



# THE DISCOVERY OF **INSULIN**

1921-2021

A JOURNEY THROUGH  
**THE HISTORY OF DIABETES**

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ON THE CENTENARY OF THE  
**DISCOVERY OF INSULIN**



THE KNOWN HISTORY  
**STARTS HERE!**

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International  
Diabetes Federation  
Europe



# EBERS PAPYRUS

(1550 BC)

**Ebers papyrus** dates from around 1550 BC and is the oldest known document referring to a disease that resembles diabetes. This papyrus was found in a tomb in Thebes, Egypt, in 1862 by Egyptologist George Ebers, becoming known by the name of its discoverer.

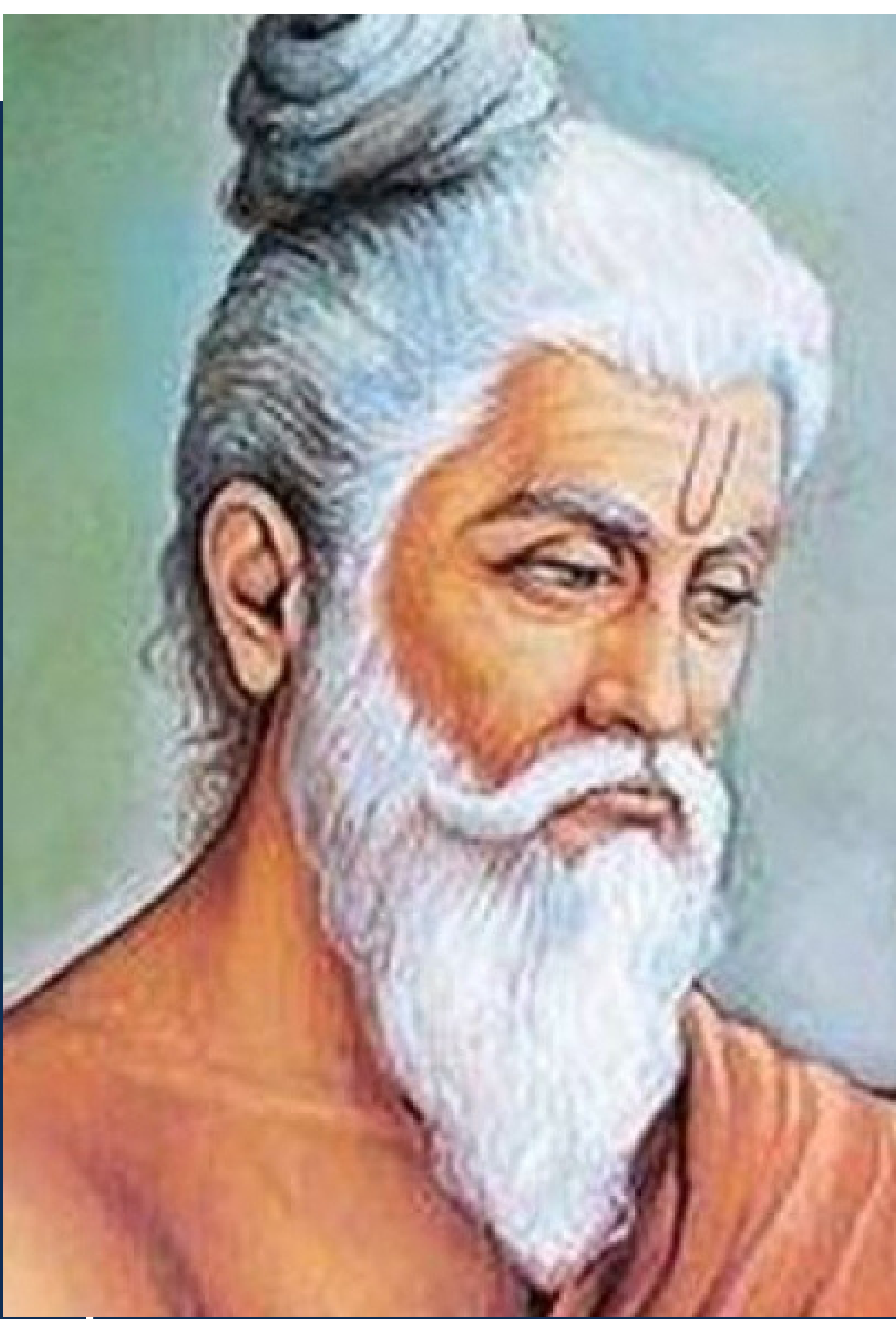
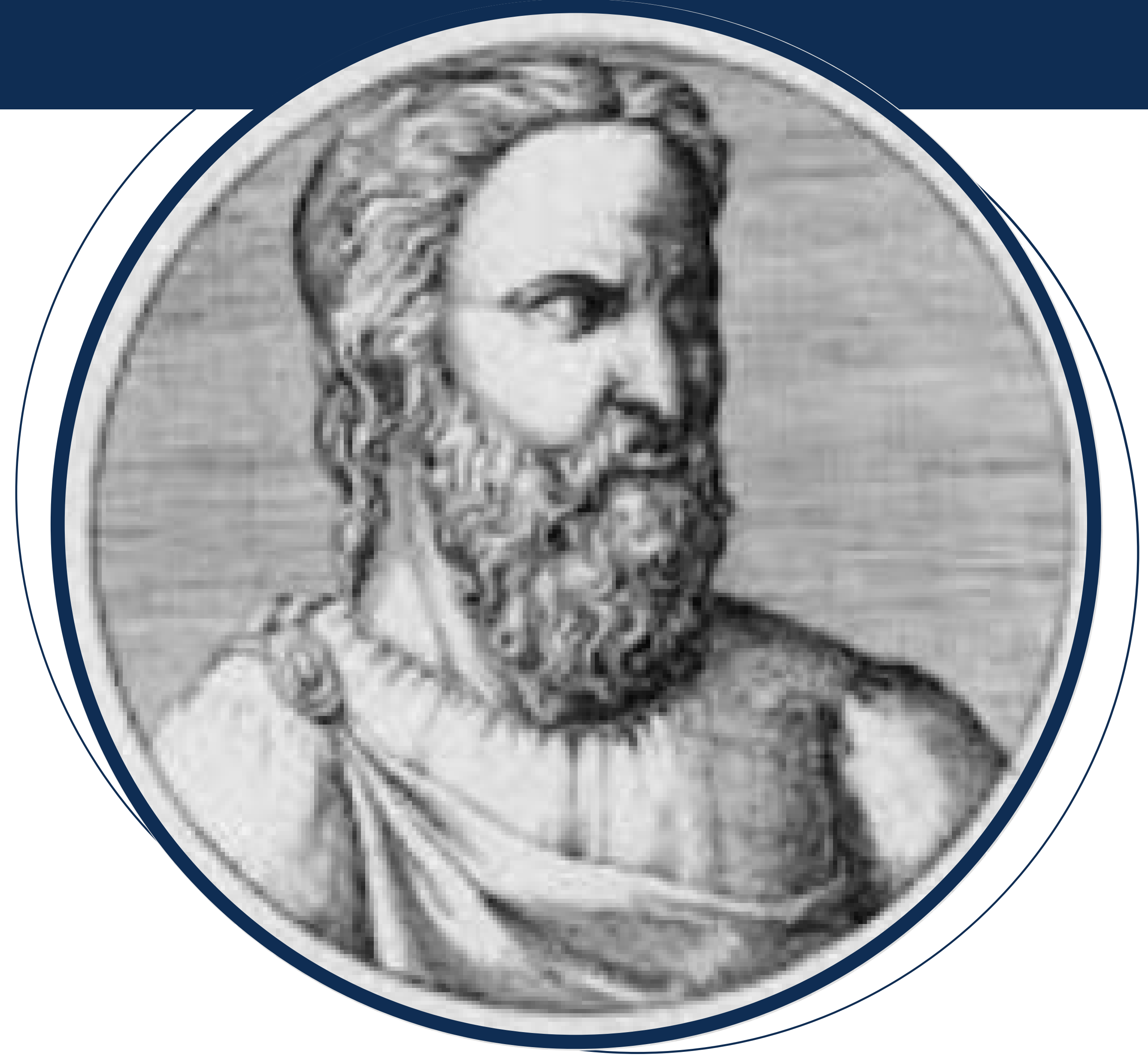
The recommended treatment lasted for four days and included a liquid layer of bones, wheat, grass and earth.



# ARATEUS OF CAPADOCIA

(2nd century AD)

**Arateus of Capadocia** used for the first time the term diabetes, originating from a Greek word, meaning "to pass through", "to cross". It defines the complete clinical picture as we know it today.



# SUSRUTA & CHARUKA

(5th-6th century AD)

The association of polyuria and sweet urine was first described in the Sanskrit literature between the 5th and 6th century by two notable Indian physicians, **Susruta** and **Charuka**.

The urine of patients was described, for the first time, as tasting of honey.

There were two types of diabetes. One affected middle-aged people and the other thin people. The latter usually evolved quickly towards death.





# AVICENNA

(960-1037)

**Avicenna** wrote a vast medical encyclopedia. He provided a detailed account of diabetes in his writings, mentioning two complications of the disease, gangrene and the collapse of sexual function.

He recommended treatment with lupine (still used today) and other seeds - a mixture that has a mild hypoglycaemic action.

# PARACELSUS

(1493-1541)

**Paracelsus** was a Swiss physician who reported the existence of an abnormal substance that remained as a residue after evaporation in the urine of people living with diabetes.

However, he claimed that this substance was a salt and that diabetes was due to the deposit of this salt in the kidneys causing thirst and polyuria.

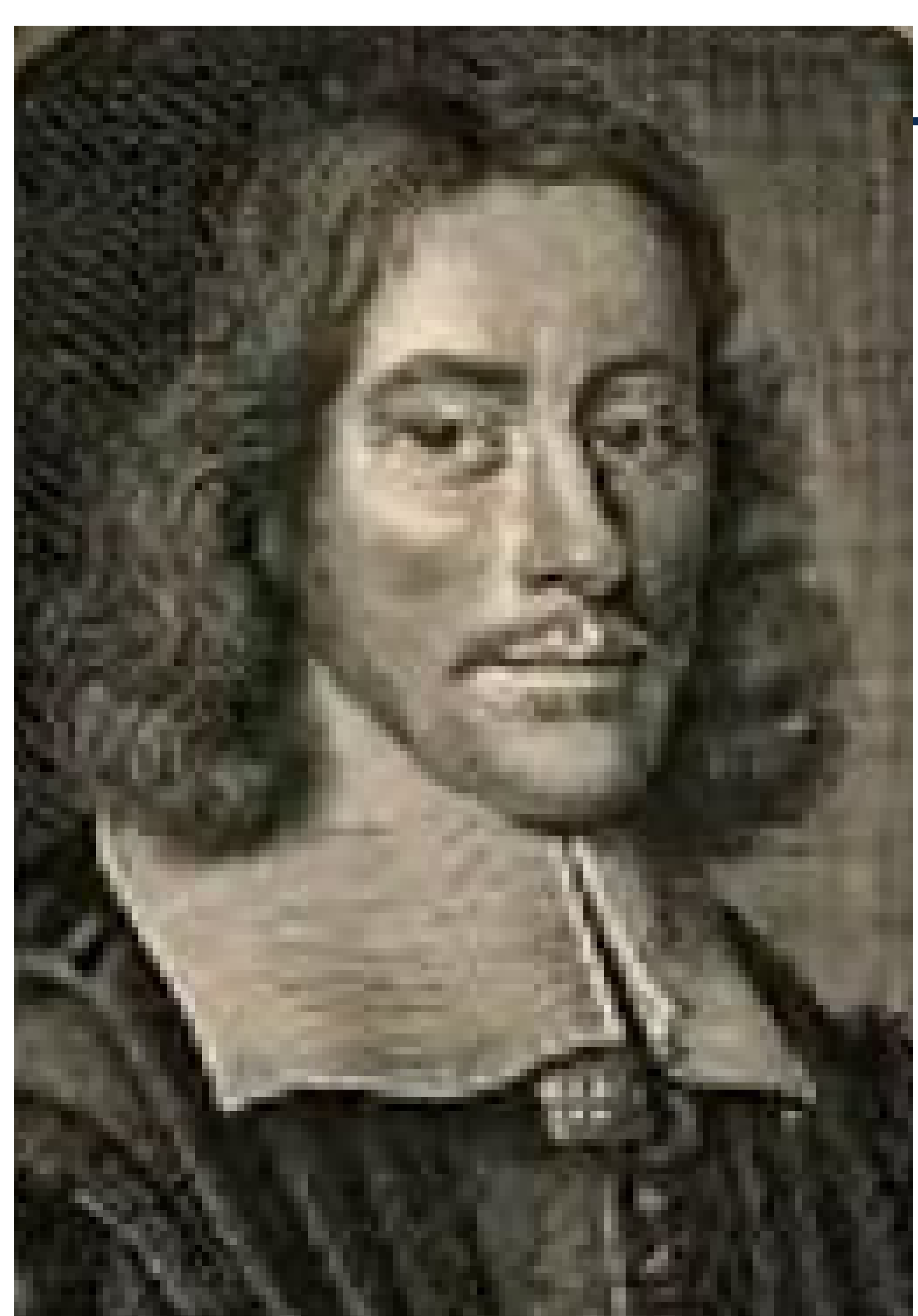


# THOMAS WILLIS

(1621-1675)

The sweet taste of urine is mentioned again in the writings of Thomas Willis in the 17th century. Willis made several observations about diabetes that are still current. He found a cluster of ants near the basin in which a patient he was visiting had recently urinated. Intrigued, he tasted the urine, found it tasted sweet and reported the finding to the British Academy of Sciences.

