Frank Schofield's Discovery of the Mouldy Sweet Clover Anticoagulant at Ontario Veterinary College and its Impact on Biomedical Sciences

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In: Education Research and Development 2003
First Schofield Memorial Lectures
College of Veterinary Medicine
Seoul National University

Introduction

The Ontario Veterinary College (OVC) was established in Toronto, Ontario, Canada in 1862 and is now the oldest continuously active veterinary college in North America. Perhaps the most significant period in its 140-year history was 1920-22. This was the time when OVC moved to Guelph, and when Dr. Frank Schofield made what most believe is his most important discovery [1,2]. I am greatly honoured to represent OVC during the Schofield Memorial Lectures at Seoul National University, to talk about Dr. Schofield's work as a veterinary pathologist at OVC. His discovery of the sweet clover anticoagulant is a story about one young man's dedicated and clever efforts to solve an unusual disease problem in cattle, that in the long term led to great benefits to many people in the world. I will also describe Dr. Schofield's lifelong dedication to veterinary education and his important role in the establishment of the specialty of veterinary pathology. A parallel story, much better known in Korea, is about the same young man whose dedicated and brave humanitarian efforts, along with those of many others, contributed to Korean independence.

Ontario Veterinary College

The seeds of OVC were sown during the American Civil War. The demand for serviceable horses was large and many were supplied from Canada in the north. At that time, there were many more livestock than human inhabitants in the region of Upper and Lower Canada, now known as the provinces of Ontario and Quebec. The British administrators established a veterinary school staffed mainly by veterinarians from Scotland and England. This school opened in 1862 in the city of Toronto in buildings that no longer exist. The school was founded on scientific principles and practical application. It flourished through times that saw the demise of many northeastern U.S. veterinary schools. By the turn of the 20th century, the OVC had graduated nearly 2500 veterinarians. In 1907 when Frank Schofield was a first year student, there were 170 graduates from OVC. In 1910, Frank graduated in a class of only 80. The need for veterinarians was declining rapidly in the new age of the automobile. Numbers did increase temporarily during the First World War (1914-1917) but by 1919, there were again few graduates. In those days, horses were no longer the mainstay of the veterinary profession, and OVC moved to its current rural location in Guelph, about 100 km west of downtown Toronto. In Guelph, OVC built closer links with the Ontario Agriculture College (OAC) and the food livestock industries that were increasingly important with a rapidly increasing Canadian population. At the same time, some ties to the medical sciences at the University of Toronto Medical School were lost. In 1964, OVC and OAC became founding colleges of the University of Guelph.

Young Frank Schofield

Frank Schofield was born on March 15th 1889 in Rugby, Warwickshire, England. He emigrated to Canada on his own when he was 16. In the fall of 1907, he was admitted to OVC, located then on University Avenue in Toronto. In 1910, he graduated at the top of his class with a Bachelor of Veterinary Science (B.V.Sc), in spite of severe financial hardship, and a crippling bout of poliomyelitis in 1909. As a veterinary student, Frank Schofield demonstrated his extraordinary work ethic and

intellect, and his belief in fairness and defence of the less fortunate. He remained an exceptional student of biology with a deep commitment to fair human values throughout his life.

After graduation, Frank was appointed as an assistant at the Bacteriology Laboratory of the Ontario Health Centre in Toronto. There, under his own initiative and curiosity, he studied bacteria he found in milk and he tracked them to dairy farms near Toronto. He then wrote a thesis entitled *"The bacteriological analysis of milk being sold in Toronto."* For this, the University of Toronto awarded him the Doctor of Veterinary Science (D.V.Sc.) in 1911. This achievement heralded the first of many notable scientific achievements. Dr Schofield quickly displayed his extraordinary curiosity and insight into health problems, and his determination to study the reasons behind them. He knew that a veterinarian must study what happens where the animals are raised in order to gather the best insight into the origins and practical solutions of health problems. The newly minted Dr. Schofield rejoined the OVC faculty in 1912 and then quickly demonstrated his investigative proficiency with diseases caused by bacteria. He did extensive original work on pyemic arthritis (joint ill) in foals with bacterial infections due to *Streptococcus* and *Salmonella*.

