The Discovery of Insulin:

What is the Definitive History?

By Christopher J. Rutty, Ph.D.
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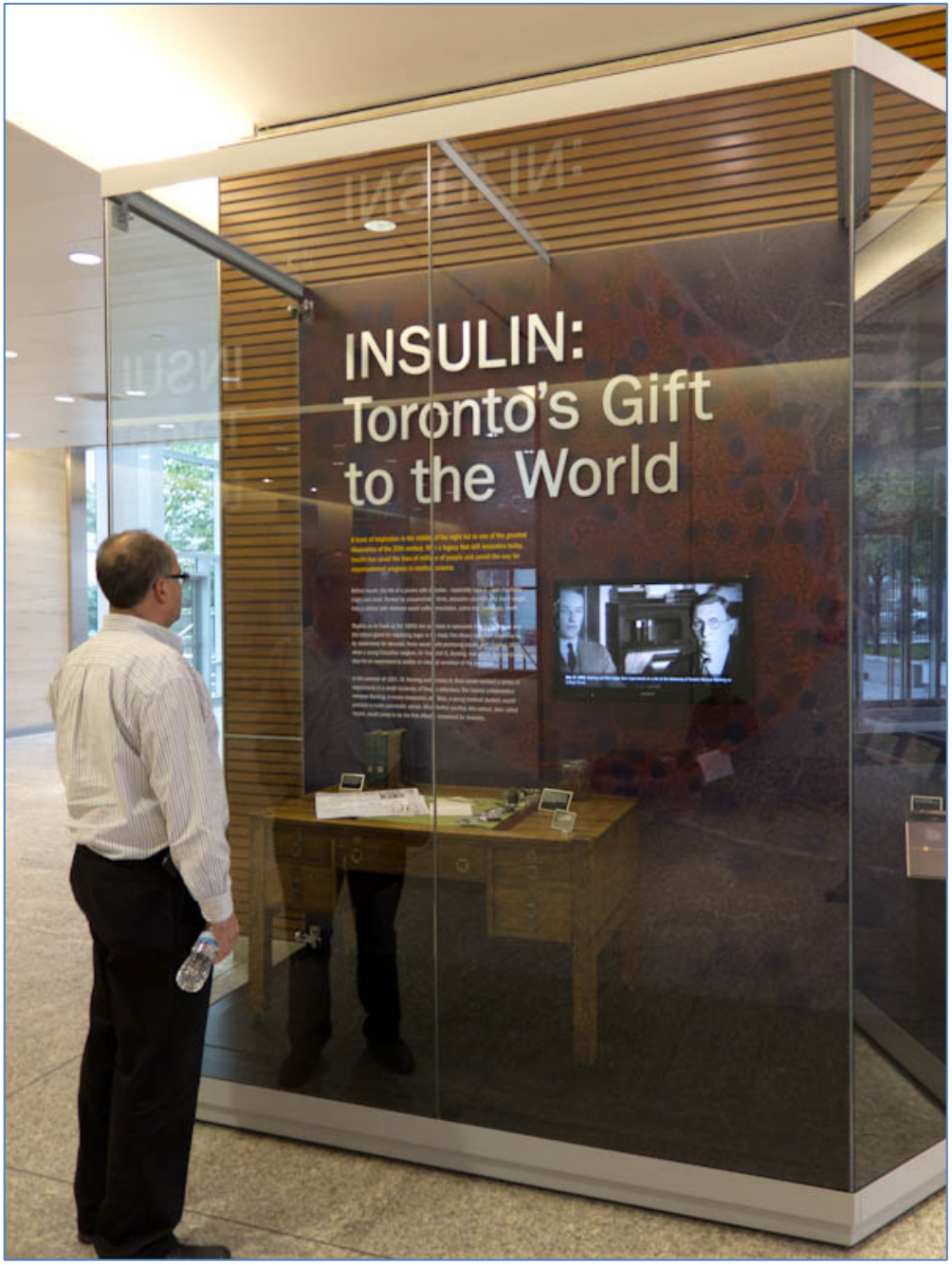
Dalla Lana School of Public Health,
University of Toronto

Emirates Diabetes Society, Insulin 100th Webinar
World Diabetes Day
November 14, 2020



Introduction

- I was asked to give a presentation about the discovery of insulin and answer the question:

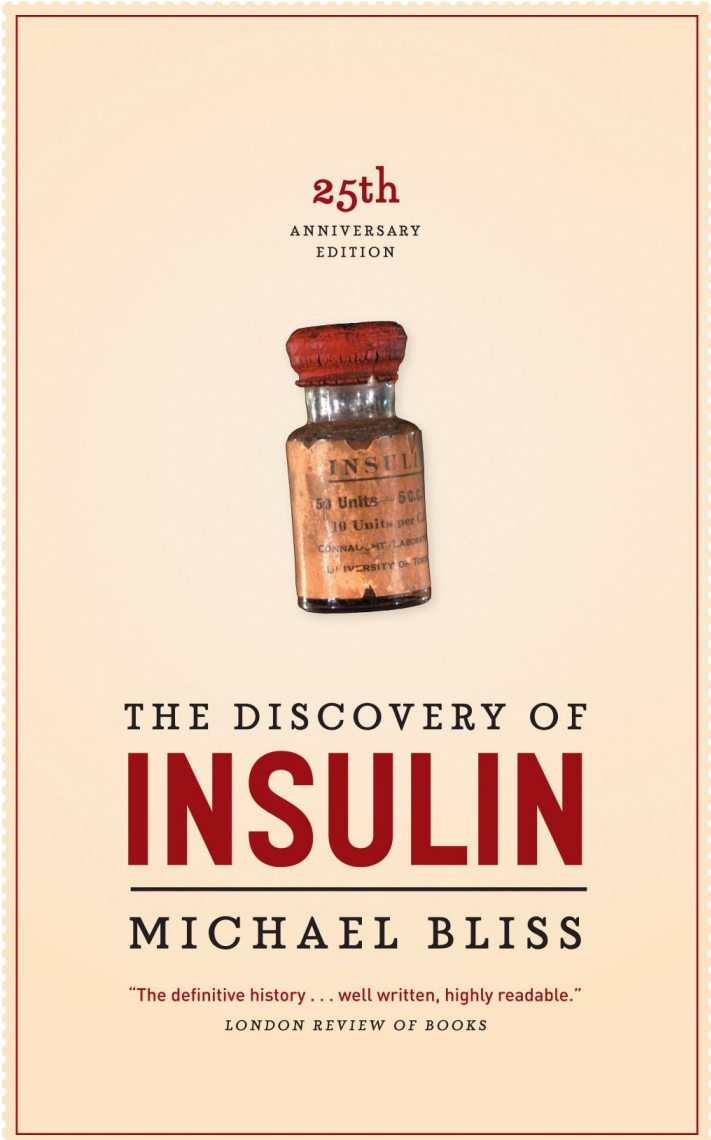
  What is the definitive history?

- The short answer is quite easy

- Michael Bliss' book, *The Discovery of Insulin*, first published in 1982, certainly remains the definitive history

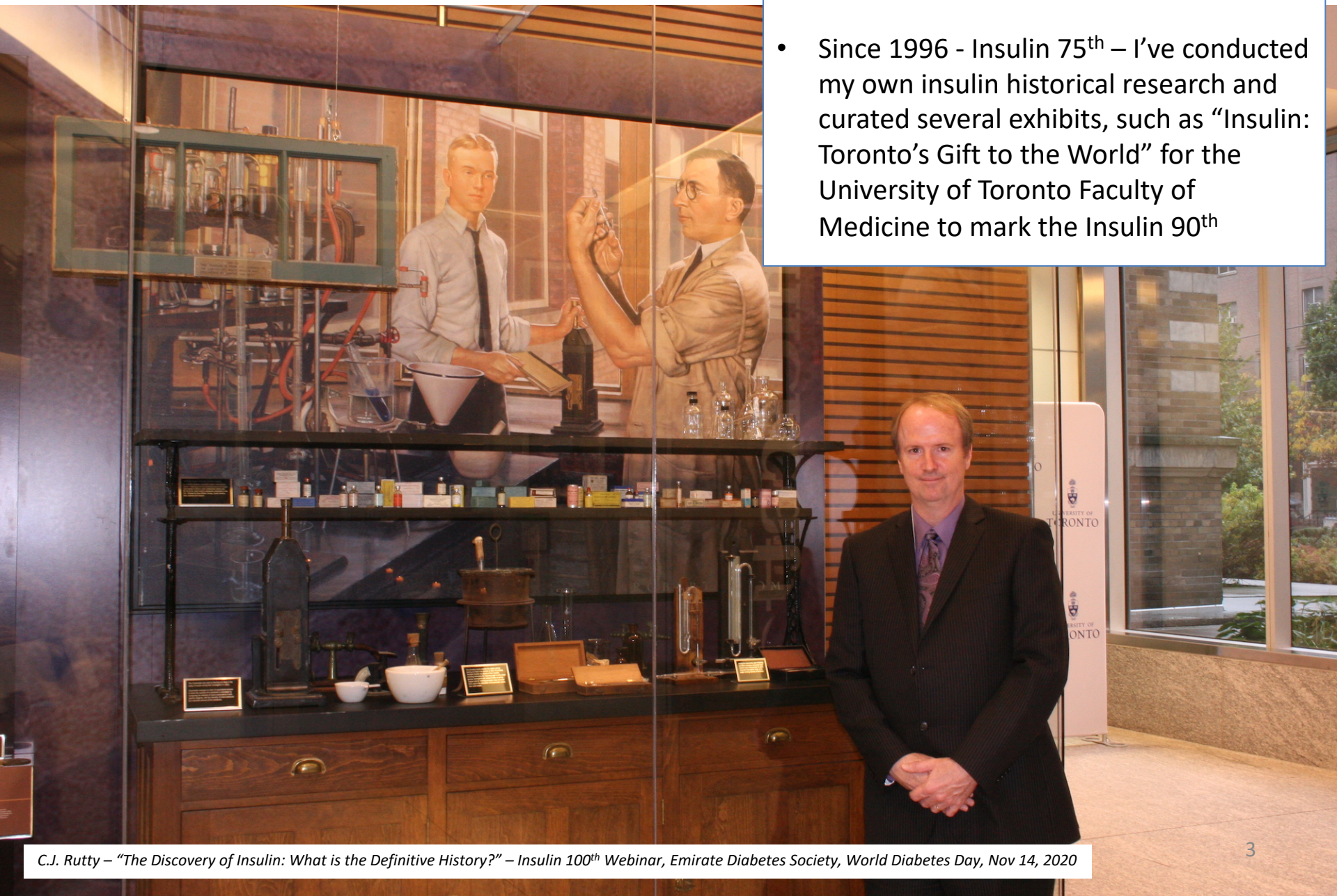
- Although the late Professor Bliss was my Ph.D. supervisor, colleague, friend, and at times my unofficial agent, I'm aware of no other histories that challenge its authority

- What I would like to do is recount key parts of the discovery story and highlight the many unique challenges of transitioning from the discovery of insulin to its development and production in order to expedite its equitable accessibility to diabetics globally



Introduction

- My Ph.D. with Prof. Bliss was about the history of polio in Canada, not insulin
- Since 1996 - Insulin 75th – I've conducted my own insulin historical research and curated several exhibits, such as "Insulin: Toronto's Gift to the World" for the University of Toronto Faculty of Medicine to mark the Insulin 90th



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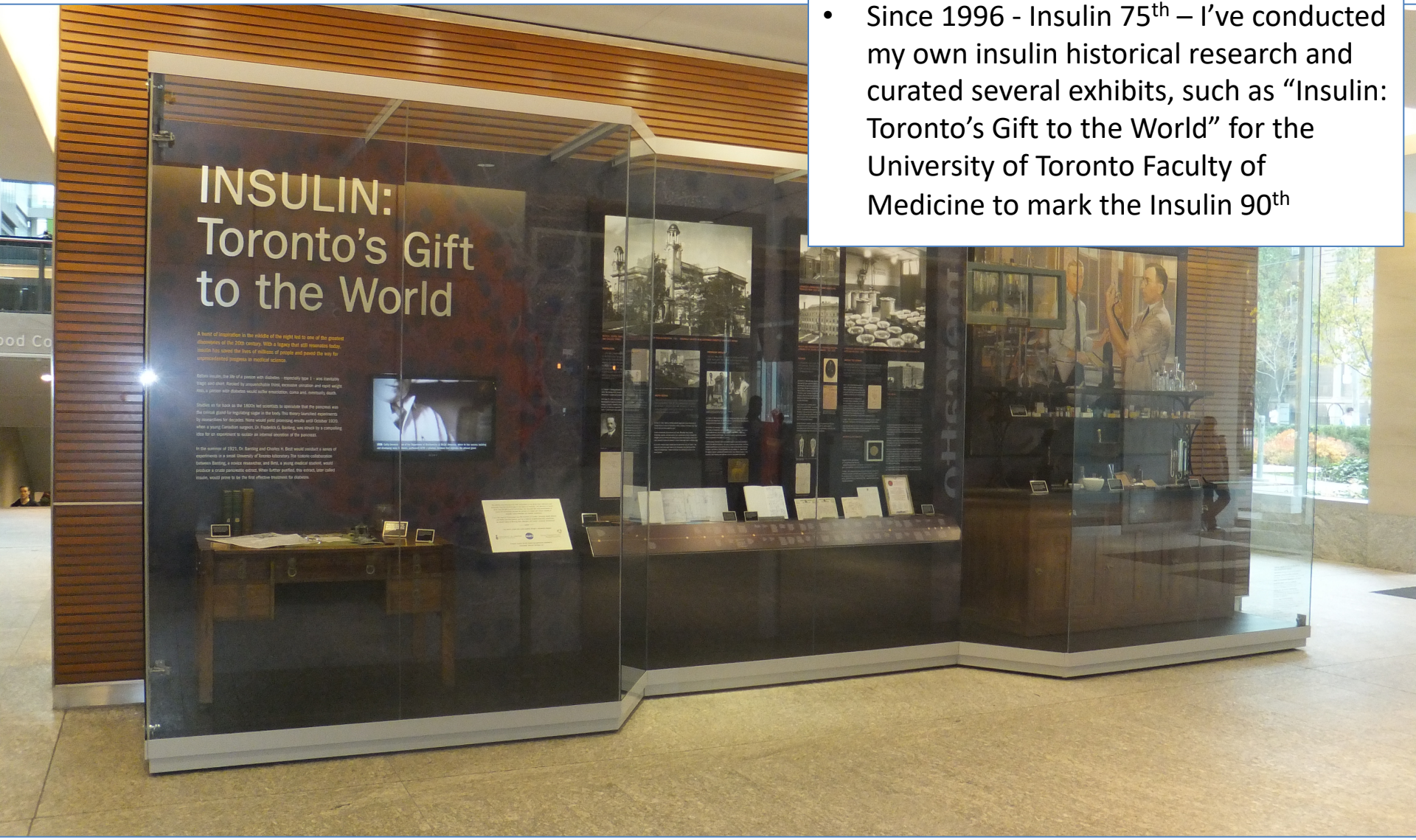

Introduction

https://definingmomentscanada.ca/insulin100/

Insulin100: Inspiration and Innovation will share the story of the uniquely Canadian and collaborative life-saving discovery and development of insulin, follow the life of Dr. Frederick Banting as an example of a ground-breaking scientist, and encourage further exploration into Canada's rich and diverse history of scientific and medical innovations.

Defining Moments Canada brings the story of insulin into your classroom through historical content and lessons to support educators and students. ***Insulin100: Inspiration and Innovation*** **shares the story of the life-saving discovery of insulin** and **follows the life of Dr. Frederick Banting in an engaging story map**. We have developed **new lesson plans**, historical articles, and microhistories – easily adapted for both physical and digital classrooms – with multiple cross-disciplinary entry points. *Insulin100* will showcase stories demonstrating the impact that diabetes has had on Canadian communities over the last 100 years.

Dr. Chris Rutty has prepared a series of historical articles which tell the story of discovery and development in great detail. **Start your exploration here**.

