Canad. Med. Ass. J.
May 1, 1965, vol. 92

The Chilliwack Respiratory Survey, 1963:

Part II. Aerometric Study

DONALD O. ANDERSON, M.D., F.R.C.P.[C],* IAN H. WILLIAMS, M.S.†
and BENJAMIN G. FERRIS, Jr., M.D.,‡
Vancouver, B.C., and Boston, Mass., U.S.A.

ABSTRACT

A study of the quality of the ambient air at Chilliwack, British Columbia, was conducted from May 1963 to April 1964. Measurements of dustfall, soiling, sulfation, hydrogen sulfide, oxidants and total hydrocarbons were made by a network of five sampling stations. The results of this survey indicated that Chilliwack was relatively free from any air pollution and would therefore be a suitable control for a study of the relationship between community air pollution and respiratory disease.

SOMMAIRE

L'analyse de la qualité de l'air ambiant à Chilliwack, Colombie canadienne a duré un an, soit de mai 1963 à avril 1964. Un réseau comportant cinq stations de cueillette d'échantillons ont mesuré les retombées de poussières, étudié les sols, la sulfatation, l'hydrogène sulfuré, les substances oxydantes et le total des hydrocarbures. Il ressort de cette étude que l'air de Chilliwack est relativement peu pollué et qu'il pourrait donc constituer une norme convenable pour étudier le rapport existant entre la pollution de l'air ambiant et les affections respiratoires.

THE relationship between community air pollution and chronic respiratory disease is still a matter of controversy despite much research on this subject. The contributions which have been made using the techniques of epidemiology have been considerable, though they have not resolved this controversy. Continuous monitoring of a population sample and the quality of its ambient air, as exemplified by the U.S. Public Health Service studies at Nashville, Tennessee,[1, 2] has demonstrated certain complex interrelationships between general mortality, asthma attacks and the level of sulfur dioxide in the air. Comparative prevalence studies of populations living in close proximity, yet exposed to different levels of air pollution, have yielded some definitive results: in the comparison of New Florence and Seward, Pennsylvania, for example, a slight yet significant airway resistance was found in the town with the higher pollution.[3] In a study of three residential areas of Berlin, New Hampshire, however, evidence was obtained which suggested that persons might have moved to areas of less pollution when they developed symptoms of obstructive lung disease;[4] for that reason comparative studies should be conducted upon populations which are sufficiently removed from each other geographically that equalizing inter-migration cannot occur.

One approach has been the international comparison suggested by Reid.[5] A number of comparative studies have since been carried out between certain British populations and American,[6, 7] Norwegian[8] and Danish[9] populations. In these analyses, differences in the prevalence of respiratory disease have been noted which parallel differences in air pollution: more severe respiratory symptoms and physiological impairment of respiration have consistently been found in Britain.

The basis of any geographic comparison of population groups rests upon careful selection of the contrasted populations, standardization of the survey instruments and techniques, and similar measurements of the parameters under study. It was the primary intention of the survey of respiratory symptoms at Chilliwack, B.C., that data would be obtained in a manner comparable with that used at Berlin, New Hampshire.[10] We have chosen, however, to record in these reports certain characteristics of the population of Chilliwack and the quality of the ambient air of this community so that other researchers may use these data in further studies.

This particular report, therefore, consists of the description and results of the air pollution survey of Chilliwack, B.C. It is clear from this analysis that Chilliwack was, as predicted, particularly free of air pollution; it can therefore serve as a suitable control for comparative studies on the relationship between air pollution and disease.

From the Division of Epidemiology of the Departments of Preventive Medicine and Medicine, Faculty of Medicine, University of British Columbia, Vancouver, B.C., and from the Department of Physiology, Harvard University School of Public Health, Boston, Massachusetts.
Supported by a Dominion of Canada National Health Research Grant (Project No. 609-7-73) and a United States Public Health Service Research Grant (OH-67).
This article is being published in four parts. Part I was published in the issue of April 24 (pp. 899-905). Part III will appear in the issue of May 8.
*Associate Professor of Preventive Medicine, University of British Columbia.
†Division of Chemistry and Chemical Engineering, British Columbia Research Council.
‡Associate Professor of Environmental Health and Safety, Harvard School of Public Health.

METHODS

The topography and character of Chilliwack, B.C., have been previously described.[10] This town is 65 miles east of Vancouver in the wide valley of the Fraser River. There is no major industry within the town and there is no apparent air pollution problem. The town is by-passed by the Trans-Canada Highway at a distance of 1.5 miles (Fig. 1).

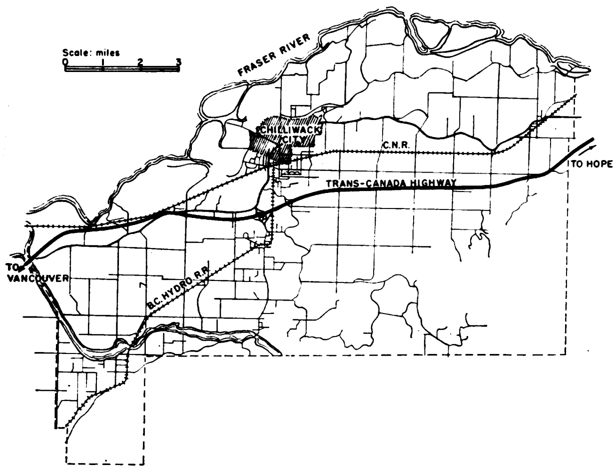

Fig. 1.—Relationship of the arterial highways to Chilliwack City, British Columbia.