Korea 1916-1919

Dr. Schofield was commissioned to work in Korea for the first time in 1916 and he taught bacteriology and sanitation at Severance Medical School. This was the beginning of his long and committed relationship with Korea as a medical scientist and as a humanitarian. His teaching was no doubt beneficial to emerging public health training in Korea. However, his activism on behalf of Korean independence made him a public figure opposed to colonialist rule. He openly opposed the Japanese administration, and at significant personal risk, helped inform other countries of the plight of the Korean people under Japanese occupation. His experiences in Korea intensified his outrage at injustice and forged his lifelong concern for Korea and its people. After the signing of the Korean Declaration of Independence by 33 Korean patriots in 1919, he became known as the 34th man. The Japanese administrators did not welcome his political activities, so he was forced to return to Canada and OVC in 1920

A New Hemorrhagic Disease in Cattle

Soon after his return to Canada, he was appointed Director of Veterinary Hygiene and Research on the OVC faculty in 1921. He became aware of several small outbreaks of a hemorrhagic disease in cattle kept in barns over winter in southern Ontario [1]. In those days, hemorrhage was a common feature of severe bacterial infections, so the disease had been considered by others to be a form of septicemia. However, Dr. Schofield understood bacterial diseases from his earlier work, so he was able to quickly and correctly recognize that the problem was not an infectious disease. He noted that the affected cattle did not develop a fever, and they did not become severely sick in the manner seen in septicemia. He went directly to the farms where he noted that affected cattle were housed in barns over winter. There they were fed silage made from sweet clover *(Meliolotus alba)*, a coarse leguminous plant resembling alfalfa. Farmers had started to grow more of this as a forage plant instead of corn that was under attack from pests such as the corn borer.

Dr. Schofield recognized that this new cattle disease presented as an *anemic form* and as a *hemorrhagic form* [1]. The anemic form was seen in calves that were recently castrated or dehorned. Their wounds would bleed profusely until the calves died of severe blood loss (anemia). The hemorrhagic form was seen usually in mature cows that developed huge swellings (hematomas) over the body and limbs, or internal bleeding into body cavities or other tissues. He proposed that it was a toxic disease resulting from generation of a toxin in the plant after it became mouldy. This was a bold assertion because livestock often consumed spoiled feed, and no toxins that prevent blood clotting after several weeks' ingestion were known.

His discovery was based on his answers to his three key questions [2].

A. *"Is sweet clover injurious because of a poisonous principle in the plant?"*
   He observed that sweet clover in the pastures was not a problem, nor was properly cured sweet clover hay or silage. Thousands of farmers grew this plant, but few had the disease. He knew that all sweet clover contained coumarin, the component responsible for its unusual odor of "new mown hay", but this was not toxic in sweet clover used as a grazing forage or as well cured hay. Numerous of his own experiments convinced him that sweet clover *"can not be considered as a poisonous plant."*
B. *"Is sweet clover injurious because of a deficiency in some essential food element?"*
   The prolonged exposure to the spoiled feed before signs occurred suggested that the problem might be nutritional. Analysis of the feed showed that it was well balanced, and an excellent stock feed in most circumstances so it was not likely to be deficient. Also, he cleverly excluded this possibility by finding that the severity of the disease was not related to the proportion of sweet clover in the feed. He observed the most severe case in animals fed small amounts along with a grain and hay in the ration.
C. *"Is sweet clover injurious because of poisonous products formed in it by microorganisms?"*
   He discovered that both forms of the disease occurred only in cattle fed mouldy sweet clover silage for several weeks. Also, he took notice that the problem recurred when farmers resumed feeding the mouldy sweet clover (in non-compliance with Dr. Schofield's clear recommendations). He demonstrated that some feed that farmers considered not spoiled actually had visible mould colonies within the core of the coarse stalks. He hand-picked contaminated and clean stalks and fed them to rabbits; only the mouldy stalks reproduced the typical disease. He first considered that the mould or some unseen bacteria within could generate the toxic principle in improperly cured silage. The particular microorganism responsible did not occur in the field or when the sweet clover hay became musty during storage. Dr. Schofield concluded that the toxic principle must be either secreted by the microorganism or released as the organism degraded the plant. He fed various isolated moulds to rabbits and found one *Aspergillus* isolate that consistently increased the blood clotting time after 5-8 days. The moulds produced the toxic factor on sweet clover, but not in red clover, alfalfa, or timothy grass.

