were futile. The results of Beecher and Todd's study had been beneficial in emphasizing the importance of anaesthesia as a cause of death and the need for further study. Griffith agreed with them that muscle relaxants should be employed only when there were clear advantages and not as a corrective for generally inadequate anaesthesia.

**Griffith HR.* The boundless realm of anaesthesiology. Canadian Medical Association Journal 1960; 82: 859-65.
This was the first Dr Harry Shields Lecture in Anaesthesia in Toronto. Griffith recalled that his original interest in anaesthesia was prompted by the opportunity to earn a few $5 fees to pay his way through medical school. At that time the attitude of the medical profession was that anaesthesia was a rather boring technical procedure that could be carried out by students, interns, and broken-down doctors. He then paid tribute to Canadian pioneers in anaesthesia and related how anaesthesia had become the most comprehensive of all the specialities. The three areas in which he elaborated were the development of new drugs and techniques; a better understanding of physiology, biochemistry and pharmacology; and better provisions for the teaching of anaesthesia.

Griffith HR. The early clinical use of cyclopropane. Anesthesia and Analgesia ... Current Researches 1961; 40: 28-31.
Griffith traced the early days of cyclopropane from Henderson's first paper in 1929 through Waters' clinical trial in 1933 to his own experience soon afterwards. Cyclopropane was a respiratory depressant and, although adequate oxygenation was no problem, prevention of carbon dioxide retention could only be remedied by adequate pulmonary ventilation through an unobstructed airway, if necessary using tracheal intubation.

Griffith HR. The pattern of anaesthesia. Canadian Anaesthetists Society Journal 1962; 9: 1-5.
The criterion of good anaesthesia was the speed and completeness of the patient's recovery. Improvements in anaesthesia which Griffith had seen over 40 years was due to more than just changes in anaesthetic agents. Among other essential factors were an unobstructed airway, adequate ventilation and fluid and electrolyte balance. Oxygenation was important, but so was carbon dioxide elimination by adequate ventilation. The educated hand was no longer acceptable. The two essential pieces of equipment were a good mechanical ventilator and good carbon dioxide absorption.

Griffith HR. History of the World Federation of Anesthesiologists. Anesthesia and Analgesia ... Current Researches 1963; 42: 389-97.
Griffith was chairman of the organizing committee and first president of the World Federation of Societies of Anaesthesiologists. He traced the thought of an international organization to McMechan's founding of the International Anesthesia Research Society in the 1920s and from the 1951 meetings in London and Paris. An interim committee was formed in 1951, and in 1953 an organizing committee was appointed to receive reports from national societies of anaesthetists, draw up a tentative constitution, and make plans for a world congress in 1955. Griffith gave a detailed history of the World Federation until after the Second World Congress in Toronto in 1960.

Griffith HR. Medical education and anesthesiology. Canadian Medical Association Journal 1964; 90: 852-3.
Griffith outlined the McGill 3 year course in anaesthesia, during which the resident spent at least 6 months at a large general hospital, a smaller general hospital, a children's hospital, and in other specialized services such as neurosurgery and thoracic surgery. Several times each week there were seminars and lectures in the basic sciences, and general discussions covering the whole field of anaesthesia. Residents were also made familiar with the aims and techniques of basic and clinical research. Insufficient numbers of Canadian medical graduates were attracted to anaesthesia and Griffith felt that medical students should be exposed to anaesthesia early in their training.

Griffith HR. Some Canadian pioneers in anaesthesia. Canadian Anaesthetists Society Journal 1964; 11: 557-66.
Griffith gave short biographies of leading Canadian anaesthetists from Horace Nelson who used ether in Montreal in 1847 to those whom Griffith had known during his own professional career.

Griffith HR. Wesley Bourne MSc MD CM FRCP(C) FFARCS 1886-1965. Anesthesia and Analgesia ... Current Researches 1965; 44: 373-4.
In this obituary Griffith paid glowing tribute to his friend and mentor who did so much to advance the specialty of anaesthesia. In 1925 and 1940 Bourne was president of the International Anesthesia Research Society, in 1942 he became president of the American Society of Anesthesiologists, and in 1945 he became the first professor and chairman of an independent department of anaesthesia in Canada. The Greek motto which Bourne gave to the Canadian Anaesthetists' Society, meaning "we watch closely those who sleep" was one that Griffith frequently quoted.

Griffith HR. Wesley Bourne. Canadian Anaesthetists Society Journal 1965; 12: 315-7.
This obituary is identical to the one above.

Griffith HR. Problems in anaesthesiology for the aged. Canadian Anaesthetists Society Journal 1966; 13: 14-20.
Griffith did not accept that there were anaesthesia problems peculiar to old age. The dangers and hazards of anaesthesia were the same at any age, but in older patients there was a smaller margin for error. In particular the anaesthetist should avoid hypoxia, improper elimination of carbon dioxide, fluid and electrolyte imbalance, drug toxicity, nerve palsies and psychic trauma. Griffith pleaded for a more intelligent approach to inevitable death than was sometimes shown by physicians, and suggested that we "temper our knowledge with wisdom and with mercy."

Griffith HR. An anaesthetist's valediction. Canadian Anaesthetists Society Journal 1967; 14: 373-81.
Griffith combined gratitude, reminiscence, admonition, aspiration and benediction in this essay which he wrote soon after he retired. Beginning with his earliest experience of giving anaesthetics during the First World War in 1916 he traced developments of the next 50 years. He wrote again of tracheal insufflation and larger bore tubes, mentioning the names of Stewart in Montreal, Hargrave in Toronto and McGill in England; Waters' invitation for Griffith to join the Anesthetists' Travel Club; McMechan the counsellor and inspiration for better anaesthesia everywhere; Bourne's recognition of the importance of basic sciences; intravenous barbiturates and cyclopropane; Lewis Wright's suggestion that curare might be useful in the operating room; the importance of ventilation as well as oxygenation; attention to blood, fluid and electrolyte replacement; regional anaesthesia; and the post anaesthesia recovery room. Griffith paid tribute to those who had helped in the development of anaesthesia as a profession and concluded, "Amen - may God bless you all!"

Griffith HR. Anaesthesia in Canada 1847-1967. II. The development of anaesthesia in Canada. Canadian Anaesthetists Society Journal 1967; 14: 510-8.
Griffith's last paper was a companion to one by Jacques "Anaesthesia in Canada 1847-1967. I. The Beginnings of Anaesthesia in Canada." Anaesthesia as a special branch of medicine hardly existed in Canada until the early years of the 20th century. Griffith gave credit to Samuel Johnston in Toronto, William Webster in Winnipeg, and Charles LaRocque and William Nagel in Montreal for their pioneering work in establishing organized departments of anaesthesia. Too often anaesthetists had worked as hospital employees at meagre salaries and there was little inducement for bright young doctors to go into this field. The battle for improved status, and equal status with other specialists, continued until after the Second World War. The Canadian Society of Anaesthetists was formed in 1920, but in 1928 members became a Section of the Canadian Medical Association. In 1930 the Montreal Society of Anaesthetists was formed which in 1943 became the Canadian Anaesthetists' Society. In 1951 the Royal College gave Fellowship status to anaesthetists. Griffith also paid tribute to Canadians who had introduced new agents and methods or who had improved the teaching of anaesthesia.