means?" the Americans are quite as fond of statistics as we are, but they manage to present them in a more condensed form. Take the following example: The Newton Baptist College, Massachusetts, on May 15th completed its sixty-fifth "commemorate work." In the report of particulars it is stated that 15 gentlemen graduated—their average age was 29, their average weight 159 lbs., their average height 5 ft. 10 in., and their average size of hat $7\frac{1}{4}$ in.

Talking of news from the States, a recent despatch brings word that a Sioux Indian has graduated in medicine at the Boston University. It is hard enough in England having to compete with the fair sex, but to have a red Indian luring away one's patients, or as a rival for an appointment as county medical officer, would be really too trying.

It is not often that bishops introduce Bills in Parliament. However, the Bishop of Peterborough has done wisely in breaking through the unwritten rule of abstention in this respect. His measure to amend the law relating to insurances on the lives of children, deserves the good wishes of all sane men, and, if passed, will do much to protect children from the wickedness of parents and guardians. However, the bishop's Bill hardly goes far enough. What is wanted is a short legislative enactment prohibiting altogether infant life insurance by companies or firms, and empowering the Government to enter into an agreement to inter any child free of cost, on the parents or guardians taking out a policy on its life, and paying a small monthly premium at the nearest post office. All the expenses would thus be met, and decent burial secured for less than half the payments now made to burial clubs in respect of young children. However, economy is a secondary consideration, the main object is to do away with all temptations to infanticide by securing that the death of an infant shall never put a sovereign in its parent's pocket.

Attention has again been called, at a coroner's inquest, to the danger to children from their use of transfer prints. Little pictures, scarcely more than an inch square, are printed in bright colours, in such a way that on moistening the surface with the tongue the picture may be transferred to the child's face or hands or arms. The pigments employed contain lead, and often arsenic and copper, when body-colours are used, and some of the transparent colours, such as gamboge, are scarcely less unwholesome. As the little pictures are to be purchased for about 24 a penny, a very small sum will buy transfers enough to produce symptoms of acute poisoning. This danger has been pointed out before from time to time, still the sale of the objectionable transfers goes on, and there seems to be no power to forbid it.

FREE LANCE.

THE NUMBER AND DISTRIBUTION OF MICRO-ORGANISMS IN THE AIR OF THE BOSTON CITY HOSPITAL.

By GREENLEAF R. TUCKER, S.B.

(*Twentieth Annual Report, State Board of Health, Massachusetts.*) [Abstract.]

THE following is an abstract of experiments which were begun in November, 1888, and continued uninterruptedly for three months. The winter was exceptionally mild, and the ground practically free from snow.

The hospital, the air of which was investigated, was the Boston City Hospital, which consists of thirteen buildings, nine being exclusively devoted to the sick. The hospital has two great pavilions, the one surgical the other medical. There are also buildings for contagious diseases. The hospital only receives acute cases. The number of patients admitted during 1888 was 5,875. The method employed in the investigation presents several new features, and is thus described:—

The apparatus used consists essentially of three parts: (1) A glass tube of special form, to which the name of *aerobioscope* has been given (see A in illustration); (2) a stout common cylinder of about sixteen litres capacity, provided with a vacuum gauge, B; (3) an air pump, D. The *aerobioscope* through which the air is aspirated is six inches long, and one and three-quarters inches in diameter at its expanded part; the upper end of it is narrowed somewhat to a neck one inch in diameter, and one inch longer. To the lower end is fused a piece of glass tubing six inches long, and three-sixteenths of an inch in bore, in which to place the filtering material.

Preparation of the *aerobioscope*: Upon the narrow part of the tube, two inches from the lower end, a slight mark is made with a file, and a little roll of brass gauze is inserted, which serves as a stop for the filter to be placed above it. Beneath the gauze stop is placed a small plug of cotton wool, and the open ends are then plugged with cotton wool; the tube is now placed in a sterilizer, and subjected to a heat of at least 150° C. for one or two hours. When cool, the non-sterilized cotton-wool plug is carefully removed from the neck, and sterilized No. 50 granulated sugar is poured in, until it just fills the four inches of narrow tube above the gauze stop. This column of sugar weighs one gramme, and is the filtering material employed to engage and retain the micro-organisms. The cotton-wool plug being replaced, the tube is again placed in the sterilizer, and re-sterilized for several hours at 120° C.