Dr. Schofield obtained three male calves for a simple experiment [1]. One calf (A) was fed some mouldy sweet clover silage. Calf B was fed some properly cured sweet clover silage that was not mouldy. The third calf C was fed good quality hay. After several weeks, he castrated the calves. Calf A bled until it died, but the others did not. He subsequently fed calf B the mouldy sweet clover for several more weeks. Then he dehorned it and it bled to death. A particularly important observation was that the blood from affected calves and cows had reduced prothrombin activity. This revealed a problem with the function of a key clotting factor in the blood. However, in those days, the nature of the blood component with prothrombin activity was unknown.

This remarkable discovery and solutions are a tribute to Dr Schofield's formidable ability to discover and solve problems. While these experiments were not as extensive as we would expect today, they yielded many correct answers that were corroborated in various ways [1,2]. Dr. Schofield asked the readers of his first report to be lenient in their judgement of the arrangement but not the substance, because the editor (T.C. Evans) had pressed him to make the article available in that issue [1].

He certainly provided solutions for the cattle owner, although he got frustrated when the knowledge was not employed. Bad feed could be avoided, diluted or fed to sheep or horses that seemed more resistant. Proper curing or intermittent feeding kept the exposure below harmful levels. He had almost no financial support for this early research because at this time, there were no government funding

programs such as we have today. Dr. Schofield had to ask the OVC Principal for any funding. Imagine how forthcoming the funds for sweet clover research would have been in 1920-22 while the new building and college relocation were underway. Also, it was unlikely that he could justify funds to pursue a solved problem when there were so many other livestock and companion animal diseases for him investigate. To offset the costs of his research, Dr. Schofield often resorted to selling donated animals that he had saved, to improvising and economizing, and sometime to using the laboratory wares of his colleagues during the night.

The importance of his work for cattle owners was obvious in 1922. With the exception of ergot, this was the only demonstration of a mould product with physiologic or toxic products. Note that his discovery predated the recognition of antibiotics and mycotoxins by many years. The mysterious ability of blood to clot had fascinated people over millennia, but in Schofield's time, the mechanisms were becoming better understood. Nonetheless, the full importance of his work did not become obvious to all for another 25 years, when the anticoagulant became something to use rather than avoid. The long list of Dr. Schofield's later contributions is indeed impressive. However, the case can be made now that his early discovery of an anticoagulant active via the oral route was one of the most important discoveries of the veterinary profession in the first half of the 20th century. Oral anticoagulants could thereby be developed to poison rodent pests, and as human drugs to prevent thrombosis. One wonders how much sooner this might have happened had Dr. Schofield made his discovery in a more developed era or place of comparative pathology and medicine.

Identification of Dicumarol

Mouldy sweet clover poisoning occurred widely across Canada and in the northern U.S. states. In 1929, Dr. Lee Roderick, a veterinary pathologist in North Dakota, confirmed that the bleeding problem in cows fed mouldy sweet clover was accompanied by prothrombin deficiency [3,4]. The discoveries of Schofield and Roderick were unnoticed for several years. Dr. Karl Paul Link, an organic chemist at the Wisconsin Alumni Research Foundation (WARF) in Madison Wisconsin, learned of the problem and the early work, so he set out to identify the active principle in mouldy sweet clover [5]. WARF was well funded by royalties from previous discoveries of nutritionally beneficial products, so Dr. Link had the help and tools he needed. Dr. Link and his assistant H.A. Campbell were self-proclaimed novices in the blood coagulation field, amid the interest generated by the discovery of vitamin K. They took the lead from Schofield's initial recognition in 1922 and Roderick's subsequent confirmation that cattle with mouldy sweet clover poisoning had reduced prothrombin activity.

By 1941, Campbell designed a sensitive new assay that detected small changes in prothrombin activity by diluting plasma of test rabbits. This got around the problem of measuring reduced activity against an excess of prothrombin in normal plasma. Purification of components with anticoagulant activity in this assay led to crystallization of the pure active ingredient that Charles Huebner identified in 1941 as dicumarol (3,3'-methylenebis,4-hydroxycoumarin). Coumarin in sweet clover was converted to 4-hydroxycumarol and then crosslinked to dicumarol when the sweet clover was infected by various fungi (*Penicillium* and *Aspergillus*). They showed it was different from other coumarins, and the anticoagulant action was associated only with the bis molecule. By 1942, a further means of preventing mouldy sweet clover poisoning was at hand, by way of breeding sweet clover that contained less coumarin.

