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The Brantford Fluorine Experiment

INTERIM REPORT AFTER FIVE YEARS OF WATER
FLUORIDATION

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TWO publications from the American Association for the Advancement of Science (1, 2) in 1942 first focussed the attention of the scientific world on the possibility of reducing the incidence of dental caries by the addition of a fluoride compound to a public water supply.

On August 19, 1942, a special meeting of the Board of Health was held (3) to discuss the appalling dental caries among Brantford school children. The School Dental Officer led the discussion of this important subject, and among those present was the Acting Director of Dental Services, Provincial Department of Health. At this time the proposal was first made that Brantford embark on a fluorine experiment, and it was decided to seek the co-operation of the Provincial Department of Health, in order that a control city might be arranged for and all the conditions of valid scientific research complied with.

With the co-operation of the Provincial Department of Health it was soon determined that Brantford could not be listed among those fortunate communities with a natural fluoride content in the public water, as the Grand River, from which the city draws its water, contains the merest trace of fluorides. As a result of an educational campaign, a strong public demand developed for the application of fluorine to the public water supply as a method of counteracting tooth decay among children. The proposal had the approval of the local dental and medical societies, the two boards of education, the Board of Trade, Rotary, Kiwanis and other service clubs, labor unions and the City Council.

It was recognized that fluorine in the public water supply was not a proven method for the prevention of dental caries, and that it might take ten years to prove or disprove its preventive value.

The financial and scientific support of the Department of Health was sought by the municipal authorities. The Department gave its approval to the project and provided the technical assistance of Dr. A. E. Berry in the application of sodium fluoride to the Brantford water supply.

As these negotiations consumed much valuable time, it was not until 1944 that the Public Utilities Commission agreed to apply the fluoride to the city water supply and to pay the cost of the chemicals. A further delay was occasioned by the difficulty of securing suitable equipment for applying sodium fluoride to the water.

On June 20, 1945, sodium fluoride was first applied to Brantford city water. This application has since been continued night and day.

The Brantford schools' dental clinic, a health service which had been functioning for some thirty years, lost most of its equipment in a school fire during 1944. The school dental officer and his assistant seized the opportunity to obtain the first D.M.F. rate for Brantford school children. D.M.F. means *diseased teeth*—those with present decay; *missing teeth*—those which have been extracted; and *filled teeth*—those with cavities restored by fillings. A dental survey of all school children was made. The dental-caries experience of each child was recorded on an individual card. The children were examined by the mouth mirror and sharp explorer method.

A second dental survey of all school children was made in the spring of 1945 before the fluoridation of the water supply. The results of these two surveys have been combined and are shown in Table I.

TABLE I
COMBINED SURVEYS OF BRANTFORD SCHOOL CHILDREN
(CONTINUOUS RESIDENTS ONLY), 1944 AND 1945
PRE-FLUORINE SURVEYS

Age	No. of Children	No. with D.M.F.'s*	No. of D.M.F.'s Permanent	No. of D.M.F.'s Deciduous	Total	D.M.F.'s per child
5	318	261	33	1793	1826	5.74
6	556	489	223	3692	3915	7.04
7	616	573	1023	4177	5200	8.44
8	614	579	1499	3931	5430	8.84
9	608	595	1936	3403	5339	8.78
10	565	546	2148	2119	4267	7.55
11	604	585	2829	1054	3883	6.42
12	658	648	4151	416	4567	6.94
13	531	514	4132	107	4239	7.98
14	307	305	2639	24	2663	8.67
15 & 16	105	103	1044	4	1048	9.98
Total	5,482	5,198	21,657	20,720	42,377	7.73
Total 12-14	1,496	1,467	10,922	547	11,469	7.66

*D.M.F.: *diseased teeth*—those with present decay; *missing teeth*—those which have been extracted; and *filled teeth*—those with cavities restored by fillings.

The first post-fluorine dental survey was made in the fall of 1946, after seventeen months of exposure to fluoridated water. The results are given in Table II.

TABLE II
FIRST POST-FLUORINE SURVEY, BRANTFORD SCHOOL CHILDREN, 1946

Age	No. of Children	No. with D.M.F.'s	No. of D.M.F.'s			D.M.F.'s per child
			Permanent	Deciduous	Total	
5	360	259	23	1482	1505	4.18
6	342	279	170	1961	2131	6.23
7	290	276	532	1866	2398	8.26
8	278	271	766	1812	2578	9.27
9	283	278	981	1603	2584	9.13
10	301	297	1276	1234	2510	8.33
11	274	273	1348	628	1976	7.21
12	258	255	1631	215	1846	7.17
13	236	234	1873	71	1944	8.23
14	117	117	1108	20	1128	9.64
15 & 16	48	48	466	—	466	9.70
Total	2,787	2,587	10,174	10,892	21,066	7.55
Total 12-14	611	606	4,612	306	4,918	8.04

The second and succeeding post-fluorine dental surveys were made at twelve-month intervals. All were made by the same dental officer, using the same methods and procedure.