It was agreed to document the relative freedom from air pollution enjoyed by Chilliwack. Accordingly, a year-long survey of air quality was started in May 1963 by the British Columbia Research Council under the direct supervision of one of us (I.W.). Throughout, every effort was made to choose techniques which would conform with those used at Berlin, N.H.[11] The following pollutants were measured: sulfur dioxide, dustfall, soiling index and hydrogen sulfide. In addition, because the only major source of pollution was likely to be the automobile, the level of total hydrocarbôns in the ambient air was measured. Although the amount of sunlight in the area was probably insufficient to result in photochemical degradation of these products, oxidants and oxides of nitrogen were also measured.

1. *Sampling Stations*

A network of five sampling stations was established at the locations indicated in Fig. 2. These sites were selected to provide a reasonably uniform coverage of the area. In every case care was taken to install sampling equipment as far as possible from any chimney or obstruction. The stations were:

Station No. 1: Harrison Street, located on the roof of a carport in a quiet residential area.

Station No. 2: Little Mountain School, located on the flat roof of a single-storey public school.

Station No. 3: Municipal Hall, located on the flat roof of a single-storey building.

Station No. 4: Post Office, located on the flat roof, two storeys above the street at "Five Corners", the business centre of the town.

Station No. 5: Health Unit, located on the flat roof of a single-storey building.

It will be noticed from Fig. 2 that two of the stations, No. 3 and No. 5, were established just outside the city limits. Station No. 5 was located at the site of the respiratory clinic.[10]

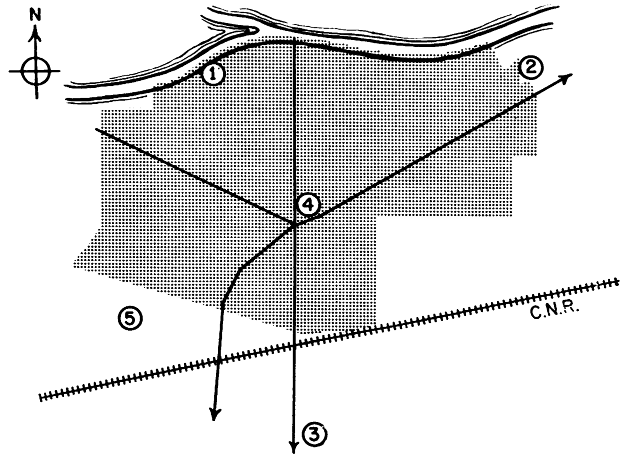

Fig. 2.—Location of the five sampling stations in the network established to measure air quality at Chilliwack, B.C., 1963. City limits of Chilliwack have been shaded.

Sampling for sulfur dioxide and dustfall was continuous at each of these five stations; the sample collectors were recovered at approximately monthly intervals for 12 months, beginning May 1, 1963. Air samples for total hydrocarbons were also collected monthly at each station. At Station No. 4 a 60- or 30-minute sample for oxidants was collected monthly, and continuous sampling was carried out by an automatic tape sampler (A.I.S.I. model). In May and July, 1963, this instrument measured hydrogen sulfide; for the remaining 10 months it recorded the soiling index. A three-hour sampling interval was chosen in both cases.

2. *Methods of Analysis*

Sulfur dioxide: This was measured by the standard lead peroxide candle method with gravimetric determination of the resulting lead sulfate.[12, 13] This sampler consisted of a porcelain cylinder around which was wrapped tapestry cloth coated with a paste containing lead peroxide. The lead peroxide reacts with sulfur compounds to form lead sulfate which can be later analyzed quantitatively and the sulfation rate estimated. This measure is not specific for sulfur dioxide (SO_2). Since the specimens are examined monthly, individual peak levels will be missed.

Dustfall: This was determined gravimetrically in standard dustfall jars as recommended by the Air Pollution Control Association.[14] Because of the heavy winter rainfall at Chilliwack, collections were made in five-gallon cylindrical polyethylene containers which had a tight-fitting lid of polyethylene. The centre of the lid was cut to accommodate a six-inch diameter polyethylene tube which was welded in place. A two-inch band of fine brass screening was placed circumferentially around the top of the six-inch cylinder to prevent birds from alighting on the rim and contaminating the sample (Fig. 3).