Dicumarol as human medicine

Dr. Link saw the medical application of dicumarol and vigorously pursued it. Vitamin K had been discovered by Henrik Dam in Copenhagen in 1929 and purified by Edward Doisey in St. Louis, Missouri in 1939. Dam and Doisy were jointly awarded the Nobel Prize in Medicine in 1943 for these discoveries. Dr. Link knew since 1939 that Vitamin K reversed the bleeding problem of a bull with mouldy sweet clover poisoning. He bravely proposed the idea that dicumarol backed by prothrombin

assays had merit as an anticoagulant in humans. Salicylates were then in therapeutic use for this purpose but their ulcerogenic properties sometimes lead to gastric hemorrhage that could not be treated with Vitamin K. Heparin had disadvantages because it was an injectable biological extract. Medical colleagues supplied by Dr. Link proved that dicumarol was indeed effective in humans and a prominent editorial appeared in Lancet titled "Heparin and a Rival" [6]. The dicumarol anticoagulant soon became an important drug but some bleeding problems occurred in human patients. Dr. Link referred to these as unfortunate examples of iatrogenic mouldy sweet clover poisoning of humans [6]. Subsequent skepticism that Vitamin K was an ineffective antidote also greatly alarmed Link, although he was sure and correct in his belief that the problems were due mainly to improper dose and monitoring rather than toxicity of the dicumarol. Nonetheless, he thought he could make a safer drug by modification of the dicumarol structure. In the 1940s, in the wake of the astounding development of penicillin, further modification of fungal products was a hot field of organic chemistry, and Link was up to the task.

Warfarin

During the earlier studies of the effects of dicumarol in various species, the WARF researchers found that rats and mice were susceptible to the stable odorless palatable dicumarol. Dr. Link knew that Vitamin K in a grain diet made dicumarol less effective in rats, so he did not think of it as a rodenticide. He gave credit for sparking this idea to an editorial statement in 1948 that dicumarols were better suited as rat poison than as human drugs, in comparison with a competing human drug (Tromexan or 3,3', 4-oxycoumarinyl). Rather than being insulted, he immediately proposed that one of his more potent coumarin derivatives that was less affected by Vitamin K should be developed as a safe rodenticide. WARF patented this under the name Warfarin in 1948 [6]. Warfarin soon became the most successful rodenticide ever. The unprecedented success of Dr. Link's vision can be related to the unique mechanism of action of the coumarin anticoagulants, the low risk of the development of resistance, the ease of administration, and the requirement for prolonged ingestion for effect.

Dr. Link heard of an army inductee in 1951 who unsuccessfully attempted suicide by consuming 567 mg of Warfarin according to the multiple dose directions. He realized that the rat poison could be safer and more effective than dicumarol as an anticoagulant for humans. Warfarin was then developed as the drug, Coumadin Sodium that is 5-10 times more effective as an oral anticoagulant than dicumarol. Coumadin is safe if given to effect established by monitoring the prothrombin time. In September 1955, Dr. Link learned that U.S. President Dwight Eisenhower was successfully and safely treated with Warfarin during his recovery from a heart attack [6]. Safe prothrombin levels were maintained. Warfarin is now the 10th most commonly prescribed drug in North America. It is used to prevent thrombosis associated with myocardial infarcts, strokes, cardiovascular surgery, coronary angioplasty, heart valve prostheses, and deep vein thrombosis, to name just a few applications.

In 1955, Dr. Schofield retired from OVC and in 1958, he returned to Korea. On one leg of his flight, he suffered a heart attack and was hospitalized in Los Angeles. By then, Warfarin had largely replaced dicumarol as an anticoagulant drug for humans with thrombotic conditions. There are reports that his cardiologist knew of a Dr. Schofield from Guelph in relation to the discovery of the importance of the Vitamin K antagonists in preventing heart attacks and strokes. However, the cardiologist did not realize that a patient travelling in such humble clothing could be a famous scientist. Dr. Schofield likely benefited from the drug that had been developed as a result of his own early work.

Dr. Schofield's other works at OVC

Dr. Schofield's early years were in the golden era of bacteriology and infectious causation of disease. Then infections were considered to be the causes of many illnesses including cancers of humans and animals. Dr. Schofield was able to think beyond his realm of experience in bacteriology at a time when this discipline had been surpassing pathology as an academic and research field at veterinary and

medical colleges in North America. Dr Schofield was a skilled investigator who believed in careful examination of animals by post mortem and microbial cultures, so he made many first discoveries of new infectious diseases in animals. For example, he recognized the viral cause of mink enteritis [7], the role of bacteria in atrophic rhinitis of swine [8], the need for hygiene and udder disinfection in the control of mastitis in cows, and the potential and limitations of the use of penicillin in the treatment of bovine mastitis [9,10]. Dr. Schofield's ability to distinguish infectious, nutritional and toxic patterns of illness was exceptional, as illustrated in the sweet clover studies. Later, he realized that hemolytic *E. coli* was responsible for colibacillosis pigs, and that they were also able to cause "gut edema" disease that he correctly interpreted as an *E. coli* enterotoxemia [11].