From that time on, it became mandatory to test urine as part of the clinical examination and some doctors began to be accompanied by tasters.





# MATTHEW DOBSON

(1735-1784)

**Matthew Dobson**, a physician, philosopher and physiologist from Liverpool, treated nine people living with diabetes and published the results of his experiments in 1776.

He demonstrated that in the blood, as well as in the urine of these people, there was a substance with a sweet taste.

He proved that this substance was sugar and concluded that it already existed in the blood before it formed in the kidneys.

This was the first demonstration that diabetes is a systemic disease and not a kidney disease.



# JOHN ROLLO

(1809)

In England, **John Rollo** achieved some therapeutic successes by treating people living with diabetes with low-carbohydrate diets and appetite-moderating products.

Rollo became known as the first, or certainly one of the first, to prescribe diets for people living with diabetes.

# CLAUDE BERNARD

(1813 - 1879)

**Claude Bernard**, a French physiologist, was the author of numerous discoveries that contributed to the understanding of diabetes in his time, such as the observation that the sugar that appears in the urine was stored in the liver in the form of glycogen. This showed that the central nervous system is involved in the regulation of blood glucose.

He conducted numerous experiments. However, he did not manage to attribute endocrine functions to the pancreas.







## PAUL LANGERHANS

(1847 - 1888)

**Paul Langerhans** first described a cluster of cells and isolated them from the rest of the exocrine and ductal tissue. However, he did not establish the relationship of these cells with diabetes. Only in 1893 did Edouard Laguesse (1861-1927) suggest that this group of cells he called Islets of Langerhans constituted the endocrine tissue of the pancreas.

In 1909, Jean de Meyer, a Belgian doctor called the hormone that lowered glucose - Insulin (from the Latin insula, island), whose existence until that point was just a hypothesis.

## MINKOWSKY & VON MERING

(1858-1931)

(1849-1908)



The hypoglycaemic properties of the pancreas were clearly demonstrated by **Oskar Minkowsky** and **Josef Von Mering**. They demonstrated that when removing a dog's pancreas, they reproduced diabetes.

They established a direct relationship between the pancreas and diabetes and tried to isolate the active ingredient as a basis for their treatment.



## APOLLINAIRE BOUCHARDAT

(1809-1886)

While in Paris, a city then besieged by the Germans, **Apollinaire Bouchardat**, noticed that food rationing led to the disappearance of glycosuria in some people living with diabetes and that physical exercise also appeared to have a positive effect.

He advanced the idea of reducing food intake for people living with diabetes.



# THE BEGINNING OF THE 20th CENTURY

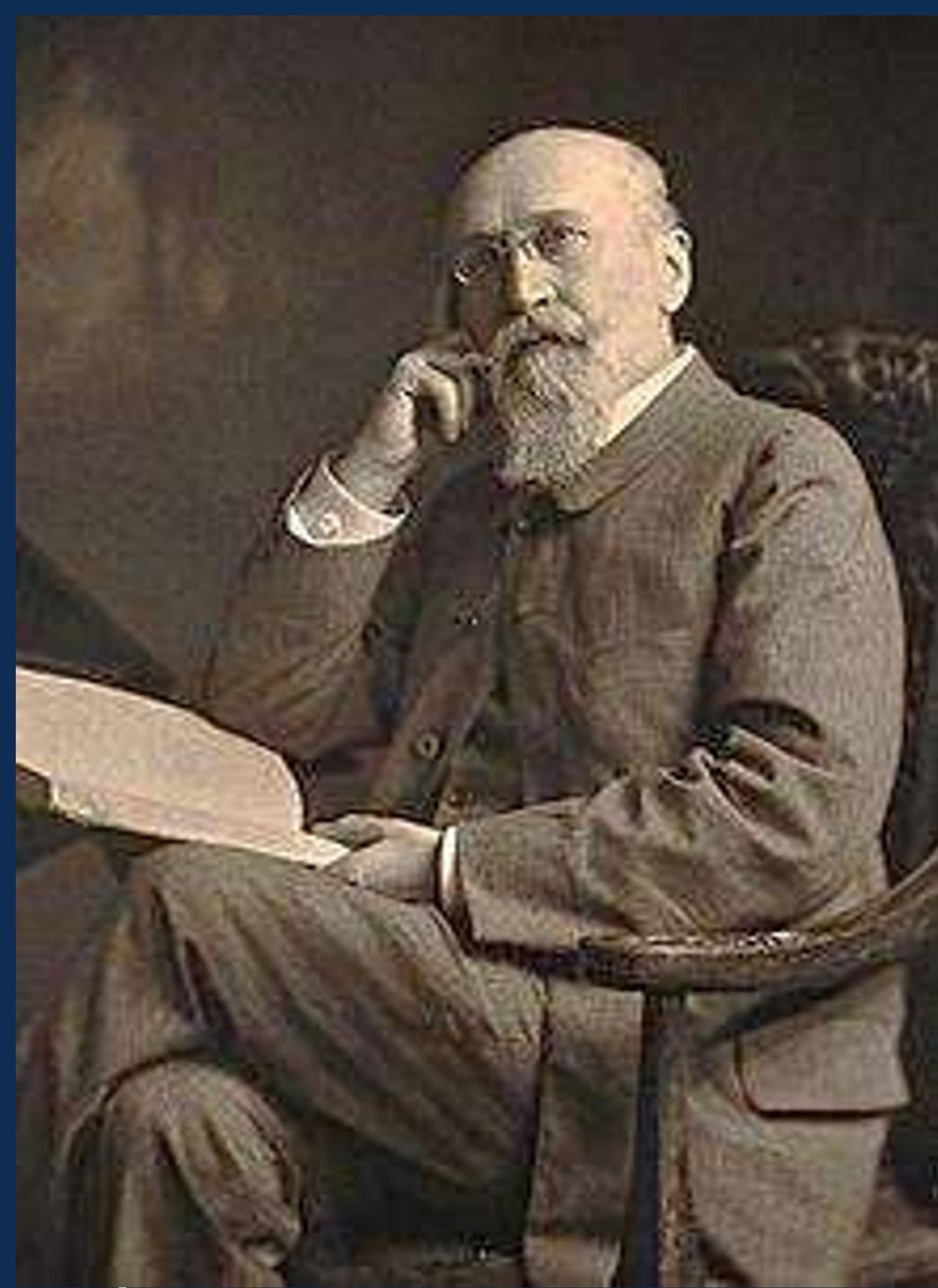
## AND THE DISCOVERY OF INSULIN

### EUGÈNE GLEY

(1857-1930)

**Eugène Gley** was a French physiologist and endocrinologist.

In 1905, he sent a document to the Secretariat of the Society of Biology (Paris) dated February 20 and titled "Sur la Sécrétion Interne du Pancréas et Son Utilisation Thérapeutique".



SUR LA SÉCRÉTION INTERNE DU PANCRÉAS  
ET SON UTILISATION THÉRAPEUTIQUE,  
par E. GLEY.

Il résulte d'une série de publications récentes que J.-J.-R. Macleod (de Toronto) a démontré, avec plusieurs collaborateurs, la présence « in extracts of degenerated and fetal pancreas » d'une substance qui a la propriété de diminuer l'hyperglycémie des Chiens auxquels on a enlevé le pancréas et d'augmenter la tolérance de ces animaux pour les hydrates de carbone ; les mêmes extraits, injectés sous la peau, diminuent le sucre du sang chez le Lapin normal (1) et, sur le même animal, diminuent l'hyperglycémie expérimentale, que celle-ci ait été provoquée par la piqûre du 4<sup>e</sup> ventricule ou par l'adrénaline ou par l'asphyxie (2).

Au cours des recherches que j'ai poursuivies autrefois sur le diabète pancréatique du Chien (3), j'ai essayé contre ce diabète l'action de divers extraits préparés avec le pancréas ou de sang défibriné ayant circulé dans le pancréas et recueilli par une veine pancréatique (4). Le peu d'effet de ces préparations m'avait rationnellement amené à l'emploi d'un extrait provenant d'un pancréas réduit à sa partie endocrine. Comme j'ai eu l'occasion de le dire à la Société en 1906, « dans un pli cacheté déposé à la Société de biologie en février 1905, j'ai donné le principe de cette méthode et indiqué les résultats généraux obtenus par son application sur le Chien. » C'est de ce pli cacheté que je demande l'ouverture et la publication.

SUR LA SÉCRÉTION INTERNE DU PANCRÉAS  
ET SON UTILISATION THÉRAPEUTIQUE,

SÉANCE DU 23 DÉCEMBRE

1323

pancréas *in situ*, on n'arrive à supprimer que le pancréas digestif. Les animaux opérés ne deviennent pas diabétiques; c'est donc que la glande continue à exercer son influence sur les matériaux sucrés de l'organisme.

On sait que la glande dans laquelle il a été injecté une matière étrangère, graisse ou autre, comme je l'ai fait à la suite de Cl. Bernard, et comme d'autres l'ont fait après moi, s'atrophie rapidement et se sclérose ; elle est bientôt réduite à une sorte de cordon fibreux. Néanmoins des éléments cellulaires y persistent et déversent régulièrement dans le sang le principe grâce auquel se fait d'une façon normale l'utilisation de la glycose. On peut penser, depuis les recherches de Laguesse surtout, que ce sont les îlots de Langerhans qui fonctionnent ainsi.

D'autre part, les essais, pratiqués jusqu'à présent, de traitement du diabète pancréatique expérimental par diverses préparations ou extraits de pancréas, n'ont donné que des résultats nuls ou incertains. Ces insuccès peuvent tenir à bien des causes, mais il est permis de supposer que l'injection à un animal diabétique de l'extrait de toute une glande complexe ne saurait donner les résultats de l'injection de la partie seule de la glande qui régit le métabolisme de la glycose.

J'ai cherché si le pancréas sclérosé, mais fonctionnant néanmoins encore, préparé dans les conditions ci-dessus rappelées, ne fournirait pas le principe actif qu'il continue à produire. En effet, l'extrait, injecté à des Chiens rendus préalablement diabétiques par l'extirpation totale du pancréas, diminué considérablement la quantité de sucre éliminée par ces animaux. En même temps s'amendent tous les caractères du diabète. Des recherches plus complètes me permettront sans doute de déterminer les conditions d'action de ces extraits.

D'autre part, il importera d'essayer d'isoler le principe actif de ces extraits, c'est-à-dire de la sécrétion interne du pancréas et

In this article, Gley described the results of his trials begun in 1890 as "extracts of degenerated pancreas" obtained by occluding the excretory ducts of the gland.

Intravenous injections of these extracts reduced the urinary excretion of pancreatectomized dogs, improving their clinical condition.



# GEORG LUDWIG ZUELZER

(1870-1949)

**Georg Ludwig Zuelzer** was a German physician.

In 1907, Zuelzer produced extracts of equine, bovine and pig pancreas.

Zuelzer administered the extract to animals with experimental diabetes and to people with diabetes. He observed a considerable decrease in glycosuria in the treated cases, although with frequent occurrences of side effects (fever, sweating, vomiting, stomatitis, muscular hypertonia).



*“First to produce, successfully, from the pancreas a preparation that eliminates sugar excretion in a shorter or longer period by IV administration”.*

Forschbach J. Dtsch. Med. Wschr. 1909; 35: 2053-2055.

(400 g Fleisch täglich) aus:

am 18. 8.	. . .	31,5 g		
19. 8.	. . .	26,0 „		
20. 8.	. . .	28,5 „		
21. 8.	. . .	30,0 „		
22. 8.	. . .	22,3 „	durchschnittlich also 28,6 g Zucker pro die.	
am 23. 8.	. . .	24,0 g	} täglich wurden 5 com = 1 g Pankreasextrakt intravenös injicirt.	
24. 8.	. . .	17,0 „		
25. 8.	. . .	21,0 „		
26. 8.	. . .	14,0 „		= pro Tag 19 g durchschnittlich.
am 27. 8.	. . .	19,0 g	} Nachperiode.	
28. 8.	. . .	23,0 „		
29. 8.	. . .	26,0 „		
30. 8.	unvollständig.			

