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978-1-108-06441-5 - Notes on Hospitals: Being Two Papers Read Before the National Association for the Promotion of Social Science, at Liverpool, in October 1858

Florence Nightingale

Excerpt

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# SANITARY CONDITION OF HOSPITALS

AND

## HOSPITAL CONSTRUCTION.

*Two Papers read before the National Association for the  
Promotion of Social Science.*

### PART I.

**F**EELING very desirous of contributing whatever aid I can to improvement in Hospital construction and administration—especially at this time, when several new hospitals are being built—it has occurred to me to transmit a few notes on defects which have come under my own observation in an extended experience of these institutions.

No one, I think, who brings ordinary powers of observation to bear on the sick and maimed can fail to observe a remarkable difference in the aspect of cases, in their duration and in their termination in different hospitals. To the superficial observer there are two things only apparent—the disease and the remedial treatment, medical or surgical. It requires a considerable amount of experience, in hospitals of various constructions and varied administrations, to go beyond this, and to be able to perceive that conditions arising out of these have a very powerful effect indeed upon the ultimate issue of cases which pass through the wards.

It is sometimes asserted that there is no such striking difference in the mortality of different hospitals as one would be led to infer from their great apparent difference in sanitary condition. There is, undoubtedly, some difficulty in arriving at correct statistical comparison to exhibit this. For, in the first place, different hospitals receive very different proportions of the same class of diseases. The ages in one hospital may differ considerably from the ages in another. And the state of the cases on admission may differ very much in each hospital. These elements, no doubt, affect considerably the results of treatment, altogether apart from the sanitary state of hospitals.

In the next place accurate hospital statistics are much more rare than is generally imagined, and at the best they only give the mortality which has taken place *in* the hospitals, and take no cognizance of those cases which are discharged in a hopeless condition, to a much greater extent from some hospitals than from others.

We have known incurable cases discharged from one hospital, to which the deaths ought to have been accounted, and received into another hospital, to die there in a day or two after admission.

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Again, the sanitary state of any hospital ought not to be inferred solely from the greater or less mortality. If the function of a hospital were to kill the sick, statistical comparisons of this nature would be admissible. As, however, its proper function is to restore the sick to health as speedily as possible, the elements which really give information as to whether this is done or not, are those which show the proportion of sick restored to health, and the average time which has been required for this object; a hospital which restored all its sick to health after an average of six months' treatment, could not be considered as by any means so healthy as a hospital which returned all its sick recovered in as many weeks. The proportion of recoveries, the proportion of deaths, and the average time in hospital must all be taken into account in discussions of this nature, as well as the character of the cases and the proportion of different ages among the sick.

Hospital mortality statistics\* give little information on the point, because there are elements in existence of which such statistics take no cognizance. In one set of metropolitan hospitals, for example, I find the mortality about two and a-half per cent. upon the cases treated, while in other metropolitan hospitals the deaths reach from about twelve to sixteen per cent. To judge by the mortality in these cases would be most fallacious. Because in the first class of hospitals every ailment, however slight, constitutes a title to hospital admission, while, in the latter class of hospitals, special diseases only, at all times accompanied by a high rate of mortality, are admitted. Hence the duration of the cases admitted, and the general course and aspect of disease afford important criteria whereby to judge of the healthiness or unhealthiness of any hospital in

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\* In Paris an Annual Report of the Hospitals ('Compte Moral Administratif') is published. But the only useful statistical information to be gleaned from it is the number of *sous* each patient has cost. For, although it gives the numbers of adults, male and female, and of children who have been admitted, and who have died during the year, yet this in itself tells little.

If the Hospitals of London and of Paris would give us the information contained under the eight following heads, so important would be the knowledge thereby conveyed, that it would be worth while to go back for many years to construct such tables, and to continue the same forms hereafter.

1. The numbers admitted for each decennial period of age for each sex per annum.
2. The numbers, similarly arranged, remaining in hospital at the end of the preceding year.
3. The numbers dead for each sex at each decennial period of age per annum.
4. The numbers discharged cured similarly arranged per annum.
5. The numbers discharged incurable similarly arranged per annum.
6. The numbers remaining in hospital at the end of the current year similarly arranged.
7. The *diseases* remaining, admitted, died, cured, discharged incurable, and remained, arranged for each sex and each decennial period of age per annum.
8. The duration of cases, similarly arranged.