INSULIN100

SIR FREDERICK BANTING

TEACHING ABOUT INSULIN100

INSULIN100: THE DISCOVERY AND DEVELOPMENT

MICROHISTORIES

- I'm currently working as "Lead Historian" for the Defining Moments Canada "Insulin 100" national digital commemoration project
- My work has recently been focused on preparing a series of 14 articles that provide the core historical content for the site's online exhibition
- Currently, the first 8 of the 14 articles are posted

Introduction

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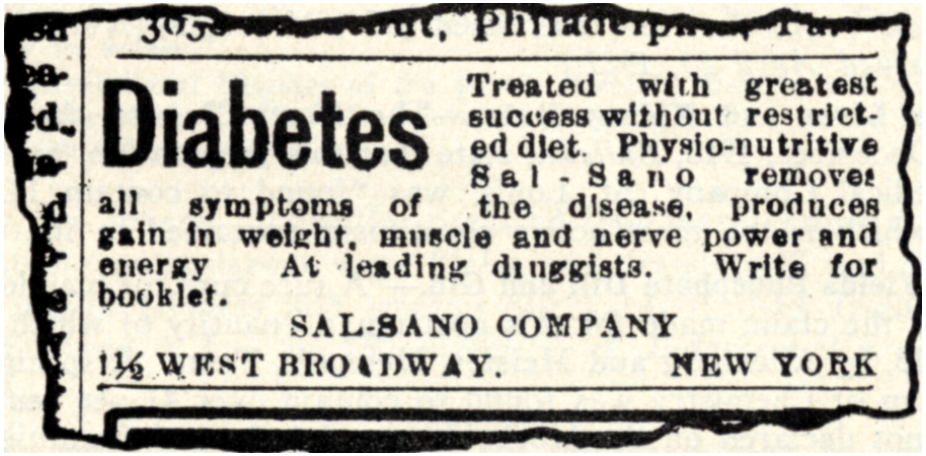
- Currently, the first 8 of the 14 articles are posted
- Coming soon:
- "Patent Protection"
- "Eli Lilly"
- "Making Insulin 2"
- "Novo Nordisk"
- "Nobel Prize: Canada's Gift to the World"
- "Better Insulin, Nothing Better Than Insulin"

Deadly Diabetes, Before Insulin

- Before Insulin, the life of a person with diabetes, especially a child with type 1, was inevitably tragic and short, dominated by unquenchable thirst, starvation diets and a body that ultimately feeds on itself

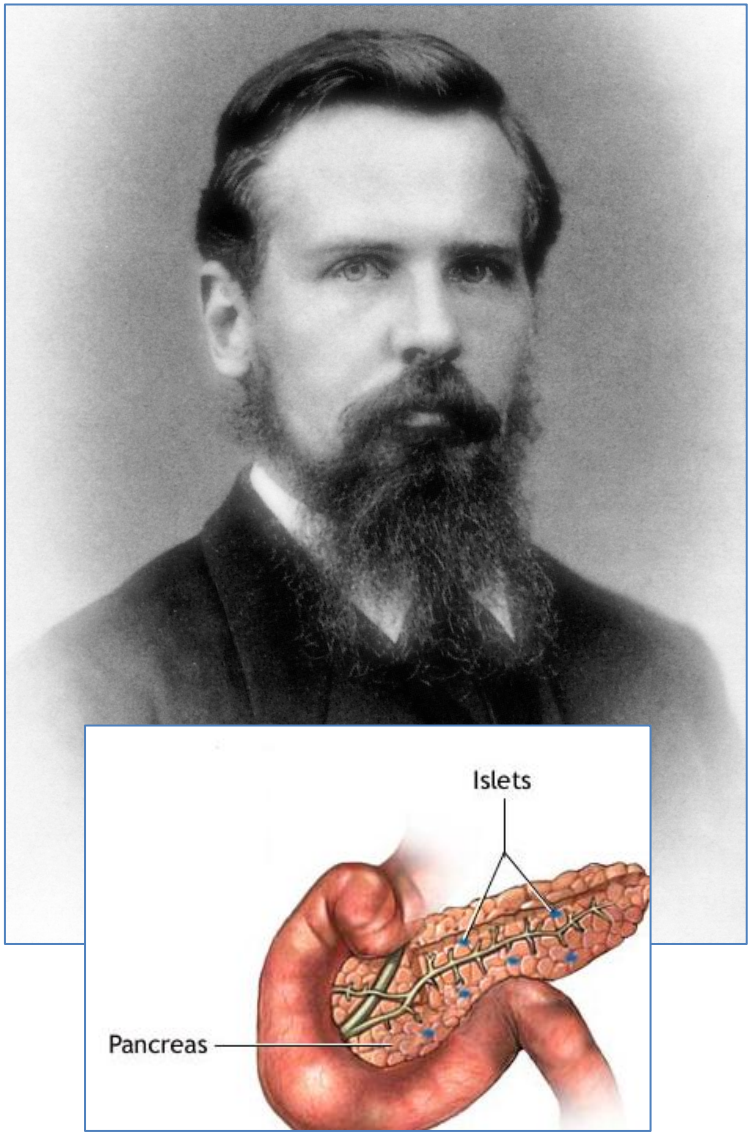
- Beyond strict dietary control, very little could be done to prevent death, despite the claims of patent medicines and others offering dubious cures



Deadly Diabetes, Before Insulin

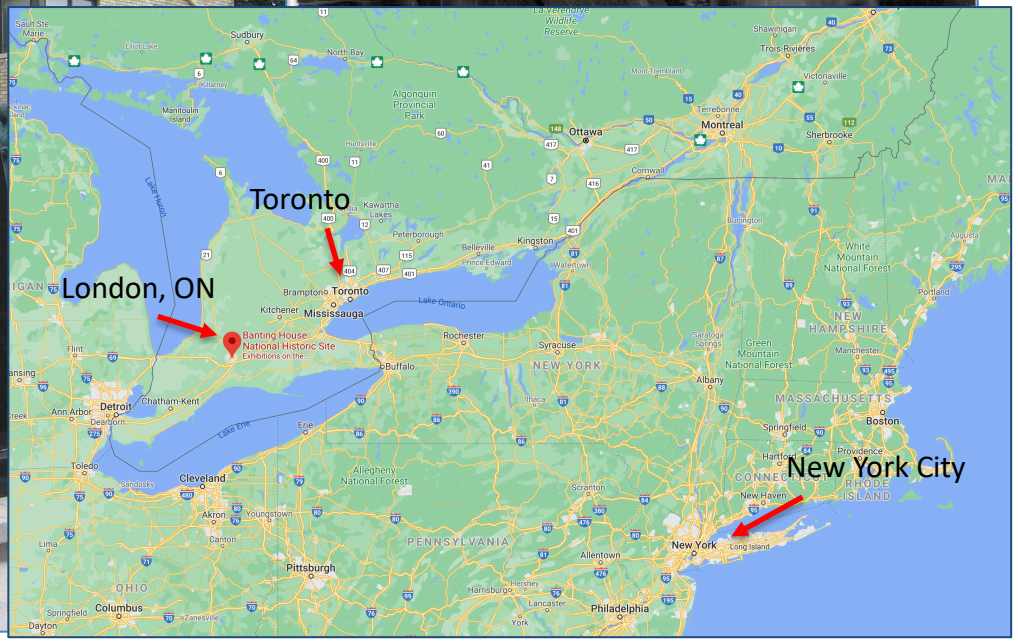
- **250 B.C.** – First use of “diabetes” (from the Greek “to pass through”)
- **1675** – “diabetes mellitus” term first used (“mellitus” Latin for honey or sweet)
- **1869** – Paul Langerhans (right) identifies “insulin”-producing “islets of Langerhans” in pancreas
- **1889** – Role of pancreas in diabetes discovered; diabetes developed in dogs when pancreas removed
- **1910** – Discovered that diabetes caused by the lack of “insulin” in the pancreas

- This work led researchers to conduct a variety of insulin extraction experiments, but with none yielding promising results until a young Canadian surgeon was struck by a compelling idea in October 1920



Banting's Idea

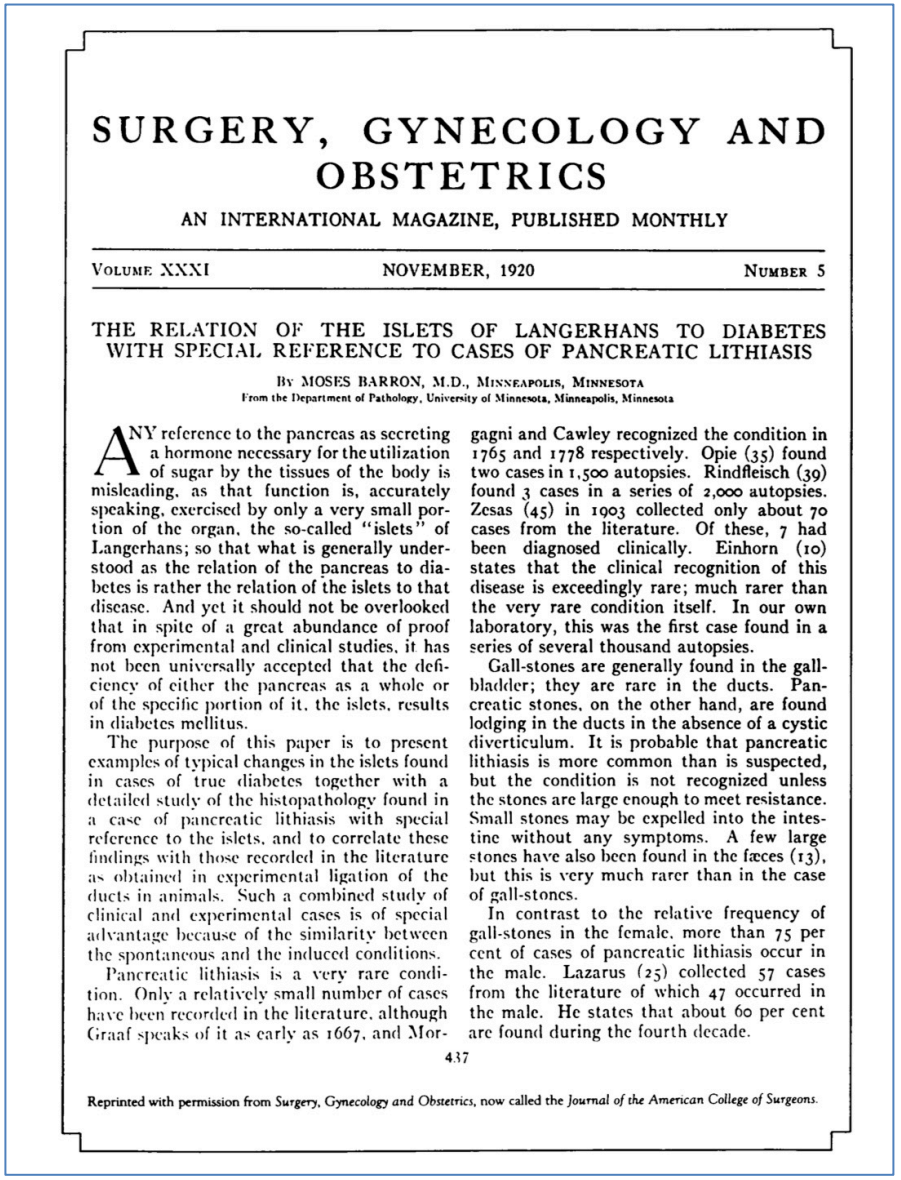
- **Oct. 31, 1920 (2:00 am)** - The Insulin story began in London, Ontario, when Dr. Frederick Banting awoke with a compelling idea…



C.J. Rutty – "The Discovery of Insulin: What is the Definitive History?" – Insulin 100th Webinar, Emirate Diabetes Society, World Diabetes Day, Nov 14, 2020

Banting's Idea

- Banting had read an article by Moses Baron about the pancreas for a lecture he was preparing at the University of Western Ontario about carbohydrate metabolism
- Baron discussed a rare case of formation of a pancreatic stone that completely obstructed the main pancreatic duct
- The blocked duct led to atrophy of the main pancreatic tissue, but the internal islet cells survived
- Baron noted that the effect of the blocked duct was similar to the effect of ligating, or tying off the duct, and supported the hypothesis that the health of the islet cells was the key factor in the development of diabetes



SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXI NOVEMBER, 1920 NUMBER 5

THE RELATION OF THE ISLETS OF LANGERHANS TO DIABETES WITH SPECIAL REFERENCE TO CASES OF PANCREATIC LITHIASIS

BY MOSES BARRON, M.D., MINNEAPOLIS, MINNESOTA

From the Department of Pathology, University of Minnesota, Minneapolis, Minnesota

ANY reference to the pancreas as secreting a hormone necessary for the utilization of sugar by the tissues of the body is misleading, as that function is, accurately speaking, exercised by only a very small portion of the organ, the so-called "islets" of Langerhans; so that what is generally understood as the relation of the pancreas to diabetes is rather the relation of the islets to that disease. And yet it should not be overlooked that in spite of a great abundance of proof from experimental and clinical studies, it has not been universally accepted that the deficiency of either the pancreas as a whole or of the specific portion of it, the islets, results in diabetes mellitus.

The purpose of this paper is to present examples of typical changes in the islets found in cases of true diabetes together with a detailed study of the histopathology found in a case of pancreatic lithiasis with special reference to the islets, and to correlate these findings with those recorded in the literature as obtained in experimental ligation of the ducts in animals. Such a combined study of clinical and experimental cases is of special advantage because of the similarity between the spontaneous and the induced conditions.

Pancreatic lithiasis is a very rare condition. Only a relatively small number of cases have been recorded in the literature, although Graaf speaks of it as early as 1667, and Morgagni and Cawley recognized the condition in 1765 and 1778 respectively. Opie (35) found two cases in 1,500 autopsies. Rindfleisch (39) found 3 cases in a series of 2,000 autopsies. Zesas (45) in 1903 collected only about 70 cases from the literature. Of these, 7 had been diagnosed clinically. Einhorn (10) states that the clinical recognition of this disease is exceedingly rare; much rarer than the very rare condition itself. In our own laboratory, this was the first case found in a series of several thousand autopsies.

Gall-stones are generally found in the gall-bladder; they are rare in the ducts. Pancreatic stones, on the other hand, are found lodging in the ducts in the absence of a cystic diverticulum. It is probable that pancreatic lithiasis is more common than is suspected, but the condition is not recognized unless the stones are large enough to meet resistance. Small stones may be expelled into the intestine without any symptoms. A few large stones have also been found in the fæces (13), but this is very much rarer than in the case of gall-stones.

In contrast to the relative frequency of gall-stones in the female, more than 75 per cent of cases of pancreatic lithiasis occur in the male. Lazarus (25) collected 57 cases from the literature of which 47 occurred in the male. He states that about 60 per cent are found during the fourth decade.

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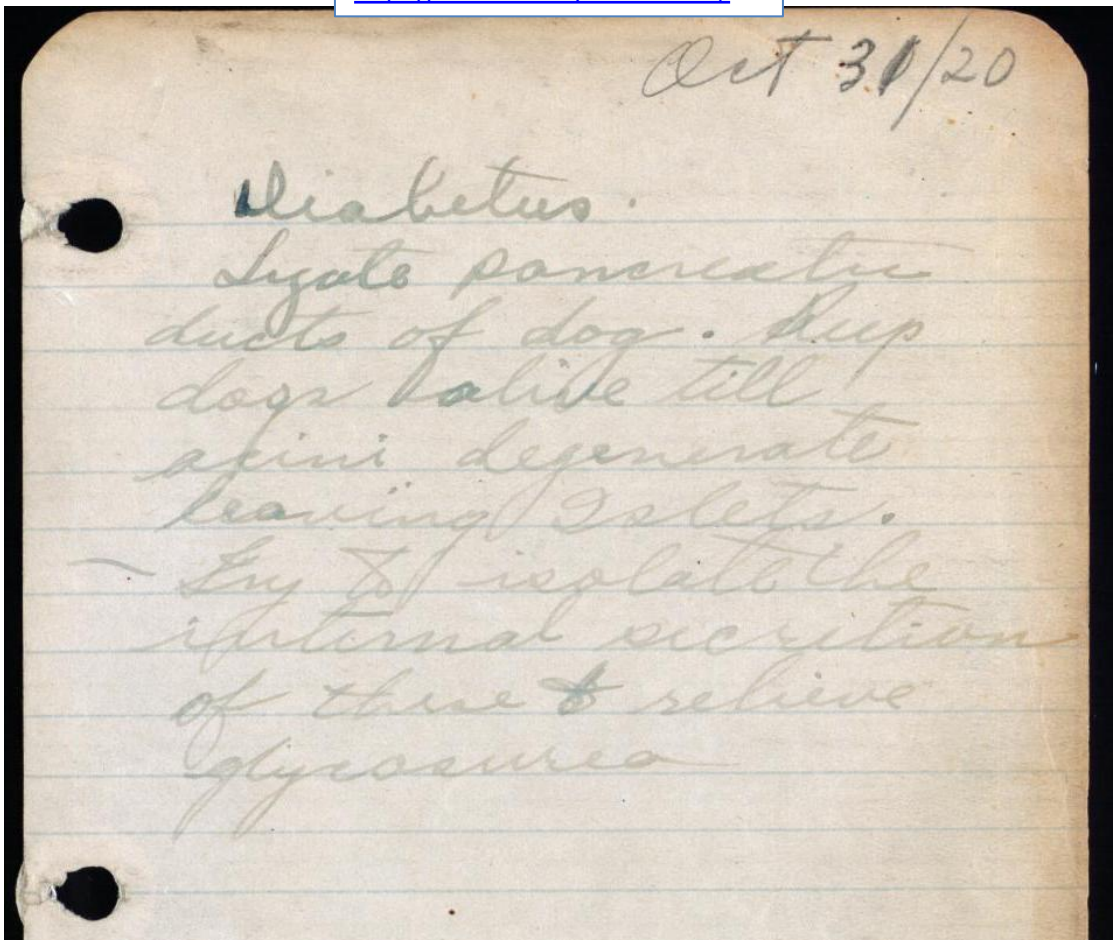
Reprinted with permission from Surgery, Gynecology and Obstetrics, now called the Journal of the American College of Surgeons.