Because Dr. Schofield understood bacteria so well, he was able to quickly recognize conditions that were not infectious, and he quickly explored other possibilities. He believed in multidisciplinary investigation before we used such terms, probably because it was a matter of common sense to look at all possibilities. He paid close attention to clinical observations of animals that were ill, to blood constituents that changed, to the lesions that could be found at post-mortem, and to what he could culture, isolate or reproduce in challenge exposure. His compulsion to see what happened circumstantially often took him along the paths that were missed by theories favoured by more specialized experts.

Over the years as head of the pathology department at OVC, he wrote numerous reports of conditions that occur in livestock in Canada. He made the first observations of scrapie in North America [12]. He was the first to recognize that white muscle disease occurred in calves [13], and that it could be treated with phosphate and vitamin E. He recognized different forms of viral encephalitis in horses in Canada [14] and was the first to report malignant catarrhal fever here [15]. He developed many practical but experimentally validated ways to deal with iron deficiency in piglets [16]. He discovered a new liver disease of horses fed mouldy Alsike clover [17]. This condition still occurs but we know little more than what Dr. Schofield reported many years ago. How much would research benefit today if we still had Dr. Schofield in this period of increased awareness of public health, zoonotic infections, mysterious illnesses, antibiotic resistance and changing husbandry practices?

Dr. Schofield's legacy to veterinary pathology and OVC

Dr. Schofield could intimidate students and faculty colleagues, particularly if he thought they fell short of his expected standards of effort, intellect or ethics. On the other hand, his ability to get to the root of the scientific matter or problem was legendary. Students and faculty could not fail to benefit from Dr. Schofield's standards, regardless of their level of discomfort during some encounters with him. He was highly respected for this intellect, commitment and generosity. Some of his former students attest to the intellectual stimulation they obtained in the classroom and on visits to farms. Dr. Schofield's old bout with poliomyelitis made it difficult for him to vary the foot throttle so he had a tendency to maintain full speed if he was at the wheel. Thus his students preferred to do the driving!

Dr. Schofield was for many years the head of the Pathology Department of OVC that also included microbiology, hygiene and public health. Dr. Schofield described himself as an OVC pathologist and he was the only Canadian charter member of the American College of Veterinary Pathologists (ACVP) when it was established in 1948. The importance of veterinary pathology grew immensely thereafter, in response to the need for better disease diagnosis in support of health management, for safer efficacious new medicines, and for the interdisciplinary teaching of veterinary medicine based on individual and herd case studies. The ACVP is now the largest veterinary exam-certified specialty with well over 1000 members. The ACVP's highest honor, Distinguished Member, was awarded to Dr. Schofield in Seoul in 1970. He is one of only eleven founders who were acknowledged in this way. Dr. D.L.T. Smith, his long-time colleague and successor as department head at OVC wrote his obituary in the ACVP journal

Veterinary Pathology [18].

In recognition of Dr. Schofield's many contributions, the OVC established the Schofield Lecture series, and the top academic award for pathology at the undergraduate level is the Schofield prize. Noted veterinary pathologist, historian and former ACVP president, Dr. Leon Saunders, described his many contributions to the veterinary pathology profession in the Schofield Lecture in 1973 [19]. As part of the recognition of the centenary of his birth, Dr. Saunders addressed the University of Guelph on his personal recollections of Dr. Schofield [20]. Pathology continues as a particularly strong discipline in OVC, and in other Canadian Veterinary Colleges, by virtue of Dr. Schofield's leadership and his influence on many students who carried this tradition in Canada and around the world. For example, this author learned in the Guelph tradition of veterinary pathology, first at the University of Melbourne veterinary school established by former OVC Professors Douglas Blood and Kenneth Jubb, and later in Saskatchewan at the Western College of Veterinary Medicine, of which Dr. Schofield's successor, Dr. D.L.T. Smith, was the founding dean.