The table shows a more than 30% reduction in daily glucose excretion in a pancreatectomized dog after administration of a single 1gm intravenous dose of pancreatic extract.

## CASE 3

(June 1907)

	Menge	Zucker	Aceton	Acetossigsäure		Menge	Zucker	Aceton	Acetossigsäure
14. 7.	2250	4,4 pCt.	+	+	29. 7.	2160	3,4 pCt.	+	+
15. 7.	1600	2,8 „	+	—	30. 7.	2670	3,2 „	+	+
16. 7.	2150	2,6 „	ganz schwach		31. 7.	1890	3,8 „	+	+
17. 7.	2350	2,6 „	—	—	1. 8.	1310	— „	+	+
18. 7.	3600	3,6 „	+	+	2. 8.	2850	2,2 „	schwach	schwach
19. 7.	2940	5,0 „	+	+	3. 8.	2050	1,8 „	ganz gering	
20. 7.	2220	4,4 „	+	+	4. 8.	1850	2,4 „	+	+
					5. 8.	2100	2,2 „	+	+

Disappearance of glycosuria and ketonuria in a six-year-old child with severe diabetes.



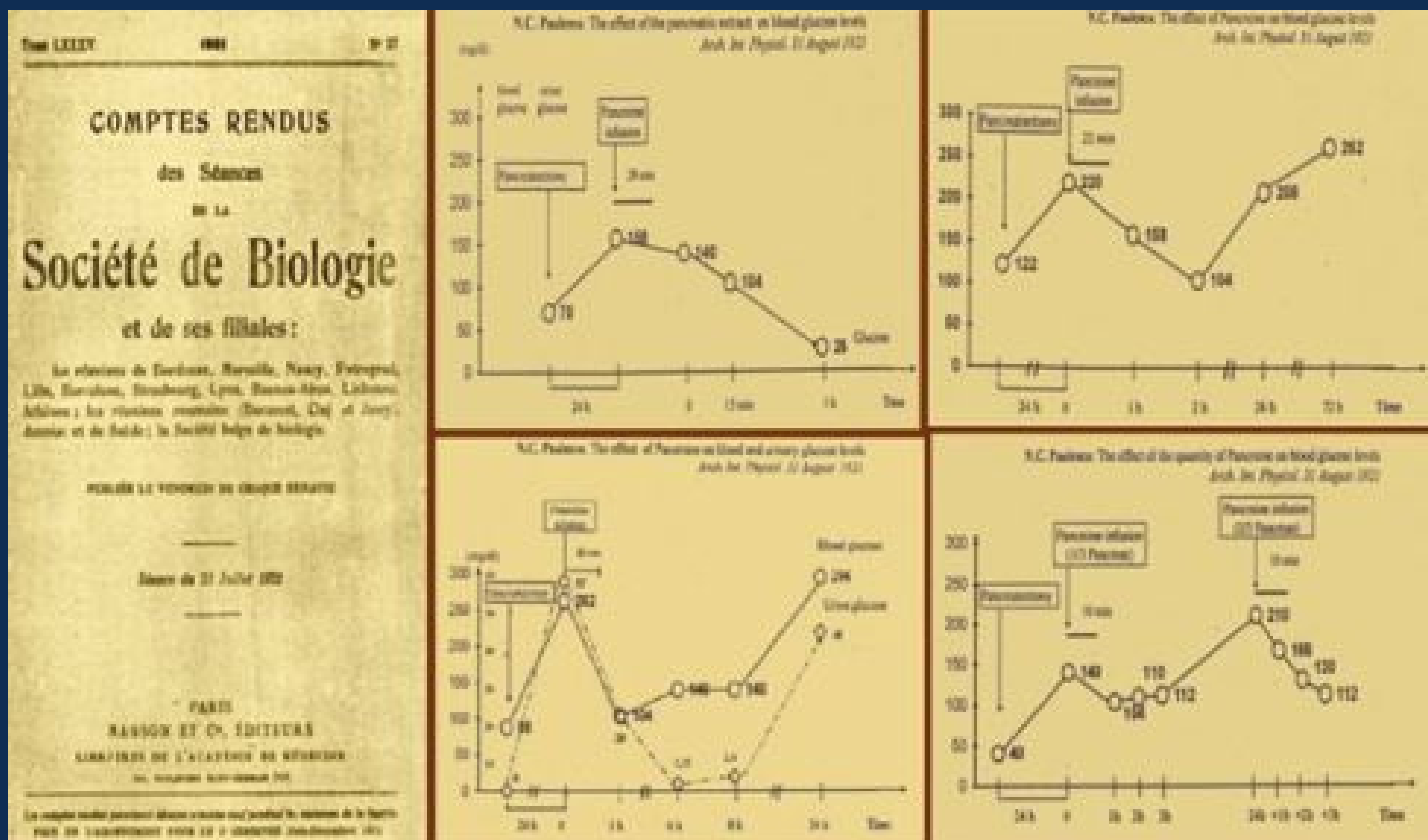
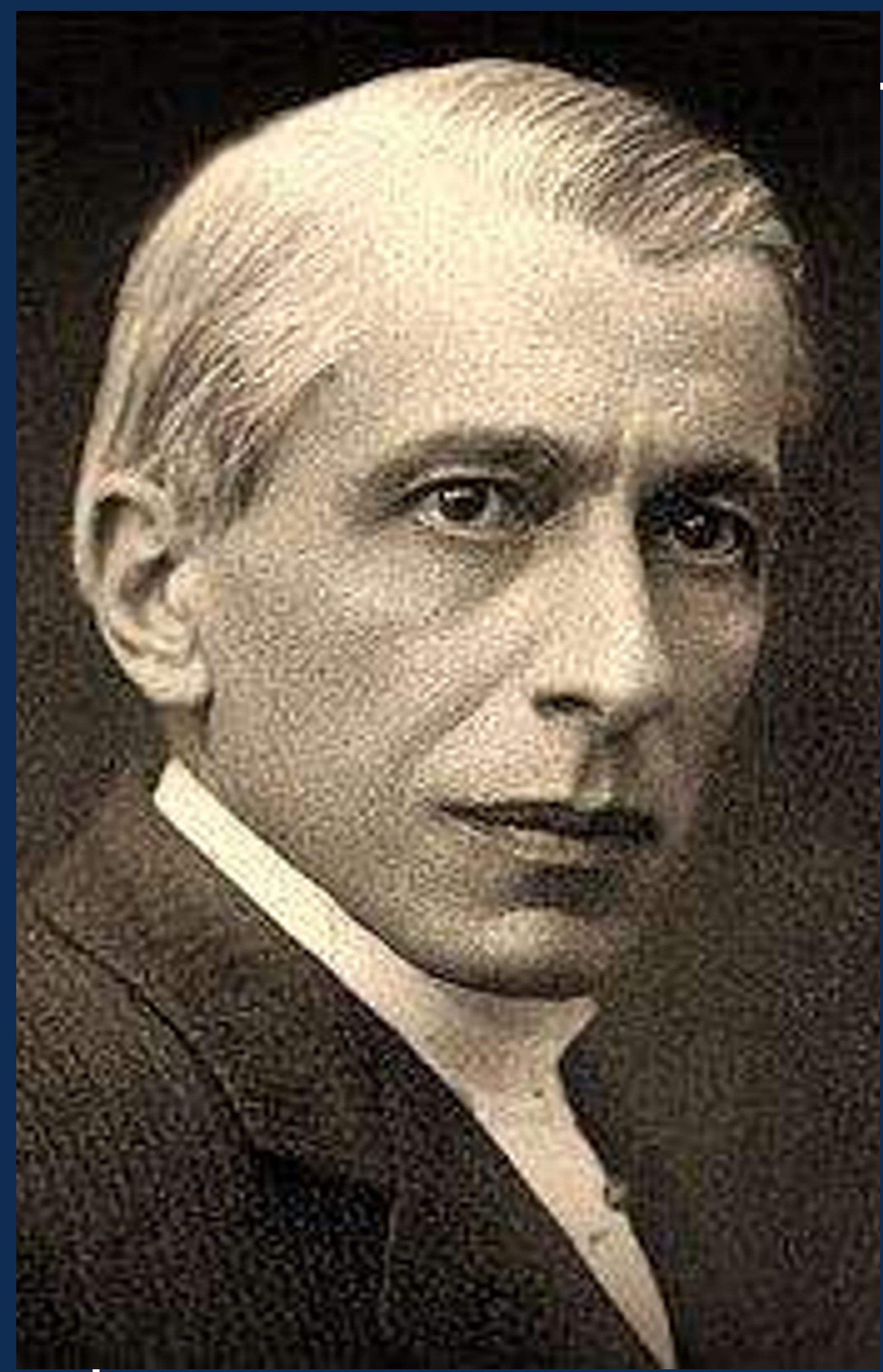
# NICOLAE PAULESCU

(1869-1931)

**Nicolae Paulescu** was a Romanian scientist who claimed to have been the first person to discover insulin, which he called pancreine.

When F. Banting and J.J. R. Macleod were awarded the Nobel Prize for Physiology and Medicine for creating usable insulin in 1922, Paulescu wrote to the Nobel Prize committee claiming that he had discovered and used insulin first.

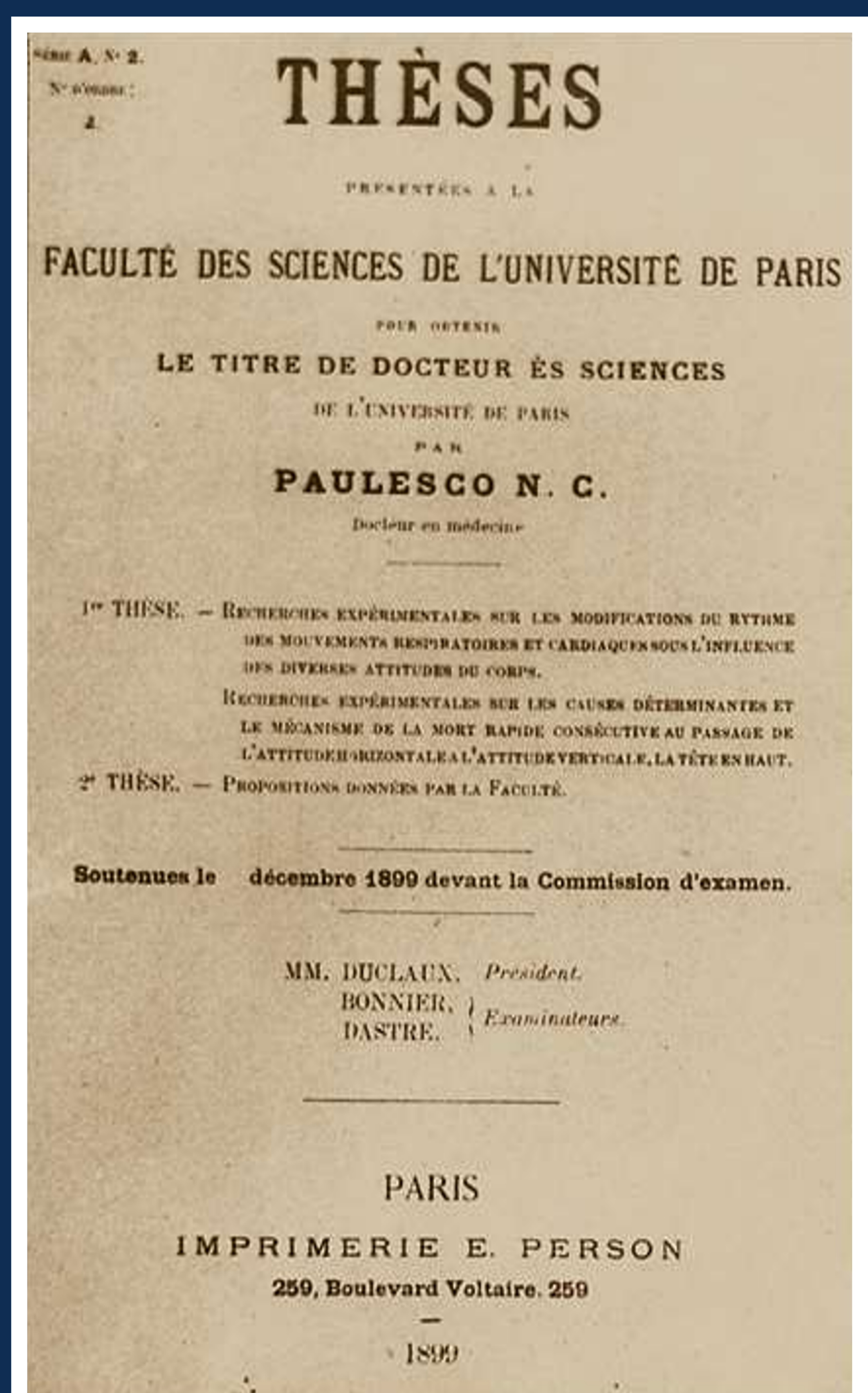
His claims were rejected, but thanks to a British professor called Ian Murray, the significance of Paulescu's achievements are now recognised in the history of insulin.