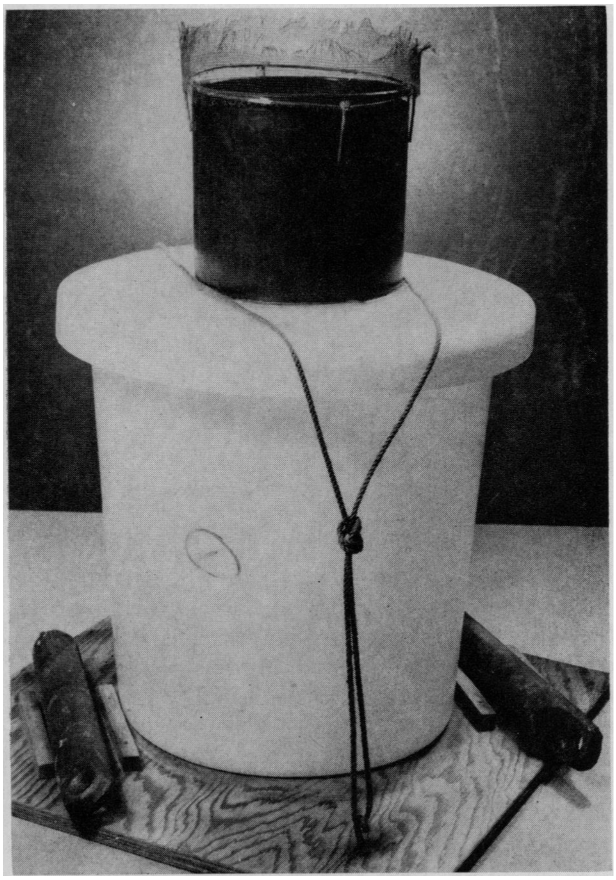

Fig. 3.—Dustfall collector and stand used in the Chilliwack survey.

Soiling Index: This was measured by means of an A.I.S.I. tape sampler.[15] With this instrument, particulate matter in the atmosphere is filtered under suction at 0.25 cu. ft. per minute through a one-inch diameter spot on a paper tape. At the end of a predetermined time, the tape is advanced by a timing mechanism to a fresh spot. The density of spots on the exposed tape is then evaluated photometrically. Results are expressed in Coh units per 1000 linear feet of air filtered. One Coh is defined as that quantity of solids producing an optical density of 0.01 when deposited on the white paper. Although it is generally the practice in Canada to operate these samplers on a time cycle of two hours, in this community a three-hour cycle was used because of the very low soiling expected.

Hydrogen Sulfide: This was also measured by the A.I.S.I. tape sampler. In this case, however, a pre-filter was used to remove dust, and the paper tape was impregnated with lead acetate. In addition, the incoming stream of air was allowed to pass over water to maintain the moisture content required for colour development of the tape.

Oxidant and Oxides of Nitrogen: These were measured by the standard photometric method specified by the American Society for Testing and Materials.[16] At first a one-hour sample was collected; later the sampling time was shortened to 30 minutes. These samples were generally drawn in the early afternoon. Each sample was then examined photometrically after reaction with alkaline iodide solution. Two technical modifications of the method were made. The first modification was the use during the collection of the sample of two impingers containing the same absorption solution in series;[17] the second sample served as a blank and proved in our hands to be more reliable than the untreated reagent blank normally used. The second modification was the use of sulfuric acid rather than acetic acid to develop the colour: this resulted in pH values considerably lower than the 3.8 recommended and thus made it possible to include oxides of nitrogen in the values measured. This procedure was considered justifiable in this particular survey where the concentrations of oxidants and oxides of nitrogen were likely to be quite low.

Total Hydrocarbons: Daytime air samples were collected monthly at each station in 250-ml. gas-sampling bulbs. These were later analyzed in the laboratory by a gas chromatograph equipped with a flame ionization detector; suitably diluted mixtures of pentane vapour and air were used for calibration purposes. Further details of the method used are to be published.[18]

3. *Meteorological Measurements*

Some meteorological information was obtained by a small weather station situated across the street from air pollution Station No. 4. This weather station was operated by the local radio station CHWK. Data such as wind speed and direction, temperature, and precipitation were monitored and recorded hourly from 6:00 a.m. to 11:00 p.m. daily by members of the staff for broadcasting. While it was not possible to obtain records for a full 24 hours, this 17-hour sample was considered reasonable. Other meteorological information has been made available by the Department of Transport, Meteorological Branch.

METEOROLOGICAL RESULTS

Data obtained from the Meteorological Branch of the Department of Transport are presented in Table I; these data represent observations during the same time period as the air pollution survey (May 1963-April 1964), and have been collected at the Chilliwack Station located at 49° 07′ latitude and 122° 06′ longitude at 21 feet altitude above sea level.