Later Years

In 1948, when Dr. Schofield was in his 60th year, the newly liberated Republic of Korea was founded. In the same year, a powerful new rodenticide and an effective oral anticoagulant were made available. Veterinary Pathology was now a defined specialty, and the prototype of many other veterinary sub-specialties. However, Dr. Schofield remained authoritative but modest where others might have laid greater claims. He continued to work in Canada, and later in Korea after he retired.

Dr. Schofield retired from OVC in 1955 due to problems with his eyesight. His seminal studies of edema disease were published in the Canadian Journal of Comparative Medicine after a brief announcement of his official retirement. He returned to his beloved Korea and began teaching at Seoul National University. Also he continued with his other charitable and humanitarian works for the Korean People. One of his priorities was the provision of scholarships to worthy Korean students, one more example of his commitment to fair opportunities for all. His long devotion to Korea, particularly during the years of foreign occupation, was recognized by various honours. These included the Republic of Korea Medal of Culture Merit (1960), the Key to the City of Seoul (1960), and the Republic of Korea Medal of National Foundation (1968). Upon his death in Korea in 1970, he was buried in the Korean National Cemetery, the first foreigner to be so honoured. He had often said, "I shall be buried in Korea", a wish that was fulfilled and which became the title of his biography by Professor Lee Jang-Nag in 1980 [21].

Dr. Schofield was well known as a generous man who kept little of his own money - he often preferred to give it or even his clothes to others in greater need. He lived modestly in a small rented house across the road from OVC while other professors of his standing lived much better, in the material sense. While travelling, he often lacked a plan or money to adequately take care of himself. In Dr. Schofield's time, it was much more difficult to travel and interact socially or scientifically with people in other countries. Dr. Schofield was always interested in other cultures, and he had an aversion to forms of colonialism that were unfair and disrespectful. He was born in England, then he emigrated to Canada, a former British and French colony, and later went to Korea when it was under Japanese colonial rule. Korea became his final home, because his experiences there best defined his whole life.

Long after he has passed from our midst, Dr. Schofield is still teaching us. It is only fitting that we should pay close attention to those lessons, particularly those that take more time, effort and thought to learn. We know he did not tolerate those who took the easy way out, those who indulged in their good fortune or those who exploited others. We also know that he was curious and industrious and that he was a brave plaintiff for the needs of his fellow man. He was not afraid to speak out, or to harangue political

leaders and other administrators on matters of principle. Dr. Schofield teaches us that science is only one source of great and often unanticipated benefit to humans and animals. The importance of education, clear thinking, service and hard work are surely no surprise to most who toil in our modern knowledge-based economies. Frank Schofield's life reminds us that the best human efforts can only thrive in an environment with justice for all and the freedom to live, learn and think.

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Year	Age	Time line of some events
1910	21	Frank Schofield graduates B.V.Sc. top of his class at OVC at the University of Toronto
1911	22	Frank Schofield receives the Doctor of Veterinary Science degree.
1914	25	Dr Schofield joins the OVC faculty and the University of Toronto
1916	27	Dr Schofield goes to Korea and teaches at the Severance Medical School
1919	30	Dr Schofield participates in the Korean Independence movement
1920	31	Dr Schofield returns to OVC
1922	33	OVC moves to Guelph. Dr Schofield discovers the mouldy sweet clover anticoagulant
1935	46	Dr Schofield becomes full professor at OVC
1940	51	Dr. Karl Paul Link and colleagues identify dicumarol as the sweet clover anticoagulant
1943	54	Dam and Doisy receive the Nobel Prize for the discovery of Vitamin K
1945	56	Korea is liberated from Japanese occupation
1948	59	The Republic of Korea is founded. Link develops a more potent dicumarol derivative - Warfarin Foundation of American College of Veterinary Pathologists. Dr. Schofield is a charter member
1955	66	Dr. Schofield retires from Ontario Veterinary College. President Eisenhower treated with Warfarin
1958	69	Dr. Schofield treated for a heart attack in Los Angeles en route to Korea
1958	70	Dr. Schofield begins teaching Pathology at Seoul National University
1962	73	Dr. Schofield receives Honorary Doctor of Laws at the 100th Anniversary of the University of Toronto
1968	79	Dr. Schofield receives the Korean Order of Merit
1970	81	Dr. Schofield made a distinguished member of American College of Veterinary Pathologists
1970	81	Dr. Schofield dies and is buried in National Patriots Section of National Cemetery in Seoul