THE SPANISH FLU AND CANADIAN INFLUENZA VACCINE INITIATIVES

Christopher J. Rutty, Ph.D.

A significant but sometimes overlooked element in the history of the Spanish Flu pandemic of 1918-19 was the experimental production, distribution and wide use of influenza vaccines. Since the vaccines were based on an erroneous view that influenza was caused by a bacteria (the influenza virus would not be isolated until 1933) such vaccines were ineffective and thus of little importance to the course of the pandemic from a medical or public health perspective.

However, the story of the vaccines produced to prevent pandemic influenza, particularly in Canada, reveals much about the application of uncertain knowledge in the face of an unprecedented public health emergency. It also reveals the changing state of Canadian biotechnology capacity at the end of World War I.

Connaught Antitoxin Laboratories of the University of Toronto led the most significant initiative to produce an influenza vaccine.[1] Connaught's flu vaccine initiative coincided with a significant production effort by the Ontario Provincial Laboratories, along with various smaller scale and more local efforts, particularly in Kingston and Winnipeg.[2] Canadian vaccine efforts were also linked to emergency vaccine preparation in New York City, Boston, and at the Mayo Clinic in Minnesota.[3] Influenza vaccines were similarly prepared in other countries in the face of the global pandemic.

In 1919, Dr. John G. FitzGerald, Director of Connaught Antitoxin Laboratories, began his summary of Connaught's influenza vaccine work by observing: "almost coincident with the end of the war a great emergency arose in which the laboratories were provided with an opportunity of doing public service work of a national character."[4]

Connaught had been established in May, 1914, as the Antitoxin Laboratory in the Department of Hygiene,

1 Online resources about the history of Connaught Laboratories include: **http://connaught.research.utoronto.ca/history/**; **http://thelegacyproject.ca**

2 J.W.S. McCullough, "The Control of Influenza in Ontario," *Canadian Medical Association Journal* 8 (Dec. 1918): 1084-85; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1585472/**; F.T. Cadham, "The Use of a Vaccine in the Recent Epidemic of Influenza," *Canadian Medical Association Journal* 9 (June 1919): 519-27; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1523545/**; Guilford B. Reed, "Some Results of Protective Inoculation Against Epidemic Influenza," *Canadian Medical Association Journal* 11 (June 1921): 454-56; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1524167/**; see also Andrew Belyea, "Dr. Guilford B. Reed: The Influenza Vaccine That (sort of) Worked," *Museum of Health Care Blog*, June 28, 2017, **https://museumofhealthcare.wordpress.com/2017/06/28/dr-guilford-b-reed-the-influenza-vaccine-that-sort-of-worked/**

3 T. Leary, "The Use of Influenza Vaccine in the Present Epidemic," *American Journal of Public Health* 8 (Oct. 1918): 754-55, 768; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1362340/**

4 J.G. FitzGerald, "Report of the Director of the Connaught Antitoxin Laboratories, for the year ending June 30, 1919," in *Annual Reports of the Director of the Connaught Laboratories, University of Toronto, 1914-1934*, Sanofi Pasteur Canada Archives, Acc. 83-005-03; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/ConLabs-AnnReptDirector-YrEnd1919-06-30-Influenza-SPC-83-005-03.pdf**

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part of a unique vision by FitzGerald to prepare, develop and distribute -- as a pubic service -- essential biological public health products. Initially, Connaught provided diphtheria antitoxin and Pasteur Rabies Treatment to provincial health departments, for free use. Any proceeds would support research and public health education.[5]

The onset of World War I triggered the expansion of the Labs, especially in response to a shortage of tetanus antitoxin in the Canadian and British military. With trench warfare exposing wounded soldiers to tetanus spores in the soil, leading to debilitating and deadly infections, tetanus antitoxin could be life-saving.

Albert E. Gooderham, of Gooderham & Worts Distillery, facilitated the Labs' expansion on a farm property at what today is Sanofi Pasteur Canada's Connaught Campus, on Steeles Avenue West, just east of Dufferin Street in Toronto. Gooderham was a philanthropist and also a member of the University of Toronto Board of Governors and chairman of the Ontario Red Cross. He would formally open the Connaught Antitoxin Laboratories & University Farm on October 25, 1917. The facility was named after the Duke of Connaught, Canada's Governor General during most of the war. A year later, just as the influenza pandemic reached Toronto, Connaught was shipping its largest ever order of tetanus antitoxin, 16,000 doses (out of a total of some 250,000 doses shipped since 1915) to the Canadian Expeditionary Forces.[6]

Although the Labs' facilities were quite modest, its staff had become accustomed to responding to challenges during the war years, mostly under the leadership of Dr. Robert D. Defries. He was Associate Director of the Labs, but worked as Acting Director while FitzGerald served in the Royal Army Medical Corps in France. Since the Labs' establishment, FitzGerald and Defries had built close connections with several U.S. laboratories, particularly at the New York City Department of Health. Thus, soon after influenza first hit in North America during August and September 1918, Defries was aware of efforts in New York and Boston to prepare an influenza vaccine.[7]

