

## T H E S I S

Quantitative Analysis of the Air of some of the Public  
Buildings in and near Manhattan

May Harris

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Outline of Thesis.

Subject : Quantitative Analysis of the Air of some of the Public  
Buildings in and near Manhattan

Buildings Tested :

1. College Buildings

1. Auditorium
2. Chemical Laboratory
3. Domestic Science Hall - basement.

11. In Manhattan

1. First M.E.Church
2. Carnegie Library
3. Central School
4. Avenue School
5. Douglas School - colored

The discovery of bacteria opened a large and attractive field for original work. One of its most interesting features is that new and intimate relations are constantly being found between the minute plant life and the health and activities of man and the other animals.

The health of mankind depends in a large measure upon the effective work of bacteria in disintegrating organic substances which would become a menace and source of disturbance to the normal body processes.

These bacteria have been found to be always present in air, water and earth. The object of the experiments here recorded was to determine the relative number of bacteria in the air when quiet and when disturbed, and to gain an idea of the number present in the air of public buildings under the usual conditions.

Method : Two tests were made for each building, the material used being agar plates, which were exposed in different parts of the room or building :

- A. When the air was quiet and the room unoccupied or but two or three present. This test was usually made in the morning before the room had been occupied or the air disturbed.
- B. When the air was in motion, due either to the presence of a number of people, or to the commotion caused by sweeping, this test being made, if possible, in the afternoon when the room or building had been occupied the greater part of the day.

The time of the exposure was determined by preliminary experiments the four minute exposure seeming to give the best results.

Preparation of the plates : The Petri dishes, after being boiled twenty minutes, were washed and covered with a cleaning solution for at least twenty minutes, then rinsed with water and allowed to drain until dry. They were next placed in the hot air sterilizer and kept at  $150^{\circ}\text{C}$  for an hour and after cooling were partially filled with agar from tubes which had been sterilized on three consecutive days. When the had solidified they were placed in the incubator for 48 hours and if, at the end of that time, they were not contaminated they were ready to be exposed. After exposure they were again placed in the incubator and when 48 hours had expired the colonies were counted. Those in the first group were counted again in 24 hours.

## Data

## 1. Auditorium

## A. Before Chapel

Nov. 11, Clear

A few members of the orchestra present

No.	Part of building	Colonies	Molds
1.	West side	14	0
2.	Middle	8	3
3.	East side	11	1
Totals		33	4
Average		11	1.3+

## B. After Chapel

Nov. 4, Rainy.

Students passing out

No.	Part of building	Colonies	Molds
1.	West side	28	0
2.	Middle	64	5
3.	East side	47	10
Totals		149	15
Average		50-	5

## 2. Chemical Laboratory

## A. At the noon hour

Nov. 7, Clear

No.	Part of building	Colonies	Molds
1.	South Laboratory	4	2
2.	Middle "	5	1
3.	North "	4	1
Totals		13	4
Average		4.3+	1.3+

## B. Afternoon

Nov. 7 &amp; 11 Clear

Nos. 1 &amp; 2 exposed Nov. 11 during sweeping

No. 3 " " 7 while a class was in session

No.	Part of building	Colonies	Molds
1.	South Laboratory	0	1
2.	Middle "	1	1
3.	North "	23	2
Totals		24	4
Average		8	1.3+

It happened as has since been determined, that there had been no class in the middle and south laboratories on the day the plates were exposed. The sweeping was done with a brush and since the floors are oil finished there was no perceptible dust raised. The janitor boy was the only person moving about the room and these facts would seem to account in a measure for the small number of bacteria found.

### 3. First Methodist Episcopal Church

#### A. Before choir practice Dec. 12

Four persons sitting quietly in the church

No.	Part of building	Colonies	Molds
1.	Choir seats	1	0
2.	Middle section	6	2
3.	West Section	2	2
Totals		9	4
Average		3	1.3+

#### B. After the Sunday evening service Nov. 12

No	Part of building	Colonies	Molds
1.	East section	58	6
2.	Middle "	82	13
3	West "	68	12
Totals		208	31
Average		69.3+	10.3+

There were more varieties as well as a larger number of bacteria in the plates exposed in the middle section.

The data for the auditorium, chemical laboratory and M.E Church has been grouped together because the plates were made from the same media and were subjected after exposure to about the same conditions. Considerable difference in the averages will be noticed between this and the following group.