Taking the air sample: In order to measure the amount of air used, the value of each degree on the vacuum gauge is determined in terms of air, by means of an air meter, or by calculation from the known capacity of the cylinder. This fact

ascertained, the negative pressure indicated by the needle on exhausting the cylinder shows the volume of air which must pass into it to fill the vacuum. By means of the air pump, one exhausts the cylinder until the needle reaches the mark corresponding to the amount of air required. A sterilized aerobioscope is attached to the cylinder, in an upright position, by means of a clamp; and, to establish communication between the two, they are joined together by means of a rubber tube attached to the lower end of the aerobioscope and to a stop-cock on the cylinder. For removing and protecting the sterilized cotton-wool plug while the air is being drawn through the tube, a very simple device is used. A glass shield with a neck slightly larger

under proper precautions, and the neck closed with a perforated sterilized rubber stopper, plugged with cotton wool. On rotating the tube, the sugar all dissolves in the gelatine, leaving the germs uniformly distributed through it. The gelatine is now congealed in an even film upon the inside of the tube, where, after four or five days, the colonies will develop, and can be counted by the aid of squares engraved upon the glass. The following cut shows the apparatus set up ready for use.

- A Aerobioscope.
- B Air Cylinder.
- C Vacuum Gauge.
- D Air Pump.
- E Glass Shield.

APPARATUS FOR THE QUANTITATIVE DETERMINATION OF MICRO-ORGANISMS IN AIR.

than the neck of the aerobioscope, and bearing a rubber finger-cot, is pushed down over the cotton-wool plug; when, by compressing the rubber, the plug can be removed (inside the shield), and remains suspended there. The plug removed, the cock is opened, when air will pass through the aerobioscope, leaving its germs in the sterilized sugar filter.

Cultivation of the germs: The aerobioscope, after the air has been drawn through, is taken to the culture room for further treatment. The tube being held in a nearly horizontal position, the sugar (which contains the germs) is made to run into the body of the tube, by a gentle tapping. Melted sterilized nutrient gelatine (25 c.c.) is now added,

Experiments were first made upon the germ contents of the outside air, and the mean of a number of these determinations showed that ten litres of the air outside the hospital contained on an average ten colonies of bacteria to seven of moulds in November; fourteen of bacteria, six of moulds in December; thirteen of bacteria and three of moulds in January, 1889.

It was also found that the number of bacteria was greater on clear than on rainy days, but that the moulds remained the same. Both moulds and bacteria were more numerous on rainy days than was expected; this, it is suggested, was owing to the fact that the experiments were made under some stone steps near a basement door frequently opened by employes.

In the original paper each ward is described, and the details of results given in full. Here we can only cite examples illustrating the chief conclusions. Taking, for instance, the medical and surgical pavilions, the following table gives the average number of bacteria and moulds found in ten litres of air:—

Medical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
WARDS.				WARDS.			
	F.	G.	H.		F.	G.	H.
Bacteria ...	15.8	13.0	33.3	Bacteria...	15.2	49.7	62.5
Moulds ...	9.2	9.0	13.2	Moulds ...	1.5	1.3	5.2

Surgical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
WARDS.				WARDS.			
	B.	C.	D.		B.	C.	D.
Bacteria ...	6.8	5.6	13.0	Bacteria...	24.7	15.8	16.5
Moulds ...	6.6	2.8	8.2	Moulds ...	13.5	20.0	26.5

The table shows the following results:—

I.—Bacteria are more abundant in the medical than in the surgical pavilion.

This appears a very important and significant fact. Here are two buildings exactly alike, all the conditions within being the same, except that in one are medical, in the other surgical, patients. If the organisms come entirely from the outside air, there is no reason why both buildings should not contain practically the same numbers. It seems probable, therefore, that a portion at least of the bacteria found in the medical wards is due to the class of diseases assigned to them.

II.—Bacteria in both medical and surgical wards are more abundant mornings than afternoons.