When the last pandemic struck in 1892, German physician Richard Pfeiffer had isolated a bacterium from the lungs and sputum of influenza patients. Pfeiffer considered *B. influenzae* to be the cause, but in the absence of another pandemic there was minimal influenza research conducted until 1918. When influenza swept through in New York City and Boston, doctors immediately looked for the "Pfeiffer's bacterium" in cases of the disease, with the idea of preparing a vaccine. We now know that *B. influenzae*

5 Christopher J. Rutty, "Personality, Politics and Canadian Public Health: The Origins of Connaught Medical Research Laboratories, University of Toronto, 1888-1917," in E.A. Heaman, Alison Li and Shelly McKellar (eds.) *Figuring the Social: Essays in Honour of Michael Bliss* (University of Toronto Press, 2008), p. 273-303; available at: **http://healthheritageresearch.com/Rutty-ConnughtOrigin-BlissEssays.pdf**

6 Robert D. Defries, *The First Forty Years, 1914-1955: Connaught Medical Research Laboratories, University of Toronto* (University of Toronto Press, 1968), p. 24.

7 Defries, *First Forty Years*, "Chapter 7: The Emergency of Epidemic Influenza, 1918-1919," p. 49-40; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/DefriesRD-FirstFortyYears-Ch7-Influenza1918-p49-50.pdf**

(known today as *Haemophilus influenzae*) is associated with influenza, but is not its cause.[8]

The first newspaper reports of an influenza vaccine appeared in the *New York Times* on October 2, 1918, which noted that "as far as health authorities know, [this] will be the first time that a vaccine has been employed to prevent influenza." The "new vaccine would be considered revolutionary to laymen, but to physicians it would not be unexpected, as it is the application of an old idea to a new disease."[9] The vaccine was prepared from influenza bacilli that was killed by exposure to heat and then suspended in a salt solution. It was first tried on volunteer lab workers and then distributed in small quantities to physicians. By October 21, newspapers were reporting on influenza vaccines prepared in Philadelphia, Boston, Winnipeg and, in Toronto, by the Connaught Laboratories.[10]

By October 21, Connaught's influenza vaccine, prepared from 18 strains provided from New York City and Boston labs, was already being distributed. Seven thousand doses had been shipped -- 3,000 to army authorities and the remainder to Ontario hospitals. Connaught's vaccine was supplemented by a supply prepared by the Ontario Provincial Board of Health Laboratories. News reports on October 22 noted that more than 10,000 doses had been sent to hospitals and municipal medical officers of health throughout Ontario. In addition, a small supply of vaccine was prepared at Toronto General Hospital by Dr. H.K. Detweiler of the Department of Pathology and offered to its staff. The Provincial Board of Health would soon have enough vaccine on hand to enable its use among the general public.[11]

Elsewhere in Canada, including in Montreal and the Maritimes, some vaccine was sourced from the Massachusetts State Board of Health. Meanwhile, in Winnipeg, there was an initiative by the Manitoba Provincial Laboratory to prepare a "mixed-strain" vaccine based on a method developed by Dr. E.C. Rosenow at the Mayo Clinic in Rochester, Minnesota. This vaccine also included strains of pneumococcus and streptococcus bacteria believed responsible for the deadly pneumonic complications of influenza. Using local strains and strains provided by Rosenow, the Manitoba Board of Health prepared some 600,000 doses for physicians' use in Winnipeg and elsewhere in Western Canada; 100,000 doses were also prepared at Winnipeg General Hospital and the city operated a series of free vaccination clinics.[12] In Kingston, Dr. Guilford B. Reed, of Queen's University, also produced a mixed-strain influenza vaccine

8 J.K. Taubenberger, J.V. Hultin, D.M. Morens, "Discovery and Characterization of the 1918 Pandemic Influenza Virus in Historical Context," *Antivir Ther* 12 (4, Pt. B) (2007): 581-91; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2391305/**

9 "Tells of Vaccine to Stop Influenza," *New York Times*, Oct. 2, 1918, p. 10; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/NewYorkTimes-1918-10-02-p10-clip.jpg**

10 *Philadelphia Inquirer*, Oct. 19, 1918, p. 13; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/PhiladelphiaInquirer-1918-10-19-p13-clip.jpg**; "Physicians Uphold Influenza Vaccine," *Boston Daily Globe*, Oct. 21, 1918, p. 3; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/BostonDailyGlobe-1918-10-21-p3-clip.jpg**; "Ban in Effect Only Small Part of Possible Measures," *Winnipeg Tribune*, Oct. 21, 1918, p. 6; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/WinnipegTribune-1918-10-21-p6-clip.jpg**; "Find Vaccine for Epidemic," *The Globe*, Oct. 21, 1918, p. 1; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/Globe-1918-10-21-p1-clip.jpg**