In 1916, after studying the pancreatotomy in dogs, Paulescu concluded that the injection of aqueous solution of pancreatic extract allowed an improvement in experimentally induced diabetes.

However, the First World War, blocked Paulescu's studies, which he was only able to resume in 1920 with new experiments whose results were published in 1921 in the journal "Archives Internationales de Physiologie."

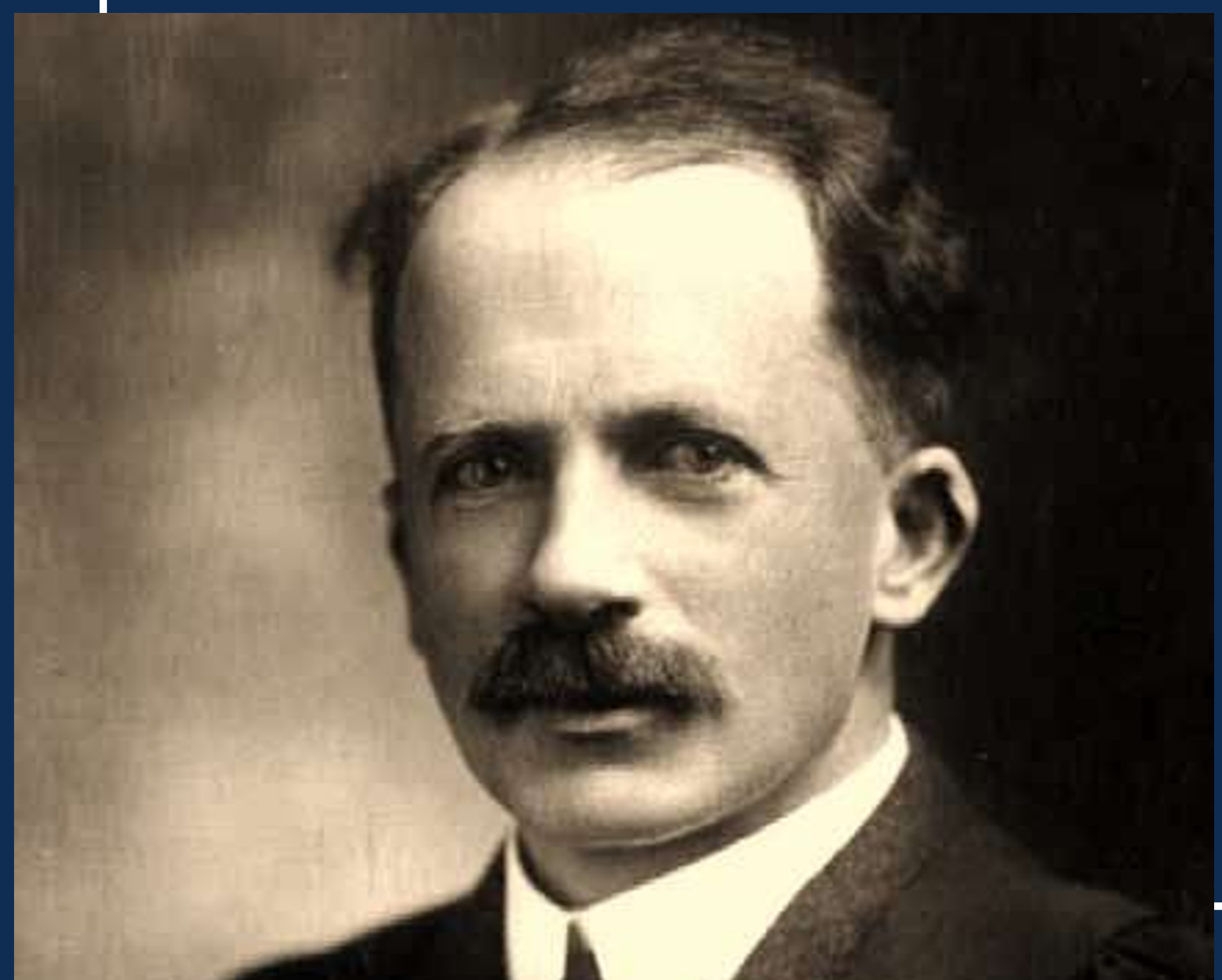
During an experiment, Paulescu removed a dog's pancreas without ligating the excretory ducts. He then emulsified the pancreatic tissue and injected it into the jugular vein of the pancreatized dog. Through this process, the Romanian physician demonstrated that the extract from the pancreas contained some substances capable of acting with an anti-diabetic effect.





# FREDERICK GRANT BANTING

(1891-1941)



&

# PROF. JOHN JAMES RICKARD MACLEOD

(1876-1935)

In 1920 **Frederick Grant Banting** was a surgeon in a floundering practice in London, Ontario, Canada.

As a demonstrator in the local medical school, Banting was preparing a lecture about the function of the pancreas on October 30, 1920. He stopped at the medical school library, where he picked up the latest issue of Surgery, Gynecology and Obstetrics, and read an article titled “The Relation of the Islets of Langerhans to Diabetes, with Special Reference to Cases of Pancreatic Lithiasis.”

While thinking about pancreatic secretions after reading the article, Banting jotted down an idea for a preliminary experiment to further investigate the relationship between pancreatic secretions and diabetes. On November 7, following the advice of a colleague, Banting brought his idea to the attention of **John James Rickard Macleod**, a Scottish physiologist and expert in carbohydrate metabolism at the University of Toronto.

Macleod decided to give him lab space, an assistant (Best), and some laboratory dogs for two months at the end of the academic year.



**Charles Herbert Best**  
(1899-1978)

Banting’s idea on October 30 involved the ligation of the pancreatic ducts of a dog and the extraction and isolation of whatever secretions were produced after the atrophy of the acini cells.

After an early summer with many setbacks and failures, in early August, the team reported that they had managed to keep a decompensated diabetic dog alive with injections of an extract made from pancreas prepared in saline solution, according to Macleod's instructions.

Amazingly, this extract dramatically lowered the blood sugar levels of experimental diabetic dogs.





## JAMES COLLIP

(1892-1965)

In late 1921, Macleod invited **James Bertram Collip**, a biochemist from the Department of Physiology at the University of Toronto, to assist Banting and Best in purifying their extract.

As the experimental pace accelerated, Banting and Best needed large amounts of their extract, and Collip began to work on purifying the extract for clinical trials in humans.

## BANTING & BEST

with the dog Majoire

Dogs were used as experimental subjects.

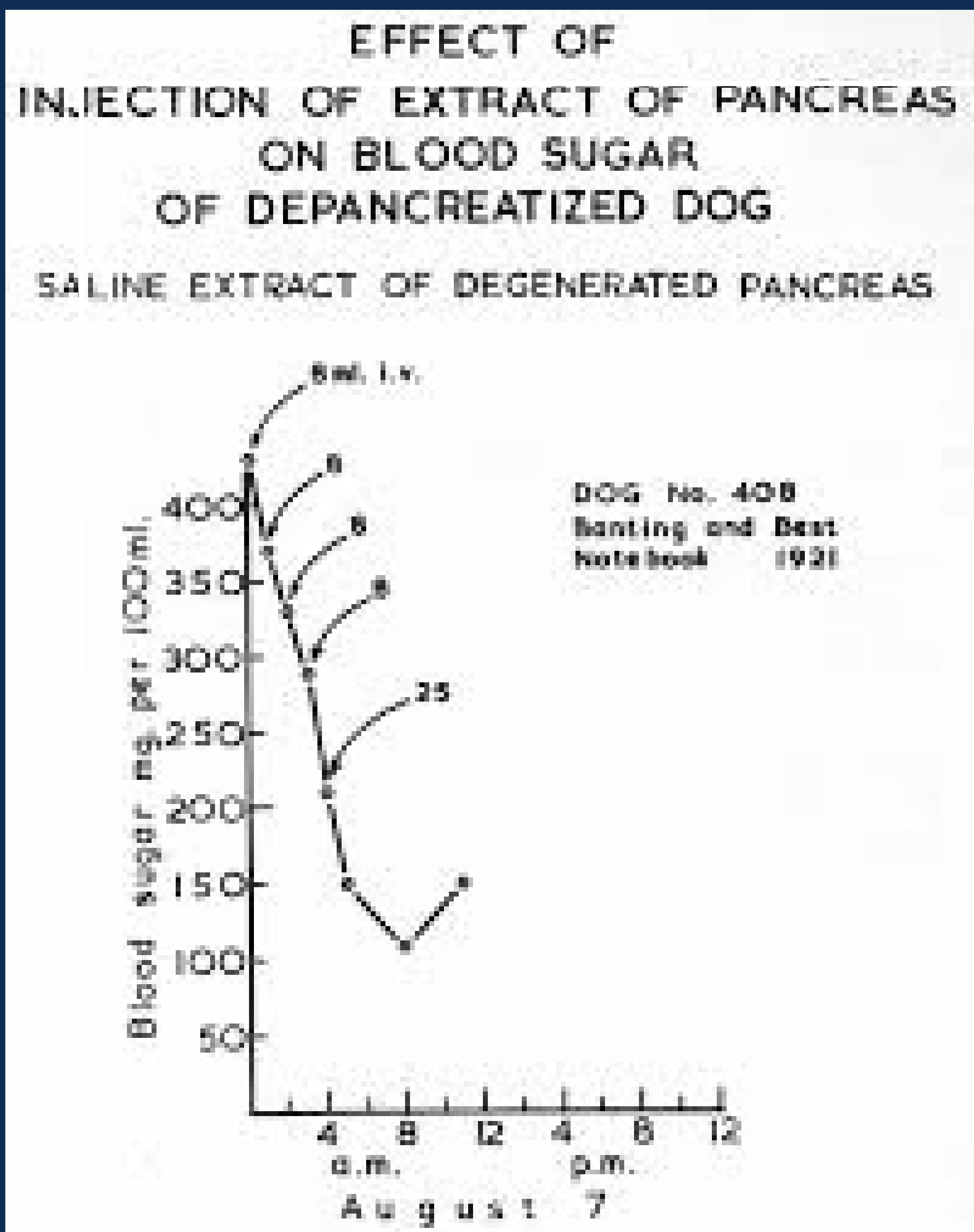
On December 30, 1921, Macleod, Banting and Best presented their findings at the American Physiological Society conference at Yale University.



Banting, out of nervousness and inexperience, gave a poor presentation and the audience reacted critically to the findings presented. Macleod, as chair of the session, stepped into the discussion in an attempt to prevent negative comments towards Banting.

After this fiasco, Banting became increasingly convinced that Macleod wanted to steal his and Best's credits, and the relationship between the two began to deteriorate.





It was Best's quick intervention that stopped Banting from attacking Collip. Fortunately for the future of insulin, a deal made a few days later allowed them to continue working together.

At the same time, as Banting grew increasingly bitter towards Macleod, he set Best against Collip in the race to purify the extract.

In early January, Collip visited Banting and Best's laboratory to inform the two that he had discovered a method to produce a pure extract, and that he was going to share it with Macleod only.

*5:30 PM dog on food commenced  
Aug 7 - 12 midnight (Aug 6-7th)  
Blood sugar - .43  
Vol. urine from 2 PM till  
12 midnight - 175 cc.  
(The last 100 cc being catheter specimen  
separate sugar determined)  
.10 hour total sugar - 3.36  
" " Nitrogen - 1.20  
g : N ratio 2.8*

*① 8 cc Salicin given  
1 PM - Blood sugar - .37  
no urine obtained by catheter  
dog about same - stands up and  
walks about. Has not vomited  
since yesterday aft.*

*② 8 cc Salicin given.  
2 AM - Blood sugar .33  
③ 8 cc Salicin  
3 AM - Blood sugar .29  
④ 8 cc Salicin given  
4 PM - Blood sugar .21*

## LEONARD THOMPSON

The first person to be successfully treated with insulin

On January 11, 1922, at Toronto General Hospital (TGH), **Leonard Thompson**, a 14-year-old person living with diabetes, was given a pancreatic extract made by Banting and Best that incorporated some of Collip's improvements. The extract failed to produce significant results and was discontinued.