The tables record the dental condition of children who were born in Brantford and have lived here all their lives. Permanent and deciduous teeth are recorded separately.

TABLE III
SECOND POST-FLUORINE SURVEY, BRANTFORD SCHOOL CHILDREN, 1947

Age	No. of Children	No. with D.M.F.'s	No. of D.M.F.'s			D.M.F.'s per child
			Permanent	Deciduous	Total	
5	302	210	8	1241	1249	4.13
6	347	267	90	1700	1790	5.16
7	332	298	333	2039	2372	7.14
8	263	255	609	1684	2293	8.72
9	262	251	734	1429	2163	8.25
10	280	272	1044	1055	2099	7.46
11	292	286	1376	572	1948	6.67
12	264	260	1545	221	1766	6.69
13	239	231	1677	56	1733	7.25
14	122	121	1034	14	1048	8.59
15 & 16	48	46	458	1	459	9.56
Total	2,751	2,497	8,908	10,012	18,920	6.87
Total 12-14	625	612	4,256	291	4,547	7.27

TABLE IV
THIRD POST-FLUORINE SURVEY, BRANTFORD SCHOOL CHILDREN, 1948

<i>Age</i>	<i>No. of Children</i>	<i>No. with D.M.F.'s</i>	<i>No. of D.M.F.'s</i>			<i>D.M.F.'s per child</i>
			<i>Permanent</i>	<i>Deciduous</i>	<i>Total</i>	
5	370	227	7	1102	1109	2.97
6	399	311	100	1885	1985	4.97
7	350	297	260	1805	2065	5.61
8	323	296	538	1918	2456	7.60
9	258	247	696	1325	2021	7.83
10	237	229	769	856	1625	6.85
11	268	256	1106	519	1625	6.06
12	286	280	1600	199	1799	6.29
13	227	224	1475	112	1587	6.99
14	103	99	686	23	709	6.88
15 & 16	42	41	350	2	352	8.38
Total	2,863	2,507	7,587	9,746	17,333	6.05
Total 12-14	616	603	3,761	334	4,095	6.64

TABLE V
FOURTH POST-FLUORINE SURVEY, BRANTFORD SCHOOL CHILDREN, 1949

<i>Age</i>	<i>No. of Children</i>	<i>No. with D.M.F.'s</i>	<i>No. of D.M.F.'s</i>			<i>D.M.F.'s per child</i>
			<i>Permanent</i>	<i>Deciduous</i>	<i>Total</i>	
5	290	179	16	901	917	3.16
6	411	277	59	1467	1526	3.72
7	382	328	286	1940	2226	5.83
8	327	293	449	1724	2173	6.61
9	313	294	683	1595	2278	7.28
10	250	239	789	971	1760	7.04
11	238	225	890	452	1342	5.64
12	255	246	1276	199	1475	5.76
13	263	255	1699	74	1773	6.74
14	104	100	728	24	752	7.23
15 & 16	37	36	297	6	303	8.19
Total	2,870	2,472	7,172	9,353	16,525	5.75
Total 12-14	622	601	3,703	297	4,000	6.43

Table VII summarizes the changes which have taken place in the dental-caries experience of Brantford school children over the five-year period during which fluorine has been added to the municipal water supply.

Table VIII gives the numbers and percentages of children with perfect teeth from 1945 to 1950.

These tables are presumptive evidence of the value of fluoridated water in the prevention of dental caries. They are presented in this interim report, in justice to the people of Brantford, who are entitled to know to what end they have so splendidly supported the fluorine experiment.

TABLE VI
FIFTH POST-FLUORINE SURVEY, BRANTFORD SCHOOL CHILDREN, 1950

Age	No. of Children	No. with D.M.F.'s	No. of D.M.F.'s			D.M.F.'s per child
			Permanent	Deciduous	Total	
5	310	168	3	809	812	2.62
6	334	233	20	1303	1323	3.96
7	390	305	197	1592	1789	4.58
8	368	328	482	1948	2430	6.60
9	313	285	570	1482	2052	6.51
10	296	275	775	1041	1816	6.14
11	243	237	854	530	1384	5.69
12	220	202	943	154	1097	4.98
13	241	236	1343	75	1418	5.88
14	119	118	893	9	902	7.57
15 & 16	39	37	284	6	290	7.44
Total	2,873	2,424	6,364	8,949	15,313	5.32
Total 12-14	580	556	3,179	238	3,417	5.89