11 "Send Vaccine to Many Centres," *The Globe*, Oct. 22, 1918, p. 8; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/Globe-1918-10-22-p8-clip.jpg**; H.B. Maitland, M.L. Cowan, H.K. Detweiler, "The Aetiology of Epidemic Influenza: Experiments in Search of a Filter-Passing Virus," *British Journal of Experimental Pathology*, 1 (Dec. 1920): 263-81; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2047652/**

12 Cadham, "The Use of a Vaccine in the Recent Epidemic of Influenza," p. 524; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1523545/**

based on cultures collected from local patients. Reed initially inoculated medical students and, after "encouraging results," provided the vaccine to military units and physicians in Eastern Ontario.[13]

Connaught's influenza production operation took place over almost two months, running 24/7 during the height of the emergency, in the cramped Connaught facilities in the Medical Building on the main U of T campus. Led by Defries and the staffs of the Antitoxin Division and the newly established Research Division, Dr. A.H. Graham, and Leila Hanna were also key to the initiative. Leila was one of the Labs' first employees and during WWI, she managed the bacteriological work relating to its products, including influenza vaccine, and directed the filling department. The Base Hospital Laboratory at the old Toronto General Hospital also assisted with vaccine preparation, collecting fresh strains and the correlation of lab findings. Connaught's vaccine was provided for free and was also offered to all provincial departments of health across the country, as well as to several U.S. states, the United Kingdom, and also the Canadian Railway Board, to vaccinate all railway employees. The vaccine was provided "on condition that records be kept in order that the merit of the vaccine might be determined."[14]

The lack of surviving primary records of Connaught's vaccine work limits our ability to appreciate the challenges encountered during this extraordinary effort, although a *Toronto Star* report on October 24, with the headline, "300 'Flu Germs Baked" provides some insight. The article noted that vaccine production was seriously handicapped by the "cooking to death" of some of the "precious" cultures that had recently arrived from Boston due to a defective thermostat.[15]

On October 26, another *Toronto Star* article described how the influenza "germ" was "grown in a culture tube, with a white transparent jelly as the substance of nutrition." The germ culture was then destroyed by "exposure to great heat." "Theoretically," the article emphasized, "the inoculation for the present pandemic of influenza is obviously sound, inasmuch as the vaccine used is prepared practically in the same way as all other vaccines." However, it was "much too soon for any definite statement to be made, but it is claimed to be scientifically sound and if it does not do any good it cannot do any harm."[16] By the end of October, as reported by Dr. J.W.S. McCullough, Ontario's Chief Medical Officer of Health, some 30 litres of vaccine, amounting to hundreds of thousands of doses, had been distributed "as fairly as possible" throughout the Province.[17]

13 Belyea, *Museum of Health Care Blog*, June 28, 2017, **https://museumofhealthcare.wordpress.com/2017/06/28/dr-guilford-b-reed-the-influenza-vaccine-that-sort-of-worked/**

14 FitzGerald, "Report of the Director of the Connaught Antitoxin Laboratories, for the year ending June 30, 1919," SP-C Archives, Acc. 83-005-03; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/ConLabs-AnnReptDirector-YrEnd1919-06-30-Influenza-SPC-83-005-03.pdf;** Defries, *First Forty Years*, "Chapter 7: The Emergency of Epidemic Influenza, 1918-1919," p. 49-40; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/DefriesRD-FirstFortyYears-Ch7-Influenza1918-p49-50.pdf**

15 "300 'Flu' Germs Baked," *Toronto Star*, Oct. 24, 1918, p. 2; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/TorStar-1918-10-24-p2-clip.jpg**

16 "Dead Germs are Used to Fight Influenza," *Toronto Star*, Oct. 26, 1918, p. 8; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/TorStar-1918-10-26-p8-clip.jpg**

17 "'Flu' Vaccine Popular," *Toronto Star*, Oct. 31, 1918, p. 3; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/TorStar-1918-10-31-p3-clip.jpg**

By November, as the pandemic's peak passed in Canada, there was less news of the vaccine, but it remained a focus of attention elsewhere as the disease spread, particularly in the U.S. By December, there was a more critical view of the vaccine's value, especially following the American Public Health Association's Annual Meeting, at which Toronto's Medical Officer of Health, Dr. Charles Hastings, presided as president. Measures taken to control the pandemic were discussed and debated at the meeting, resulting in a strong sense that while the vaccine seemed to offer some protection against the more serious stages of influenza. However, as it was not being used until the peak of the disease, little could be proven of its preventive value.[18] In addition, doubts increased about the actual role of *B. influenzae* in the disease, prompting intensified research attention to the hypothesis that a much smaller, filterable virus, might be the real cause of influenza.[19]

Nevertheless, the Canadian experience with preparing an influenza vaccine during the 1918 pandemic, and especially Connaught's work, galvanized a broader national public health presence for the Labs. During the war, Connaught's focus and growth had largely been based on service for the troops in Europe. But the domestic "Spanish flu" emergency, as FitzGerald stressed in his Annual Report, provided the Labs "with an opportunity of doing public service work of a national character." Subsequently, Connaught would serve as the primary focus of vaccine research and production on Canada. In fact, in the face of pandemic influenza threats in 1957 and 1976, Connaught played a similar role as it did in 1918, albeit based on a much clearer understanding of the viral nature of the disease.