Toward the end of January, Collip had discovered a method to produce an extract whose purity far exceeded that of previous attempts.

After the subcutaneous administration of 7.5 cc of the extract into each buttock, a slight decrease of the heavy glycosuria and a 25% decrease in the blood sugar were observed together with an "aseptical abscess" at one of the injected sites.

Leonard is considered the first patient to be successfully treated with insulin.



Leonard, now recovered, injected an average of 85 units of insulin daily but never managed to have optimal blood glucose levels.

In 1932, he was admitted again at TGH in a diabetic coma and acute bilateral bronchopneumonia. He died on April 20, 1935, at the age of 27. A blood culture post-mortem grew *Staphylococcus aureus*.

Form 20

**Toronto General Hospital**  
 Medica Division 31161

NAME Leonard Thompson HISTORY NUMBER ONLY \_\_\_\_\_  
 Ward H Address 87 Pickering St.  
 Sex M DIAGNOSIS Diabetes mellitus  
 Age 13 Result Improved  
 Married, Single, Widowed \_\_\_\_\_ Complication \_\_\_\_\_  
 Occupation School Complication Result \_\_\_\_\_  
 Birthplace Canada Admitted Dec 2-21  
 Discharged May 15-22  
 HOUSE PHYSICIAN Dr. Jeffrey PHYSICIAN Prof. Graham  
 History of former Admission \_\_\_\_\_  
 Date \_\_\_\_\_ Physician or Surgeon \_\_\_\_\_  
 Division \_\_\_\_\_ DIAGNOSIS \_\_\_\_\_  
 History No. \_\_\_\_\_  
 X Ray No. \_\_\_\_\_  
 Pathological No. \_\_\_\_\_  
 Autopsy No. \_\_\_\_\_  
 Abstracts from Notes \_\_\_\_\_

Particular care is requested to see that Patient's Name is spelled correctly. Diagnosis, Complication and Result, with History of previous admission to be filled in by House Physician.

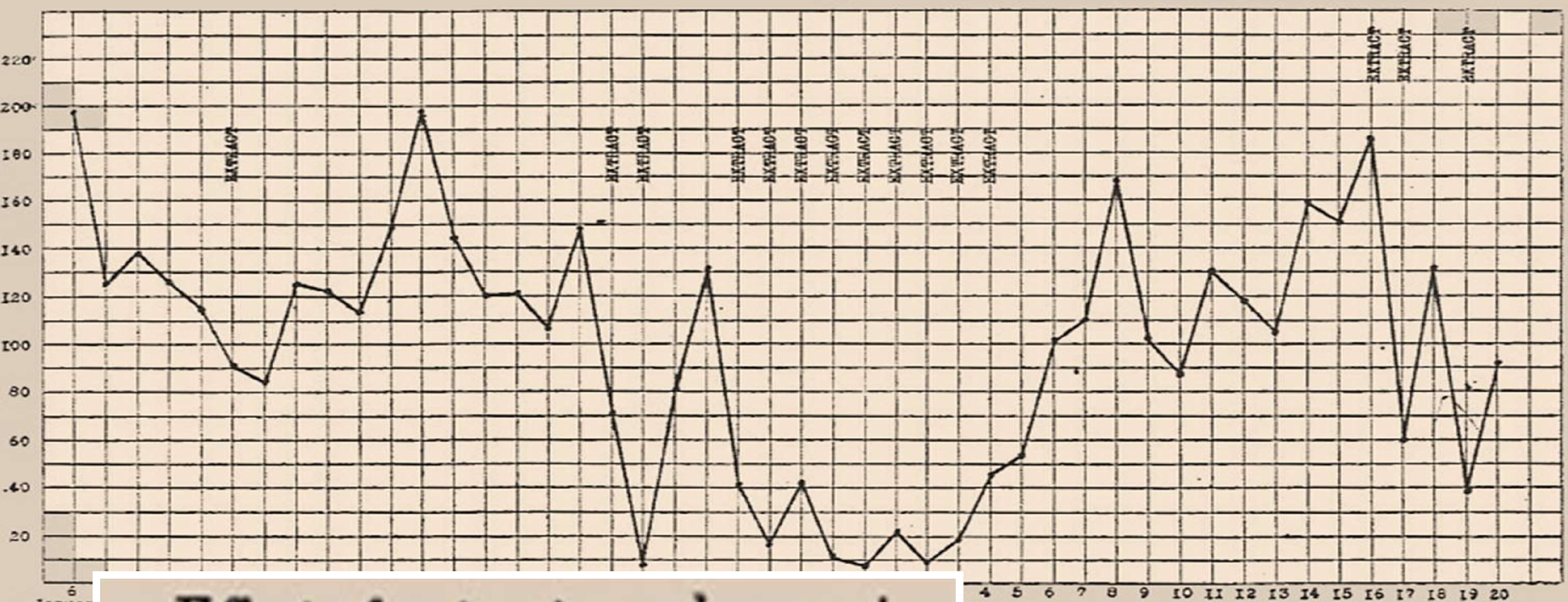
History taken by \_\_\_\_\_

Record of Leonard Thompson's first admission to the TGH at age 13, December 1921.

(Heritage University of Toronto)

On May 3, 1922, Macleod, representing the group at a meeting of the Association of American Physicians, announced to the international medical community that he had discovered "insulin" - the antidiabetic agent.

THE CANADIAN MEDICAL ASSOCIATION JOURNAL

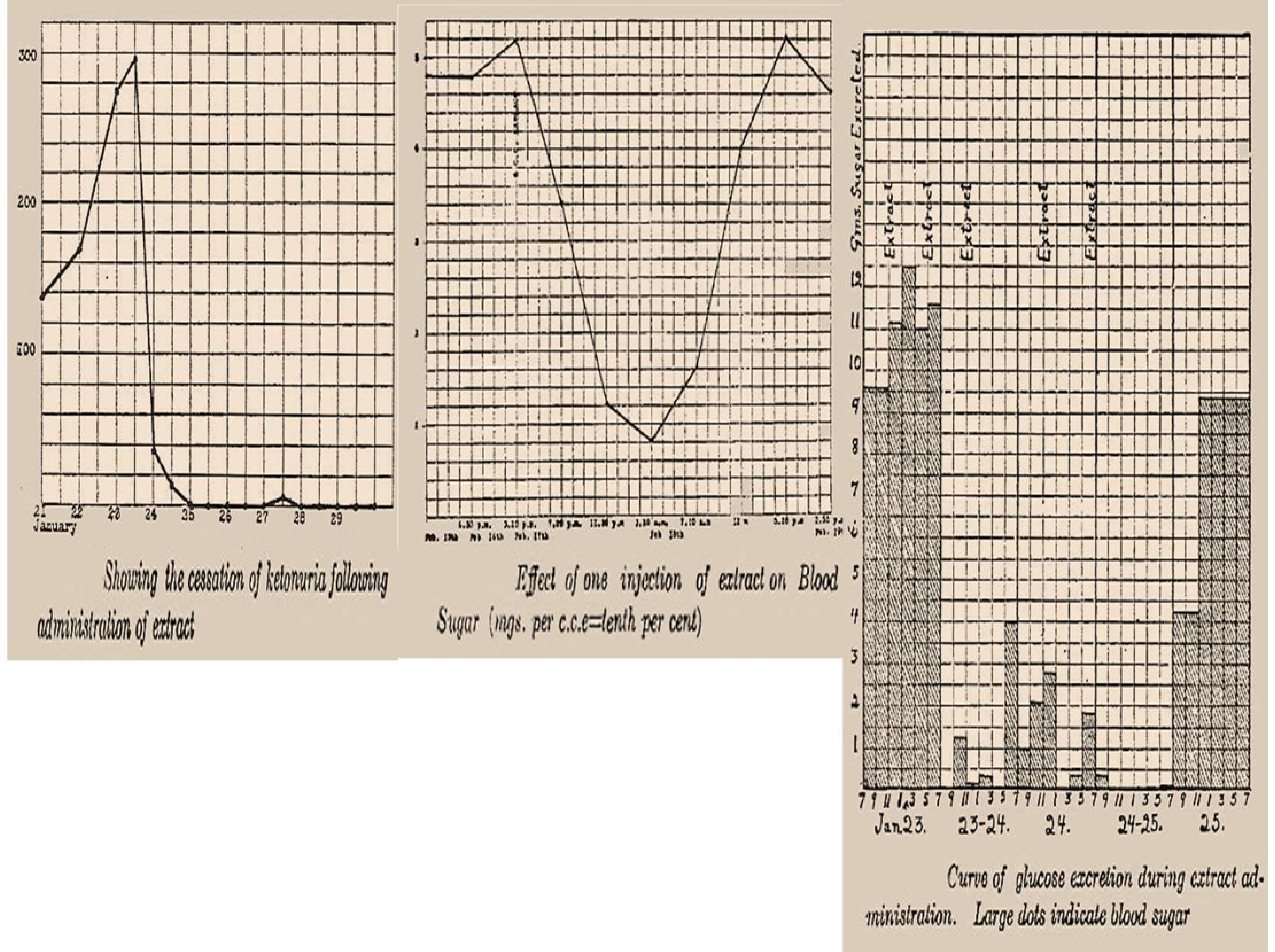


Effect of extract on glycosuria

(Banting FG, Best CH, Collip JB, Campbell WR, and AA Fletcher. Pancreatic extracts in the treatment of Diabetes Mellitus.

The Canadian Medical Association Journal 1922;2:141-146)

THE CANADIAN MEDICAL ASSOCIATION JOURNAL





# TORONTO DOCTORS ON TRACK OF DIABETES CURE

**RAILROAD UNIONS IN U.S. MAY JOIN IN MINERS' STRIKE**

Coal-Diggers Expect Walkout to Be Hundred Per Cent Effective.

**PLANS ARE MATURING**

President Harding May Make a Public Appeal for Conciliation.

**Special to The Star.**

Cleveland, Ohio, March 22.—Possibility that the railroad brotherhood, 2,500,000 strong, may support the 600,000 mine workers ordered to quit work at midnight March 31 was seen here to-day.

This possibility was revealed in the situation from brotherhood officials that "the protective agreement" between miners and brotherhoods "will doubtless receive the sanction of the railroad organizations." The executive board of the United Mine Workers, it was said, already have ratified the agreement.

**Expect Effective Strike.**

Special to The Star.

New York, March 22.—The great coal strike, called for midnight 31, will be one hundred per cent effective, officials of the union workers of America declared today. Reports from the oil and bituminous fields through United States indicate that every one of the 600,000 men obey the order to suspend work.

President John L. Lewis said mine workers who he does here yesterday, believe it will be to rebel movement against the strike. He asserted that the miners would quit work, despite the fact that P.

## DIABETES SUFFERERS GIVEN MESSAGE OF HOPE

Discovery Made at University of Toronto Will Be Means of Prolonging Life Considerably—F. G. Banting and C. H. Best Pushed Experiments All Last Summer.

### BANTING STAKES HIS ALL ON THE RESULT

A message of hope to sufferers from diabetes goes out authoritatively to-day from the medical research laboratories of the University of Toronto. The modesty of medical men and scientific investigators of the genuine bread attempts to minimize the results obtained. The harm of exaggeration and the reliance to both patients and research men in awaiting false and premature hopes before the extracts can possibly be manufactured cannot be over-emphasized. But the fact remains that one of the most important discoveries in modern medical research has been made at the university here. It is not a cure for diabetes, the authors state. Within six months, however, their discovery will be used on a large scale, they hope, to prolong life quite considerably at least. There will be no surgery, as from the beginning. The medical profession will know all the facts.

Most significant of all the statements in the article issued by the experimenters to the Canadian Medical Association Journal is the little sentence: "The effects observed in the pancreatic animals have been paralleled in man." An active man

Prof. J. J. R. Macleod, an investigator from diabetes goes out authoritatively for over 15 years, that every opportunity was given to the young doctor from London to push on his experiments. As the best man to assist Dr. Banting, Prof. Macleod chose Charles H. Best, a clever young graduate in the physiology and biochemistry course, who celebrated his twenty-third birthday a few days ago. Together they concentrated upon the problem in hand.

Work on the new hypothesis began in May. All through the best of the summer the two young men, soon fast friends, pushed their experiments night and day. Both had served overseas. They had this in common too, and they often slept beside their work.

Everything that Banting possessed in the world he staked on the result. He had just been appointed to a junior position in surgery and an assistant in general pathology at the University in London, Ontario, when he got his idea while reading an article dealing with the islets of Langerhans, a peculiar group of the pancreas to which no definite function had been proved up to that time. Banting had won the licentiate of the Royal College of Physicians and his membership in the Royal College of Surgeons overseas, and was not

## "DRY" LAWS HERE CAUSE HARDSHIP IN OLD FRANCE

French Government Anxious for New Trade Agreement With Canada.