This is due to the conditions of the wards at the time of experiments. In the morning the disturbing influences are many—bed-making, sweeping, dusting, changing of surgical dressings, toilet and general care of patients. Such work occupies the time between seven and ten a.m., at which time morning samples were taken. This general disturbance of the morning distributes the organisms throughout the air, where we find them in increased numbers; while in the afternoon a sufficient time has elapsed for many of them to settle out again.

III.—In the afternoon micro-organisms are most abundant in the upper wards of each pavilion.

Ward H in the medical and D in the surgical pavilion are seen to be higher in micro-organisms in the afternoon than the other wards. There are two reasons for this: First, cubic space; second, unusual disturbance by patients. The cubic space per bed for the lower ward is 1,265 cubic feet; for the upper ward, 790 cubic feet. This comes from the difference in height—16 feet for the lower

wards, against 10 feet for the upper wards. The unusual disturbances alluded to in these wards consists in a greater amount of walking about. There are fewer helpless cases, and consequently a larger proportion are up and about the wards. So much movement in a ward keeps the micro-organisms more completely in suspension, so that large numbers are more uniformly found throughout the afternoon than in more quiet wards with greater cubic space.

IV.—Female wards contain less micro-organisms than the male wards.

There is far less commotion in a female than in a male ward, women being much more quiet than men. Such patients as are able to be up remain, as a rule, sitting quietly by their bedsides, so that the fewer number of micro-organisms in the air of a female ward is quite what we should expect.

The next example taken, that will be cited from Mr. Tucker's paper, will be the results obtained from an examination of the air of the contagious wards.

CONTAGIOUS WARDS.

The two new wards for infectious diseases are practically alike. They are connected with each other and the rest of the hospital group by two-story corridors, the upper story being open and the lower one enclosed.

Each building may be considered as divided into five sections. The centre section contains the service-rooms: on either side is an open ward, and in the end sections are placed the isolating-rooms. A second story over each end section furnishes room for more complete isolation of patients when necessary. The open wards are 25 feet 8 inches, by 35 feet 4 inches, and are 16 feet high; giving to each bed, eight in number, 1,200 cubic feet of air.

In the centre of each ward is a square ventilating shaft, 5 feet by 4 feet, and on two sides are fireplaces. None of the basement rooms are intended for occupancy. The space under the wards has concrete floors, and is white-washed. Air is admitted by direct inlets, placed at proper intervals in the basement walls, and by means of a diaphragm may be made to pass over coils in galvanized iron boxes, or may pass directly to the wards without going over the coils. The system will supply 48,000 cubic feet of warm air per hour, or 6,000 cubic feet per patient. The upper portions of the wards are ventilated through register faces in the walls and ceilings, and thence upwards to a ventilating ridge chamber. The lower portions of the ward are ventilated downwards through registers in the floors, and thence to the aspirating shaft in the centre of each ward. The capacity of each ward is 24 beds, or, including the chambers, a total capacity for both wards of 72 beds. Ward A is devoted to the treatment of scarlet fever, ward E to diphtheria.

CONTAGIOUS WARDS.

Ward A (Scarlet Fever). Samples taken Afternoons, November, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 10	—	72	4	1	2	Sample taken in A, North. Ward quiet.
„ 15	—	73	7	12	2	Sample taken in A, South. Three visitors present. Ward quiet.
„ 21	—	64	7	0	2	Sample taken in A, North. Ward quiet.
Average				4.2	2	

Ward E (Diphtheria). Samples taken Afternoons, November, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 1	3.00 p.m.	73	5	4	5	Sample taken in E, South.
„ 10	2.15 „	72	4	7	6	Sample taken in E, North. Ward quiet.
„ 15	2.45 „	73	7	17	0	Sample taken in E, South. Three visitors. Nurse caring for patients. Ward quiet.
„ 21	3.15 „	74	7	1	5	
Average				7.1	4	

Ward E (Diphtheria). Samples taken Mornings, December, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Dec. 1	12.00 a.m.	68	4	0	7	Sample taken in E, South. End window open.
„ 5	11.35 „	69	6	0	0	Sample taken in E, North. Ward quiet.
„ 10	11.35 „	74	7	4	7	Sample taken in E, South. One visitor.
„ 14	10.35 „	65	—	8	4	Sample taken in E, North. Making beds.
„ 26	11.40 „	—	6	5	17	
Average				5.8	6.4	

The above tables, representing the determinations made in the contagious wards, show a freedom from micro-organisms not to be found in any other wards of the hospital, the nearest approach to them being the three female medical wards.