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addition to that afforded by the mortality statistics. Besides, careful observers are now generally convinced that the origin and spread of fever in a hospital, or the appearance and spread of hospital gangrene, erysipelas and pyæmia generally, are much better tests of the defective sanitary state of a hospital than its mortality returns. But I would go further, and state that to the experienced eye of a careful observing nurse, the daily, I had almost said hourly, changes which take place in patients, and which changes rarely come under the cognizance of the periodical medical visitor, afford a still more important class of data, from which to judge of the general adaptation of a hospital for the reception and treatment of sick. One insensibly allies together restlessness, languor, feverishness, and general *malaise*, with closeness of wards, defective ventilation, defective structure, bad architectural and administrative arrangements, until it is impossible to resist the conviction that the sick are suffering from something quite other than the disease inscribed on their bed-ticket—and the inquiry insensibly arises in the mind, what can be the cause? To this query many years' experience of hospitals in various countries and climates enables me to answer explicitly as the result of my own observation, that, even admitting to the full extent the great value of the hospital improvements of recent years, a vast deal of the suffering, and some at least of the mortality in these establishments, is avoidable.

What, then, are those defects to which such results are to be attributed?

I should state at once that to original defects in the sites and plans of hospitals, and to deficient ventilation and overcrowding accompanying such defects, is to be attributed a large proportion of the evil I have mentioned.

The facts flow almost of necessity from ascertained sanitary experience. But it is not often, excepting perhaps in the case of intelligent house surgeons, that the whole process whereby the sick, who ought to have had rapid recoveries, are retained week after week, or perhaps month after month, in hospital, is continuously observed. I have known a case of slight fever received into hospital, the fever pass off in less than a week, and yet the patient, from the foul state of the wards, not restored to health at the end of eight weeks.

The defects to which such occurrences are mainly to be attributed are four:—

1. The agglomeration of a large number of sick under the same roof.
2. Deficiency of space.
3. Deficiency of ventilation.
4. Deficiency of light.

These are the four radical defects in hospital construction.

But on the very threshold of the subject we shall probably be told that not to these defects, but to 'contagion' and 'infection,' is much of the unhealthy condition of some hospitals attributable, at least so

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far as concerns the occurrence of zymotic diseases. On the very threshold, therefore, we are obliged to make a digression in order to discuss the meaning of these two familiar words, and to lay these spectres which have terrified almost all ages and nations.

This is the more necessary, because on the exact influence exercised by these two presumed causes of hospital sickness and mortality depends to a great degree the possibility of our introducing efficient hospital attendance and nursing. Unfortunately both nurses\* and medical men, as well as medical students, have died of zymotic diseases prevailing in hospitals. It is an all-important question to decide whether the propagation of such diseases is inevitable or preventible.

\* To show the great importance of this point I give the following tables, kindly prepared by Dr. Farr, from returns furnished to me with the greatest readiness by fifteen of the metropolitan hospitals. Table I. gives the ages of living and dying among the nursing staff. Table II. gives the mortality from zymotic diseases, and the comparison between the nurses' mortality and the mortality of the female population of London.

TABLE I.—*Numbers and Ages of Matrons, Sisters and Nurses (Living and Dying) in Fifteen London Hospitals.*

(Names of the Hospitals,—*St. Mary's ; St. George's ; Westminster ; Charing Cross ; Middlesex ; University College ; Royal Free ; King's College ; St. Bartholomew's ; London ; Guy's ; St. Thomas' ; Small Pox ; Fever ; and Consumption.*)

LIVING (1858).

	Total of all Ages.	Total.		Specified Ages of the Living, March, 1858.												
		Ages Specified.	Ages not Specified.	Under 20.	20.	25.	30.	35.	40.	45.	50.	55.	60.	65.	70 and up.	
Matrons, Sisters and Nurses }	521	391	130	1	10	45	55	93	64	59	34	18	8	4	...	
Matrons and Sisters } ...	118	90	28	...	...	4	11	22	16	20	8	5	3	1	...	
Nurses ... ..	403	301	102	1	10	41	44	71	48	39	26	13	5	3	...	