### HOME FOR STUDENTS

Opportunity for Our Lumbermen, Says Philippe Roy, the Commissioner.

Special to The Star.

Ottawa, March 22.—"Prohibition in the majority of the provinces of Canada, in the United States, the closing of the Russian market, and high import duties on wine into Great Britain have, all combined, caused hardship among the peasants and vine growers of France," declared Philippe Roy, commissioner-general for Canada in France, who arrived in Ottawa yesterday to make a personal report to the prime minister.

Those connected with the vast french wine industry can understand why people in other countries should desire themselves of alcohol, but it is beyond their comprehension why anyone should want to do without wine, stated Mr. Roy.

Mr. Roy says the French people and government are anxious to

## RESERVES OF COAL ARE HIGH IN CITY, PRICE TO GO DOWN

After Strike Trouble Prominent Dealers Looks for a Decline.

### SHUT DOWN IN WEST

Canadian Diggers to Go On Strike With the United States Unions.

Between six and seven thousand coal miners in western Canada are involved in the order to cease work on April 1st, sent out by the heads of the United Mine Workers' Federation, then judging by the statements of railway officials and coal dealers to close touch with the situation. The general impression seems to be that on April 1st the mines in western Canada where the members of the United Mine Workers are employed will shut down. It may be that both work and representatives of the department of labor are in the western coal fields investigating the situation now.

It is stated that Toronto industries have a soft coal reserve which will carry them over six weeks and as a result of the dispute hard coal will be cheaper. The railways have reserves to carry on business for a considerable period.

Col. C. B. Marshall, president of the Standard Fuel Company, states that Toronto industries generally speaking "have reserves supplies of soft coal enough to carry them over six weeks if a strike occurs in the coal regions." In addition, the coal pits cut there are many independent "retail operators in the soft coal region, whose mines will continue to operate even in the event of a strike. "There is no cause for anxiety as far as the soft coal is



**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 15th last, that the U. of T. has made a discovery of the greatest importance. Dr. P. D. Banting, on the 11th, a young man of 30, a creditable student at Toronto University in 1915, brought his hypothesis at the head of

## CIVIL WAR STAGE NOT YET REACHED, BUT DANGER GREAT

People on Both Sides of Ulster Border Apprehend an Attack.

### NERVES ALL ON EDGE

No Real Massing of Troops Yet, But Many Harming Raids.

### Imperials May Separate Irish

Associated Press Dispatch.

London, March 22.—The British government may have to consider whether it will be possible to draw a cordon of imperial troops between the warring elements on the Ulster frontier, Whitehall secretary stated in the House of Commons to-day.

By WILLIAM B. BRAYDEN, Special Cable to The Toronto Star and the Chicago Daily News.

Dublin, March 22.—Along the 200 miles of border between the northern and southern Ireland practically the whole of the population on each side apprehends an attack from the other. Though the newspapers talk of civil war, the republic has not yet reached that dimension. There is no massing of troops, but many small harrying raids are occurring in widely separated districts, keeping everybody's nerves on edge.

There is a conflict of testimony as regards the fact, but there have been considerable raids up to the north-western corner of the republic.

**PROCEEDINGS AND TRANSACTIONS OF THE ROYAL SOCIETY OF CANADA**

THIRD SERIES—VOLUME XVI

MEETING OF MAY, 1922

Communication of the discovery of insulin by Macleod, on behalf of the UT Research Group, presented to the Association of American Physicians.

(Washington, D.C., 3th May, 1922)

Canadian Patent 234336  
(University of Toronto)

## Canadian Intellectual Property Office

Home > Canadian Patent Database > Number Search > Patent Summary

### Canadian Patents Database / Patent 234336 Summary

- ▶ Third-party information liability
- ▶ Claims and Abstract availability

<b>(12) Patent:</b>	<b>(11) CA 234336</b>
<b>(21) Application Number:</b>	234336
<b>(54) English Title:</b>	EXTRACT OBTAINABLE FROM THE MAMMALIAN PANCREAS OR FROM RELATED GLANDS OF FISHES
<b>(54) French Title:</b>	EXTRAIT DE PANCREAS OU AUTRES GLANDES DE POISSONS MAMMIFERES



During the first months of 1922, the method of concentration of insulin by adsorption on benzoic acid developed at Connaught Laboratories (University of Toronto), provided insulin to patients with satisfactory results. However, this method involved tedious filtration steps that limited its ultimate utility.

**CONCENTRATION OF INSULIN BY ADSORPTION ON BENZOIC ACID.**

By P. J. MOLONEY AND D. M. FINDLAY.

(From the Research Division, Connaught Antitoxin Laboratories, University of Toronto, Toronto, Canada.)

(Received for publication, July 17, 1921.)

In the preparation of insulin on a large scale, a problem which is of considerable importance is the concentration of dilute aqueous solutions of the potent material. On account of the expense and loss of potency which result in boiling down such solutions, it seemed desirable to investigate the possibilities of adsorption. It was found that the potent material could be almost completely removed from aqueous solutions by certain materials, such as decolorizing carbons, but attempts to redissolve the insulin from the solid by heating, altering the acidity, using a different solvent, etc., were only partially successful.<sup>1</sup> It was decided to try some reagent which could be used in a finely divided form, and which could be subsequently dissolved. For this purpose certain organic acids, such for example as benzoic and salicylic, suggested themselves on account of their relative insolubility in water and the fineness of division in which they come down when a dissolved salt is treated with an acid.

PATENT OFFICE

APPLICATION FOR PATENT.

No. 234337

DATE: SEP 18 1922

No. 293747

FILED: Jan 12 / 1922

APPLICANT: P. J. Moloney & D. M. Findlay, University of Toronto

ATTORNEY: Chas. F. Ritchie

INVENTION: Method of concentrating insulin by adsorption on benzoic acid

PATENT MAY ISSUE

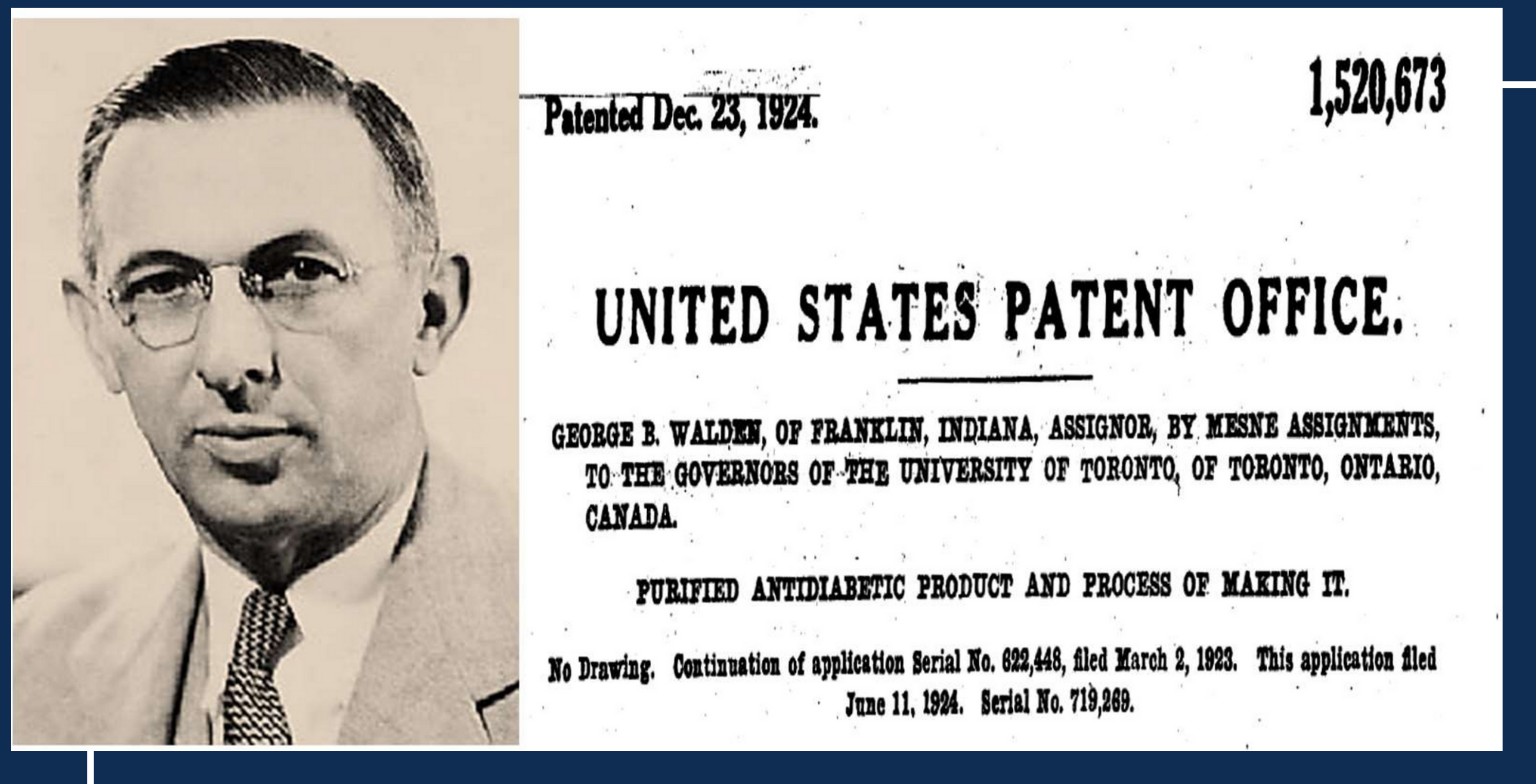
Chief of Patent Office



# The University of Toronto creates an Insulin Committee to handle negotiations with Eli Lilly

On May 30, 1922, the University of Toronto and Eli Lilly reached an agreement for the large scale production of insulin. The Eli Lilly team, led by George B. Walden, Harley W. Rhodehamel, immediately began its work.

Large scale Insulin Production (1922): **HARLEY W. RHODEHAMEL** and **GEORGE B. WALDEN** (*Lilly Archives*)



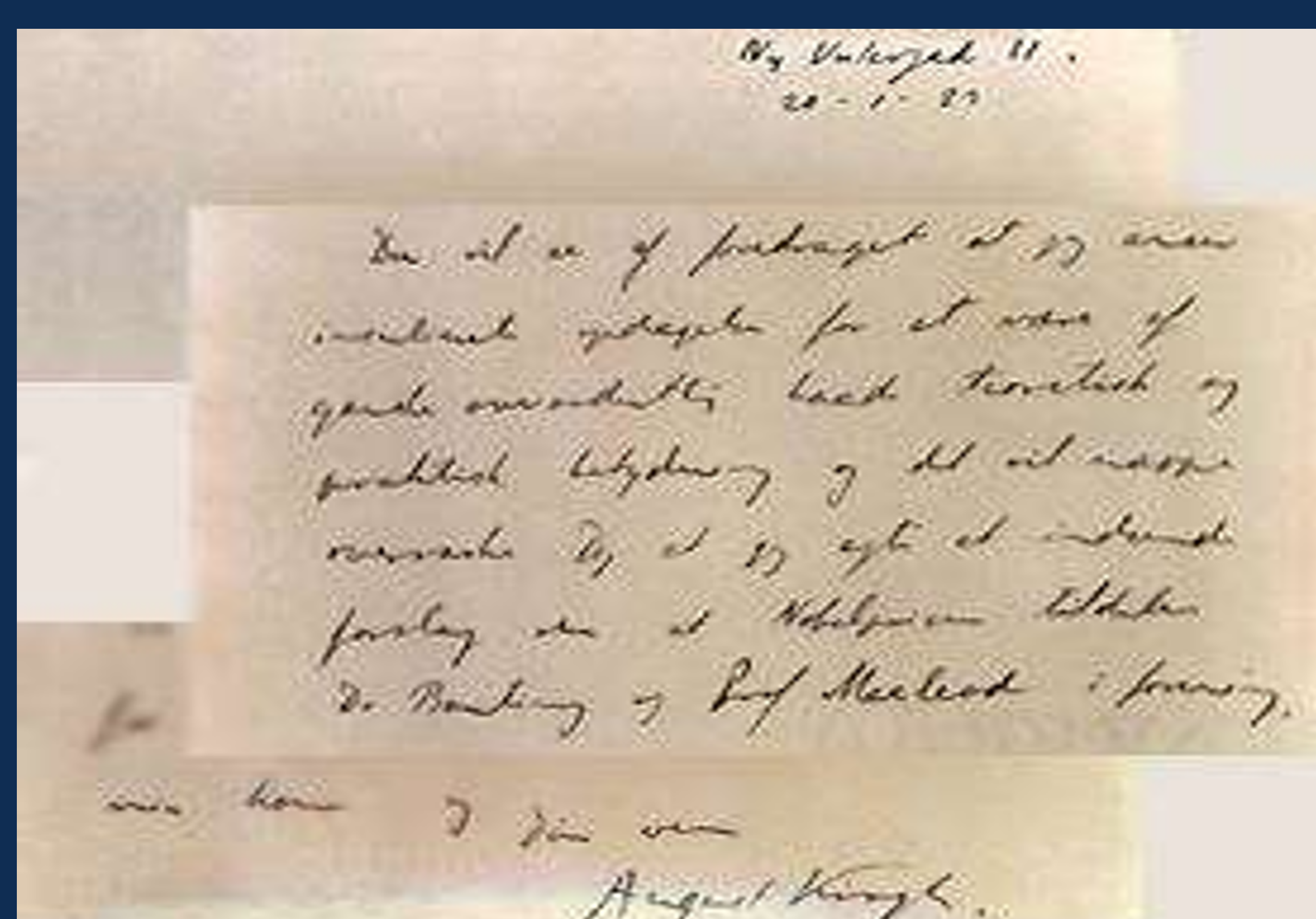
In November 1922, Danish biomedical scientist and Nobel laureate **August Krogh** arrived in Toronto.