Postscript

A single vial (or "ampoule") of Connaught Laboratories' "influenza vaccine" prepared during the 1918 pandemic is held in the artifacts collection of the Canada Science and Technology Museum in Ottawa. A curator at CSTM had not been aware of this small artifact until I came across a listing about it on the CSTM collections website while searching for sources related to the Connaught Laboratories 1918 influenza vaccine. The vaccine ampoule was also the focus of an August 8, 2018, CBC News Ottawa article, available at: **https://www.cbc.ca/news/canada/ottawa/hidden-treasure-science-museum-spanish-flu-1.4776733**

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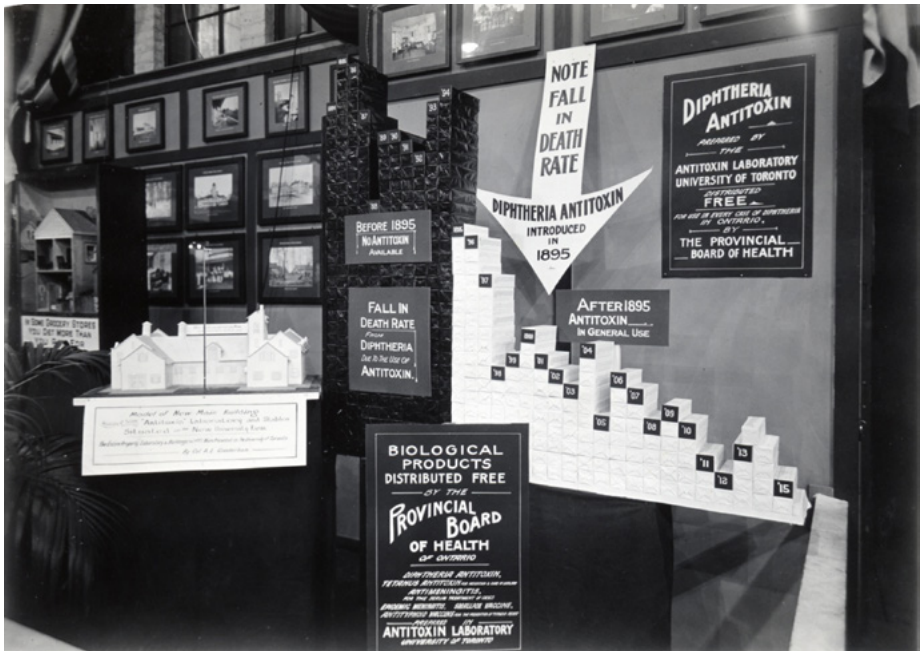
18 "Health Officers Split on Influenza Scourge," *New York Times*, Dec. 13, 1918, p. 9; available at: **http://healthheritageresearch.com/clients/docs/Influenza-1918-Vaccine/NewYorkTimes-1918-12-13-p9-clip.jpg**

19 See, for example: W.H. Park and A.W. Williams, "Studies on the Etiology of the Pandemic of 1918," *American Journal of Public Health* 9 (Jan. 1919): 45-49; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1362460/**; A.H.W. Caulfied and Donald T. Fraser, "Certain Bacteriological and Serological Aspects of Epidemic Influenza," *Canadian Medical Association Journal* 10 (May 1920): 436-46; available at: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1523884/**

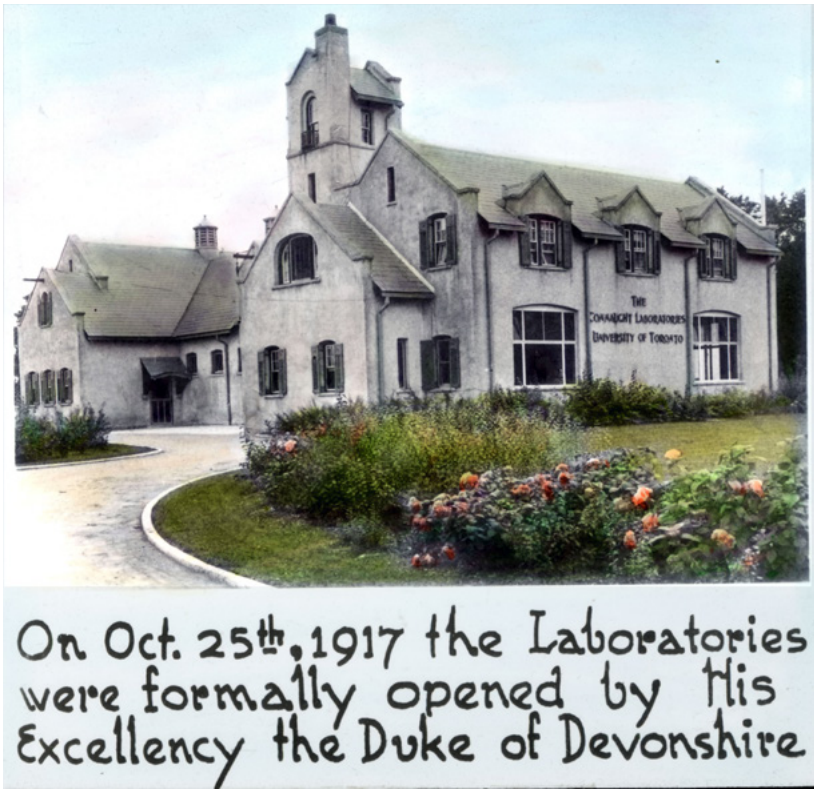
Connaught Laboratories Insulin Vaccine ampoule, 1918, in collection of Canada Science & Technology Museum, Ottawa. (See listing: **https://ingeniumcanada.org/ingenium/collection-research/collection-item.php?id=2002.0715.001** *)*