DYING (1848-57).

	Total of all Ages.	Total.		Ages of the Dying.												
		Ages Specified.	Ages not Specified.	Under 20.	20.	25.	30.	35.	40.	45.	50.	55.	60.	65.	70 and up.	
Matrons, Sisters and Nurses }	79	79	...	...	...	4	11	8	18	8	10	7	6	2	5	
* Matrons and Sisters (so distinguished) } ...	19	19	...	...	...	2	1	4	...	3	2	1	1	5	...	
Nurses ... ..	60	60	...	...	...	4	9	7	14	8	7	5	5	1	...	

\* In the returns of deaths, four Hospitals do not distinguish the Matrons and Sisters from the Nurses, and in this Table they are included with the Nurses.

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If the former, then the whole question must be considered as to whether hospitals necessarily attended with results so fatal should exist at all. If the latter, then it is our duty to prevent their propagation.

The idea of 'contagion,' as explaining the spread of disease, appears

TABLE II.—*Table of the Mortality of Matrons, Sisters, and Nurses, at different Ages, in Fifteen London Hospitals, compared with the Mortality of the Female Population of London.*

Ages.	Matrons, Sisters, and Nurses (1848—57).		Female Population of London.	
	Annual Rate of Mortality to 1000 living at the respective Ages.			
	By all returned Diseases.	By Zymotic Diseases.	By Zymotic Diseases (1848—57).	By all returned Diseases (1848—54).
25 to 35	15.89	9.53	2.19	9.92
35 — 45	15.80	10.94	2.73	14.65
45 — 55	17.80	11.87	3.17	20.36
55 — 65	46.36	14.26	4.94	36.02

The fatal zymotic diseases included in this table are fever and cholera, and it will be seen that these two diseases occasioned nearly 50 per cent. of the total mortality among the nursing staff as against 16 per cent. among the London female population. This single fact is quite enough to prove the very great importance of hospital hygiene. The calculated total mortality is also very much higher among the nurses, even if we assume that the deaths in the returns are all the deaths due to hospital nursing, which is very doubtful. If we assume that the non-zymotic mortality among nurses ought to be the same as it is among the female population, and if to this we add the zymotic deaths among nurses, we find the total mortality among nurses to exceed the total mortality among the female population of the metropolis by about 40 per cent. The loss of a well-trained nurse by preventable disease is a greater loss than is that of a good soldier from the same cause. Money cannot replace either, but a good nurse is more difficult to find than a good soldier.

The data from which these tables have been deduced are imperfect, and it would be very desirable if in future all hospitals would keep a register of nurses. The following form would be one well calculated to give the required information. The subject is of additional importance in connexion with the proper working of a Superannuation Fund for nurses:—

*Form of Register of Sisters and Nurses in Hospital. Commenced from January 1, 1859.*

No.	Name.	Age when first Ap- pointed.	Date.		State of Health on Leaving the Ser- vice: and, if Ill, the Disease, its Duration, and probable Cause.	Date of Death, Cause of Death, and fatal Disease.
			Of Appoint- ment.	Dismissal, Resignation, or Super- annuation.		
1	Jane Jones. (Sister.)	25	June 6, 1858.	Resigned August 6, 1858.	In good Health.	
2	Mary Evans. (Nurse.)	29	April 2, 1848.			July 7, 1854, Typhoid Fe- ver, after 11 days' illness.

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to have been adopted at a time when, from the neglect of sanitary arrangements, epidemics attacked whole masses of people, and when men had ceased to consider that nature had any laws for her guidance. Beginning with the poets and historians, the word finally made its way into medical nomenclature,\* where it has remained ever since, affording to certain classes of minds, chiefly in the southern and less educated parts of Europe, a satisfactory explanation for pestilence and an adequate excuse for non-exertion to prevent its recurrence.