TABLE I.—MEAN TEMPERATURE, TEMPERATURE EXTREMES, PRECIPITATION AND SNOWFALL BY MONTH, CHILLIWACK, B.C., MAY 1963 - APRIL 1964

	Temperature			*Total precipitation**		
Month	*Mean (°F.)*	*Max. (°F.)*	*Min. (°F.)*	*(inches)*	*Snowfall (inches)*	*Rainfall (inches)*
May	57.2	93	37	1.82	0.00	1.82
June	60.2	87	46	1.77	0.00	1.77
July	62.5	84	47	3.44	0.00	3.44
August	60.6	86	50	0.35	0.00	0.35
September	64.0	90	49	2.33	0.00	2.33
October	53.6	74	37	8.91	0.00	8.91
November	42.6	57	21	15.36	4.10	14.95
December	39.0	61	24	11.49	6.30	10.86
January	39.5	54	27	9.14	7.30	8.41
February	40.4	57	26	3.64	trace	3.64
March	42.2	70	31	10.16	1.90	9.97
April	46.9	67	31	4.92	0.00	4.92

*Total precipitation is the sum of the rainfall plus the water equivalent of the snowfall, which is depth of snowfall divided by 10.
Source: Monthly summaries, Meteorological Branch, Department of Transport, Canada. (Wm. H. Mackie, Gonzales Observatory, Victoria, B.C.)

The total precipitation during this 12-month period (73.33″) was greater than the 30-year average (66.92″). Precipitation was particularly heavy in November (6.86″ greater than the 30-year average) and March (5.44″ greater than the 30-year average). The total snowfall, however, was small, being 19.6″ compared to the 30-year average of 33.4″.

The mean temperature showed some deviation from the average: the mean temperatures in September and January were at least 4° F. above the 11-year average. May 1963 had some very hot days with the temperature approaching the maximum recorded.

Mean hourly wind direction at the CHWK station for each month is presented graphically in Fig. 4 based upon a 17-hour sample. It will be

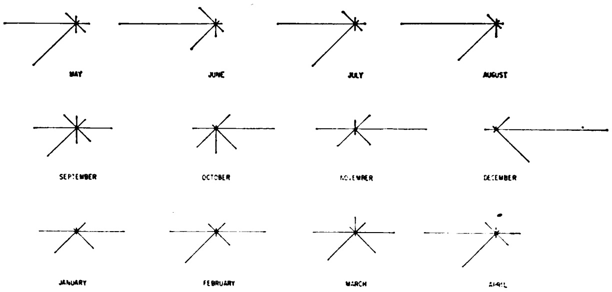

Fig. 4.—Wind direction for Chilliwack, May 1963 to April 1964. Wind direction is towards the centre of the rose. Length is proportional to the frequency of occurrence.

observed that the winds characteristically blow up the valley from the west during the late spring and summer, and down the valley from the east during the late fall and early winter.

In general, the climatology of the Chilliwack area favours the dispersion of air pollutants by ventilation up or down the Fraser Valley. Precipitation is heavy—a climatic feature which "washes down" pollution by particulate matter.

The number of days of sunshine is recorded in Table II for the period the air pollution survey was conducted. These data were prepared by the Meteorological Branch of the Department of Transport from entries on the aviation reports at Abbotsford for the hours 04, 10 and 16 Pacific Standard Time (PST). This airport is situated

TABLE II.—NUMBER OF DAYS SUNNY AND CLOUDY AT ABBOTSFORD AIRPORT, B.C., MAY 1963 - APRIL 1964

Month	*Days sunny**	*Days cloudy**
May	15	16
June	7	23
July	7	24
August	12	19
September	15	15
October	3	28
November	3	27
December	7	24
January	1	30
February	6	23
March	5	26
April	6	24
Total	87	279

*Definitions given in the text.
Source: Meteorological Branch, Air Services, Department of Transport, Canada.

about nine miles southwest of Chilliwack. Cloud amounts were observed and recorded in tenths of the whole sky. The values for these three hours were then totalled: if the total exceeded 15, the day was considered cloudy; if the total was 15 or less, the day was considered sunny. It is clear from these data that only limited photochemical oxidation of hydrocarbons in the air is likely to occur because of the relative scarcity of sunny days.

AIR POLLUTION SURVEY RESULTS

1. *Sulfur Dioxide*

Mean sulfation rates for the five stations were as shown in Table III, and the monthly variation in the mean rate has been graphed in Fig. 5. The

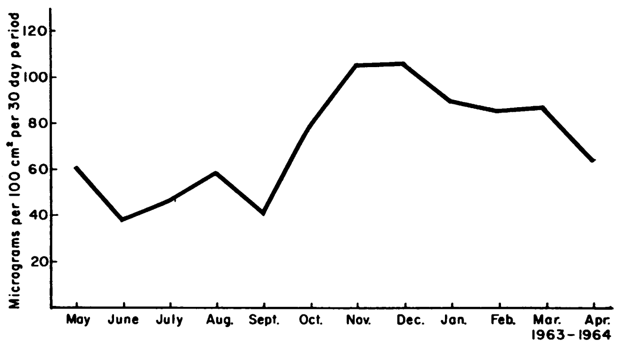

Fig. 5.—Monthly variation in mean sulfation rates for a five-station network established at Chilliwack, May 1963 to April 1964.

three-fold increase in sulfur dioxide pollution from a low level in June to a high level in November is characteristic of most cities and is due mainly to domestic use and space heating during the winter months.

The mean rate for all samples was 73 micrograms (μg.) of SO_3 per 100 sq. cm. per day, the 95% confidence limits for this value being from 56.2 to 89.9 μg. This rate was one-tenth of that found at Berlin, N.H.[11] In comparison, the mean sulfation rate for the city of Vancouver, 65 miles west of Chilliwack, approximated 600 μg.[19] during the winter and spring of 1960-61.