The purpose of his visit was twofold. First, he wanted to investigate the claims of discovery with an eye to awarding the Nobel Prize. But there was also a personal consideration — Krogh's wife lived with diabetes and he wanted to bring the technology back to Denmark. He and **Dr. H. C. Hagedorn** successfully did so, and established the Nordisk Insulin Company.



**Prof. August Krogh** and **Prof. Goran Liljestrand** (Executive Secretary of the Nobel Committee since 1918) were close friends; the relationship between the two grew stronger after Liljestrand's stay in Copenhagen for academic reasons.

On January 20, 1923, Krogh wrote a letter to Goran Liljestrand with the following comment: *"As you understand from my discourse, it is my opinion that the discovery of insulin is of extraordinary, both theoretical and practical, importance and it will hardly surprise you that I intend to submit a nomination that the Nobel Prize be awarded to Dr. Banting and Professor Macleod."*





# 1923

## NOBEL PRIZE IN PHYSIOLOGY AND MEDICINE



On October 25, 1923, the Nobel Prize was awarded to Banting and Macleod.

The joint prize made a bad situation exponentially worse. Banting was livid that he had to share the glory of a Nobel Prize with his rival, Macleod. His first instinct was to reject the prize altogether, but instead, he announced that he had chosen to share his prize money with Best.

Macleod, perhaps in reaction to Banting's gesture, also announced that he had decided to share his prize with Collip.

### FREDERICK GRANT BANTING

(1891-1941)

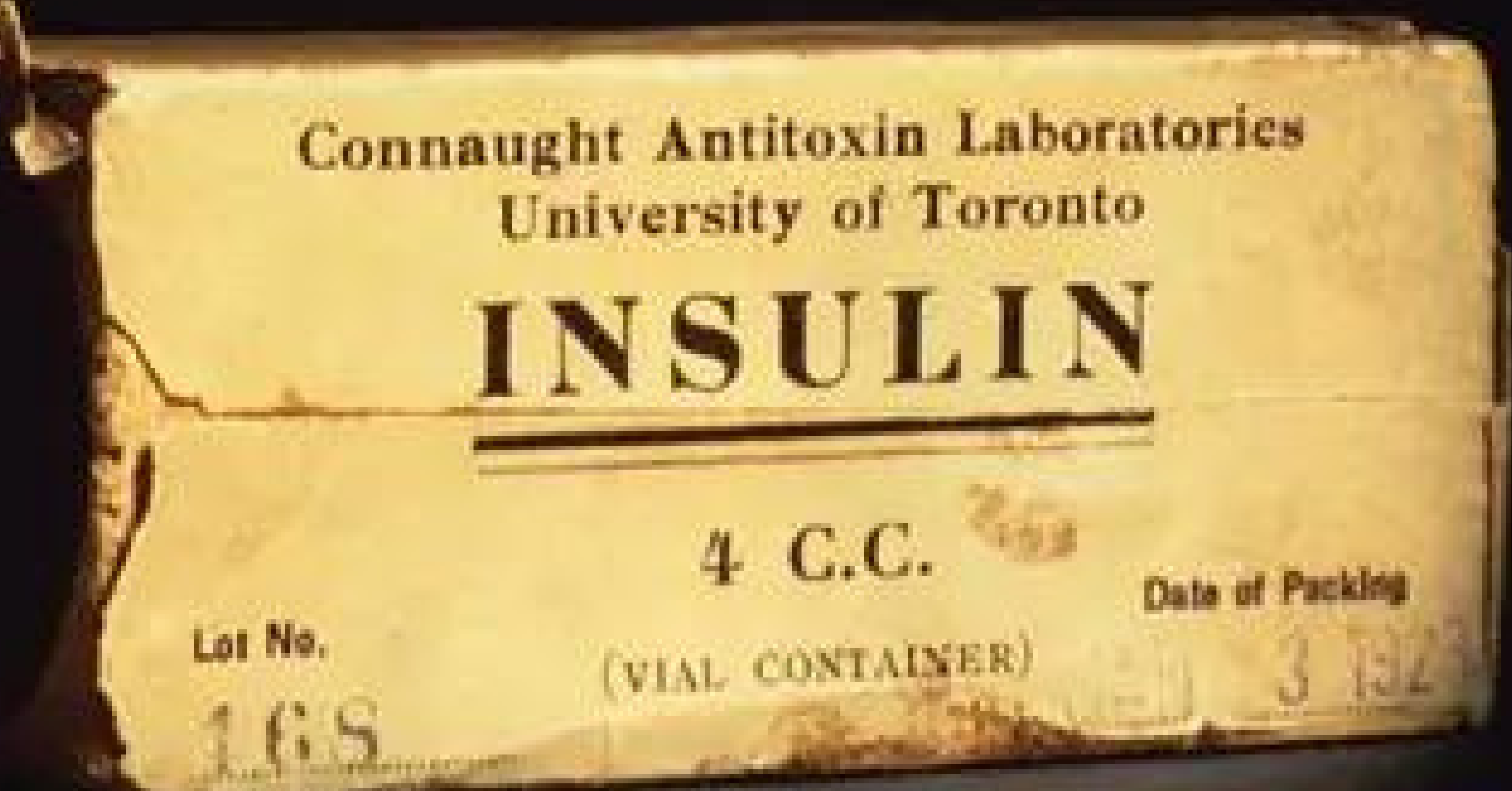


### PROF. JOHN JAMES RICKARD MACLEOD

(1876-1935)

By late 1923, insulin had been in commercial production for a year at Eli Lilly and Company laboratories in Indianapolis.

People with diabetes who received insulin injections recovered from coma, and realised they had been given another chance at life.





# 100 YEARS

## OF INNOVATION IN DIABETES CARE

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### FIRST **ORAL MEDICATIONS** FOR TYPE 2 DIABETES

(1955)



### FIRST **BLOOD GLUCOSE METER**

(1971)

### FIRST COMMERCIAL **INSULIN PUMP**

(1979)



### FIRST **INSULIN PEN**

(1985)

### FIRST **CONTINUOUS GLUCOSE MONITORING SYSTEM**

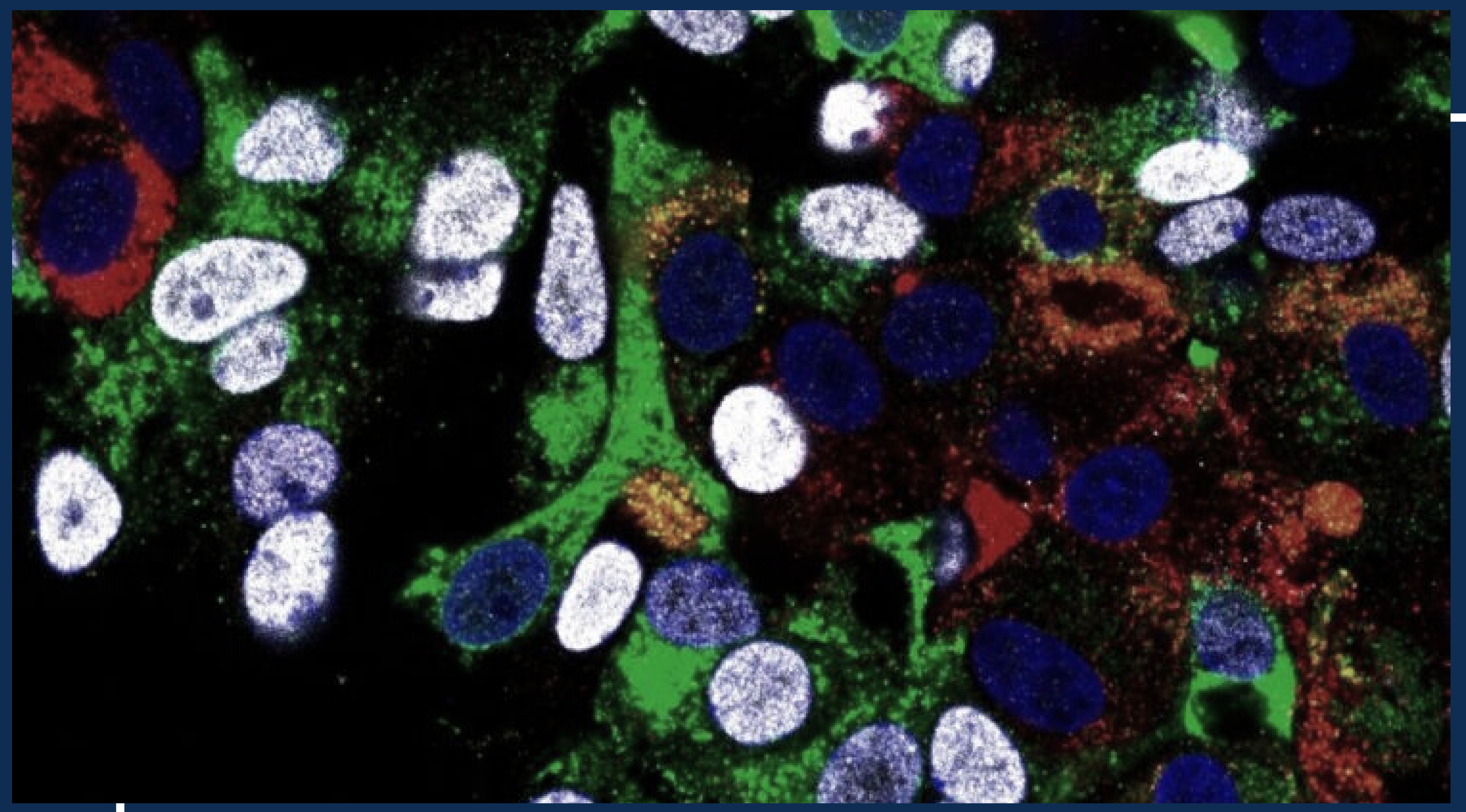
(1999)





# FIRST ISLET CELL TRANSPLANTATIONS

(2000)



## INTRODUCTION OF **GLP-1 RECEPTOR AGONISTS** FOR TYPE 2 DIABETES

(2005)

## INTRODUCTION OF **DPP-4 AND SGLT2 INHIBITORS** FOR TYPE 2 DIABETES

(2006-2013)



## FIRST **CLOSED-LOOP INSULIN DELIVERY SYSTEM**

(2016)



# 2021-2023



INSULIN AT  
**100**

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...Today, people living with diabetes continue to face challenges in accessing diabetes medicines, supplies, technologies, care and education.