Banting's Idea

- Banting fell asleep after reading this article, and also after studying about carbohydrate metabolism and diabetes
- At about 2:00 am he suddenly woke up with an idea for a novel surgical method and experiment to isolate the internal secretion from the pancreas that might control diabetes
- He jotted down in a notebook,

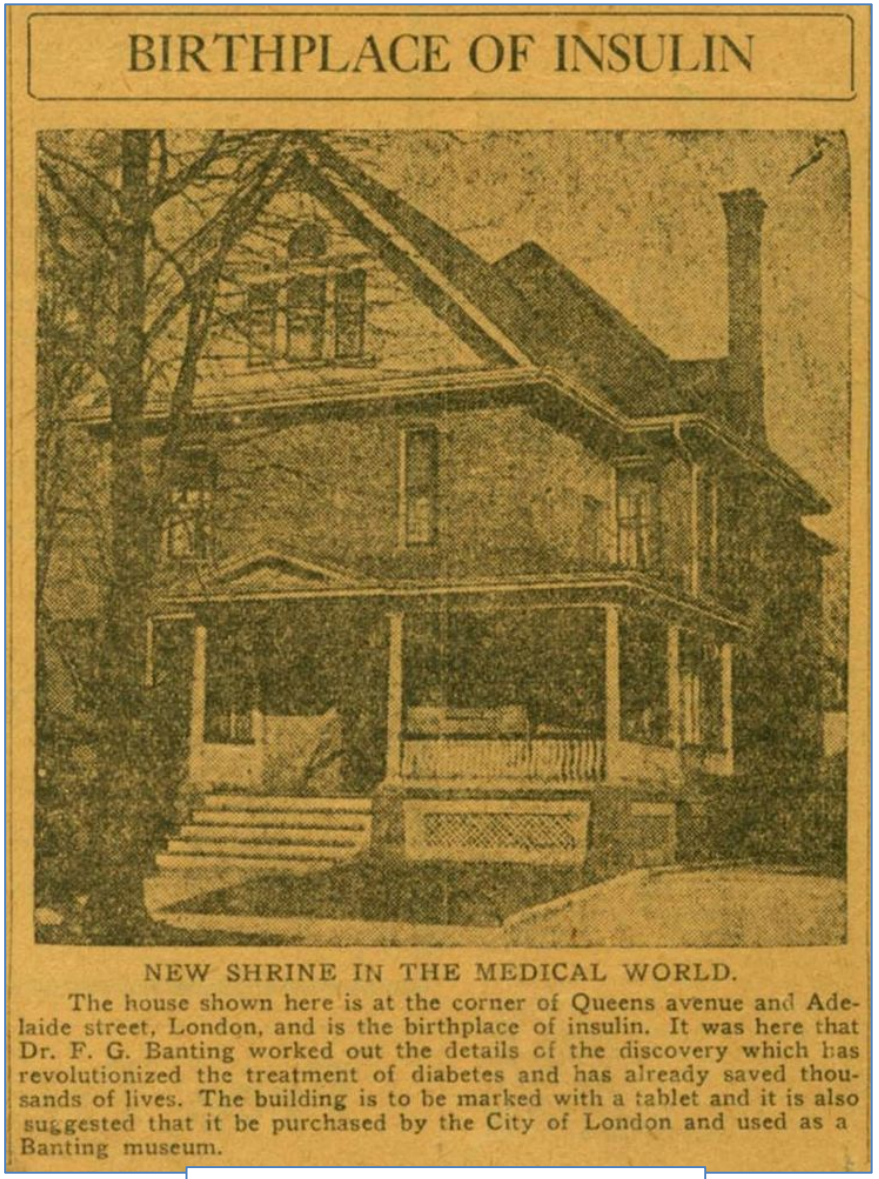
https://insulin.library.utoronto.ca/



"Diabetus: Ligate pancreatic ducts of dog. Keep dogs alive till acini degenerate leaving Islets. Try to isolate the internal secretion of these and relieve glycosurea"

Banting's Idea

- Born on November 14, 1891 (now World Diabetes Day) in Alliston, Ontario, Dr. Frederick G. Banting brought a surgeon's perspective to the problem of diabetes
- **1912** - He entered the University of Toronto and graduated with an expedited class because of WWI
- After the war, he worked at the Hospital for Sick Children in Toronto before moving to London, Ontario
- **1920** - Banting started his own practice, but lack of patients led him to work as a demonstrator in the University of Western Ontario medical school's physiology department


BIRTHPLACE OF INSULIN

NEW SHRINE IN THE MEDICAL WORLD.

The house shown here is at the corner of Queens avenue and Adelaide street, London, and is the birthplace of insulin. It was here that Dr. F. G. Banting worked out the details of the discovery which has revolutionized the treatment of diabetes and has already saved thousands of lives. The building is to be marked with a tablet and it is also suggested that it be purchased by the City of London and used as a Banting museum.

https://bantinghousenhsc.wordpress.com/

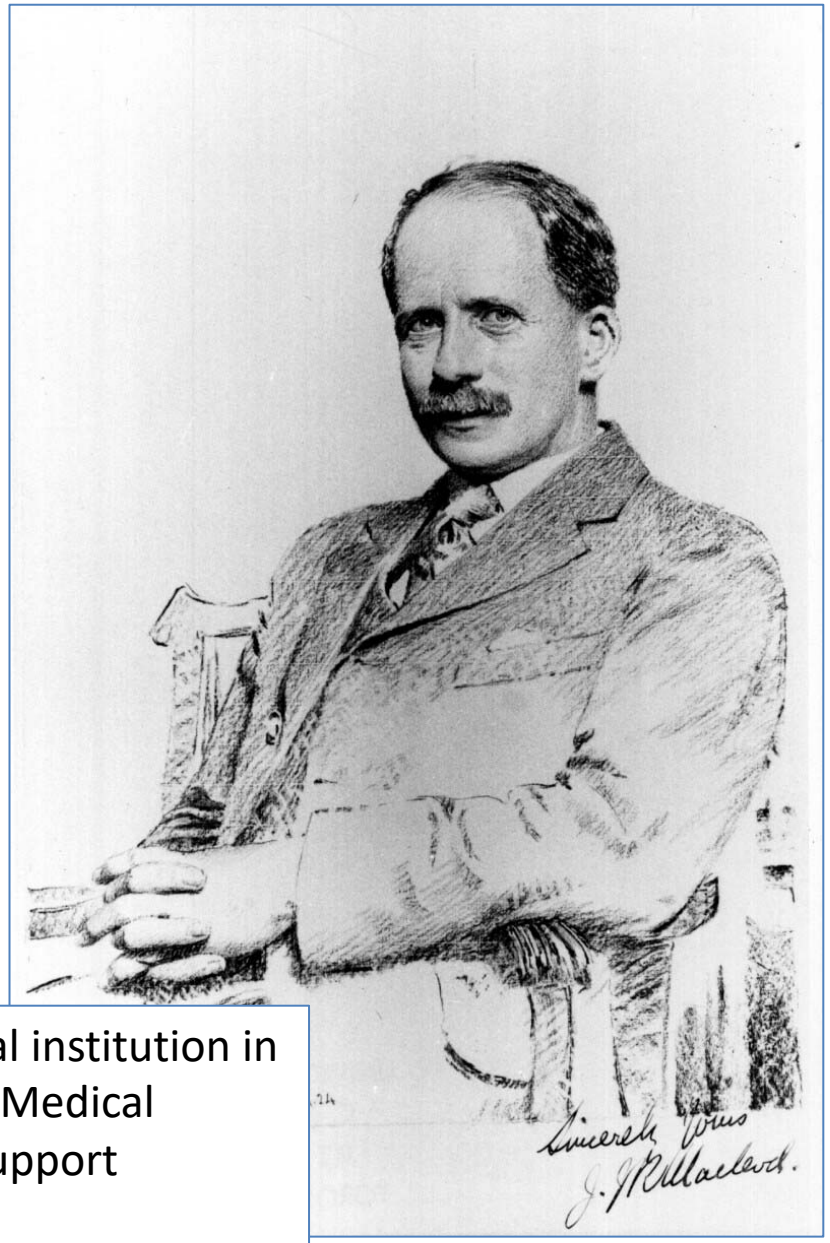
Banting's Idea

- Today, Banting's London home and medical practice in 1920 is known as "Banting House," which includes a museum and a diabetes education centre operated by Diabetes Canada
- A prominent feature of Banting House is the "Flame of Hope," which will burn until a cure for diabetes is found

https://bantinghousenhsc.wordpress.com/

Banting's Idea

- **Nov. 6, 1920** – Banting took his idea to the University of Toronto and presented it to Dr. J.J.R. Macleod, Professor of Physiology and a specialist in the study of diabetes



- **Early 1920s** - The University of Toronto an ideal institution in which Banting could develop his idea, with its Medical Building, built in 1903, specially designed to support scientific research

Banting's Idea

- U of T stood at the centre of a uniquely linked group of medical and scientific institutions -- Toronto General Hospital (r), the Hospital for Sick Children (l), and its singular public health biologicals producer, Connaught Antitoxin Laboratories -- each ready to play key roles in the insulin story

Sanofi Pasteur Canada Archives

Discovering Insulin in Toronto

- After meeting Macleod, who was intrigued, though skeptical, Banting was soon given a small lab, access to experimental dogs, a $100 budget, and the assistance of Charles Best, a recent graduate in Physiology and Biochemistry

- They got started on May 17, 1921

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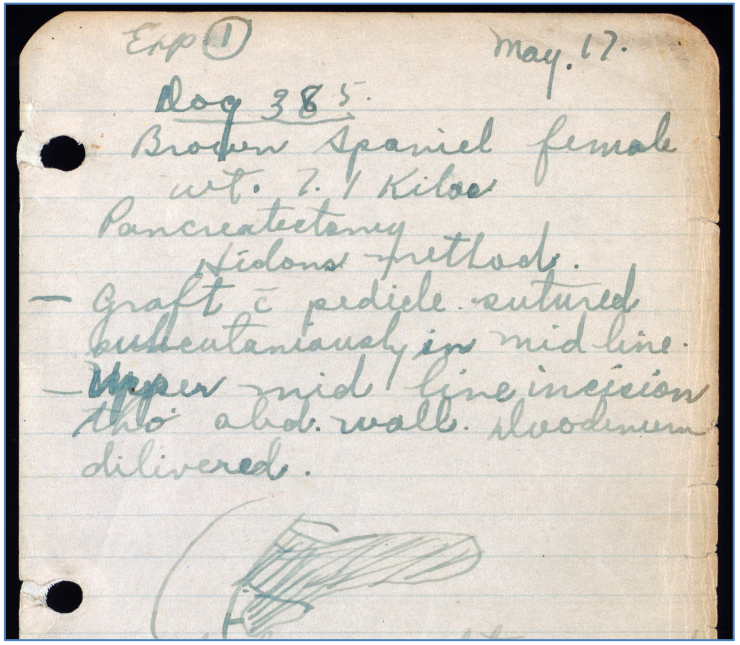
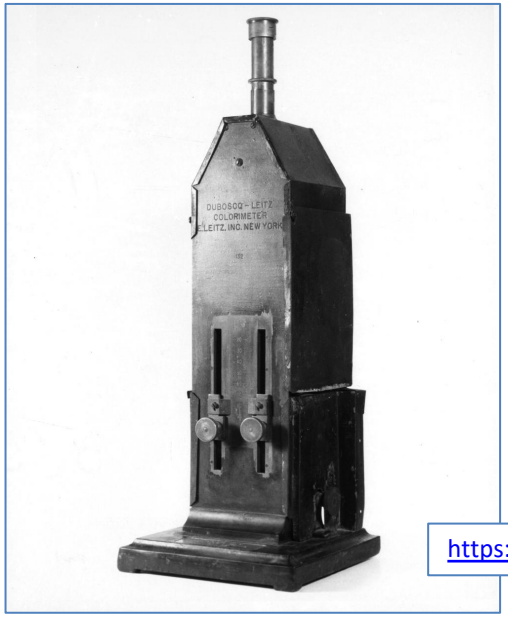
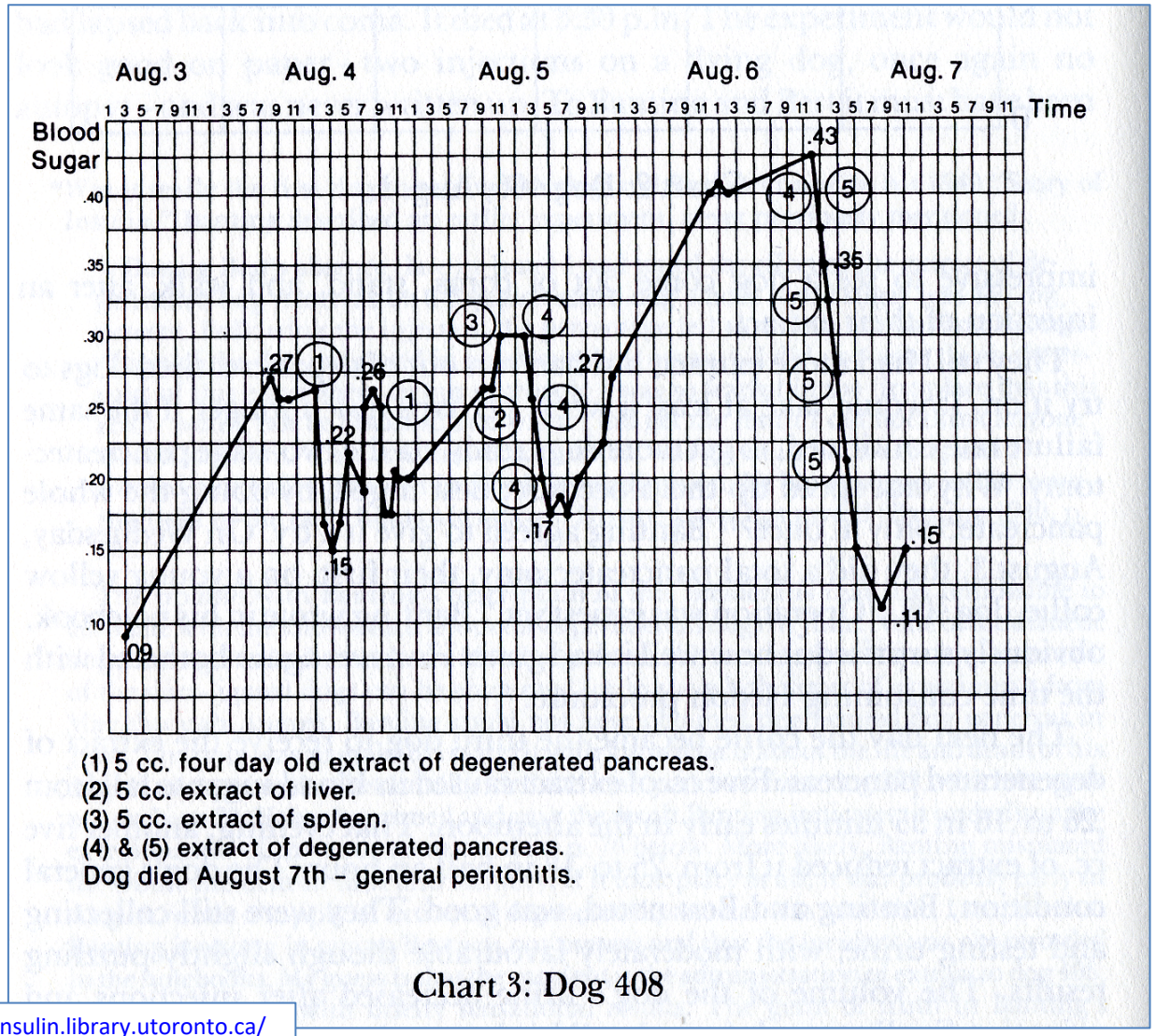


Discovering Insulin in Toronto

- **May-Aug 1921** – During an especially hot summer, Banting and Best reported encouraging results with a pancreatic extract controlling blood sugar levels in de-pancreatized dogs.