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TABLE III.—RATES OF SULFATION,* CHILLIWACK, B.C., MAY 1963 - APRIL 1964

Month	*Station number* 1	2	3	4	5	*Mean*
May	36	41	51	78	99	61
June	21	30	24	57	58	38
July	(lost)	30	44	61	51	46
August	40	46	57	75	77	59
September	24	27	41	62	54	42
October	30	26	20	196	120	78
November	36	51	15	272	153	105
December	48	45	18	281	141	106
January	ND	42	20	256	131	90
February	51	49	33	195	103	86
March	51	56	105	152	123	97
April	29	39	18	164	72	64
Mean	33	40	37	154	99	73

*Expressed as micrograms of SO_3 per 100 sq. cm. of exposed surface per day.
ND = None detected.

A greater variation was observed between stations than between months (Table III). The comparatively high sulfation rates found at Station No. 4 are to be expected because of its location at the centre of town.

Foran, Gibbons and Wellington[20] have related the values for the sulfation rate obtained with lead peroxide candles to values for sulfur dioxide obtained with a Thomas Autometer. Using this relationship, the mean sulfation rate found at Chilliwack over the 12-month period beginning May 1, 1963, would be equivalent to an atmospheric concentration of sulfur dioxide of less than five parts per billion.

2. *Dustfall*

The mean monthly dustfall for each station and each month were as shown in Table IV, where they have been expressed as the fraction soluble and insoluble in water. The monthly variation in total dustfall has been graphed in Fig. 6. The mean total dustfall for the five-station network was 9.24 tons per square mile per 30-day period, the 95% confidence limits for this value being from 8.12 to 10.36 tons. This was less than one-sixth of the average for Berlin, N.H.,[11] which was based on nine months of observations.

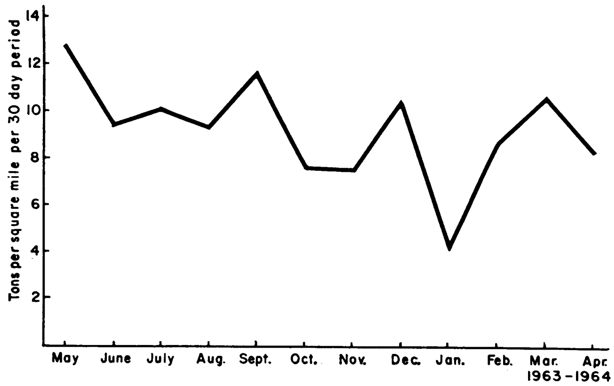

Fig. 6.—Monthly variation in mean total dustfall for a five-station network established at Chilliwack, May 1963 to April 1964.

Apart from unusually low values in January, the monthly variation in total dustfall was relatively small. There appears to be no reasonable explanation for the low values for January. The total dust collected by a dustfall jar consists not only of particulate matter such as fall ash, which settles down, but also of dust picked up by winds from the ground which subsequently falls out. A snow cover or a wet surface can decrease ground pickup. Yet little snow fell in January, and rainfall was less than during the two preceding months (Table I).

The insoluble component of dustfall averaged about 66.7% of the total over the year. The main constituent of this fraction was siliceous rock matter. During the winter months amounts of carbonaceous material and fly ash increased noticeably. X-ray diffraction analysis of typical samples of dust showed the mineral content to be largely silica, with smaller amounts of siliceous minerals such as homblende, feldspar and mica.

TABLE IV.—TOTAL INSOLUBLE AND SOLUBLE DUSTFALL,* CHILLIWACK, B.C., MAY 1963 - APRIL 1964

Station number	*Dustfall fraction*	*Month* May	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*	*Mean*
1	Insoluble	7.80	4.00	4.30	4.85	3.75	2.00	0.80	2.00	0.75	2.80	4.85	4.35	3.52
	Soluble	1.40	2.85	2.35	1.95	1.85	3.10	6.10	3.25	2.65	4.75	4.05	2.35	3.05
	Total:	9.20	6.85	6.65	6.80	5.60	5.10	6.90	5.25	3.40	7.55	8.90	6.70	6.57
2	Insoluble	8.25	4.65	4.15	4.85	5.45	2.60	0.15	3.05	0.30	1.60	4.30	4.55	3.66
	Soluble	1.30	3.55	2.15	2.05	2.10	2.70	3.85	1.55	1.50	2.10	3.45	2.10	2.37
	Total:	9.55	8.20	6.30	6.90	7.55	5.30	4.00	4.60	1.80	3.70	7.75	6.65	6.03
3	Insoluble	15.20	9.80	10.50	11.65	21.90	5.40	1.50	4.60	2.20	6.70	7.25	8.75	8.79
	Soluble	1.75	1.95	1.70	2.10	1.90	2.70	3.35	2.65	2.70	4.35	2.50	1.80	2.45
	Total:	16.95	11.75	12.20	13.75	23.80	8.10	4.85	7.25	4.90	11.05	9.75	10.55	11.24
4	Insoluble	11.50	9.70	9.95	7.05	8.20	5.45	3.85	10.90	3.50	7.90	13.50	10.40	8.49
	Soluble	1.50	1.65	2.20	1.90	1.70	4.15	9.80	9.05	3.00	6.75	5.40	3.35	4.21
	Total:	13.00	11.35	12.15	8.95	9.90	9.60	13.65	19.95	6.50	14.65	18.90	13.75	12.70
5	Insoluble	12.40	6.60	9.65	7.25	9.00	5.00	2.45	11.30	1.45	1.80	4.65	4.65	6.35
	Soluble	2.55	2.55	3.45	2.90	2.60	4.85	5.65	4.05	1.95	4.60	3.40	1.25	3.32
	Total:	14.95	9.15	13.10	10.15	11.60	9.85	8.10	15.35	3.40	6.40	8.05	5.90	9.67
Mean	Insoluble	11.03	6.95	7.71	7.13	9.66	4.09	1.75	6.37	1.64	4.16	6.91	6.54	6.16
	Soluble	1.70	2.51	2.37	2.18	2.03	3.50	5.75	4.11	2.48	4.51	3.76	2.15	3.08
	Total:	12.73	9.46	10.08	9.31	11.69	7.59	7.50	10.48	4.12	8.67	10.67	8.69	9.24