Dr. John G. FitzGerald (1882-1940), founder and first Director of Connaught Laboratories. (Sanofi Pasteur Canada Archives)

Medical Building, University of Toronto; Connaught Laboratories HQ, 1914-1927. (Sanofi Pasteur Canada Archives)



Ontario Provincial Board of Health's Diphtheria Antitoxin exhibit, Canadian National Exhibition, Toronto, 1916. (Sanofi Pasteur Canada Archives)



Official opening of Connaught Laboratories "Farm" site, October 25, 1917, which included new laboratory building, which still stands today. (Sanofi Pasteur Canada Archives)

Dr. Robert D. Defries (1889-1975), Dr. FitzGerald's right-hand man from the start of Connaught Labs, and its second Director, from 1940 to 1955. (Sanofi Pasteur Canada Archives)

FIND VACCINE FOR EPIDEMIC

Connaught Laboratories of University of Toronto Announce Discovery

SEND IT TO HOSPITALS

Though Difficult to Prepare, Large Supply May Soon be Available

A preventive vaccine for influenza has been discovered in Toronto, and already its distribution to Ontario hospitals has commenced. Announcement to this effect was made last night by the Connaught Laboratories at the University of Toronto. The vaccine consists of dead germs of influenza, and eighteen strains of these germs are used in its preparation. The preparation of the vaccine in large quantities is difficult, but 7,000 doses already have been sent out.

The Director of the Connaught Laboratories, Major J. G. Fitzgerlad, is at present overseas as officer in command of No. 39 Mobile Laboratory, France. Dr. R. D. Defries, the acting Director, is in charge of the work.

The statement issued by the Connaught Laboratories is as follows:

"The Connaught Laboratories, University of Toronto, have announced the production of a preventive vaccine for influenza.

Work Commenced on Outbreak.

"Immediately after the outbreak of the epidemic here, work was commenced on the subject of influenza, and this work has been actively carried on with the co-operation of both the military and civil authorities, with the idea of determining the cause and means of spread of the disease. Following the work of the New York City Health Department, a vaccine has been prepared in large enough quantities for distribution. The vaccine consists of dead germs of influenza, and eighteen strains of these germs are used in the preparation of the vaccine. These strains were obtained through the New York and Boston authorities, and represent strains isolated in these cities and in several of the army camps of the United States. The influenza germ must be cultivated on special media and is extremely difficult to grow, being a very delicate organism. The preparation of a vaccine in large quantities is therefore most difficult. Yesterday distribution of the first supply of vaccine was commenced to the hospitals in Ontario for the use of the nurses and doctors and to the army authorities. The first supply of vaccine amounted to 7,000 doses. The work is being carried out on a large scale, and a steady supply of vaccine, it is hoped, will soon be available. The University desires to point out that as the vaccine is extremely difficult to prepare, it should be used first in those places where it is most needed. The vaccine will be distributed by the University entirely free at present.

Established For Investigation.

"The Connaught Laboratories were established along the lines of the Rockefeller Institute of New York and the Lister Institute of London, England, for investigation in the field of preventive medicine and production of public health vaccines and serums. The laboratories have distributed during the last four years diphtheria antitoxin and other necessary products, not only throughout Canada, to the Provincial Health Departments, but also have supplied the Department of Militia and Defense with all the tetanus (lockjaw) preventive serum required for our overseas forces."

First newspaper article announcing Connaught Laboratories influenza vaccine production; The Globe, Oct. 21, 1918, p. 1. Globe-1918-10-21-p1-InfluenzaVaccine-Connaught-clip.jpg

SEND VACCINE TO MANY CENTRES

Three Local Laboratories Now Preparing Treatment for Preventing Influenza

More than 10,000 doses of a prophylactic influenza vaccine were sent out yesterday by the Provincial Board of Health to hospitals and Medical Officers of Health throughout the Province, to be used in checking the spread of the disease. Applications for the vaccine poured in to the board yesterday, and a large staff was put to work to promptly fill the orders.