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Discovering Insulin in Toronto

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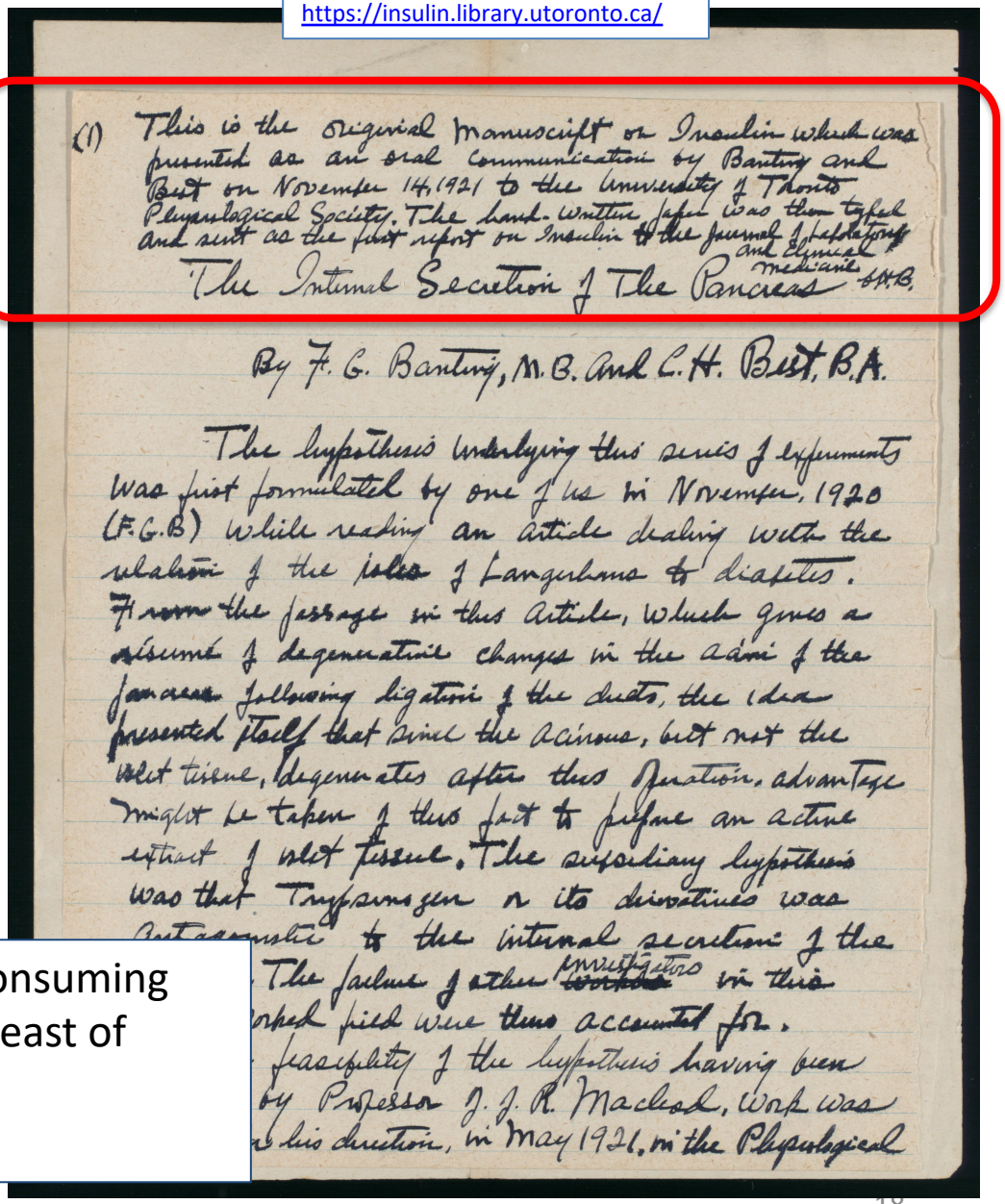
- **Nov 14, 1921** – Banting and Best – on Banting's 30th birthday -- gave the first presentation about their pancreatic extract research to the Journal Club of the U of T Department of Physiology

- The presentation prompted a suggestion of a longevity experiment with the extract given regularly to a diabetic dog over an extended period

- But where would the extract come from?



(1) This is the Original Manuscript on Insulin which was presented as an oral communication by Banting and Best on November 14, 1921 to the University of Toronto Physiological Society. The hand-written paper was then typed and sent as the first report on Insulin to the Journal of Laboratory and Clinical Medicine

The Internal Secretion of The Pancreas

By F. G. Banting, M.B. and C.H. Best, B.A.

The hypothesis underlying this series of experiments was first formulated by one of us in November, 1920 (F.G.B) while reading an article dealing with the relation of the islets of Langerhans to diabetes. From the passage in this article, which gives a résumé of degenerative changes in the acini of the pancreas following ligation of the ducts, the idea presented itself that since the acinous, but not the islet tissue, degenerates after this duration, advantage might be taken of this fact to prepare an active extract of islet tissue. The supporting hypothesis was that Trypsinogen or its derivatives was antagonistic to the internal secretion of the The failure of other investigators in this worked field were thus accounted for. feasibility of the hypothesis having been by Professor J. J. R. Macleod, work was his direction, in May 1921, in the Physiological

- The duct-ligation process was time consuming and expensive on several levels, not least of which involved the reliance on dogs
- There had to be a better way

Discovering Insulin in Toronto

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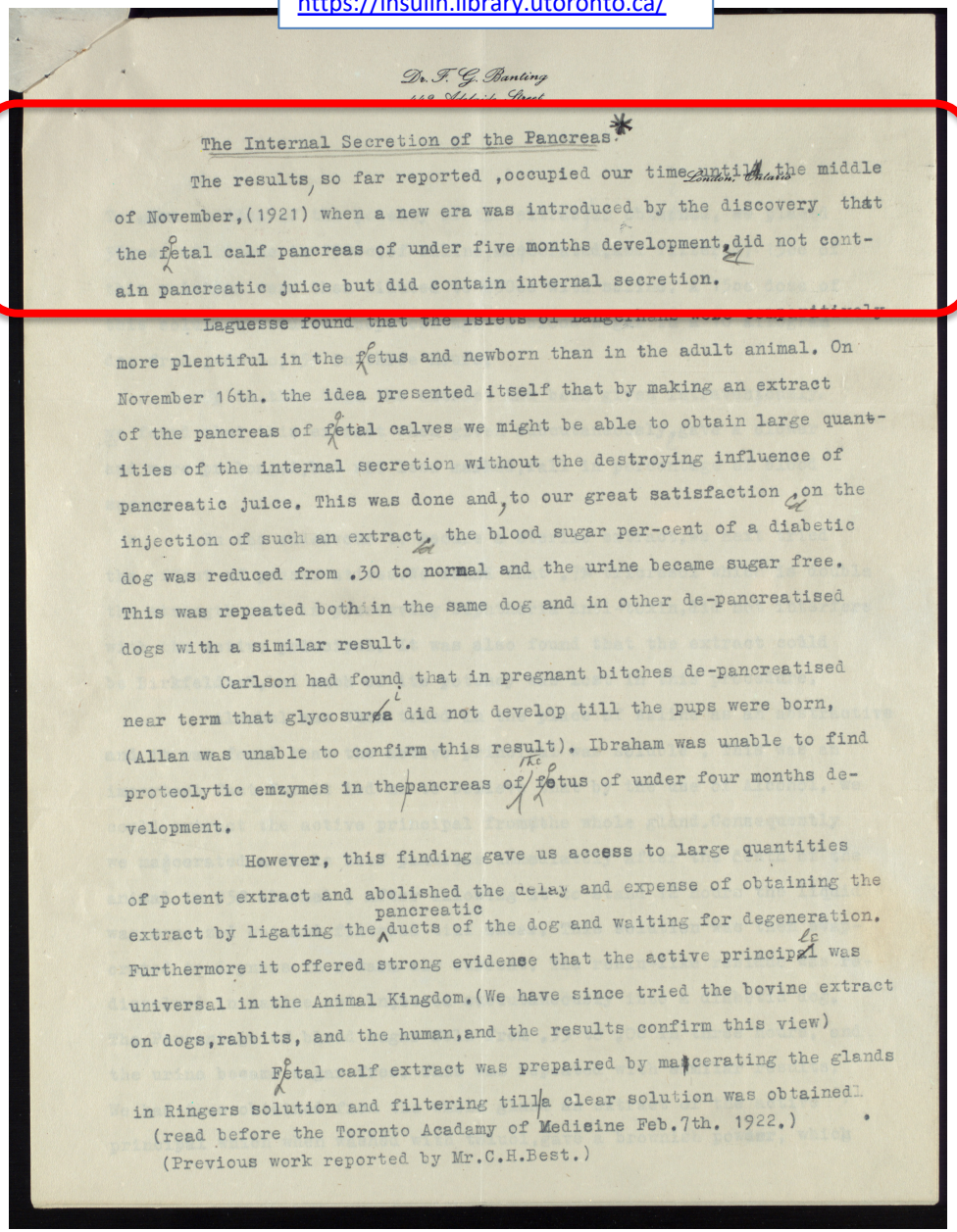
- **November 16, 1921** - Banting was struck by another idea that led to preparing the extract from foetal calf pancreas

- It soon became clear that fresh whole beef pancreas would prove to be a much more readily available source of the extract



Dr. F. G. Banting

The Internal Secretion of the Pancreas.*

The results, so far reported, occupied our time until the middle of November, (1921) when a new era was introduced by the discovery that the foetal calf pancreas of under five months development did not contain pancreatic juice but did contain internal secretion.

Laguesse found that the islets of Langerhans were proportionately more plentiful in the foetus and newborn than in the adult animal. On November 16th. the idea presented itself that by making an extract of the pancreas of foetal calves we might be able to obtain large quantities of the internal secretion without the destroying influence of pancreatic juice. This was done and, to our great satisfaction, on the injection of such an extract, the blood sugar per-cent of a diabetic dog was reduced from .30 to normal and the urine became sugar free. This was repeated both in the same dog and in other de-pancreatised dogs with a similar result.

Carlson had found that in pregnant bitches de-pancreatised near term that glycosuria did not develop till the pups were born, (Allan was unable to confirm this result). Ibraham was unable to find proteolytic emzymes in the pancreas of foetus of under four months development.

However, this finding gave us access to large quantities of potent extract and abolished the delay and expense of obtaining the extract by ligating the pancreatic ducts of the dog and waiting for degeneration. Furthermore it offered strong evidence that the active principle was universal in the Animal Kingdom. (We have since tried the bovine extract on dogs, rabbits, and the human, and the results confirm this view)

Foetal calf extract was prepaired by macerating the glands in Ringers solution and filtering till a clear solution was obtained.

(read before the Toronto Acadamy of Medicine Feb. 7th. 1922.)

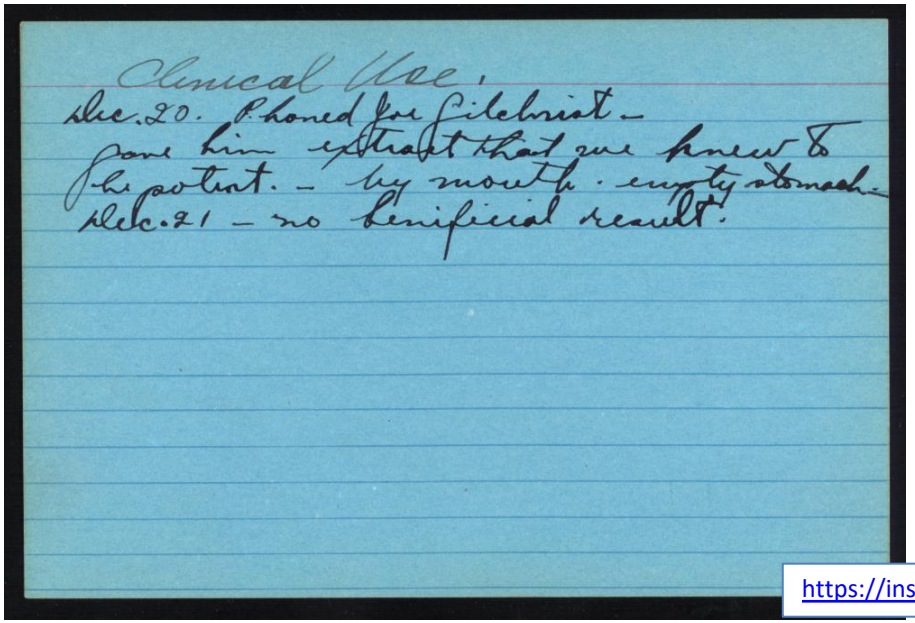
(Previous work reported by Mr. C.H.Best.)

Discovering Insulin in Toronto

- **Dec. 1921** - Dr. James Bertram Collip, a biochemist from the University of Alberta on sabbatical in Toronto, joins Banting and Best to help purify the extract.

- Encouraging results with dog #33, “Marjorie,” lead to the extract’s first human use (administered orally), but it was unsuccessful

Sanofi Pasteur Canada Archives



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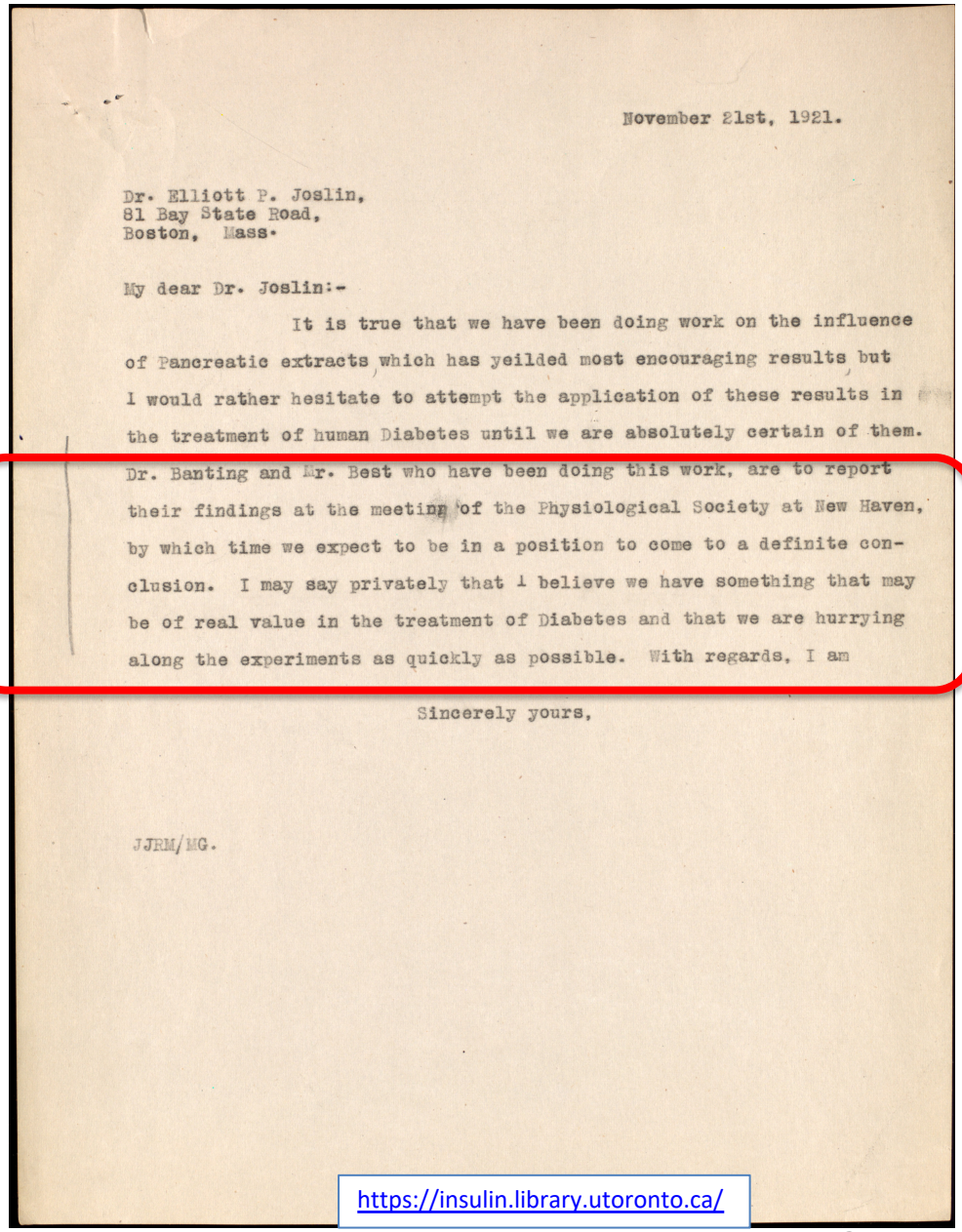
Discovering Insulin in Toronto

- **Dec. 30, 1921** –The work of the Toronto group presented at the Annual Meeting of the American Physiological Society in New Haven, CN, and attended by the leading diabetes specialists
- Banting was nervous giving the presentation and Macleod stepped in to help answer questions
- Dr. George Clowes, research director of Eli Lilly & Co, of Indianapolis was impressed with the work's potential and closely followed its progress



November 21st, 1921.

Dr. Elliott P. Joslin,
81 Bay State Road,
Boston, Mass.

My dear Dr. Joslin:-

It is true that we have been doing work on the influence of Pancreatic extracts which has yeilded most encouraging results but I would rather hesitate to attempt the application of these results in the treatment of human Diabetes until we are absolutely certain of them. Dr. Banting and Mr. Best who have been doing this work, are to report their findings at the meeting of the Physiological Society at New Haven, by which time we expect to be in a position to come to a definite conclusion. I may say privately that I believe we have something that may be of real value in the treatment of Diabetes and that we are hurrying along the experiments as quickly as possible. With regards, I am

Sincerely yours,

JJRM/MG.