*Expressed as tons per square mile per 30-day period.

The ratio of soluble to insoluble dustfall varied considerably throughout the year. Highest values for the soluble portion occurred in the winter months of heavy precipitation (Table IV). This fraction contains soluble salts such as chlorides, sulfates and nitrates. This seasonal variation is characteristic of that generally observed.

The insoluble dustfall for three stations has been plotted in Fig. 7. Station No. 3 was the more

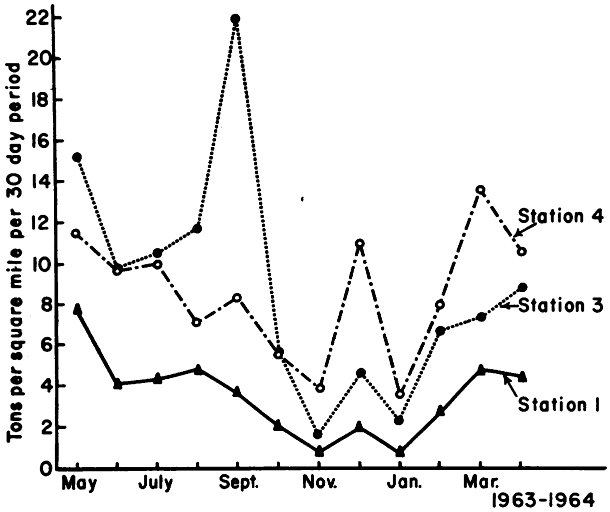

Fig. 7.—Monthly variation in insoluble dustfall for three sampling stations, Chilliwack, May 1963 to April 1964.

rural, while Station No. 4 was located in the centre of the town. Though there was much variation month by month, the insoluble dustfall was highest at the centre of the city in the winter, where it was quite likely the result of combustion; it was highest in the country in the early fall where it was most likely ground pick-up of top soil and dust from the agricultural lands around the city. Similar anomalies have been noted at Winnipeg.[21]

Pollen identified as belonging to the conifer family was found in the dustfall at several stations on two occasions, June 1963 and May 1964.

3. *Soiling Index*

Unfortunately a considerable amount of mechanical trouble was experienced with the A.I.S.I. tape sampler established at Station No. 4, and for this reason only a very few months were recorded in their entirety. The breakdowns, however, were of short duration, and estimates of the mean monthly soiling index are given in Table V. The soiling index is expressed in terms of coefficient of haze (Coh); these values are considered to be roughly indicative of the fine air-borne particles of sub-micron size which contribute very little to the weight of dustfall collected in gravimetric jars. The highest mean values at Chilliwack were observed to occur during the winter months but these values were still very low. Generally, any value below one Coh per 1000 feet indicates a clear atmosphere. Some values above one Coh unit were recorded: there were 21 readings of greater than 1.5 Coh units in December. The highest reading reported was 2.68 on December 12, 1963. October, January and February were the only months with a few readings greater than 1.5 Coh units.

TABLE V.—MEAN MONTHLY SOILING INDEX* AT STATION No. 4, CHILLIWACK, B.C., JUNE 1963 - APRIL 1964

Month	*Soiling index (Coh/1000 linear ft. of air)*
June	0.2
August	0.3
September	0.5
October	0.5
November	0.4
December	0.7
January	0.6
February	0.7
March	0.5
April	0.4
Mean	0.45

*Three-hour sampling periods.

4. *Hydrogen Sulfide*

No measurable amounts of hydrogen sulfide (H_2S) were detected at Station No. 4 during May or July. Since the same instrument was used to measure soiling, it was decided to discontinue bimonthly measurements of H_2S which had originally been planned.