Three local laboratories are now making a vaccine for the prevention of the disease. The vaccines are practically the same as those used in New York and Boston, although they differ in minor details one from the other. The vaccine sent out yesterday by the Provincial Board of Health was made in the Provincial Laboratories. The Connaught Laboratories announced on Sunday the discovery of its vaccine, and Dr. H. K. Detweiler at the Pathological Department of the Toronto General Hospital started making practically the same vaccine early last week, and treated the staff of that institution.

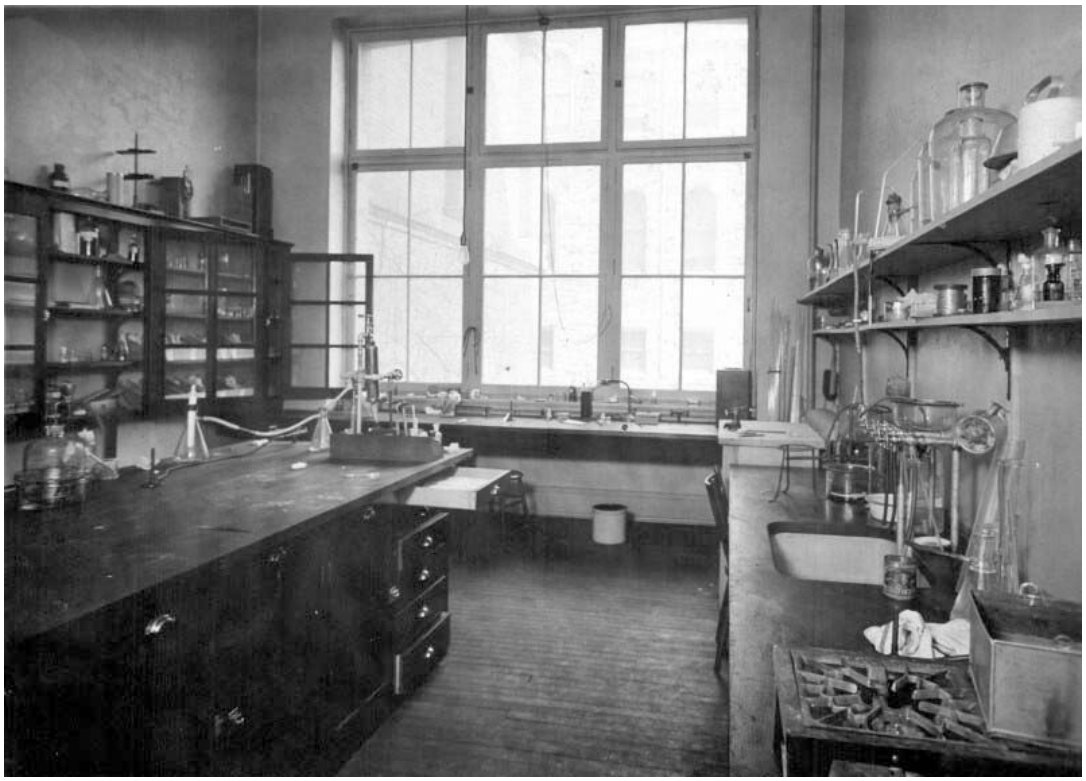
The Provincial Board of Health explicitly states in instructions sent out to the Local Health Boards that the vaccine is for preventive purposes only, and that it is not considered useful in the treatment of the disease.

Sudbury's Large Share.

The vaccine that was sent out yesterday was for use in fifty municipalities. Sudbury received the largest supply of 5,000 doses. Yesterday the staff in the offices of the Provincial Board of Health were inoculated with the vaccine.

There is a steady demand on the department for nurses, lecturers and doctors from different parts of the Province. London Victoria Hospital reports that several of its nurses have taken sick, and a half a dozen nurses to take their places were asked for by the Superintendent. In some rural parts of the Province the malady is gaining a hold, according to the reports, and it is often difficult to give proper treatment to those afflicted.

Newspaper article describing influenza vaccine production and distribution in Ontario; The Globe, Oct. 22, 1918, p. 8. Globe-1918-10-22-p8-clip.jpg



Connaught Laboratories first research laboratory, Medical Building, 1918, at which influenza research was conducted during pandemic. (Sanofi Pasteur Canada Archives)

Leila Hanna, one of Connaught Labs' first employees, starting in 1914 and serving in a wide variety of capacities until 1924. (Sanofi Pasteur Canada Archives)