TABLE VII
CHANGES IN THE DENTAL-CARIES EXPERIENCE OF BRANTFORD SCHOOL CHILDREN, 1944-1950

Age	Pre-Fluoridation		Post-Fluoridation			1950	% Reduction
	1944 & 1945	1946	1947	1948	1949		
5	5.74	4.18	4.13	2.97	3.16	2.62	54 %
6	7.04	6.23	5.16	4.97	3.72	3.96	43 %
7	8.44	8.26	7.14	5.61	5.83	4.58	45 %
8	8.84	9.27	8.72	7.60	6.61	6.60	20 %
9	8.78	9.13	8.25	7.83	7.28	6.51	26 %
10	7.55	8.33	7.46	6.85	7.04	6.14	18 %
11	6.42	7.21	6.67	6.06	5.64	5.69	11 %
12	6.94	7.17	6.69	6.29	5.76	4.98	28 %
13	7.98	8.23	7.25	6.99	6.74	5.88	26 %
14	8.67	9.64	8.59	6.88	7.23	7.57	12 %
15 & 16	9.98	9.70	9.56	8.38	8.19	7.44	25 %
Total	7.73	7.55	6.87	6.05	5.75	5.32	31 %

TABLE VIII
YEARLY PERCENTAGES OF BRANTFORD SCHOOL CHILDREN WITH PERFECT TEETH, 1944-1950

Year	Number of Pupils	Having Perfect Teeth	
Pre-fluoridation 1944 and 1945	5,482	284	5.18
Post-fluoridation 1946	2,787	200	7.17
1947	2,751	254	9.23
1948	2,863	356	12.44
1949	2,870	398	13.86
1950	2,873	449	15.63

APPLICATION AND CONTROL DATA

Sodium fluoride is introduced to Brantford city water by a Novadel Agene dry-feed machine, designed to feed vitamin B₁ to moving belts conveying flour. It is essentially volumetric in principle, depending on dry material being withdrawn from a hopper by means of a roller. Gross adjustments may be made by changing pulley sizes. Fine adjustment is achieved by controlling the size of the ribbon of fluoride, stripping off the roll by means of a calibrated slide device. Originally the machine was equipped with a solution pot so that the dry fluoride dropped into a constantly moving stream of water which, by means of a rubber hose, was directed to the influent flume to the filters.

Laboratory observation showed that the varying alum dose used to clarify the water affected fluoridation adversely. The point of feeding was therefore changed to the clear well, following filtration, where great turbulence readily disperses the fluoride and long contact in a baffled reservoir assures uniform solution.

As a result of these changes, the solution pot was dispensed with. A gravimetric type of feeder is now available, and would be preferable to the machine now in use in Brantford.

Sodium fluoride was obtained originally from the United States, but prices increased from 12.89 cents up to 17.84 cents per pound, causing us to purchase Canadian-made material at 12.6 cents per pound.

Silicofluoride is a possible alternative to sodium fluoride. Its cost is much lower, 5.95 cents per pound, and its fluoride content is much higher, 60.5 per cent as against 48.5 per cent for sodium fluoride. However, the Brantford Fluorine Committee decided that, as the experiment was started with sodium fluoride, no change should be made.

The fluoride content of Brantford water is determined by the procedure outlined in the ninth edition of "Standard Methods" (4). Operators, when making routine control tests for chlorine, also take a small sample for fluoride analysis. At the end of twenty-four hours the plant laboratory therefore is provided with a composite sample composed of twenty-four small samples. Since samples contain chloramine, which precludes accuracy in fluoride determination, this condition is overcome by treating samples and standards alike with one drop each of 10 per cent sodium thiosulphate. The reason for the use of thiosulphate has recently been discussed in detail by Taras, Cisco and Garnell (5).

It was initially intended to apply the fluoride so as to produce 1 p.p.m. fluoride ion in the finished water, this requiring the addition of 23.3 pounds of sodium fluoride (approximately 95 per cent pure) to 1 Imperial M.G.T. (Imperial gallon—10 pounds). Finally, as a result of a discussion at a meeting of the Brantford Fluorine Committee held on February 15, 1949, the dosage was raised to produce 1.20 p.p.m. fluoride ion in finished water. We, therefore, feed 28 pounds of sodium fluoride per million Imperial gallons.

The cost of adding fluoride to Brantford water has varied due to changing source of supply of the fluoride. In 1948 the cost for fluoride was \$5,899 for an assumed consumer population of 35,000, giving a figure of 17 cents per capita.

In 1949 costs dropped to \$5,030 for an assumed consumer population of 40,000, giving a per capita cost of 12.6 cents, which may be low.

This interim report is purely a record of local studies. It is a matter for profound satisfaction that in 1948 the Department of National Health and Welfare became interested in the Brantford fluorine experiment. As a result, Dr. H. K. Brown, Chief Dental Officer, undertook a long-range comparative study of dental conditions in Stratford, Sarnia and Brantford, which in the course of years should yield valuable data and valid conclusions. It is also gratefully acknowledged that in 1949 the Ontario Department of Health became a financial partner by contributing to meet the higher costs of the chemicals used.

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