These buildings, being divided into sections, although communicating, furnish wards about the size of the three female wards, but with fewer beds; and the results obtained in wards of this character show that they are less likely to become contaminated with micro-organisms than the larger wards.

All the conditions which are unfavourable to a vitiated atmosphere, except the patients themselves, are found in these wards. The buildings are new, sanitary conditions perfect, ventilation good, cubic space large, great cleanliness of rooms and furni-

ture, and an intelligent and abundant use of disinfectants. Nevertheless, in spite of the greatest precautions, the opportunity of infectious material being set free in the room exists in the treatment and care of patients. Diphtheritic patients especially receive a vast amount of spraying, douching and painting of throats. Discharges from the mouth and nose are very profuse, and offensive in odour. Cloths, bits of rag, and feathers are used in removing such discharges; but, with all precautions, bedding and clothing of patients, especially children, must become more or less contaminated, and from these infectious material is transmitted to the air.

The duties of the nurses in these wards are very laborious; but, the separate wards being small, the work is carried out in a quiet manner, and the commotion of the larger wards is never seen in them.

Up to the present point, it has been the object of this paper to show the number and distribution of micro-organisms in the wards of the hospital; it now remains to consider some other facts brought out by these experiments. It has been shown that the micro-organisms present in the air of a room in the forenoon exceed those found in the afternoon, and that this is due to the disturbances which always occur in the morning. We should therefore think of them as associated with the room itself, rather than with the air; for the air of a room, if left undisturbed, soon becomes practically free from organisms. That there are micro-organisms at all in the air of rooms, depends upon whether they are occupied or not, or upon the degree of commotion in them. With a view to finding out how nearly the air of the wards became free from micro-organisms under the most favourable conditions, the following experiments were carried out between eleven and twelve o'clock at night:—

Night Work.

Date.	Ward.	Time.	Bacteria.	Moulds.
Dec. 27....	B	11.20 p.m.	1	4
„ 27.....	C	11.45 „	2	1
„ 27.....	D	12.10 a.m.	0	2
„ 28.....	F	11.15 p.m.	1	0
„ 28.....	G	11.35 „	0	1
„ 28.....	H	11.52 „	13	3

Between seven and eight o'clock p.m. helpless patients are made comfortable for the night, others prepare for bed, and at eight o'clock the lights are turned out. One person is on duty in each ward during the night. Usually a few very sick patients require attention; but, with this exception, the wards remain quiet until morning.

It will be noticed, from the table of night work, that the wards in which these determinations were made are those belonging to the large three-storey medical and surgical buildings, where all our greatest numbers of micro-organisms were found. These experiments show conclusively that the air

of a room vitiated by bacteria will in three or four hours become practically free from them, if disturbing influences are removed. The determination in ward H gave 13 bacteria and 3 moulds—numbers nearly as large as we should obtain under ordinary conditions. Unusual results of this kind cannot be anticipated, and, as four or five days are required to complete a determination, the cause can seldom be traced. The moulds are a trifle higher than the bacteria, in numbers; which is what we should expect, for we know that moulds are relatively lighter than bacteria, and of course remain suspended longer.

EXPERIMENTS BEFORE AND AFTER SWEEPING.

The following experiments were undertaken to bring out more clearly the effects of unusual disturbances in increasing the numbers of micro-organisms in the air of a ward. The greatest amount of commotion occurs between 7.30 and 9.30 a.m., and the greatest amount of dust is caused by the first sweeping of the morning. There is a good deal of dust, lint, etc., upon the floor of these large wards in the morning; and, as dust and micro-organisms go hand in hand, we should expect to find micro-organisms more abundant just after sweeping than at any other time. The following table of determinations, made just before and after sweeping, shows this to be the case:—

Date.	Ward.	Before Sweeping.		After Sweeping.	
		Bacteria.	Moulds.	Bacteria.	Moulds.
Dec. 18	F	56	1	99	2
" 27	B	23	3	55	26
" 27	C	32	22	104	40
" 27	D	31	32	30	37
" 28	F	104	2	160	3
" 28	G	45	2	38	15
" 28	H	43	8	81	1
Jan. 2	P	40	12	10	11
" 2	T	26	15	24	13
" 3	B	20	6	7	30
Average		42	10.3	70.8	17.8

The average number of bacteria found after sweeping is seen to be nearly twice the number found before sweeping. The ratio of bacteria to moulds in these wards is in the proportion of 4 to 1, under both conditions.