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Discovering Insulin in Toronto

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- **Jan. 11, 1922** - 13-year-old Leonard Thompson is the first to receive an injection of the extract, but with limited effect, and with some reaction (abscesses)

- **Jan 23, 1922** – Leonard receives Collip's more purified extract, with striking results

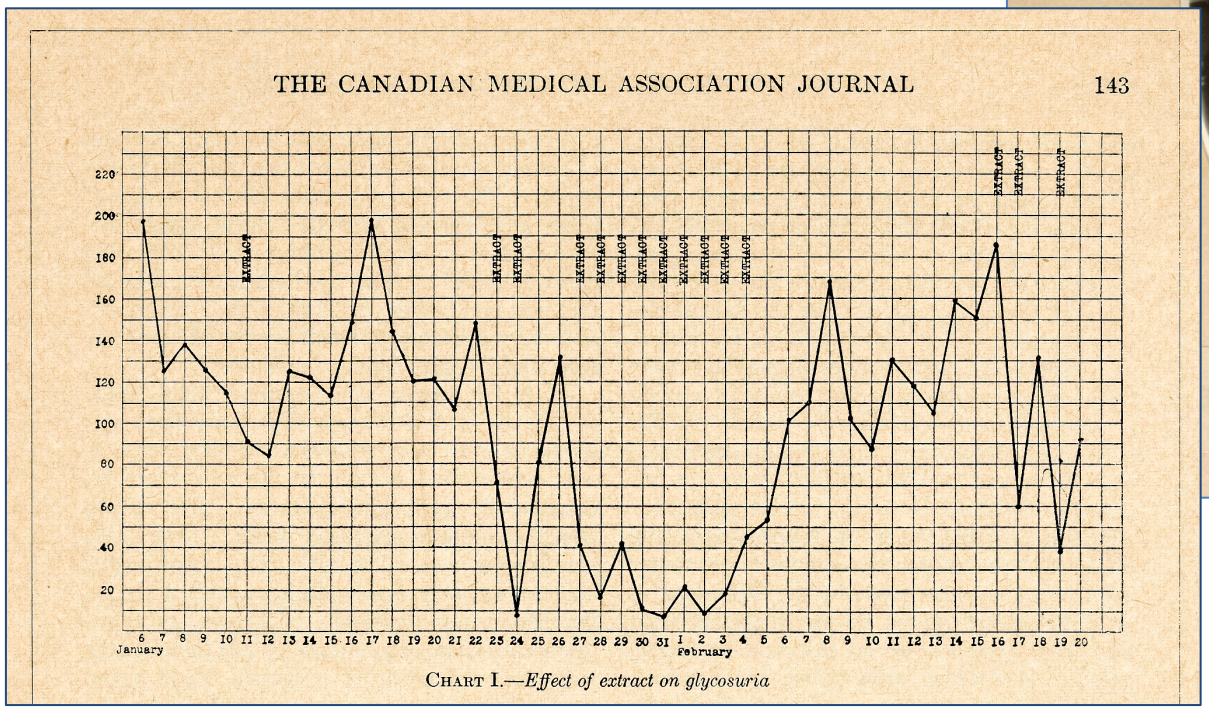
THE CANADIAN MEDICAL ASSOCIATION JOURNAL 143

Chart I.—*Effect of extract on glycosuria*


LEONARD THOMPSON
First patient to receive insulin in Toronto.

Developing Insulin in Toronto

- **Jan 25, 1922** - Encouraged by Leonard Thompson's successful treatments, but concerned about the future control of the new extract's production, the director of U of T's Connaught Laboratories, John FitzGerald (right), facilitated an agreement with Banting, Best, Collip and Macleod

- He offered them funds and the Lab's facilities in the Medical Building, not far from Banting & Best's lab, to help develop methods to produce the extract for clinical trials

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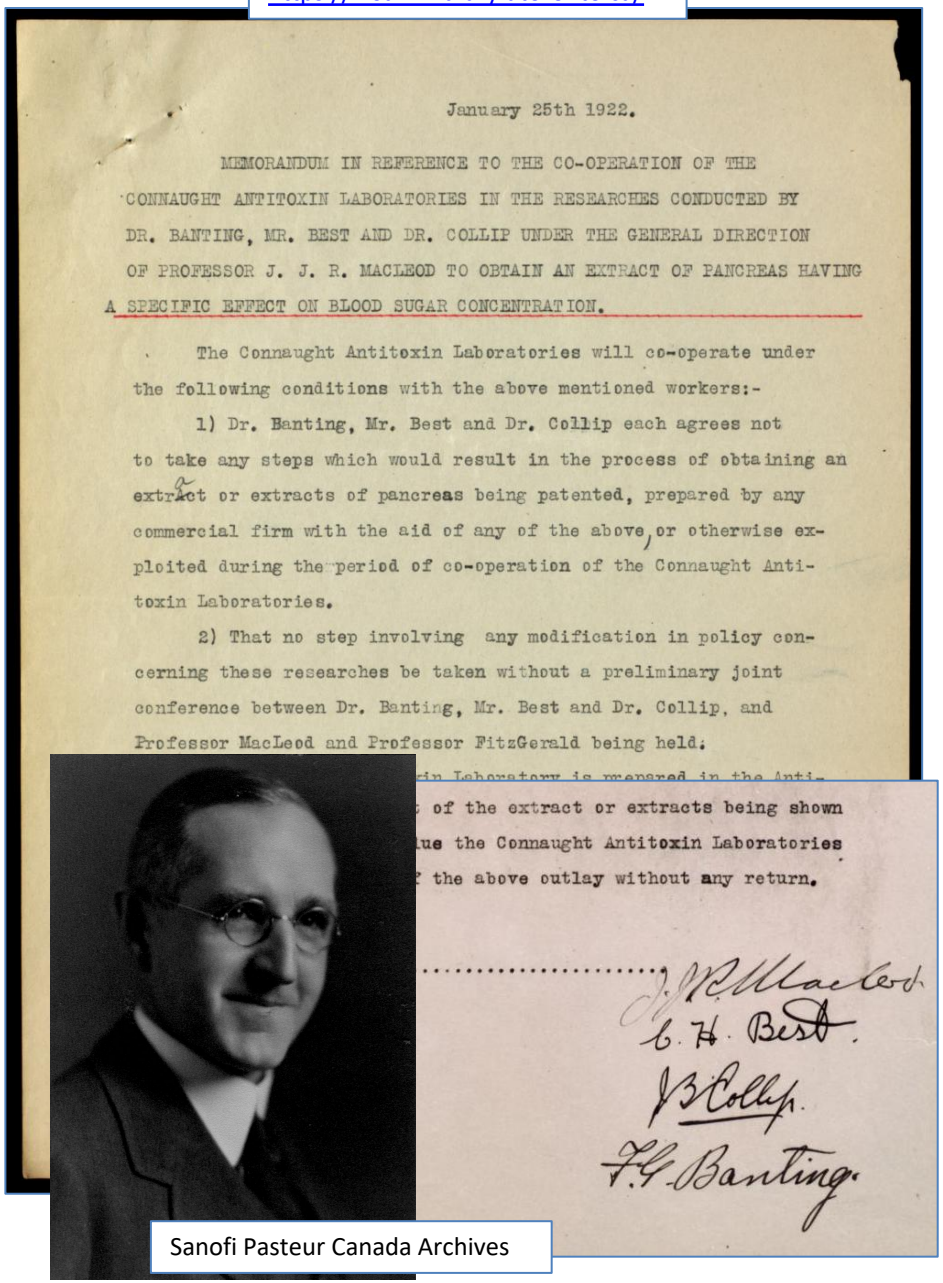


January 25th 1922.

MEMORANDUM IN REFERENCE TO THE CO-OPERATION OF THE CONNAUGHT ANTITOXIN LABORATORIES IN THE RESEARCHES CONDUCTED BY DR. BANTING, MR. BEST AND DR. COLLIP UNDER THE GENERAL DIRECTION OF PROFESSOR J. J. R. MACLEOD TO OBTAIN AN EXTRACT OF PANCREAS HAVING A SPECIFIC EFFECT ON BLOOD SUGAR CONCENTRATION.

The Connaught Antitoxin Laboratories will co-operate under the following conditions with the above mentioned workers:-

1) Dr. Banting, Mr. Best and Dr. Collip each agrees not to take any steps which would result in the process of obtaining an extract or extracts of pancreas being patented, prepared by any commercial firm with the aid of any of the above, or otherwise exploited during the period of co-operation of the Connaught Antitoxin Laboratories.

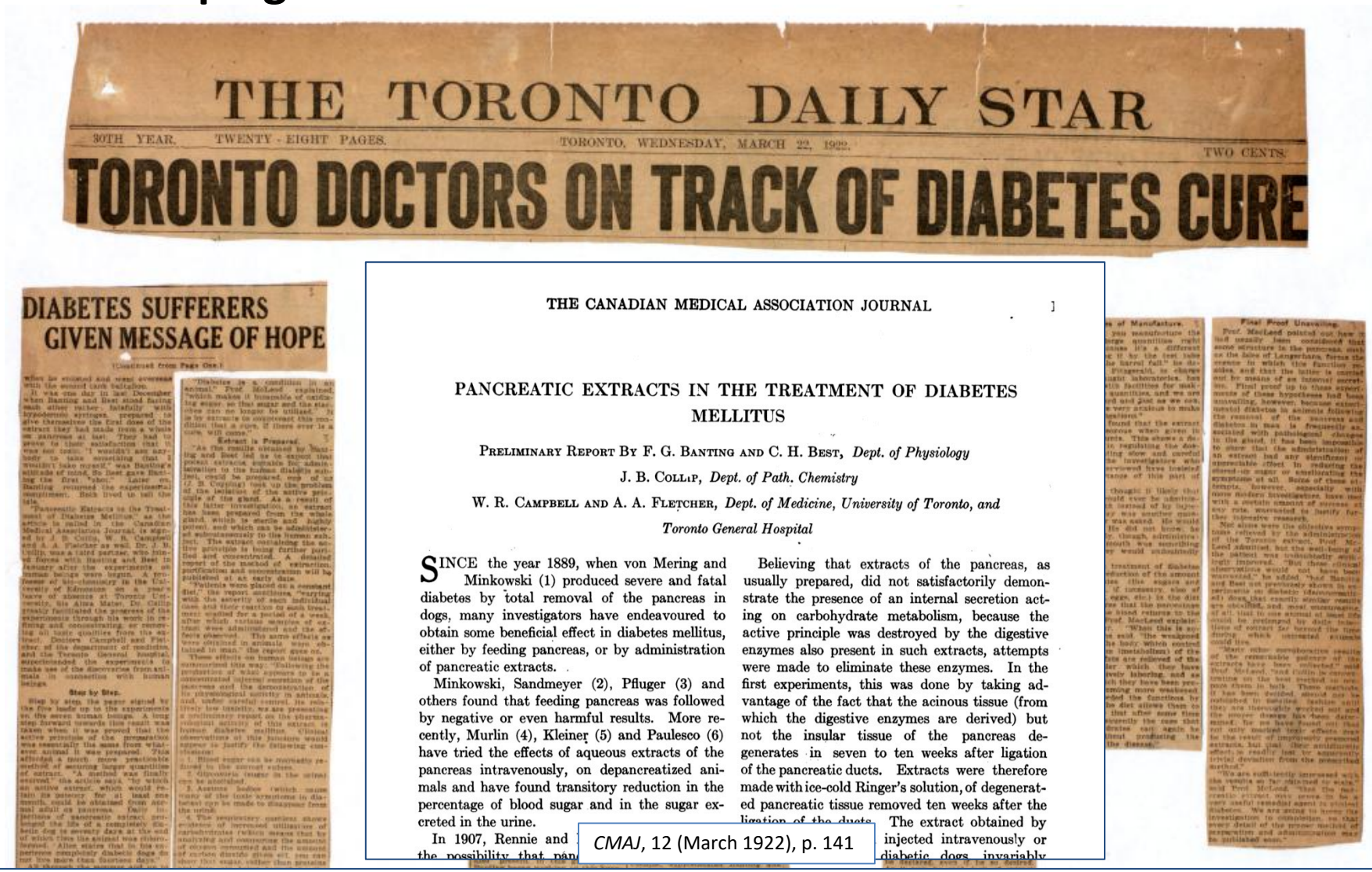
2) That no step involving any modification in policy concerning these researches be taken without a preliminary joint conference between Dr. Banting, Mr. Best and Dr. Collip, and Professor MacLeod and Professor FitzGerald being held.

of the extract or extracts being shown
ue the Connaught Antitoxin Laboratories
the above outlay without any return.

J. R. Macleod
C. H. Best
J. B. Collip
F. G. Banting

Sanofi Pasteur Canada Archives

Developing Insulin in Toronto



THE TORONTO DAILY STAR

30TH YEAR. TWENTY-EIGHT PAGES. TORONTO, WEDNESDAY, MARCH 22, 1922. TWO CENTS.

TORONTO DOCTORS ON TRACK OF DIABETES CURE

DIABETES SUFFERERS GIVEN MESSAGE OF HOPE

THE CANADIAN MEDICAL ASSOCIATION JOURNAL

PANCREATIC EXTRACTS IN THE TREATMENT OF DIABETES MELLITUS

PRELIMINARY REPORT BY F. G. BANTING AND C. H. BEST, *Dept. of Physiology*

J. B. COLLIP, *Dept. of Path. Chemistry*

W. R. CAMPBELL AND A. A. FLETCHER, *Dept. of Medicine, University of Toronto, and Toronto General Hospital*

SINCE the year 1889, when von Mering and Minkowski (1) produced severe and fatal diabetes by total removal of the pancreas in dogs, many investigators have endeavoured to obtain some beneficial effect in diabetes mellitus, either by feeding pancreas, or by administration of pancreatic extracts.

Minkowski, Sandmeyer (2), Pfluger (3) and others found that feeding pancreas was followed by negative or even harmful results. More recently, Murlin (4), Kleiner (5) and Paulesco (6) have tried the effects of aqueous extracts of the pancreas intravenously, on depancreatized animals and have found transitory reduction in the percentage of blood sugar and in the sugar excreted in the urine.

In 1907, Rennie and

Believing that extracts of the pancreas, as usually prepared, did not satisfactorily demonstrate the presence of an internal secretion acting on carbohydrate metabolism, because the active principle was destroyed by the digestive enzymes also present in such extracts, attempts were made to eliminate these enzymes. In the first experiments, this was done by taking advantage of the fact that the acinous tissue (from which the digestive enzymes are derived) but not the insular tissue of the pancreas degenerates in seven to ten weeks after ligation of the pancreatic ducts. Extracts were therefore made with ice-cold Ringer's solution, of degenerated pancreatic tissue removed ten weeks after the ligation of the ducts. The extract obtained by

injected intravenously or

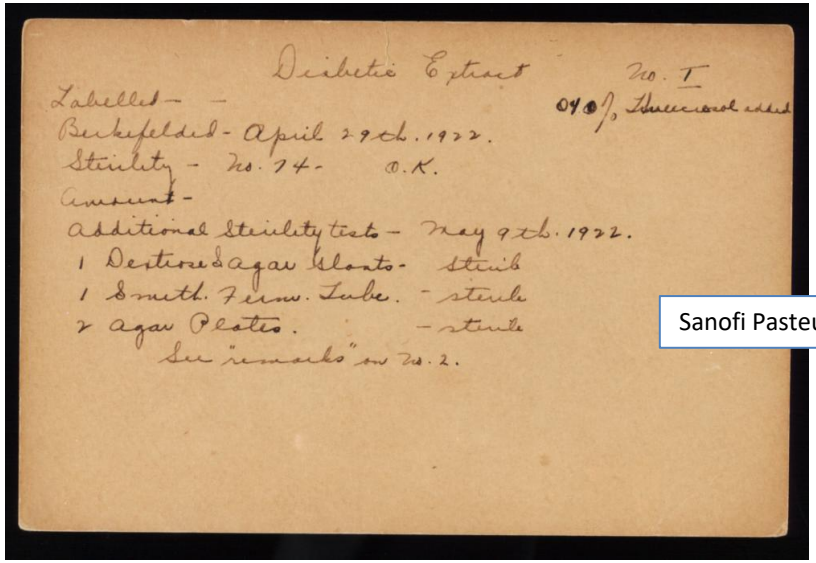
diabetic dogs invariably

CMAJ, 12 (March 1922), p. 141

- **March 22, 1922** – In the meantime, news of the extract and its successful human use was first reported the *Canadian Medical Association Journal* and in newspapers

Developing Insulin in Toronto

- Moving from lab to clinical trial scale, and then to large-scale production of the extract was a major challenge for Connaught Labs
- **March-May 1922** - After frustrating failures, production was restored under Best's direction
- Connaught then dedicated its full, though modest, resources to insulin production and output rose steadily


Diabetic Extract No. I

Labelled –

Berkefeld - April 29th. 1922.

Sterility - No. 74 - O.K.