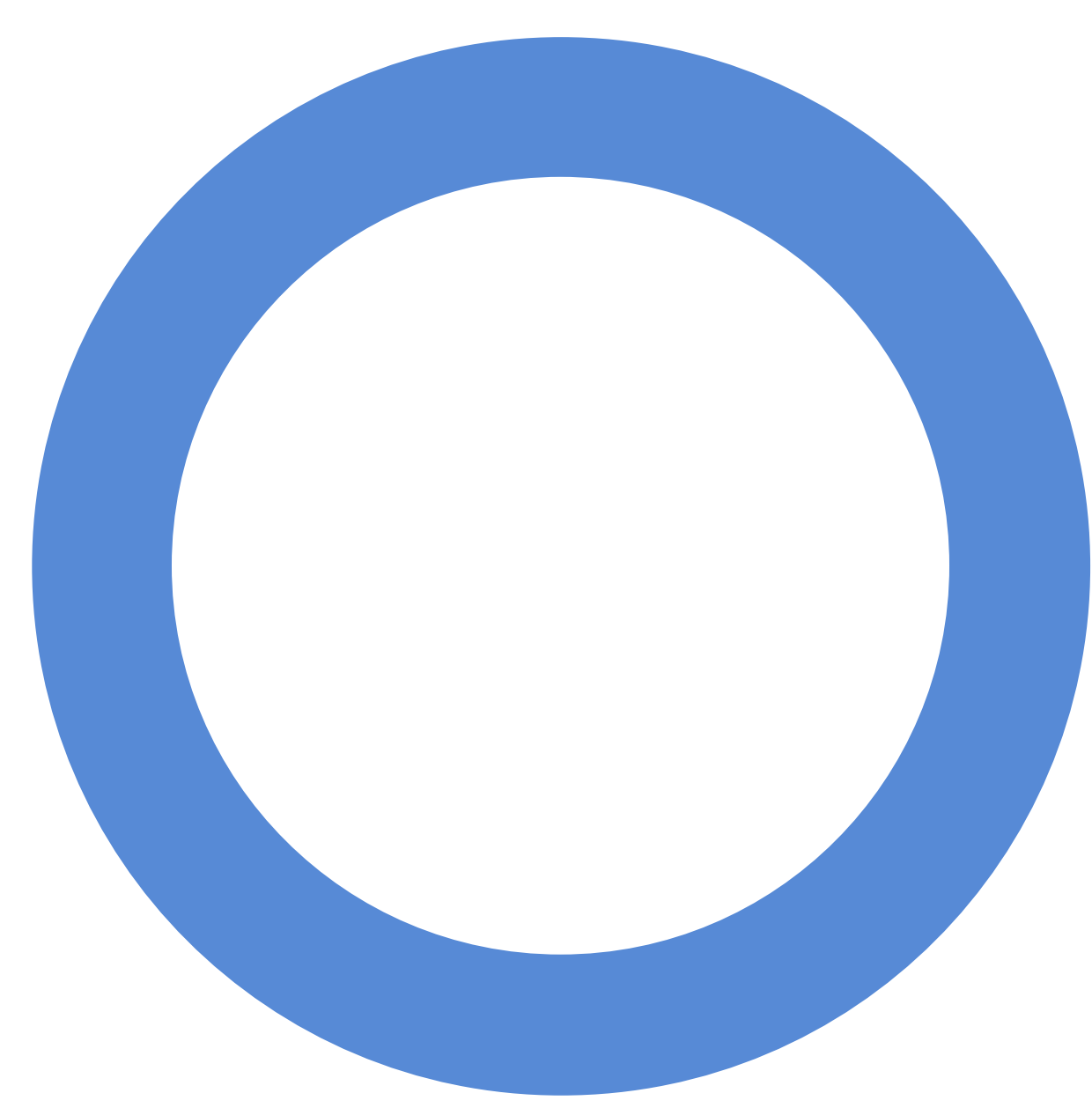
**BE PART OF THE CHANGE.  
HELP US SHAPE THE NEXT  
100 YEARS OF INSULIN!**





**International  
Diabetes Federation  
Europe**

IDF Europe is the European chapter of the International Diabetes Federation (IDF). We are an umbrella organisation representing **70 national diabetes organisations in 44 countries across Europe**. We are a diverse and inclusive multicultural network of national diabetes associations, **representing both people living with diabetes and healthcare professionals**.



## IDF EUROPE **VISION** AND **MISSION**

Our vision is to **improve the lives of people with diabetes** and our mission, in Europe, is to **unite the voice of people with diabetes** and to engage all stakeholders in **creating a person-centred diabetes ecosystem**.

## IDF EUROPE **PRIORITY** **OBJECTIVES**

- Improving access to care and quality of life for people living with diabetes
- Increasing the voice of people with diabetes on all levels
- Reducing diabetes incidence and preventing complications

*Timeline on the discovery of insulin courtesy of APDP - Diabete Portugal*





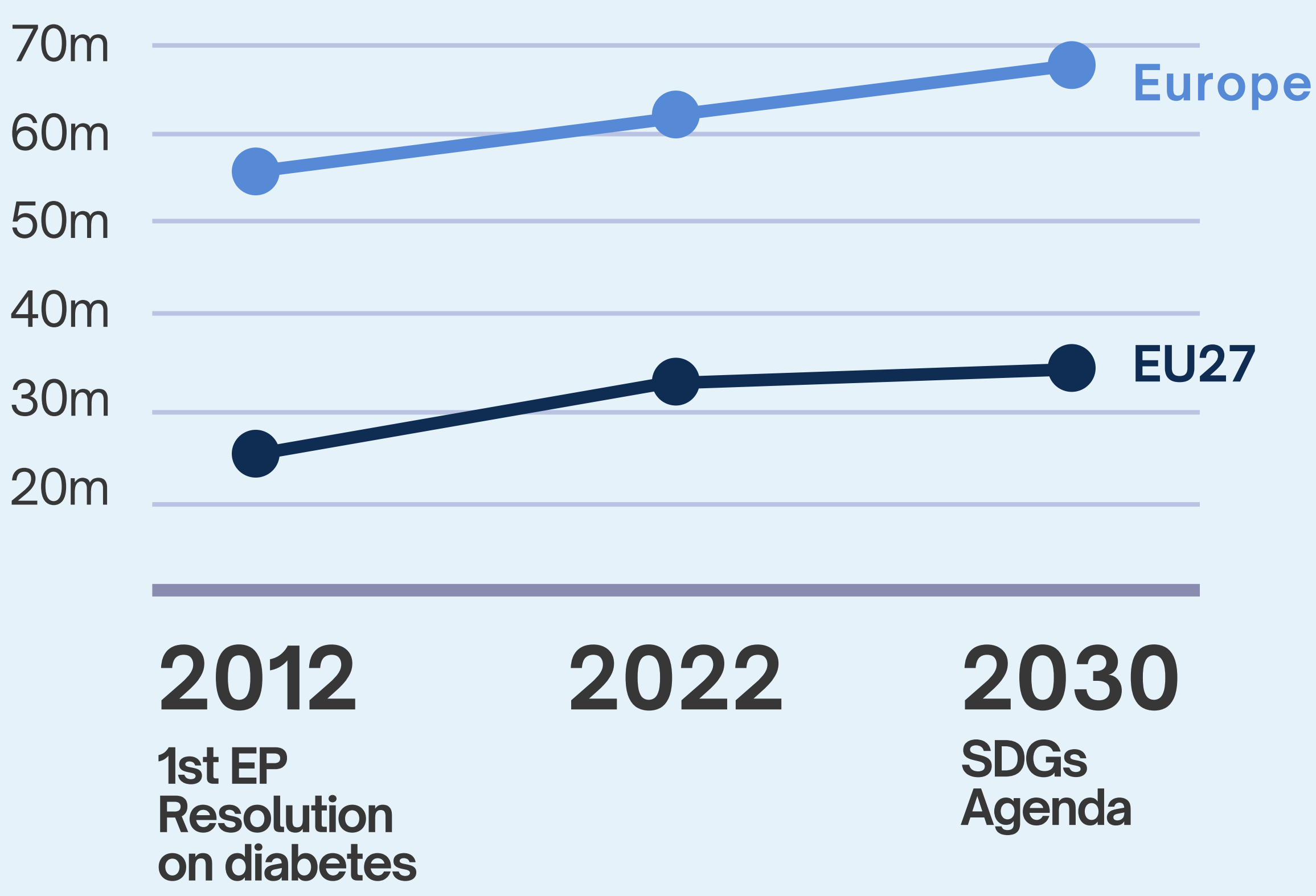
# Why we have to act on DIABETES now

## NOBODY IS IMMUNE TO DIABETES

It affects babies, children and adults across all socio-economic groups and geographies, and the situation is getting worse.



Number of people living with diabetes (PwD)



### DIABETES:

#### LIFELONG DISEASE WITH NO CURE

**1/3** of PwD are undiagnosed

**up to 1/2** of PwD do not achieve optimal blood glucose targets

#### ROOT CAUSE OF MANY OTHER NCDs

**1/3** of PwD develop CVDs

Diabetes/+ hypertension cause **80%** of end-stage renal disease

**1/3** of PwD develop diabetic retinopathy

**€78 bn** **3/4** of diabetes costs result from diabetes-related complications

#### MORE MIGHT BE TO COME

COVID-19 increases the risk of developing diabetes

Diabetes during pregnancy may program the unborn child to be more susceptible to diabetes

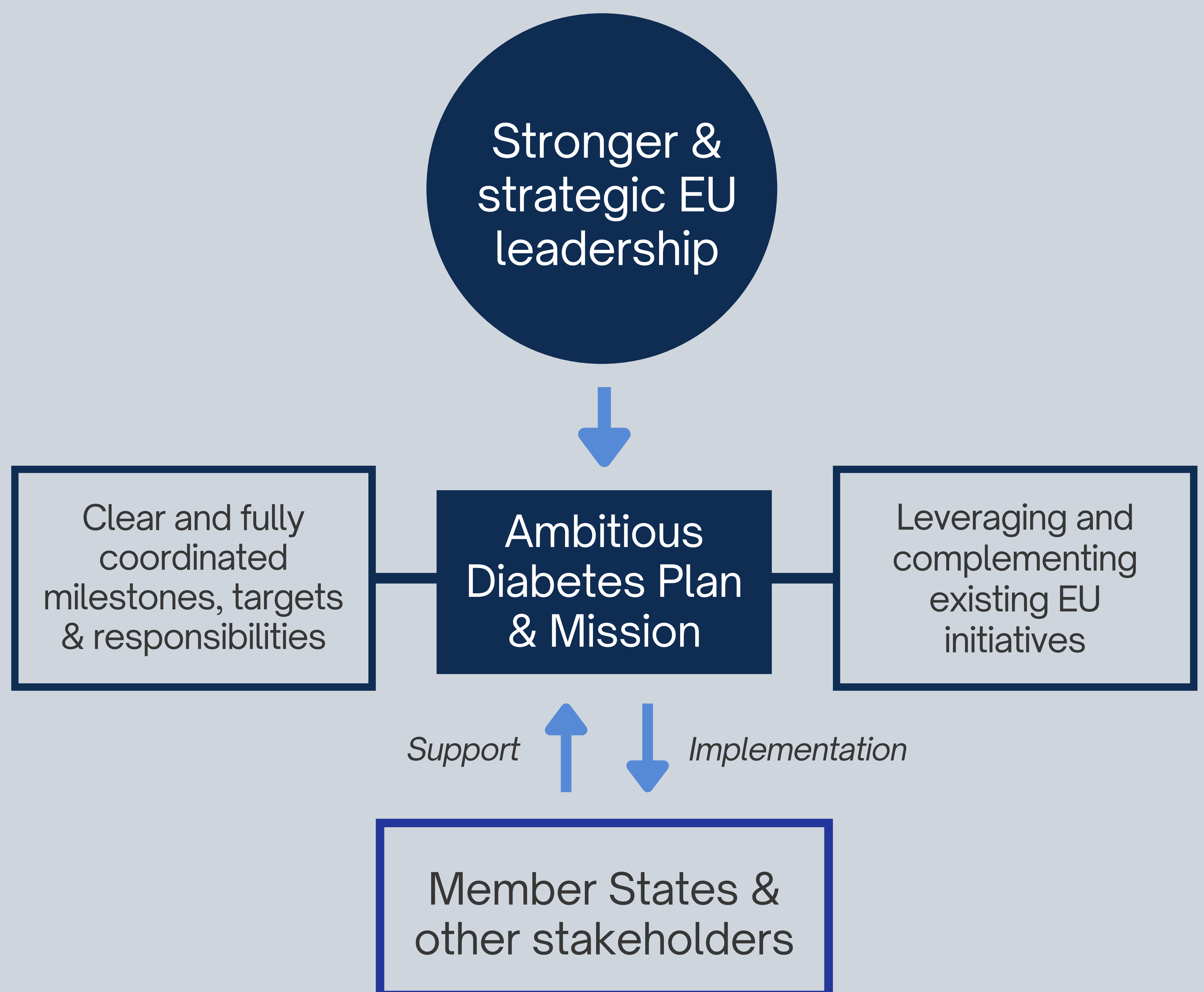


## DIABETES CARE IS A MARKER OF THE FUTURE RESILIENCE OF NATIONAL HEALTH SYSTEMS

Effective diabetes prevention and management touch on all aspects of national health systems. They keep PwD and others away from the healthcare system, lower costs, improve resource utilisation and contribute to digitalisation, thereby shoring up resilience.

## EU POLICY ACTION LACKS THE REQUIRED LEADERSHIP

Turning the tide requires concerted and coordinated EU leadership, an ambitious Diabetes Plan and Mission, with an implementation roadmap, leveraging EU initiatives, and working in close collaboration with Member States and other stakeholders.



The diabetes community is united in its support of the motion for a new Diabetes Resolution