The table not only shows the effect of sweeping, but the whole general effect attending the opening of a large general ward in increasing the number of micro-organisms. We have seen by the previous table of determinations, made about midnight, that the micro-organisms of a ward practically all settle out in three or four hours. It follows, then, that the air remains free from them throughout the night, and is free at the time of opening the ward. The number of bacteria present in ten litres of air at any time after midnight is one or less than one. If, then, we consider the number present at the

beginning of the hospital day as one, the increase in numbers due to disturbances caused by routine work of the morning, other than sweeping, would be as 42 to 1; and, including sweeping, as 61 to 1.

Probably the greatest factor, next to sweeping, in increasing the number of micro-organisms in the air of a room, is bed-making. The hospital bed, made up, measures about 8 feet 3 inches, by 2 feet 6 inches; which gives, in a ward of 28 beds, 577 square feet of surface area—a little more than one-fourth the total floor area. These beds, of course, cover an amount of floor space equal to their size; so that, in reality, the surface which they present to falling organisms is about one-third the whole surface exposed. In the process of bed-making, many of the organisms which have previously settled out upon the clothes are again wafted into the air, as of course would be any slight bacterial discharges with which the bed linen might be contaminated. In case of noticeable discharges, the soiled linen is immediately removed, with proper precautions.

ADMINISTRATION AND OTHER BUILDINGS.

No standard has hitherto been proposed for the number of micro-organisms habitually present in the air of hospital wards. The terms large and small, as applied to the number of organisms found in this investigation, have therefore been used entirely in a relative sense. The determinations that have been made upon outside air, while useful as a comparison, cannot properly be taken as a standard of the purity of the air of rooms; for individual experiments made on outside air and the air of wards at about the same time show no relation whatever, and it is quite possible for rooms of the better class to contain far less organisms than outside air. In the absence, then, of a proper standard of purity for hospital air, it seemed that an investigation of the air of certain hospital buildings not occupied by the sick would afford a useful means of comparison. With this object in view, the air of the following buildings was examined:—

First.—Administration building.

Second.—Nurses' home.

Third.—Laundry, with rooms of the laundry employes.

Administration Building.—The number of micro-organisms found in various places on each floor of the administration building is shown by the following table:—

ADMINISTRATION BUILDING.

First Floor.

Place of Experiment.	Date.	Bacteria.	Moulds.
Reception-room	Jan. 5	64	2
Hall ..	" 5	48	6
Dining-room	" 5	18	7
Private office	" 5	12	2
Average		35.2	4.3

Second Floor.

Place of Experiment.	Date.	Bacteria.	Moulds.
Sleeping-room	Jan. 5	1	1
Library	" 5	1	2
Parlour	" 5	5	5
Hall	" 5	1	7
Sleeping-room	" 5	2	5
Average		2	4

Third Floor.—Domestics' Rooms.

Room 1	Jan 12	3	5
" 3	" 12	28	0
" 4	" 12	37	4
" 5	" 5	34	20
" 6	" 5	14	8
" 7	" 5	5	9
Average		20.1	9.3

First Floor.—This floor contains, besides a spacious hall, the superintendent's office, matron's room, family dining-room, and a large reception-room. This, being the executive department, is visited each day by many hundred people, representing all classes of society. Such is the neatness and the order of this floor, however, that no indication is ever seen of the immense amount of business transacted. The largest number of bacteria was found in the reception-room and hall, where the greatest amount of activity exists. In the dining-room and office the numbers were much less. That bacteria are here present in the numbers found in the reception-room and hall, shows plainly how these organisms are transported by people coming from outside air into a room, by dirt on their feet and clothing.