5. *Oxidants and Oxides of Nitrogen*

The results of the survey for oxidants are recorded in Table VI. The values have been reported for an eight-month period only. Modification of the technique as discussed in "Methods" was carried out during the first three-month period. These values indicate that the photochemical oxidation of hydrocarbons and other organic pollutants in the presence of nitrogen dioxide was very low.

TABLE VI.—CONCENTRATION OF OXIDANTS* (INCLUDING OXIDES OF NITROGEN) AT STATION No. 4, CHILLIWACK, B.C., OCTOBER 1963 - MAY 1964

Date of sample	*Sampling period (mins.)*	*Ozone (ppb*)*
October 3/63	60	6
November 4/63	60	14
December 3/63	60	6
January 3/64	60	6
February 3/64	30	3
March 3/64	30	16
April 3/64	30	6
May 4/64	30	16

*Oxidants expressed as parts per billion by volume, measured in terms of ozone equivalent.

6. *Total Hydrocarbons*

The total hydrocarbons were measured by spot sampling at all stations to ascertain if there was in fact much pollution of the atmosphere by petroleum products even though there was probably insufficient sunlight to cause much photochemical oxidation. The results are presented in Table VII. Station No. 1 was located on a carport and the readings here might be expected to vary with the movement of the car. Station No. 4 was located two storeys above the busy main intersection of the city ("Five Corners"). It is of interest that even at this sampling site, low levels of total hydrocarbons

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TABLE VII.—CONCENTRATION OF TOTAL HYDROCARBONS,* CHILLIWACK, B.C., JUNE 1963 - MAY 1964

	Station number				
Sampling date†	*1*	*2*	*3*	*4*	*5*
June 3/63	—	0.17	0.08	0.20	0.06
July 3/63	0.12	0.07	0.11	0.12	0.07
August 2/63	0.16	0.21	0.12	0.09	0.08
September 3/63	0.11	0	0.04	0.09	0
October 3/63	0	—	0.02	0.05	0
November 4/63	0	0	0.02	0.10	0
January 3/64‡	0	0	0	0	0
February 3/64	0	0	0.08	0.01	trace
March 3/64	0	0	0	0.02	0
April 3/64	0	0	0.39	0	0
May 4/64	0.25	0	0.08	0.11	trace

*Expressed as parts per million by volume in terms of pentane equivalents.
†Samples taken between 10:00 a.m. and noon.
‡Readings for December were omitted as being unreliable owing to suspected contamination of the sampling bulbs.

were obtained. On April 3, a slight odour of gasoline was noted at Station No. 3, which probably accounts for the high value obtained for that particular sample.

Though these values have been expressed as pentane equivalents, it is probable that a large percentage of the total hydrocarbons recorded is methane from natural biological processes; if that should be the case, then the amount present would be four to five times as great as indicated in Table VII. This is because the flame ionization detector used in the gas chromatograph is considerably more sensitive to pentane (used as the standard) than methane. Even in view of this level of sensitivity, the values found at Chilliwack are low; the concentration of methane found in urban atmospheres has been reported to range between 1.5 and 2.5 parts per million.[22]

DISCUSSION

Chilliwack, B.C., has been shown by this study of air quality to be relatively free from air pollution. Because methods were selected to conform with those used in a previous survey of Berlin, New Hampshire, some comparisons can be made between these two communities.[23]

It is tempting to compare this aerometric description of Chilliwack with aerometric descriptions of other communities. This is not always wise because of differences in the method of collecting and analyzing these data.

This problem is exemplified by the measurement of dustfall. Dustfall measurements are greatly influenced by the shape and size of the collector so that comparisons of dustfall rates cannot readily be made.[24] Furthermore, in many cities of North America, only insoluble dust is measured and reported as total dustfall. Comparative data have been presented in Table VIII for a number of Canadian communities taken from publications of the International Joint Commission on pollution in the Detroit River area[25] and from data reported by Katz.[21] Comparable data from Chilliwack have

TABLE VIII.—MEAN MONTHLY DUSTFALL IN VARIOUS CANADIAN COMMUNITIES

City	*Year*	*Mean corrected* dustfall (tons/sq. mile/month)*
Sydney, N.S.	1958	53
Montreal	1960	60
Ottawa, Ont.	1956-57	31
Toronto (industrial)	1956	85
(industrial—residential)	1956	44
(residential—semi-rural)	1956	22
Windsor, Ont. (industrial)	1955	83
(residential—commercial)	1955	47
(residential—semi-rural)	1955	36
Winnipeg, Man.	1958	49
Vancouver, B.C.	1957	21
Chilliwack	1963-64	11

*Corrected to correspond roughly to the data obtained with the Detroit - Windsor collector.
Source: Prepared from references 21, 24 and 25.

been added to this table to emphasize that dustfall is relatively low in this town. The standardization of the Chilliwack measurements to those expected with the Detroit-Windsor collector has been done by assuming that the collector used at Chilliwack, which has a 6″ diameter, is comparable to the "Pittsburgh bowl" tested by Fisher.[24]

In like fashion, the soiling index is not comparable without careful standardization of sampling time, air flow and area of the spot.[26] In Canada a two-hour sampling cycle is generally used, while at Chilliwack a three-hour cycle was chosen. The relationship between the optical density of a spot of soiling and the duration of sampling is such that the soiling index will be depressed with a longer sampling time.[26] At low levels of soiling, however, this may not be a problem. Some soiling indices for a variety of Canadian communities have been presented in Table IX. Again, Chilliwack is noted to be relatively free from fine air-borne dust particles.