Amount -

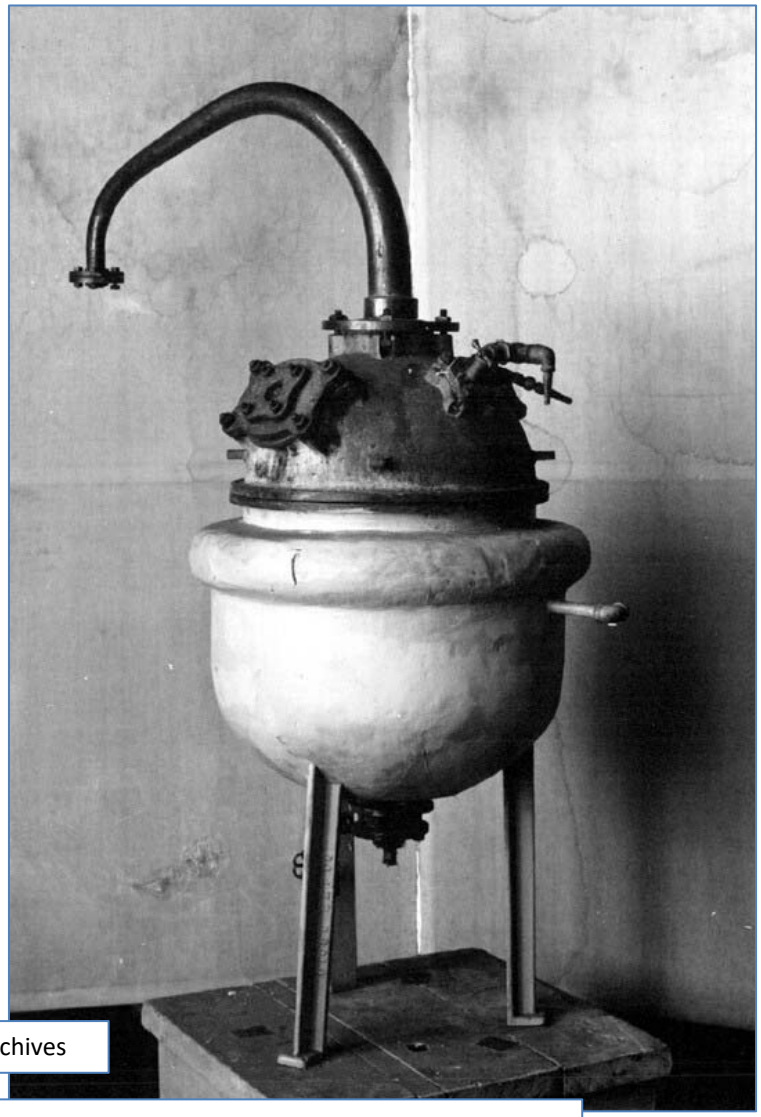
Additional Sterility tests – May 9th. 1922.

1 Dextrose Agar Gloucto - sterile

1 Smith. Ferm. Tube. - sterile

2 Agar Plates. - sterile

See "remarks" on No. 2.



Sanofi Pasteur Canada Archives

- **May 1922** - The extract was given the name "Insulin"

Developing Insulin in Toronto

- **May 3, 1922** – The insulin success story with the first human diabetic cases – and the first public use of the "insulin" name – was told in a seminal presentation by Macleod in Washington, D.C. at a major conference attended by physicians and the leading diabetes specialists from across North America

- Macleod's presentation prompted a wave of letters to the Toronto team from physicians on behalf of their desperate diabetic patients, pleading for insulin, although the supply was very limited

- **May 21-26** - The first American treated with insulin was 22-year-old Jim Havens of Rochester, NY

https://insulin.library.utoronto.ca/

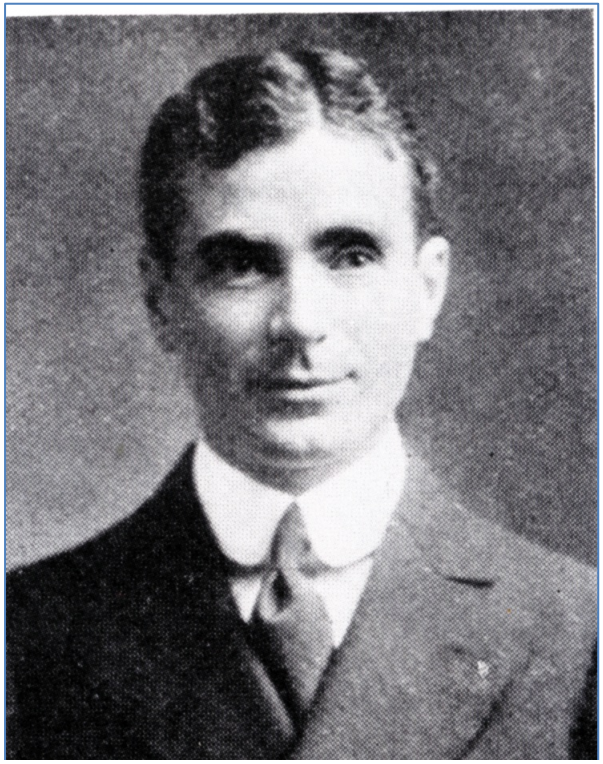
Developing Insulin in Toronto

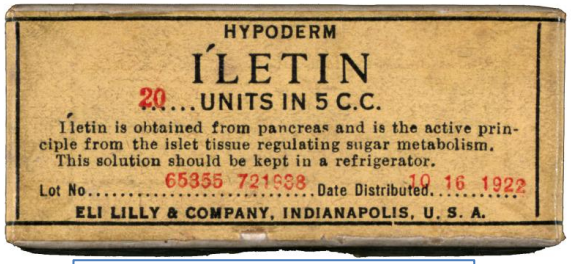
- **May 30, 1922** - A unique collaboration agreement arranged between the University of Toronto and Eli Lilly & Co. of Indianapolis, designed to expedite the the development of large-scale insulin production methods

- This and other agreements relating to insulin production, licensing and patent protection was negotiated by the University of Toronto's Insulin Committee

- Charles Best assumed leadership of Connaught's Insulin production and worked closely with Eli Lilly, especially the company's Research Director, Dr. G.H.A. Clowes (right)

- The agreement granted Eli Lilly exclusive rights to supply Insulin (branded as "Iletin") in the U.S. to diabetic specialists until June 1923

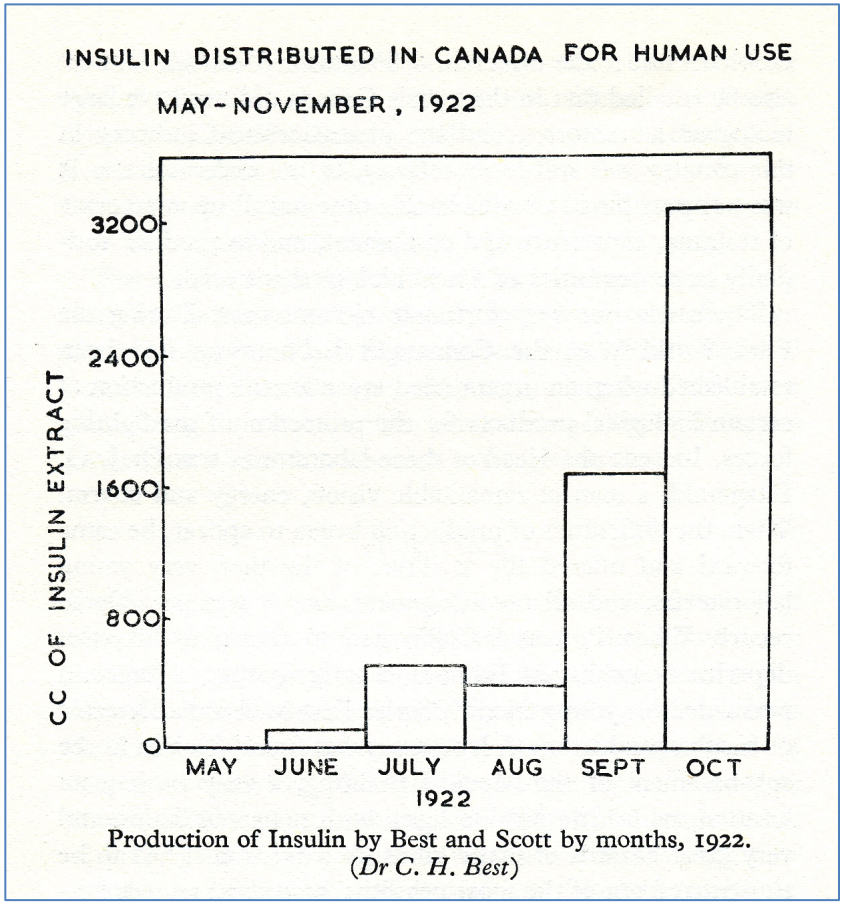




Sanofi Pasteur Canada Archives

Developing Insulin in Toronto

- The severe insulin supply challenges during the spring and summer of 1922 meant only a few critically ill patients, mostly children, could be treated



Production of Insulin by Best and Scott by months, 1922.
(*Dr C. H. Best*)


HAVE THEY ROBBED DIABETES OF ITS TERRORS?

Shown in these pictures are the four Toronto medical men on the University staff who figure most prominently in the discovery of a pancreatic extract to be used in the clinical treatment of diabetes in human beings. This is one of the most important medical discoveries of modern research, whose possibilities as an ultimate cure of this dread disease are very encouraging, it may be gathered from the announcement to-day of the success of the extract on seven human patients at the Toronto General Hospital since January this year. Dr. F. G. Banting on the upper left, a young man of 30, a graduate from Toronto University in 1916, brought his hypothesis at the basis of the experiments with him from London, Ontario, last May. Associated with him in all the experimental work has been a younger man still, Dr. C. H. Best, only 23 years of age, on the upper right, a nephew of Mrs. Prof. Hallam, of Wycliffe College, and a son of Dr. H. H. Best, of Maine. Dr. Best on account of the promise of his work, was chosen by Prof. J. J. R. MacLeod, associate Dean of Medicine at the University, and one of the most eminent authorities on diabetic research, to assist Dr. Banting in his experiments. Dr. J. B. Collip, on the lower left, professor of bio-chemistry at the University of Alberta, on leave of absence this year as assistant-professor of pathological chemistry at Toronto, a graduate of 1912, has greatly facilitated the work in refining and concentrating the extract from ox pancreas that was finally used on human beings for the first time in January at the General Hospital.

Star Weekly

Toronto Star Weekly, March 26, 1922

Insulin Resurrections

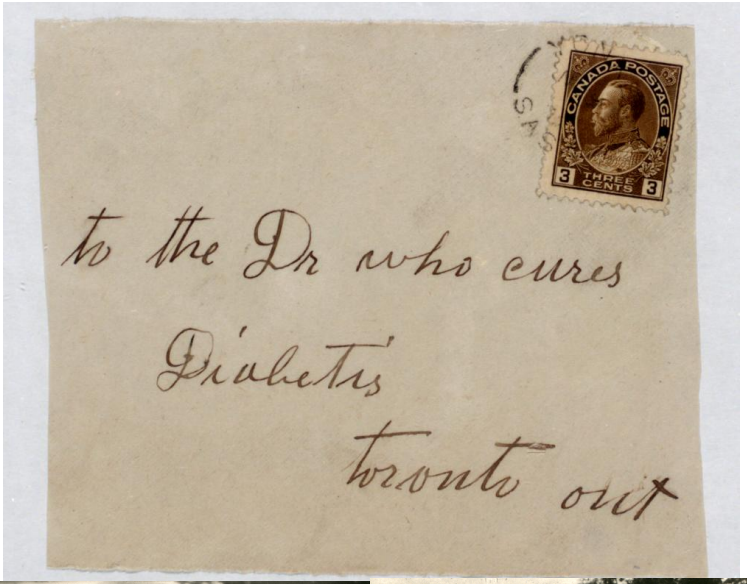
- **June - July 1922** – The rapidly growing attention to the Toronto insulin discovery brought desperate pleas from diabetics, their doctors and families, few of whom Banting could help due to a limited supply of insulin

- However, Banting was able to help three severe diabetic cases who came to Toronto from the U.S. for insulin treatment

- Ruth Whitehall (8 years old), treated in Toronto June 17 to the end of September

- Myra Blaustein (11 years old), treated in Toronto July to the end of September

- Teddy Ryder (6 years old), treated in Toronto July 8 through October



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Insulin Resurrections

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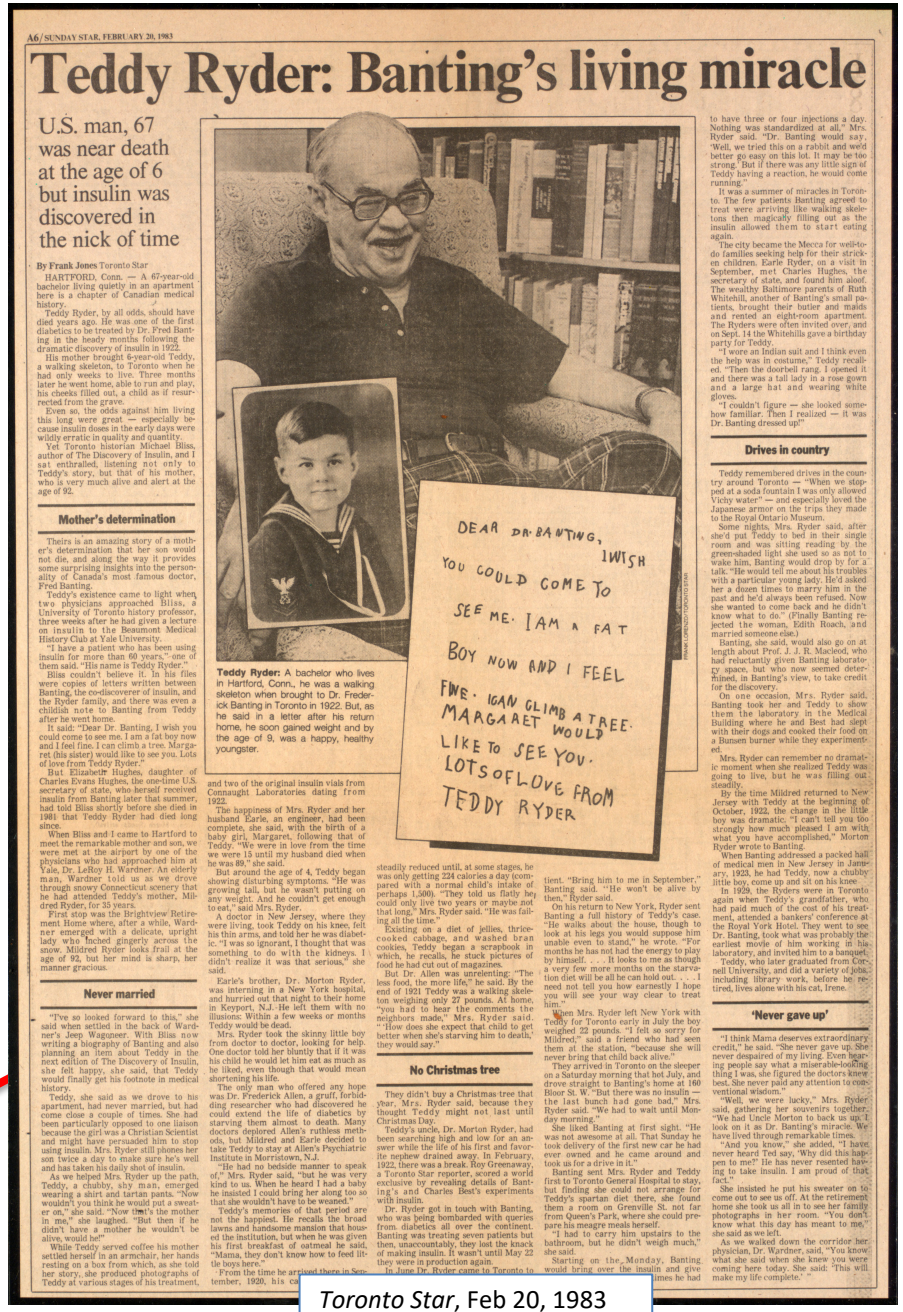
- Teddy Ryder (6 years old), treated in Toronto July 8 through October
- Teddy would live until March 1993



A6/SUNDAY STAR, FEBRUARY 20, 1983

Teddy Ryder: Banting's living miracle

U.S. man, 67 was near death at the age of 6 but insulin was discovered in the nick of time

By Frank Jones Toronto Star

HARTFORD, Conn. — A 67-year-old bachelor living quietly in an apartment here is a chapter of Canadian medical history.

Teddy Ryder, by all odds, should have died years ago. He was one of the first diabetics to be treated by Dr. Fred Banting in the heady months following the dramatic discovery of insulin in 1922.

His mother brought 6-year-old Teddy, a walking skeleton, to Toronto when he had only weeks to live. Three months later he went home, able to run and play, his cheeks filled out, a child as if resurrected from the grave.

Even so, the odds against him living this long were great — especially because insulin doses in the early days were wildly erratic in quality and quantity.

Yet Toronto historian Michael Bliss, author of The Discovery of Insulin, and I sat enthralled, listening not only to Teddy's story, but that of his mother, who is very much alive and alert at the age of 92.

Mother's determination

Theirs is an amazing story of a mother's determination that her son would not die, and along the way it provides some surprising insights into the personality of Canada's most famous doctor, Fred Banting.

Teddy's existence came to light when two physicians approached Bliss, a University of Toronto history professor, three weeks after he had given a lecture on insulin to the Beaumont Medical History Club at Yale University.