The media for the last group was probably better suited to the requirements of bacterial growth than that used for the first. This may or may not have been due to the fact that the first was made from beef and the second from beef extract. Besides, the thermo-regulator had been placed in the incubator and for this reason a much more even temperature was maintained. I am confident that the uniformity of temperature had much to do with the more satisfactory results obtained from the plates exposed during the last week or two of the term. A set exposed in the library and school houses down town a week before the thermo-regulator was placed in the incubator gave averages of but from 5 to 25 colonies and the exposures were made during school hours or while the pupils were passing from the building. Upon examination it was found that in the two days incubation previous to exposure the plates had become so dry as to prevent the growth of any but the most vigorous bacteria and molds; for this reason the data was discarded.

In all cases the colonies were counted at the end of 48 hours but those in the first group were counted again the next day and the data here given was that of the second count at the expiration of 72 hours. In the second, circumstances being more favorable the development was more rapid and the count used was that taken after 48 hours, because the second count gave practically the same results as the first.

#### 4. Domestic Science Hall-basement laboratory

##### A. Unoccupied 12.15 P.M. Dec.18

No.	Part of building	Colonies	Molds
1.	Opening between lab. & laundry	76	3
2.	South table	35	0
3.	North West window		
Totals		111	3
Average		56	1.5

No. 3 had to be discarded for the plate was too dry.

B. During sweeping Dec. 22, Clear.  
Several persons moving about.

No.	Part of building	Colonies	Molds
1.	Opening between lab. & laundry	15	0
2.	South table	30	1
3.	West window	65	1
Totals		110	2
Average		37-	1-

#### 5. Carnegie Library

A. 11.45 A.M. Dec. 18, cloudy

No.	Part of building	Colonies	Molds
1.	North reading room	63	3
2.	South reading room	127	2
3.			
Totals		190	5
Average		95	2.5

B. Closing time 5.55 P.M. Dec. 22 Clear  
Five persons present

No.	Part of building	Colonies	Molds
1.	Librarians desk	37	0
2.	South reading room	147	0
3.	North reading room	198	1
Total		382	1
Average		127	0+

## 6. Central school

A. Before school 7.40 A.M. Dec. 21 Clear			
No.	Part of building	Colonies	Molds
1.	South east room	24	0
2.	South west room	21	0
3.	Hall	185	0
Total (first two)...		45	0
Average " "		23	0

The janitor came around with his feather duster while the third plate was being exposed, hence it could hardly be counted in and called a fair test.

## B. About 9.20 A.M. Dec. 18, Cloudy

About 35 children in the room

No.	Part of building	Colonies	Molds
1.	South east room	39	2
2.	" " "	23	0
3.			
Total		62	2
Average		31	1

## 7. Avenue School.

A. Before school 8.A.M. Dec. 21 Clear			
No.	Part of building	Colonies	Molds
1.	& Hall	155	0
2.	Near west door of hall	104	0
3.	Near central radiator	50	1
Total		309	1
Average		103	0

B. Hall - as the children passed in  
10.45 A.M. Dec. 18, cloudy

No.	Part of building	Colonies	Molds
1.	Hall	158	0
2	Near west door of hall	94	1
3.	Near radiator	43	0
Total		295	
Average		98+	0

One reason for the difference in numbers between this and the other schools may be due to the plates being exposed on the floor in this building, while in the others the exposure was made from the desks.

In A three of the teachers passed through the hall before the exposure was completed

#### 8. Douglas School

A. Before school Dec. 21 8.15 A.M. clear

No.	Part of building	Colonies	Molds
1.	South room	47	0
2.	" "	68	0
3	North "	46	1
Totals		161	
Average		53	0

B. 11:30 A.M. Dec 18, cloudy

35 in in South room, 24 in north

No.	Part of building	Colonies	Molds
1.	South room - entirely covered by film of growth		
2.	" "	150	0
3.	North room	93	1
Total (for 2 and 3.)		243	1
Average		121	0

One lot of 25 plates was filled when there was a large class in the laboratory and after 48 hours incubation 13 were contaminated. Ascribing this to the movements of the students about the table, I filled the next lot about an hour after the class had gone and the laboratory contained but one or two persons. The result was that out of 17 plates 14 were all right and the contamination of the remaining three was slight in comparison with the others.

The different kinds of bacteria on each plate ranged from three to ten - six or seven being the usual number. In all I found about fifteen different kinds.

The colors ranged from white, through, yellowish white, yellow and salmon pink to orange. In one form a brownish ring, with a radius of from one-eighth to one-half inch, extended around the whitish colony about the size of a pinhead.

#### Group 1

A. No. of colonies range from 3 to 11  
 B. " " " " " 8 " 69

#### Group 11

A. " " " " " 23 " 103  
 B. " " " " " 31 " 127

In none of the tests was the air heavily laden with dust. The object was to make the tests under ordinary conditions rather than to make a comparison of quiet air and dust laden air in motion.