And now, what does 'contagion' mean? It implies the communication of disease from person to person by *contact*. It pre-supposes the existence of certain germs like the sporules of fungi, which can be bottled up and conveyed any distance attached to clothing, to merchandize, especially to woollen stuffs, for which it is supposed to have a particular affection, and to feathers, which of all articles it especially loves—so much so, that, according to quarantine laws, a live goose may be safely introduced from a plague country; but if it happen to be eaten on the voyage, its feathers cannot be admitted without danger to the entire community. There is no end to the absurdities connected with this doctrine. Suffice it to say, that in the ordinary sense of the word, there is no proof, such as would be admitted in any scientific inquiry, that there is any such thing as 'contagion.'

There are two or three diseases in which there is a specific virus,

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\* The history of the doctrine of 'Contagion' is given by Dr. Adams in his very learned translation of the works of Paulus Ægineta, Vol. 1, p. 284—(Sydenham Society). He says, in his comment, 'the earlier ancient authors appear to have entertained no suspicions of contagion as a cause of febrile or of other complaints. 'The works of the fathers of history, and of medicine, have likewise been ransacked in vain for any traces of the doctrine of contagion.'

Thucydides, and after him several of the Latin poets describe the plague of Athens, which appears to have been a form of Dysentery, as communicable from person to person. The later Greek historians contain allusions to the infectious nature of certain diseases; but Procopius, though cognizant of one of the greatest pestilences on record, was a non-contagionist.

Virgil's allusions to contagious diseases among cattle will be found in Ecl. I. Georg. III., 464.

Aræteus appears to be the first medical author who believed in contagion. Galen seems to have held the doctrine of infection. Of the later Greek and Arabian medical writers, some were contagionists, and others make no allusion to the subject. Dr. Adams states, in regard to plague, a disease which, in later times, has been considered as the very type of all 'contagious' pestilences, 'The result of our investigations into the opinions of the ancients on this subject leads us to the conclusion that all, or at least the most intelligent of the medical authorities, held that the plague was communicated not by any specific virus, but in consequence of the atmosphere around the sick being contaminated with putrid effluvia.'

The obvious practical result of this view of infection is, that abundance of pure air will prevent infection. All my own hospital experience confirms this conclusion. If infection exists, it is preventible. If it exists, it is the result of carelessness, or of ignorance. 'Contagion,' as a doctrine, on which distinct practical proceedings have been taken, appears to be of very modern invention; but it has been not the less injurious to civilization and humanity, from the loss of life which has from time to time followed from the practices which it inculcates, and from the immense tax which it has entailed upon commerce.

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which can be seen, tasted, smelt, and analysed, and which in certain constitutions propagates the original disease by inoculation—such as small-pox, cow-pox, &c. But these are not ‘contagions’ in the sense supposed.\*

The word ‘infection,’ which is often confounded with ‘contagion,’ expresses a fact, and does not involve a hypothesis. But just as there is no such thing as ‘contagion,’ there is no such thing as *inevitable* ‘infection.’ Infection acts through the air. Poison the air breathed by individuals and there is infection. Shut up 150 healthy people in a Black-hole of Calcutta, and in twenty-four hours an infection is produced so intense that it will, in that time, have destroyed nearly the whole of the inmates. Sick people are more susceptible than healthy people; and if they be shut up without sufficient space and sufficient fresh air, there will be produced not only fever, but erysipelas, pyæmia, and the usual tribe of hospital-generated epidemic diseases.

Again, if we have a fever hospital with over-crowded, badly-ventilated wards, we are quite certain to have the air become so infected as to poison the blood not only of the sick, so as to increase their mortality, but also of the medical attendants and nurses, so that they also shall become subjects of fever.

It will be seen at a glance, that in every such case and in every such example, the ‘infection’ is not inevitable, but simply the result of carelessness and ignorance. As soon as this practical view of the subject is admitted and acted upon, we shall cease to hear of hospital contagions.

In certain hospitals it has been the custom to set apart wards for what are called ‘infectious’ diseases, but in reality there ought to be no diseases so considered. With proper sanitary precautions, diseases reputed to be the most ‘infectious’ may be treated in wards among other sick without any danger. Without proper sanitary arrangements, a number of healthy people may be congregated together so as to become subject to the worst horrors of ‘infection.’