300 "FLU" GERMS BAKED

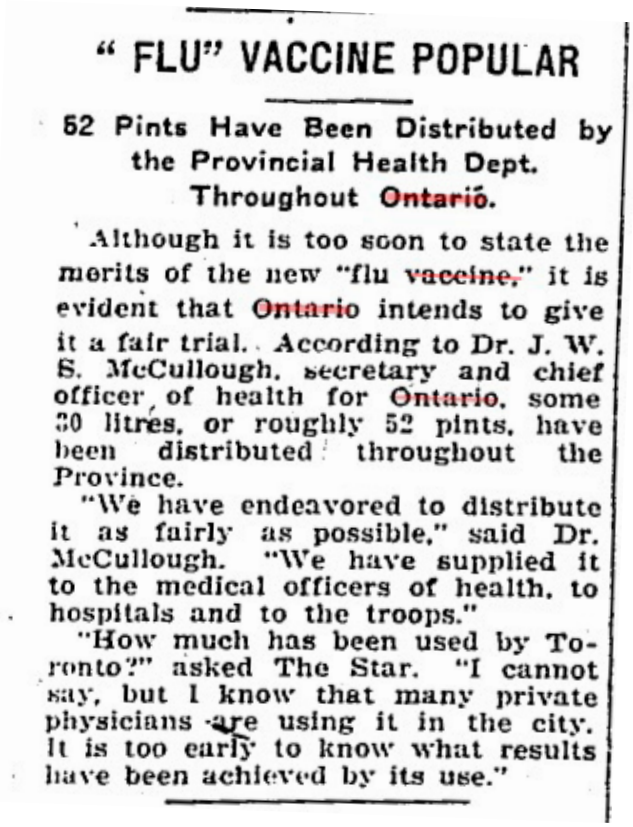
Loss of "Boston Baked Bugs" is Regarded as Highly Regretable.

The local manufacture of the anti-flu vaccine has been seriously handicapped and delayed by the cooking to death of a quantity of the virulent but precious "cultures," which form the basis of the serum.

This disaster, The Star learns, has occurred at the Connaught laboratories and was due to a defective system of thermostats.

The cultures in question had just reached the city from Boston.

Interesting newspaper article describing an unforeseen complication in Connaught Labs' influenza vaccine production; Toronto Star, *Oct. 24, 1918, p. 2.*



"FLU" VACCINE POPULAR

52 Pints Have Been Distributed by the Provincial Health Dept. Throughout Ontario.

Although it is too soon to state the merits of the new "flu vaccine," it is evident that Ontario intends to give it a fair trial. According to Dr. J. W. S. McCullough, secretary and chief officer of health for Ontario, some 30 litres, or roughly 52 pints, have been distributed throughout the Province.

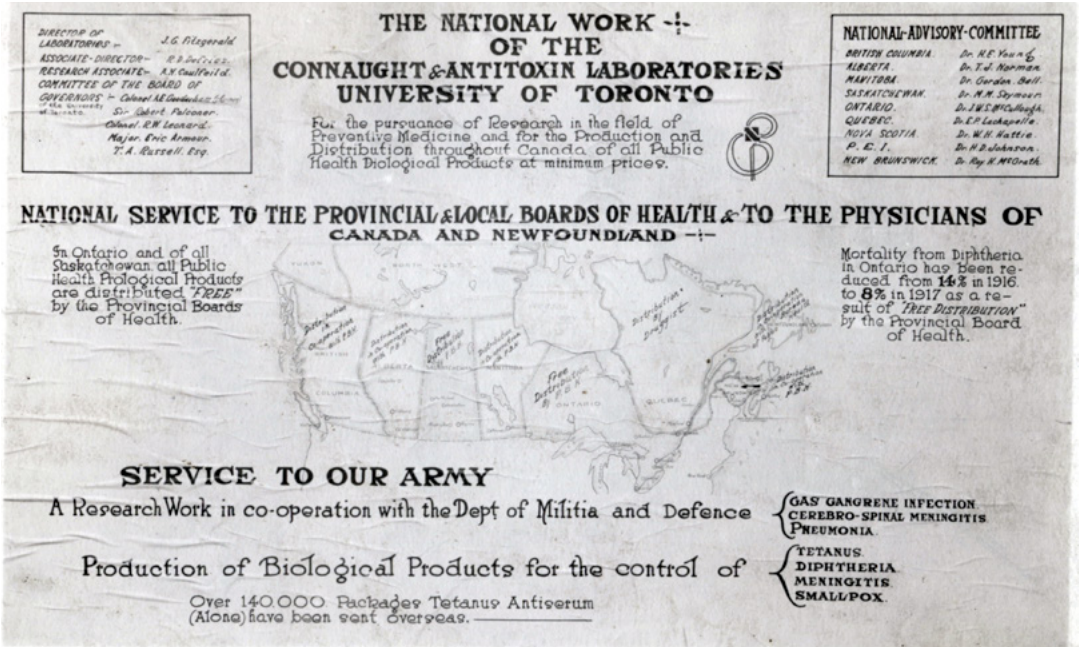
"We have endeavored to distribute it as fairly as possible," said Dr. McCullough. "We have supplied it to the medical officers of health, to hospitals and to the troops."

"How much has been used by Toronto?" asked The Star. "I cannot say, but I know that many private physicians are using it in the city. It is too early to know what results have been achieved by its use."