TABLE IX.—SOILING INDEX FOR VARIOUS CANADIAN COMMUNITIES

City	*Mean soiling index (Cohs/1000 linear ft. of air)*
Ottawa (commercial district)	2.2
Windsor (urban)	1.8
Winnipeg (central business)	0.8
(residential)	0.4
Vancouver (commercial)	1.1
Harrow, Ont.	0.6
Chilliwack	0.5

Source: Prepared from references 21 and 25.

Despite these words of caution, it is clear that Chilliwack has the quality of air expected in a small community in a rural setting. Evidence from the network of sampling stations indicates that neither a reducing nor an oxidizing type of atmospheric condition is to be found in this town.

SUMMARY

A brief description has been given of the year-long survey of the air quality of Chilliwack, B.C. Sampling for dustfall, soiling, sulfation, hydrogen sulfide, oxidants and total hydrocarbons was conducted by a network of five stations from May 1963 to April 1964. Some meteorological measurements were also made. The results of this survey indicated that Chilliwack was relatively free from any air pollution and would therefore be a suitable control town for studies of the relationship between air pollution and chronic non-specific respiratory disease.

The excellent co-operation of Dr. A. S. Arneil and his staff at the Upper Fraser Valley Health Unit, and of Mr. H. Fulton of the Dominion Department of Agriculture is gratefully acknowledged. We are also grateful to the management of Radio Station CHWK for supplying meteorological data.

A portion of this paper has been presented by Mr. Williams to the Pacific Northwest International Section of the Air Pollution Control Association, Portland, November 5, 1964.

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PAGES OUT OF THE PAST: FROM THE JOURNAL OF FIFTY YEARS AGO

"GULLY ROOT", GONORRHEA AND STONES

The patient, F.C. (British descent), aged 32, had been admitted to the Barbados General Hospital in January, 1910, suffering from acute retention of urine. He had contracted gonorrhœa two weeks previously, and had neglected treatment until the day before admission, when he drank a bush tea made from the leaves of a native plant called "gully root". This decoction produces intense irritation of the genito-urinary tract, congestion, strangury, and frequently hematuria, and has a local reputation for the cure of gonorrhœa. His bladder was found distended. I passed a catheter without encountering obstruction or stone, and twenty ounces of cloudy urine were withdrawn. The patient left hospital four days later, and nothing was heard of him until January 4th, 1915, when he presented himself to be treated for a swelling of the penis just anterior to the scrotum, associated with passage of very cloudy urine. This swelling was about the size of a hen's egg, and on palpation gave the same impression as does a fowl's crop when full of Indian corn. Diagnosis was made of urethral calculi, and this was confirmed by x-ray examination.

The patient was admitted and given a mixture containing urotropin for a few days. I operated on January 9th, and removed eleven facetted stones. On passing a catheter prior to operation a stone was encountered about midway in the penile urethra. The catheter was kept in position by an assistant, to act as a guide for the urethra, and an incision was made from the tip of this catheter downwards and in the mid line of the sac for two inches. Eleven stones were removed from a smooth-walled sac, which undoubtedly was a fusiform dilatation of the urethra. This sac was about two inches in length and, in its broadest part, one and a half inches. The corpus cavernosum was slightly altered in shape, but nearly all the bulging was lateral and anterior. A number twelve bougie was passed without obstruction, and the bladder was searched for stones, but none were found.

According to Fenwick (Trans. Path. Soc. London, 41: 188, 1890) such multiple stones may be retained in extra-urethral sacculations. In this case there was simply a fusiform dilatation of the penile urethra containing eleven facetted calculi bathed in pus. I therefore removed the greater part of the sac, leaving a sufficient expanse of the dorsal wall to form—the edges being brought together by suture—a urethra of normal size. It is deserving of note that there was no stricture of the urethra either anterior or posterior to this sac. A number twelve catheter was passed and left *in situ* for eight days. I left the skin incision open for some little time, in case of any leakage. The patient was discharged cured on January 20th.

While isolated impacted urethral calculi are occasionally encountered, these cases of multiple formation of calculi either in sacculations or in dilatations of the urethra are so rare that each case deserves record. Cases of calculi in sacculations, if I mistake not, are in general post-scrotal, in connection with the prostatic and membranous portions of the channel. Most of the reported cases of urethral calculus, in fact, deal with their presence in the prostatic or membranous regions. Isolated calculi are occasionally impacted in the spongy portion, sometimes in the fossa navicularis, but of multiple calculi in the spongy portion Dr. Adami tells me that he knows of only one case: there is, namely, in the Museum of St. Bartholomew's a portion of a collection of 149 calculi stated to have been removed from the middle of the spongy portion.—Case Report, G. M. Manning, *Canad. Med. Ass. J.*, 5: 508, 1915.