"I have a patient who has been using insulin for more than 60 years," one of them said. "His name is Teddy Ryder."

Bliss couldn't believe it. In his files were copies of letters written between Banting, the co-discoverer of insulin, and the Ryder family, and there was even a childish note to Banting from Teddy after he went home.

It said: "Dear Dr. Banting, I wish you could come to see me. I am a fat boy now and I feel fine. I can climb a tree. Margaret (his sister) would like to see you. Lots of love from Teddy Ryder."

But Elizabeth Hughes, daughter of Charles Evans Hughes, the one-time U.S. secretary of state, who herself received insulin from Banting later that summer, had told Bliss shortly before she died in 1981 that Teddy Ryder had died long since.

When Bliss and I came to Hartford to meet the remarkable mother and son, we were met at the airport by one of the physicians who had approached him at Yale, Dr. LeRoy H. Wardner. An elderly man, Dr. Wardner told us as we drove through snowy Connecticut scenery that he had attended Teddy's mother, Mildred Ryder, for 35 years.

First stop was the Brightview Retirement Home where, after a while, Wardner emerged with a delicate, upright lady who inched gingerly across the snow. Mildred Ryder looks frail at the age of 92, but her mind is sharp, her manner gracious.

Never married

"I've so looked forward to this," she said when settled in the back of Wardner's limo. "Myra Bliss is now writing a biography of Banting and also planning an item about Teddy in the next edition of The Discovery of Insulin, she felt happy, she said, that Teddy would finally get his footnote in medical history.

Teddy, she said as we drove to his apartment, had never married, but had come close a couple of times. She had been particularly opposed to one liaison because the girl was a Christian Scientist and might have persuaded him to stop using insulin. Mrs. Ryder still phones her son twice a day to make sure he's well and has taken his daily shot of insulin.

As we helped Mrs. Ryder up the path, Teddy, a chubby, shy man, emerged wearing a shirt and tartan pants. "Now wouldn't you think he would put a sweater on," she said. "Now that's the mother in me," she laughed. "But then if he didn't have a mother he wouldn't be alive, would he!"

While Teddy served coffee his mother settled herself in an armchair, her hands resting on a box from which, as she told her story, she produced photographs of Teddy at various stages of his treatment, and two of the original insulin vials from Connaught Laboratories dating from 1922.

Teddy Ryder: A bachelor who lives in Hartford, Conn., he was a walking skeleton when brought to Dr. Frederick Banting in Toronto in 1922. But, as he said in a letter after his return home, he soon gained weight and by the age of 9, was a happy, healthy youngster.

The happiness of Mrs. Ryder and her husband Earle, an engineer, had been complete, she said, with the birth of a baby girl, Margaret, following that of Teddy. "We were in love from the time we were 15 until my husband died when he was 89," she said.

But around the age of 4, Teddy began showing disturbing symptoms. "He was growing tall, but he wasn't putting on any weight. And he couldn't get enough to eat," said Mrs. Ryder.

A doctor in New Jersey, where they were living, took Teddy on his knee, felt his thin arms, and told her he was diabetic. "I was so ignorant, I thought that was something to do with the kidneys. I didn't realize it was that serious," she said.

Earle's brother, Dr. Morton Ryder, was interning in a New York hospital, and hurried out that night to their home in Keyport, N.J. He left them with no illusions. Within a few weeks or months Teddy would be dead.

Mrs. Ryder took the skinny little boy from doctor to doctor, looking for help. One doctor told her bluntly that if it was his child he would let him eat as much as he liked, even though that would mean shortening his life.

The only man who offered any hope was Dr. Frederick Allen, a gruff, forbidding researcher who had discovered he could extend the life of diabetics by starving them almost to death. Many doctors deplored Allen's ruthless methods, but Mildred and Earle decided to take Teddy to stay at Allen's Psychiatric Institute in Morristown, N.J.

"He had no bedside manner to speak of," Mrs. Ryder said, "but he was very kind to us. When he heard I had a baby he insisted I could bring her along too so that she wouldn't have to be weaned."

Teddy's memories of that period are not the happiest. He recalls the broad lawns and handsome mansion that housed the institution, but when he was given his first breakfast of oatmeal he said, "Mama, they don't know how to feed little boys here."

From the time he arrived there in September, 1920, his ca[illegible] steadily reduced until, at some stages, he was only getting 224 calories a day (compared with a normal child's intake of perhaps 1,500). "They told us flatly boy could only live two years or maybe not that long," Mrs. Ryder said. "He was failing all the time."

Existing on a diet of jellies, thrice-cooked cabbage, and washed bran cookies, Teddy began a scrapbook in which, he recalls, he stuck pictures of food he had cut out of magazines.

But Dr. Allen was unrelenting: "The less food, the more life," he said. By the end of 1921 Teddy was a walking skeleton weighing only 27 pounds. At home, "you had to hear the comments the neighbors made," Mrs. Ryder said. "'How does she expect that child to get better when she's starving him to death,' they would say."

No Christmas tree

They didn't buy a Christmas tree that year, Mrs. Ryder said, because they thought Teddy might not last until Christmas Day.

Teddy's uncle, Dr. Morton Ryder, had been searching high and low for an answer while the life of his first and favorite nephew drained away. In February, 1922, there was a break. Roy Greenaway, a Toronto Star reporter, scored a world exclusive by revealing details of Banting's and Charles Best's experiments with insulin.

Dr. Ryder got in touch with Banting, who was being bombarded with queries from diabetics all over the continent. Banting was treating seven patients but then, unaccountably, they lost the knack of making insulin. It wasn't until May 22 they were in production again.

In June Dr. Ryder came to Toronto to [illegible] tient. "Bring him to me in September," Banting said. "He won't be alive by then," Ryder said.

On his return to New York, Ryder sent Banting a full history of Teddy's case. "He walks about the house, though to look at his legs you would suppose him unable even to stand," he wrote. "For months he has not had the energy to play by himself. . . . It looks to me as though a very few more months on the starvation diet will be all he can hold out. . . . I need not tell you how earnestly I hope you will see your way clear to treat him."

When Mrs. Ryder left New York with Teddy for Toronto early in July the boy weighed 22 pounds. "I felt so sorry for Mildred," said a friend who had seen them at the station, "because she will never bring that child back alive."

They arrived in Toronto on the sleeper on a Saturday morning that hot July, and drove straight to Banting's home at 160 Bloor St. W. "But there was no insulin — the last bunch had gone bad," Mrs. Ryder said. "We had to wait until Monday morning."

She liked Banting at first sight. "He was not awesome at all. That Sunday he took delivery of the first new car he had ever owned and he came around and took us for a drive in it."

Banting sent Mrs. Ryder and Teddy first to Toronto General Hospital to stay, but finding she could not arrange for Teddy's spartan diet there, she found them a room on Grenville St. not far from Queen's Park, where she could prepare his meagre meals herself.

"I had to carry him upstairs to the bathroom, but he didn't weigh much," she said.

Starting on the Monday, Banting would bring over the insulin and give [illegible] times he had to have three or four injections a day. Nothing was standardized at all," Mrs. Ryder said. "Dr. Banting would say, 'Well, we tried this on a rabbit and we'd better go easy on this lot. It may be too strong.' But if there was any little sign of Teddy having a reaction, he would come running."

It was a summer of miracles in Toronto. The few patients Banting agreed to treat were arriving like walking skeletons then magically filling out as the insulin allowed them to start eating again.

The city became the Mecca for well-to-do families seeking help for their stricken children. Earle Ryder, on a visit in September, met Charles Hughes, the secretary of state, and found him aloof. The wealthy Baltimore parents of Ruth Whitehill, another of Banting's small patients, brought their butler and maids and rented an eight-room apartment. The Ryders were often invited over, and on Sept. 14 the Whitehills gave a birthday party for Teddy.

"I wore an Indian suit and I think even the help was in costume," Teddy recalled. "Then the doorbell rang. I opened it and there was a tall lady in a rose gown and a large hat and wearing white gloves.

"I couldn't figure — she looked somehow familiar. Then I realized — it was Dr. Banting dressed up!"

Drives in country

Teddy remembered drives in the country around Toronto — "When we stopped at a soda fountain I was only allowed Vichy water" — and especially loved the Japanese armor on the trips they made to the Royal Ontario Museum.

Some nights, Mrs. Ryder said, after she'd put Teddy to bed in their single room and was sitting reading by the green-shaded light she used so as not to wake him, Banting would drop by for a talk. "He would tell me about his troubles with a particular young lady. He'd asked her a dozen times to marry him in the past and he'd always been refused. Now she wanted to come back and he didn't know what to do." (Finally Banting rejected the woman, Edith Roach, and married someone else.)

Banting, she said, would also go on at length about Prof. J. J. R. Macleod, who had reluctantly given Banting laboratory space, but who now seemed determined, in Banting's view, to take credit for the discovery.

On one occasion, Mrs. Ryder said, Banting took her and Teddy to show them the laboratory in the Medical Building where he and Best had slept with their dogs and cooked their food on a Bunsen burner while they experimented.

Mrs. Ryder can remember no dramatic moment when she realized Teddy was going to live, but he was filling out steadily.

By the time Mildred returned to New Jersey with Teddy at the beginning of October, 1922, the change in the little boy was dramatic. "I can't tell you too strongly how much pleased I am with what you have accomplished," Morton Ryder wrote to Banting.

When Banting addressed a packed ball of medical men in New Jersey in January, 1923, he had Teddy, now a chubby little boy, come up and sit on his knee.

In 1929, the Ryders were in Toronto again when Teddy's grandfather, who had paid much of the cost of his treatment, attended a bankers' conference at the Royal York Hotel. They went to see Dr. Banting, took what was probably the earliest movie of him working in his laboratory, and invited him to a banquet.

Teddy, who later graduated from Cornell University, and did a variety of jobs, including library work, before he retired, lives alone with his cat, Irene.

'Never gave up'

"I think Mama deserves extraordinary credit," he said. "She never gave up. She never despaired of my living. Even hearing people say what a miserable-looking thing I was, she figured the doctors knew best. She never paid any attention to conventional wisdom."

"Well, we were lucky," Mrs. Ryder said, gathering her souvenirs together. "We had Uncle Morton to back us up. I look on it as Dr. Banting's miracle. We have lived through remarkable times.

"And you know," she added, "I have never heard Ted say, 'Why did this happen to me?' He has never resented having to take insulin. I am proud of that fact."

She insisted he put his sweater on to come out to see us off. At the retirement home she took us all in to see her family photographs in her room. "You don't know what this day has meant to me," she said as we left.

As we walked down the corridor her physician, Dr. Wardner, said, "You know what she said when I knew you were coming here today. She said: 'This will make my life complete.'"

Toronto Star, Feb 20, 1983

Insulin Resurrections

- **August 15 – November 30** – Banting's most famous diabetic patient was 15-year-old Elizabeth Hughes, press attention to her heighted by her being the daughter of the U.S. Secretary of State, Charles Evans Hughes

Toronto Star, Aug 17, 1922

DAUGHTER OF U.S. SECRETARY OF STATE TRIES NEW TORONTO DISCOVERY.

On the left is Mrs. Charles Evans Hughes, who accompanied her daughter to Toronto this week to take a new treatment for diabetes, which has been worked out at the University of Toronto. In the centre is her fifteen-year-old daughter, who is here to take the treatm ent. On the right is Dr. F. G. Banting, 160 Bloor street west, who is the originator of the insulin treatment for diabetes, and who for over a year has been doing research work along with Mr. C. H. Best, of Toronto. The new treatment has already prolonged the lives of many sufferers from the disease.

HELPED BY INSULIN 'CURE'

Daughter of Secretary of State Hughes Recovers From Diabetes

Toronto, Oct. 16.—Miss Elizabeth Hughes, fifteen-year-old daughter of the American Secretary of State, Charles E. Hughes, has been taking the Insulin treatment for diabetes for about two months under the personal attention of Dr. F. G. Banting, discoverer of the treatment.

She has gained sixteen pounds and is eating everything, was the way one who knows her described her condition.

When she came here she was suffering from the malady in acute form. As is customary with patients of this type, she was unable to assimilate the staple foods which contain carbo-

SCIENCE'S NEW CURE LEADS HUGHES'S CHILD TO HEALTH

Toronto, Oct. 15.—A gain of sixteen pounds in two months shows the remarkable response of Miss Elizabeth Hughes, fifteen, daughter of Charles Evans Hughes, Secretary of State, to the Insulin treatment for diabetes, which she has been taking here under the personal attention of Dr. F. G. Banting, who discovered the method.

When Miss Hughes came here she was unable to assimilate any of the staple foods which contain carbohydrates, and as a consequence she was forced to a diet which bordered on starvation.

Miss Elizabeth Hughes

After a few injections of the extract which forms the basis of the treatment, her improvement was marked. These injections provided the element in her blood which oxidized the sugar and after the first week she has been extending her diet until now it embraces al- foods.

is making her home in Toronto with a nurse, Miss Burgess, who has been with the Hughes family for some years. Mrs. Hughes visited the city in August, expecting to take her daughter to the Toronto General Hospital, and was overjoyed when she found that this step was unnecessary.

Insulin Resurrections

- **August 15 – November 30** – Banting's most famous diabetic patient was 15-year-old Elizabeth Hughes, press attention to her heighted by her being the daughter of the U.S. Secretary of State, Charles Evans Hughes

https://insulin.library.utoronto.ca/

78 Grosvenor Street,
Toronto,
Canada.
August 22nd, 1924.

Dearest, dearest Mumsey,

I hope to goodness this does reach you safely for it carries in it some very interesting news I think. Dr. Banting came in as usual last night about 5.30 P.M. and said he had a good report to make. The insulin which they have been working on for so long will now be ready for use in a couple of days at the most, and it is the most powerful that has yet been made. So much so, in fact, that I will only have to take 1 C.C. at a time when I begin on my two doses, which will be very soon, I think. He is getting enough of it so that his three outside patients, Ruth Whitehill, Teddy Rider, and myself will not have to change our insulin for a month or so, which is a very good thing as you know. He was so happy over that part of it, and he really feels that it is becoming more stabilized all the time. He said, you can tell your Mother that I can promise her that with this new extract , the next time you see me I will be on 2240 calories the full amount that a girl of my age should be having. It will be divided like this 60 of protein 50 of carbohydrate, and 200 of fat. Now if I don't begin to gain weight on that I will be crazy. The power of this new insulin is so strong that he expects me to carry all that on only 2 C.C.'s per day, one in the morning and the other at night. You see what he's so happy about, is that once he finds out my balance on that, why he has enough insulin on hand now, so that I won't have to change for at least a month, anyway. If I once get on 2240 calories, it will be an established diet plenty of calories for me, and maybe then I can live at home with Blanche to give me the extract and tend to all my food, for once my diet is established like that I wouldn't need a doctor unless something went ra-

Toronto Star, Aug 17, 1922

On the new treatme
teen-year-ol
west, who i
search work
sufferers fr

- Elizabeth documented her recovery story in many letters she wrote from Toronto to her parents

Insulin: From Toronto To The World

SEEK PATENTS AS PROTECTION FOR DISCOVERY

Originators of "Insulin" Offer to Assign Them to U. of T.

AN OFFICIAL STATEMENT

The Globe has received from authorities at the University of Toronto the following statement on the Insulin treatment for diabetes. This may be regarded as an official statement by the University.

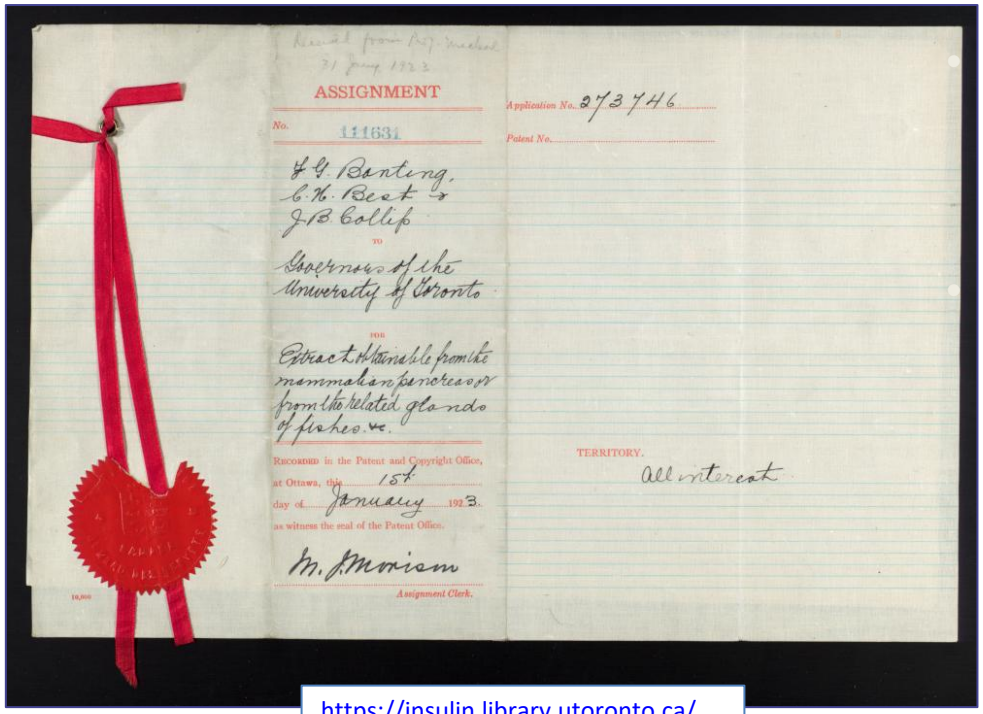
"The originators of the method of preparation of Insulin have applied for patents in Canada and other countries, and have offered to assign these, when granted, to the University of Toronto, to administer in whatever way it deems best, so as to prevent commercial exploitation of the product and to safeguard the production of a standardized extract.