Second Floor.—Here are the living-rooms of the superintendent and a few of his officers. It corresponds to a private house of the first class. The table of data shows the air of this floor to be almost free from bacteria, as might be expected from the cleanliness and quiet which prevail.

Third Floor.—The third floor is divided into chambers for the use of domestics; the rooms are small, low studded, and the ventilation is poor, being only by transom windows. Consequently, a larger number of bacteria is found in the air of these rooms. The rooms are vacant most of the day, and were vacant at the time of the experiment.

Nurses' Home.—This building differs from any that has been considered; it is new, outside the hospital grounds, and is reached by a short walk in the open air. It is four stories in height, each floor having a central corridor extending its whole length, from which nurses' rooms open on either side. It is essentially what its name implies—"a nurses' home," where quiet and comfort are found by the nurses after their duties at the hospital are over. The nurses leave the building at about half-past six a.m., and return for the night at eight

p.m. The samples of air were all taken at about the centre of each corridor. The table below shows for the air of this building very small numbers of bacteria. Even in the morning, with housework going on, the average number of only nine bacteria were found; while in the evening, after so many nurses, fifty or sixty, had entered the building, and distributed themselves throughout its various parts, the air showed an average of but three bacteria. These results show that bacteria are not transported from the hospital wards to the "home," at least in any appreciable numbers, and that they are not accumulated by any cause.

The very moderate number of bacteria found in this building is evidence enough that the air of even a large building may be kept comparatively free from bacteria, under proper hygienic conditions. It is noticeable that the number of bacteria found is less than we should expect to find by the same number of determinations on outside air.

NURSES' HOME.

Samples taken Jan. 4, 1889, 9 to 10 a.m.

Corridor.	Bacteria.	Moulds.	Remarks.
Basement	7	20	Strong draught.
First floor	18	59	Before sweeping; floor dirty.
Second floor...	3	7	Very quiet; floor clean.
Third floor ...	10	11	Floor partly swept.
Fourth floor ...	9	16	Sweeping finished before experiment.
Average.....	9.4	22.6	

Samples taken Jan. 4, 1889, 8 to 9 p.m.

Basement	0	20	Very hot; no one present.
First floor	2	4	Quiet.
Second floor ...	3	8	Very little walking.
Third floor ..	5	17	Very quiet; some draught.
Fourth floor ...	7	16	Very quiet.
Average.....	3.4	13	

The Laundry.—In the laundry there was an average of 45.7 bacteria and 8.9 moulds; the rooms of the laundry employes also did not give a satisfactory result, twenty-eight to thirty seven colonies of bacteria being found, and three to five moulds. It is stated in the paper that the rooms were badly ventilated, and that the habits of the women employed were not cleanly.

CONCLUSIONS.

The results obtained from buildings of the hospital group occupied by employes, investigated for the sake of comparison with the wards, taken together with the results furnished by outside air, furnish abundant proof that the air of the hospital is remarkably free from micro-organisms. Whether the numbers found are greater or less than would be found in similar institutions, is not known. So far as I am familiar with the work of other investi-

gators in this field, the results show that hospitals of this class, as compared with other buildings, will take first rank in the freedom of their air from micro-organisms.

This is as it should be: bacteria, in a way, represent so much dirt. In a well-managed hospital, one has an approach to an ideal degree of cleanliness, and in no class of buildings is the same care taken to secure freedom from dirt as is taken in such a hospital. Undoubtedly, the systematic, thorough renovation which is going on continually in the hospital, is of great importance in removing accumulations of germs, which must inevitably occur in the wear and tear of a building. This hospital is particularly fortunate in this respect; with its large tent service, wards in turn can be vacated during the summer months, and put in thorough repair, to an extent not otherwise possible.