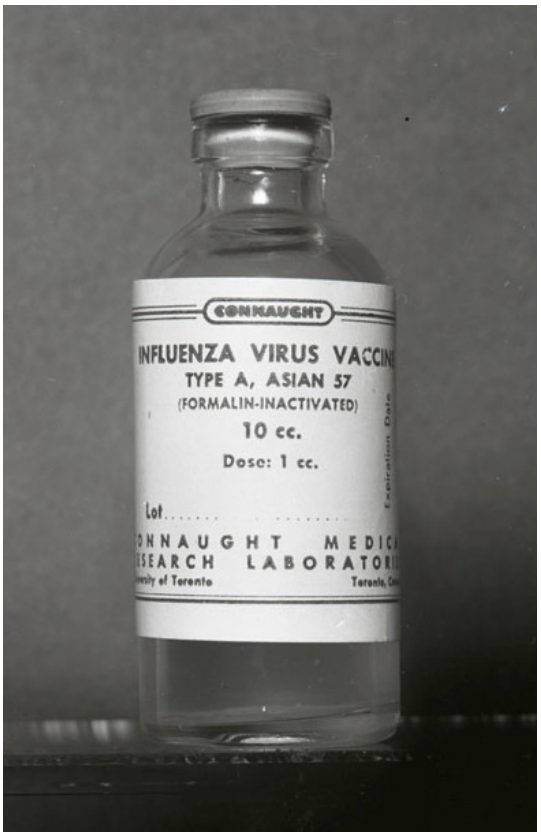
Newspaper article summarizing the production and distribution of influenza vaccine in Ontario at the end of October 1918; Toronto Star, *Oct. 31, 1918, p. 3.*


JOHN W. S. McCULLOUGH, M.D.
Chief Health Officer of Ontario.

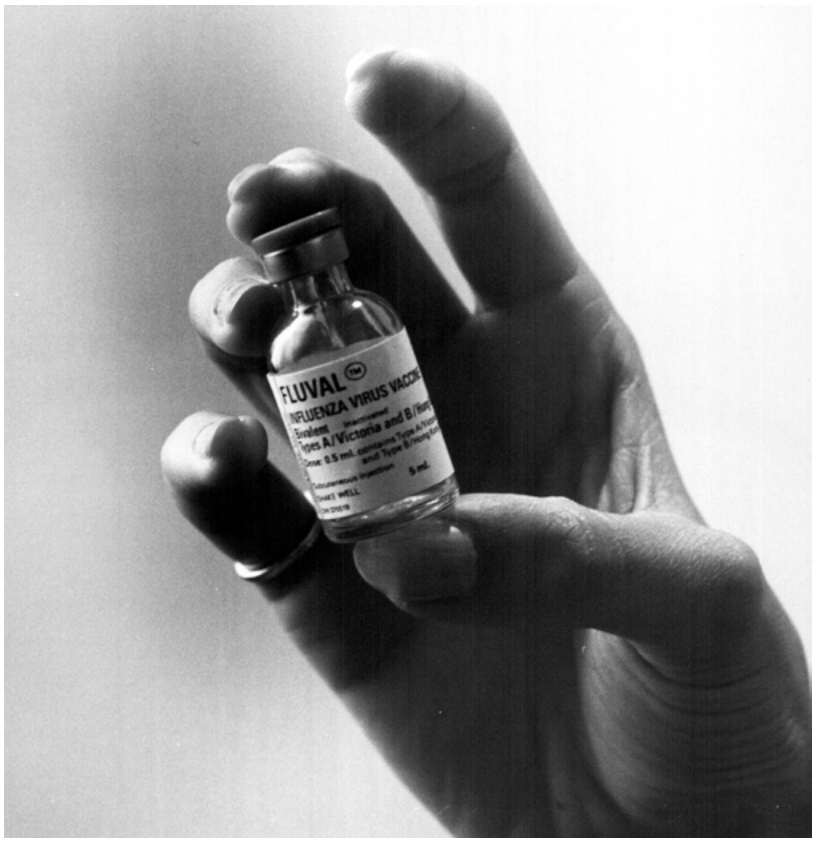
Dr. J.W.S. McCullough, Ontario's Chief Medical Officer of Health from 1910 to 1935. He managed the distribution of influenza vaccine produced by Connaught Labs and the Provincial Laboratories during the 1918 pandemic. (Public Health Journal, 2 (Aug. 1911), p. 352.



Map illustrating the national service work of Connaught Laboratories to provincial and local boards of health, physicians and Department of Defense at the end of World War I. (Sanofi Pasteur Canada Archives)



Connaught Medical Research Laboratories, Influenza Vaccine, produced in preparation of the Asian influenza pandemic, 1957.
(Sanofi Pasteur Canada Archives)



Connaught Laboratories Limited, Influenza Vaccine, prepared in preparation of the "Swine Flu" pandemic in 1976, although the pandemic never developed
(Sanofi Pasteur Canada Archives)