No stronger condemnation of any hospital or ward could be pronounced than the simple fact that any zymotic disease has originated in it, or that such diseases have attacked other patients than those brought in with them. And there can be no stronger condemnation of any town than the outbreak of fatal epidemics in it. Infection, and incapable management, or bad construction, are in hospitals as well as in towns, convertible terms.

It was necessary to say thus much to show to what hospital diseases are *not* necessarily due. To the following defects in site, construction, and management, as we think, they are mainly to be attributed.

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\* Curiously enough, these directly communicable diseases were excluded from the operation of general quarantine law by the International Quarantine Conference of Paris, 1851, which restricted the objects of quarantine to plague, yellow fever, and cholera, while it gave a logical *coup de grace* to the ‘contagion’ hypothesis by abolishing the ‘suspected bill of health.’

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[More information](#)1. *The agglomeration of a large number of sick under one roof.*

It is a well-established fact that, other things being equal, the amount of sickness and mortality on different areas bears a ratio to the degree of density of the population.

Why should undue agglomeration of sick be any exception to this law? Is it not rather to be expected that, the constitutions of sick people being more susceptible than those of healthy people, they should suffer more from this cause?

But if anything were wanting in confirmation of this fact, it would be the enormous mortality in the hospitals which contained perhaps the largest number of sick ever at one time under the same roof, viz., those at Scutari. The largest of these too famous hospitals had at one time 2500 sick and wounded under its roof, and it has happened that of Scutari patients two out of every five have died. In the hospital tents of the Crimea, although the sick were almost without shelter, without blankets, without proper food or medicines, the mortality was not above one-half what it was at Scutari. Nor was it even so high as this in the small Balaclava General Hospital, while in the huts of the Castle Hospital, on the heights above Balaclava, at a subsequent period, the mortality among the wounded did not reach three per cent. It is not to this, however, that we appeal, as the only proof of the danger of surface over-crowding. It is to the fact of 80 cases of hospital gangrene having been recorded during one month at Scutari (and many, many more, passed unrecorded); to the fact that, out of 44 secondary amputations of the lower extremities consecutively performed, 36 died; and to the cases of fever which broke out in the hospital, not by tens but by hundreds.

All experience tells the same tale, both among sick and well. Men will have a high rate of mortality in large barracks, a low one in separate huts, even with a much less amount of cubic space.\*

The example which France and Belgium have lately set us of separating their hospitals into a number of distinct pavilions, containing generally not more than 100 sick each, should be elsewhere imitated. It may be useful, by way of illustrating good and bad hospital structure, to annex plans of the newest civil and military hospitals constructed in Paris, in contrast with plans of the newest civil and military hospitals constructed in England.

The Lariboisière as a civil hospital, the Vincennes as a military one, exhibit the latest and the best specimens of hospital construction in Paris.

King's College as a civil hospital, Netley as a military one, are among the latest—we would we could say the best—plans of hospital construction in England.

The Lariboisière, as will be seen from the plan, contains 600 beds, under six different roofs.

\* It must never be forgotten that, during the last six months of our occupation in the Crimea, the death-rate among our men, barracked in huts, was only two-thirds of what it is among the men in barracks at home.



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In the Vincennes plan the pavilions are end to end, two and a-half in each wing, and contain about 600 beds in four pavilions and two half-pavilions.

Netley Hospital is to contain 1000 sick and invalids, under two roofs.

2. *Deficiency of Space.*—Wherever cubic space is deficient, ventilation is bad. Cubic space and ventilation will therefore go hand in hand. The law holds good with regard to hospitals, barracks, and all inhabited places. Deficiency of cubic space is confounded by unskilful sanitary statisticians with surface over-crowding in towns, although the things are quite different, and lead to different results. In a recent paper it has been argued that because the statistics of disease in towns of different densities do not show so large a proportionate mortality from consumption as takes place in the army, *therefore* the allegation that the army mortality is caused by overcrowding and bad ventilation is incorrect. We happen to know that deficient external ventilation and over-crowding in barracks, as regards cubic space, stand as follows:—

The cavalry barracks, as a whole, are the least over-crowded, and have the freest external movement of air. Next come the infantry; and the most crowded and the least ventilated externally are the Guards' barracks; so that the mortality from consumption which follows the same order of increase in the different arms augments with increase of crowding, and difficulty of ventilation.