In this connection, it will be interesting to reproduce some valuable tables prepared by Professor Thomas Carnelly and his colleagues, showing the number of micro-organisms in the air of clean and unclean buildings in Dundee:—

				Bacteria in 10 litres of air.
One-roomed houses, clean	...	...	...	180
" " dirty	...	...	...	410
" " dirtier	...	...	...	490
" " very dirty	...	...	...	930
				Bacteria in 10 litres of air.
Naturally ventilated schools, cleaner	...	...	...	910
" " " average cleanliness	...	...	...	1,250
" " " dirtier	...	...	...	1,980
Mechanically ventilated schools, cleanest	...	...	...	30
" " " clean	...	...	...	160
" " " less clean	...	...	...	300

These results leave no doubt that the cleanliness of rooms and persons also is of the greatest importance in preventing accumulations of micro-organisms. It will be noticed that the numbers found in mechanically ventilated schools are far less than for those ventilated naturally; but the results as a whole, both in schools and dwelling-houses, are enormous, as compared with those obtained in this hospital. On the other hand, Carnelly found in the wards of the Dundee Royal Infirmary, between 4 and 5 o'clock p.m., from ten to twenty bacteria. Neumann (*Vierteljahrsschrift f. gerichtliche Medicin*, 1886. B. 14, p. 30) made thirty-five experiments by Hesse's method. At different elevations, from 1.40 to 3.20 metres, about the same number of organisms were found. In the morning, after sweeping, 10 litres of air gave 80 to 140 bacteria, while four consecutive determinations at the same height showed a gradual decrease; the last examination, at 8 p.m., giving from 4 to 10 bacteria.

The results obtained in both the above hospitals are in perfect accord with those obtained in this investigation.

The extent of vitiation which the air of dwelling-houses may reach is further shown by determina-

tions made by Carnelly, on one, two and four-roomed houses, between 12.30 and 4.30 a.m.

	Bacteria.	Moulds.
One-roomed houses	580	12
Two-roomed houses	430	22
Four roomed houses, and more	160	10

When it is remembered that the air of the Boston City Hospital is practically free from bacteria at the hour of midnight, the above results, representing the condition of the air breathed by human beings, is certainly startling, and goes far to show the value of the information furnished by such determinations. The atmosphere of a building vitiated by micro-organisms can be so readily brought at least to a moderate state of purity, by a proper degree of cleanliness and oversight, that there is no legitimate reason why the air of public buildings should reach the condition of vitiation shown by Carnelly's experiments, in certain buildings in Dundee.

In any comparison of the number of micro-organisms found in the air of a hospital with those of other buildings, allowance must of course be made for the fact that a very small number of organisms found in hospital air, if pathogenic, might be more dangerous than large numbers of non-pathogenic forms found elsewhere. The great majority of micro-organisms found in air are probably harmless; but their functions as yet are so imperfectly understood, that it would seem unwise to consider them entirely harmless. Many of them evince a power in the decomposition of the various culture media, which is suggestive of what might happen in or upon the human system, should they find there a suitable *nidus* for development. Although no attempt was made in this investigation, except in a very general way, to determine the character of the germs present, it was found that the same species which occurred in the outside air were met with in the hospital; but certain species were met with in the hospital that were not found in outside air. In the ward devoted to diphtheria, species were always fewer in number than elsewhere, and the colonies were not unlike those obtained from the material furnished by the patients themselves, although no proof of their identity was obtained. The presence of pathogenic bacteria has frequently been demonstrated in the air of hospital wards; for example, Cornet, of Koch's Hygienic Institute, found bacilli tuberculosis in fifteen out of twenty-one wards in seven hospitals in Berlin, and out of ninety-four animals inoculated, twenty died of tuberculosis. Von Eiselsberg (*Langenbeck's Archiv*. B. 35, heft. 1), in an erysipelas room of the hospital, found erysipelas cocci; also, in a surgical ward, where wounds were treated under aseptic precautions, the presence of *Staphylococcus Pyogenes Aureus* was demonstrated. Emmerich (*Deutsch. Med. Wochenschrift*, 1887, No. 3) not only found erysipelas cocci in the

air of an old dissecting room, but also in the plastering and walls and ceilings.

In this connection, it should be stated that the ordinary methods employed in the cultivation of the germs of the air would fail to reveal the presence of certain pathogenic bacteria, as, for example, bacilli tuberculosis; such forms, however, are not difficult to determine by special means. Pathogenic bacteria are as likely to exist in this hospital as in any other, and probably do exist; but it is worthy of note that the general health of employes is excellent, that contagious diseases are seldom contracted by them, or by patients themselves, although isolated cases occasionally occur.