Accepts Trust.

"The University, through the Board of Governors, has accepted the trust and has appointed a committee composed of representatives of the Board of Governors and of those who participated in the researches to advise it as how best to carry the above purposes into effect. The first step in large-scale production of Insulin was taken by the Connaught Anti-toxin Laboratories, but it was found that experimentation on a still wider scale was necessary to master the unexpected technical difficulties encountered in the work. It was found with each attempted expansion of the scale of production that fresh difficulties were encountered, and that products of unequal potency and of uncertain clinical value were obtained. It was decided, therefore, to collaborate with some large firm in the United States experienced in the preparation of extracts from slaughterhouse material, so that enough Insulin could be produced in the country to supply it to a selected group of physicians, so as to test its therapeutic value in diabetes, its proper dosage and so forth, before it on the market.

The Globe, Oct. 21, 1922, p. 23

- **Oct 1922** – Banting, Best & Collip assign Insulin patent to the University of Toronto Board of Governors for $1 as a public trust, "so as to prevent commercial exploitation of the product and to safeguard the production of a standardized product"



ASSIGNMENT

Application No. 273746

No. 111631

Patent No.

F. G. Banting,
C. H. Best &
J. B. Collip

TO

Governors of the University of Toronto

FOR

Extract obtainable from the mammalian pancreas or from the related glands of fishes, etc.

RECORDED in the Patent and Copyright Office, at Ottawa, this 15th day of January 1923.

TERRITORY. All interest

As witness the seal of the Patent Office.

M. J. Morison

Assignment Clerk.

https://insulin.library.utoronto.ca/

Jan 1923 – Canadian and U.S. patents for insulin granted

April 1923 – Unique "patent pooling" policy established by Insulin Committee to assure the sharing of any insulin production advancements among licensed producers

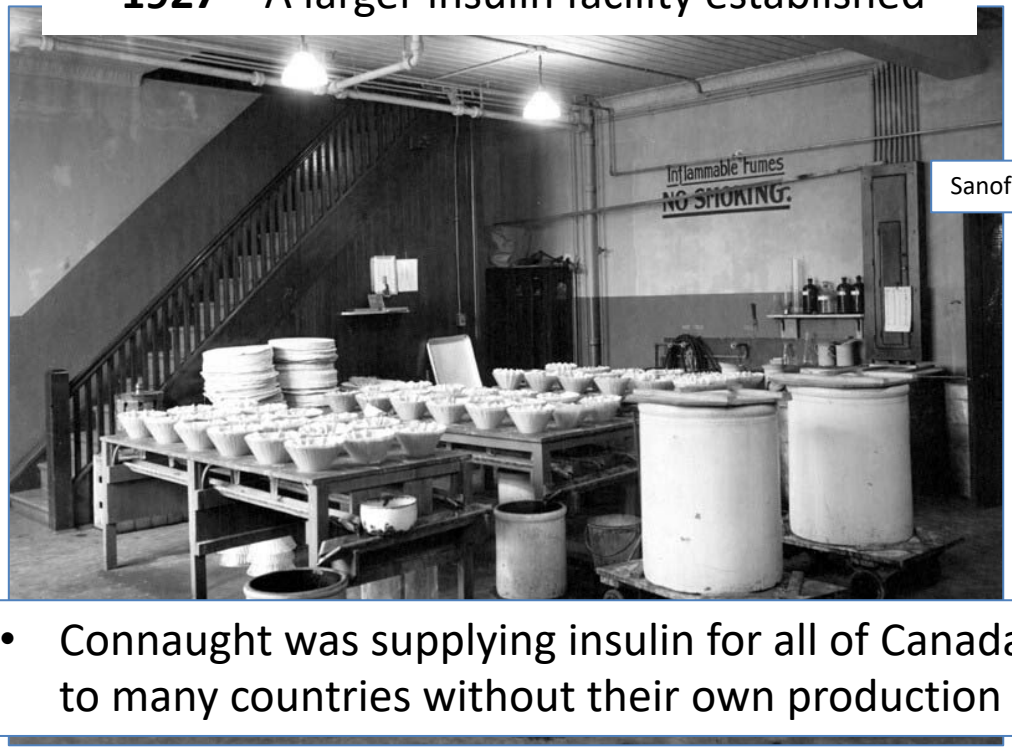
Insulin: From Toronto To The World

- **August 1923** - Canada's insulin supply found a firm foothold with a larger insulin production plant for Connaught Labs, thanks to funds from the Ontario government and the Labs' reserves; the plant established in U of T's vacant YMCA building on campus
- **1927** – A larger insulin facility established

ONTARIO LEADS THE WAY TO THE WORLD

43

To-morrow the Ontario Government will open the former Y.M.C.A. uilding at the University of Toronto as headquarters for the free dis- ribution of insulin to those unable to pay for it. This is due to the in- iative of the new Provincial Minister of Health, Hon. Dr. Forbes God- ey, who by his prompt recognition of the duty devolving upon the state uch matters has the satisfaction of having blazed the trail for the rities in the Old Land, who are to adopt a similar policy.



Sanofi Pasteur Canada Archives

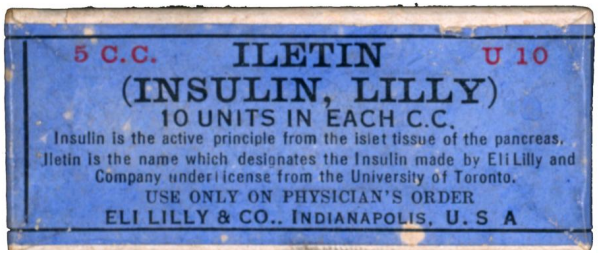
- Connaught was supplying insulin for all of Canada, and exporting it to many countries without their own production facility

C.J. Rutty – "The Discovery of Insulin: What is the Definitive History?" – Insulin 100th Webinar, Emirate Diabetes Society, World Diabetes Day, Nov 14, 2020

Insulin: From Toronto To The World

- As Insulin production steadily grew in Canada and the U.S., the University of Toronto Insulin Committee facilitated insulin patents and the licensing of production in other countries
- The Insulin Committee oversaw insulin quality control and licensing rights in North America
- In Canada, Connaught Laboratories held excusive insulin production and distribution rights (until 1980); Connaught remained part of U of T until 1972 and today its legacy is part of Sanofi Pasteur Canada/Sanofi Canada
- Eli Lilly held sole U.S. rights until June 1923, when other firms were able to apply to the U of T Insulin Committee for licenses

Sanofi Pasteur Canada Archives



Insulin: From Toronto To The World

- U of T Insulin Committee also granted patent/licensing authority to carefully selected public bodies in several countries, i.e.:

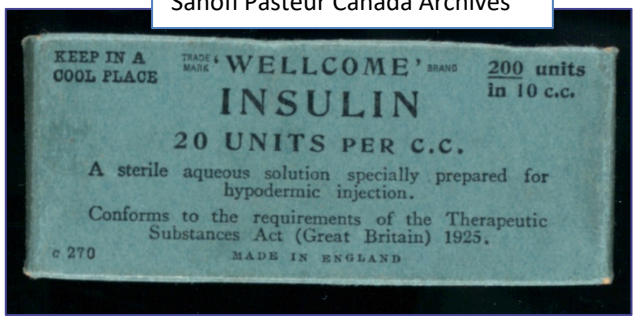
- **Nov 1922** – U.K. Medical Research Council (first insulin prepared in hospitals Jan 1923, then Burroughs Wellcome main producer April 1923)

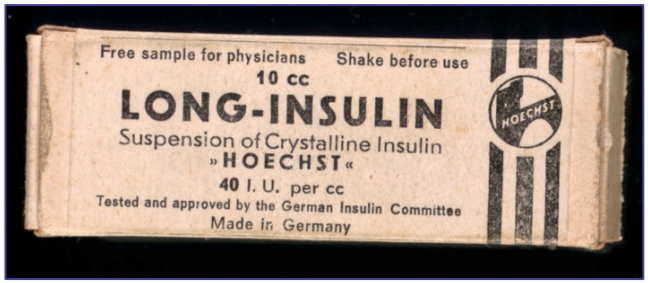
- **Nov 1922** – Nordisk Insulin Laboratory (Scandinavia) (first Nordisk insulin late 1923)

- **July 1923** – German Insulin Committee (Hoechst first insulin Oct 1923)

- **July 1923** – Gov't of Australia (Commonwealth Serum Laboratories first insulin Sept 1923)

Sanofi Pasteur Canada Archives





- By 1926, insulin was patented and trademarked in 44 countries, with the Insulin Committee carefully regulating who produced it

Insulin: Honouring the Discoverers

- The insulin story attracted significant international attention to Toronto, most notably,
- **Oct. 25, 1923** – The greatest global honour came when Banting and Macleod won the Nobel Prize for Medicine for the discovery of insulin

- However, recognizing that two others were similarly deserving, Banting shared his half of the Prize with Best, while Macleod shared his with Collip

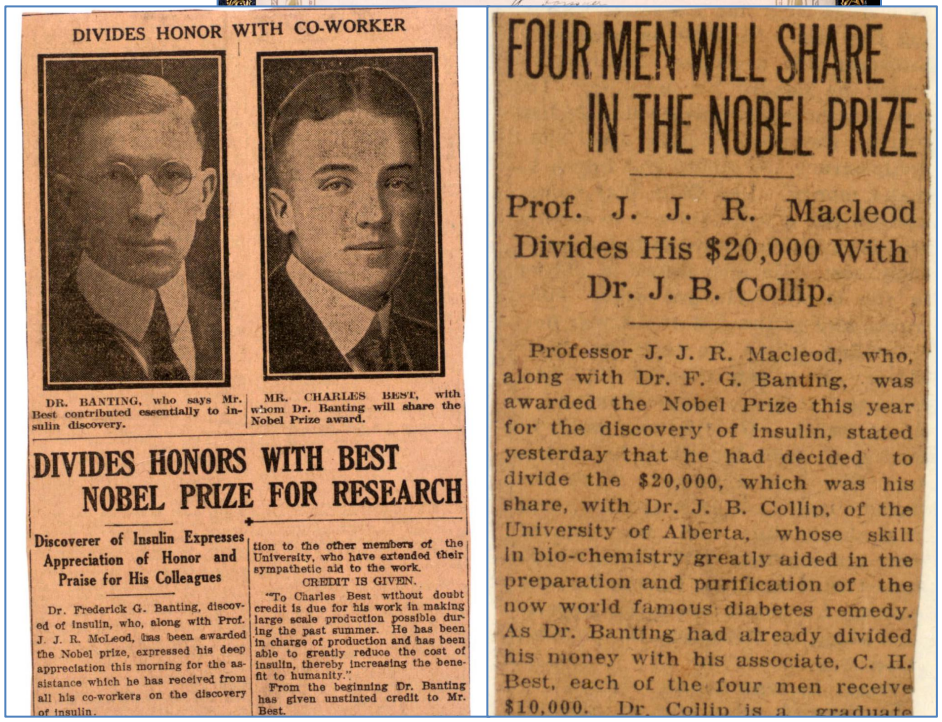

K. KAROLINSKA MEDIKO KIRURGISKA INSTITUTET

vilket enligt testamente, som den 27 november 1895 upprättats av ALFRED NOBEL, äger att med NOBELPRIS belöna den viktigaste upptäckt, varmed de fysiologiska och medicinska vetenskaperna under den senaste tiden rikatats, har denna dag beslutit att tillerkänna det år 1923 utgående priset till

FREDERICK G. BANTING
OCH
JOHN J. R. MACLEOD

för deras upptäckt av insulin.

Stockholm den 25 oktober 1923.


DIVIDES HONOR WITH CO-WORKER

DR. BANTING, who says Mr. Best contributed essentially to insulin discovery.

MR. CHARLES BEST, with whom Dr. Banting will share the Nobel Prize award.

DIVIDES HONORS WITH BEST NOBEL PRIZE FOR RESEARCH

Discoverer of Insulin Expresses Appreciation of Honor and Praise for His Colleagues

Dr. Frederick G. Banting, discoverer of insulin, who, along with Prof. J. J. R. McLeod, has been awarded the Nobel prize, expressed his deep appreciation this morning for the assistance which he has received from all his co-workers on the discovery of insulin.

tion to the other members of the University, who have extended their sympathetic aid to the work.

CREDIT IS GIVEN.

"To Charles Best without doubt credit is due for his work in making large scale production possible during the past summer. He has been in charge of production and has been able to greatly reduce the cost of insulin, thereby increasing the benefit to humanity."

From the beginning Dr. Banting has given unstinted credit to Mr. Best.

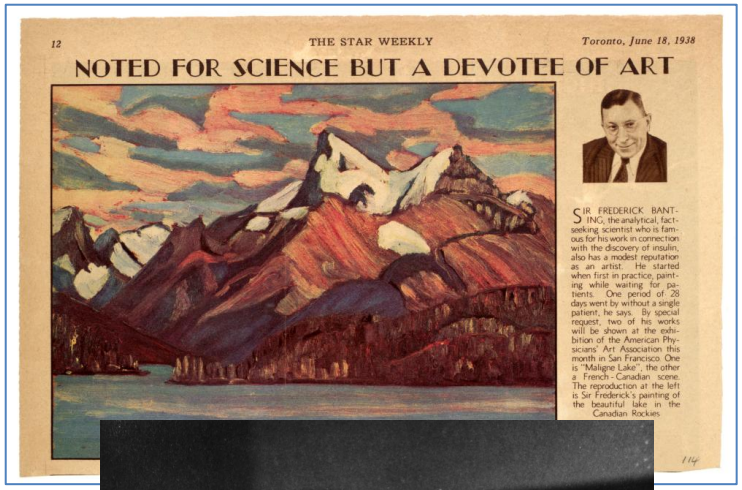
FOUR MEN WILL SHARE IN THE NOBEL PRIZE

Prof. J. J. R. Macleod Divides His $20,000 With Dr. J. B. Collip.

Professor J. J. R. Macleod, who, along with Dr. F. G. Banting, was awarded the Nobel Prize this year for the discovery of insulin, stated yesterday that he had decided to divide the $20,000, which was his share, with Dr. J. B. Collip, of the University of Alberta, whose skill in bio-chemistry greatly aided in the preparation and purification of the now world famous diabetes remedy. As Dr. Banting had already divided his money with his associate, C. H. Best, each of the four men receive $10,000. Dr. Collip is a graduate

Epilogue: Discoverers After Discovery

- Frederick Banting would focus on medical research, but was drawn to a growing interest in art, especially painting
- There were great expectations that Banting would make another major medical discovery, which proved quite frustrating, and art provided an important escape
- When World War II started, Banting became involved with aviation medicine studies
- He also worked closely with the British Air Force and was on a secret flight to Britain on February 20, 1941, when his small plane crashed shortly after taking off from Gander, Newfoundland; he died the next day


12 THE STAR WEEKLY Toronto, June 18, 1938

NOTED FOR SCIENCE BUT A DEVOTEE OF ART

SIR FREDERICK BANTING, the analytical, fact-seeking scientist who is famous for his work in connection with the discovery of insulin, also has a modest reputation as an artist. He started when first in practice, painting while waiting for patients. One period of 28 days went by without a single patient, he says. By special request, two of his works will be shown at the exhibition of the American Physicians' Art Association this month in San Francisco. One is "Maligne Lake", the other a French-Canadian scene. The reproduction at the left is Sir Frederick's painting of the beautiful lake in the Canadian Rockies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BANTING CRASH PROBED

Planes Rushed To Scene Of Wreck On Newfoundland Coast

Epilogue: Discoverers After Discovery

- **1925** – Charles Best completed his M.D. amidst the insulin development period and then pursued postgraduate studies in Europe

- **1927** - Best returned to Toronto to continue as Connaught's Assistant Director until 1929, and to also serve as Head of the Department of Physiological Hygiene at the School of Hygiene

- **Late 1920s** - Best also initiated studies of liver extract as a treatment of anemia, and he focused especially on the development of Heparin to control blood coagulation, this work very much involving Connaught; Best died in 1978

Discover More About the Discovery of Insulin

- To learn more about the discovery and development of insulin, and the discovery team, explore the Defining Moments Canada ”Insulin 100” national digital commemoration project, the first phase of which recently launched,

- http://definingmomentscanada.ca

INSULIN100

SIR FREDERICK BANTING

TEACHING ABOUT INSULIN100

INSULIN100: THE DISCOVERY AND DEVELOPMENT

MICROHISTORIES

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