If over-crowding or its concomitant, bad ventilation, among healthy people, generates disease, it does so to a far greater extent among the sick in hospitals. In civil hospitals the amount of cubic space varies between 600 and 2000 cubic feet per bed. In some military hospitals it is under 300; and from 700 to 800 appear to be considered a somewhat extravagant allowance. The army regulation as to cubic space in hospitals is over-crowding. At Scutari, at one time, not even half the regulation-space was given; and the great over-crowding consequent thereupon was one element in the disastrous result which followed. Any one in the habit of examining hospitals with different relative amounts of cubic space cannot fail to have been struck with the very different appearance of the sick, and with the different state of the ward atmosphere. It is impossible to ventilate a ward in a brick or stone hospital by natural means, when the cubic space is less than a certain amount. Crowded wards are, in fact, offensive, with all the windows open.

In the country less cubic space is essential than in towns. In detached huts or pavilions, especially if they be but one story high, less cubic space is necessary than where numbers are massed together.

Under all circumstances, however, the progress of the cases (in solidly-built hospitals) will betray any curtailment of space much below 1500 cubic feet. In Paris 1700, and in London 2000 and even 2500 cubic feet are now thought advisable.

The master of some large works in London lately mentioned the following fact:—He was in the habit of sending those of his work-

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men who met with accidents to two different metropolitan hospitals. In one they recovered quickly: in the other they were frequently attacked with erysipelas, and some cases were fatal. On inquiry it appeared that in the former hospital a larger amount of cubic space was allowed than in the latter, which is also so deficient in external ventilation and in construction, that nothing but artificial ventilation could effectively change its atmosphere.

It is no less important to have a sufficient surface-area between the adjoining and the opposite beds. Piling cubic space above the patient is not all that is wanted. In the lofty corridors of Scutari I have seen two long rows of opposite beds with scarcely three feet from foot to foot. Certainly it cannot be thought too much, under any circumstances, to give to each bed a territory to itself of at least eight feet wide by twelve feet long.

3. *Deficiency of Ventilation.*—The want of fresh air may be detected in the appearance of patients sooner than any other want. No care or luxury will compensate indeed for its absence. Unless the air *within* the ward can be kept as fresh as it is *without*, the patients had better be away. Except in a few cases well known to physicians the danger of admitting fresh air directly is very much exaggerated. Patients in bed are not peculiarly inclined to catch cold,\* and in England, where fuel is cheap, somebody is indeed to blame, if the ward cannot be kept warm enough, and if the patients cannot have bed-clothing enough, for as much air to be admitted from without as suffices to keep the ward fresh. No artificial ventilation will do this. Although in badly-constructed hospitals, or in countries where fuel is dear, and the winter very cold, artificial ventilation may be necessary, it never can compensate for the want of the open window. The ward is never fresh, and in the best hospitals at Paris, artificially ventilated, it will be found that, till the windows are opened in the morning, the air is close. Natural ventilation, or that by open windows and open fire-places, is the only efficient means for procuring the life-spring of the sick—fresh air. But to obtain this the ward should be at least sixteen feet high, and the distance between the opposite windows not more than thirty feet. The amount of fresh air required for ventilation has been hitherto very much underrated, because it has been assumed that the quantity of carbonic acid produced during respiration was the chief noxious gas to be carried off. The total amount of this gas produced by an adult in twenty-four hours is about 40,000 cubic inches, which, in a barrack-room, say, containing sixteen men, would give 370 cubic feet *per diem*. Allowing eight hours for the night occupation of such a room, when the doors and windows may be supposed to be shut, the product of carbonic acid would be 123 cubic feet, or

\* 'Catching cold' in bed follows the same law as 'catching cold' when up. If the atmosphere is foul, and the lungs and skin cannot therefore relieve the system, then a draught upon the patient may give him cold. But this is the fault of the foul air, not of the fresh.