The importance of obtaining definite information regarding the dangerous or innocuous character of micro-organisms found in the atmosphere is evident; but, until methods are so amplified that species can be identified with a greater degree of certainty and far less expenditure of time than at present, we must be content with a determination of the number and distribution of bacteria in the air of buildings.

Carnelly has proposed a standard for the air of dwellings and schools; *i.e.*, twenty micro-organisms per litre, or two hundred per ten litres (excess over outside air)—numbers so greatly in excess of all results obtained in this hospital as to make evident the necessity of a standard for various classes of buildings.

The air of this hospital compares favourably with the external air. In the absence, then, of a standard of purity for hospital air, it would not be unreasonable to require that the number of micro-organisms in the air of a ward should but slightly exceed the numbers found in outside air.

BUGS.—The common bed bug (*Acanthia lectularia*) should always be considered a "nuisance" under the Public Health and Sanitary Acts. There is every reason to believe that a notice to cleanse a living room of bugs would be perfectly legal, and would be supported by the superior courts if its legality were seriously contested. The tenacity of life of these small insects is surprising. Leunis (*Zoologie*, p. 639) mentions the case of a female shut up in a box for six months and forgotten; at the end of that time it was found not only alive, but surrounded by a circle of little ones. Goze found bugs in the hangings of a bed which had not been used for six years, they were perfectly transparent and white like paper; Weismann makes a similar observation. De Geer exposed bugs to a temperature for months of intense cold, a portion of the time the thermometer marking 33° C., they still survived. Experiments on strictly scientific lines do not yet appear to have been made as to the best way of destroying bugs. Probably thorough disinfection of a room first with chlorine of gas then with spray of mercuric chloride solution will answer the purpose.

SANITARY LEGISLATION.—HOUSING OF THE WORKING CLASSES.

By DR. T. ORME DUDFIELD.

THE Acts dealing with the dwellings of the working classes (including Lord Shaftesbury's, Torrens's, and Cross's Acts) are 13 in number, ranging from the Labouring Classes Lodging Houses Act, 1851 (Shaftesbury's Act), to the Housing of the Working Classes Act, 1885. All of these measures the Government propose to consolidate, a Bill for the purpose ("Housing of the Working Classes Acts Consolidation Act") having been prepared and brought in by Mr. Ritchie, Mr. Matthews, and Mr. Long. Few amendments have been introduced, and those not of material importance from a sanitary point of view; some of them being intended to remove doubts as to interpretation, and others making the new measure consonant with previous legislation. A few provisions of the existing Acts no longer required are repealed. The subjects dealt with in the Bill have received a good deal of attention from the Housing of the Working Classes Committee of the County Council, who recently had an important interview with the Home Secretary, in order, as they state in their annual report, to place before him suggestions which, if carried out, would make Torrens's Acts more workable. "The difficulties in the way of dealing with insanitary areas were represented to him. . . . The committee suggested that in order to put a local authority in motion the Council should have the power of requiring the local medical officer to report; that in the case of demolition the local authority, or, failing it, the Council should have the same powers of compulsory purchase as the Acts give with regard to obstructive buildings; that where premises are required to be purchased, the owner should not have the option of retaining the site; that the term 'obstructive building' should be defined; and that some other mode of appeal should be provided than to the High Court. . . . If clauses to the above effect were to be introduced by Her Majesty's Government this Session, in an amending Act," the Committee believe that "much good result would accrue to London." The action of the Committee had a good result, Mr. Ritchie, Mr. Matthews, and Mr. Long having introduced an amending Bill ("Housing of the Working Classes (Amendment) Act" which gives effect to some of their suggestions. Part I. of the Bill ("Artizans Dwellings Acts") is to be construed as one with the Acts 1868 to 1885, proposed to be consolidated, and to be known in future as the "Dwellings Act," 1868, 1879, etc. The Medical Officer of Health is to report to the local authority any premises, as defined by the Dwellings Act of 1868, which appear to him to be in a state so injurious to health as to be unfit for human habitation. The local authority is to take proceedings with a view to closing such premises by obtaining a "closing order" (sec. 2). The local authority may pass a resolution that it is