
THE SANITARY INSTITUTE, INCORPORATED 1888.
SALUS GENERIS HUMANI.

1891.

TRANSACTIONS

OF

THE SANITARY INSTITUTE.

VOLUME XII.

(Being the Third Volume of Transactions published since the Incorporation of The Institute.)

1891.

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1892.

The Institute is not responsible for the facts and opinions advanced in the Addresses and Papers published in the Transactions.

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Officers of the Institute for 1891-92.

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PREFACE.

THE usual Autumn Congress not having been held in 1891, in consequence of the Meeting of the International Congress of Hygiene and Demography, the present Volume of Transactions is exceptionally small.

The Classified Catalogue of the contents of the Museum has been included in the Volume, as it will probably be found useful for reference.

Congresses held by the Institute.

LEAMINGTON, 1877.

President.—B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—Edwin Chadwick, C.B.
„ II.—George Wilson, M.A., M.D., F.C.S.
„ III.—R. Brupenell Carter, F.R.C.S.

STAFFORD, 1878.

President.—EDWIN CHADWICK, C.B.

Presidents of Sections.

Section I.—B. W. Richardson, M.D., LL.D., F.R.S.
„ II.—Henry Day, M.D., F.R.C.S.

CROYDON, 1879.

President.—B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—Alfred Carpenter, M.D., M.R.C.P.Lond., C.S.S.Camb.
„ II.—Captain Douglas Galton, R.E., C.B., D.C.L., F.R.S.
„ III.—G. J. Symons, F.R.S.

EXETER, 1880.

President.—THE RIGHT HON. EARL FORTESCUE.

Presidents of Sections.

Section I.—Prof. de Chaumont, M.D., F.R.S.
„ II.—R. Rawlinson, M.Inst.C.E., C.B.
„ III.—Sir Antonio Brady.

NEWCASTLE-UPON-TYNE, 1882.

President.—CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

Presidents of Sections.

Section I.—Denis Embleton, M.D., F.R.C.S.
„ II.—H. Law, M.Inst.C.E.
„ III.—Arthur Mitchell, M.A., M.D., LL.D., F.R.S.

GLASGOW, 1883.

President.—PROF. G. M. HUMPHRY, M.D., F.R.S.

Presidents of Sections,

Section I.—Prof. W. T. Gairdner, M.D., LL.D.
„ II.—Prof. T. Roger Smith, F.R.I.B.A.
„ III.—R. Angus Smith, Ph.D., F.C.S.

DUBLIN, 1884.

President.—SIR ROBERT RAWLINSON, C.B.

Presidents of Sections.

Section I.—T. W. Grimshaw, M.A., M.D.
„ II.—C. P. Cotton, M.Inst.C.E.
„ III.—Charles A. Cameron, F.R.C.S.I.

LEICESTER, 1885.

President.—PROF. F. DE CHAUMONT, M.D., F.R.S.

Presidents of Sections.

Section I.—Arthur Ransome, M,A., M.D., L.S.A., F.R.S.
„ II.—Percival Gordan Smith, F.R.I.B.A.
„ III.—William Marcet, M.D., F.R.Met.Soc., F.C.S. F.R.S

YORK, 1886.

President.—SIR SPENCER WELLS, Bart.

Presidents of Sections.

Section I.—Prof. F. de Chaumont, M.D., F.R.S.
„ II.—Baldwin Latham, M.Inst.C.E., F.R.Met.Soc.
„ III.—William Whitaker, B.A., F.G.S.

BOLTON, 1887.

President.—RIGHT HON. LORD BASING, F.R.S.

Presidents of Sections.

Section I.—Prof. J. Russell Reynolds, M.D., F.R.S.
„ II.—Prof. T. Hayter Lewis, F.S.A., F.R.I.B.A.
„ III.—Prof. A. Dupré, Ph.D., F.I.C., F.C.S., F.R.S.
Conference of M.O.H.—Prof. W. H. Corfield, M.A., M.D.

WORCESTER, 1889.

President.—G. W. HASTINGS, M.P., J.P.

Presidents of Sections.

Section I.—George Wilson, M.A., M.D.
„ II.—Henry J. Marten, M.Inst.C.E.
„ III.—J. W. Tripe, M.D., F.R.C.P. F.R.Met.Soc.
Conference of M.O.H.—Prof. W. H. Corfield M.D.

BRIGHTON, 1890.

President.—SIR THOMAS CRAWFORD, K.C.B., M.D.

Presidents of Sections.

Section I.—G. Vivian Poore, M.D., F.R.C.P.
„ II.—Prof. T. Roger Smith, F.R.I.B.A.
„ III.—William Topley, F.R.S., F.G.S.
Conference of M.O.H.—Arthur Newsholme, M.D., D.P.H.
Conference of Inspectors of Nuisances—Alfred Carpenter, M.D., M.R.C.P. D.P.H.

THE SANITARY INSTITUTE.

FOUNDED 1876.—INCORPORATED 1888.

REPORT OF THE COUNCIL,

Read at the Ordinary General Meeting, March 17th, 1891.

In presenting their Fourth Report to the Fellows and Members, the Council are glad to record that their anticipations with regard to the growth and development of the Institute have been fully realised.

SESSIONAL MEETINGS.

Sessional Meetings were held in February, March and April. The following papers were read and discussed:—

"Dwellings for the Labouring Classes," by KEITH D. YOUNG, F.R.I.B.A.

"The Sanitary Condition of Japan," by Prof. W. KINNINMOND BURTON.

At the Meeting in April an Address was given by Sir ROBERT RAWLINSON, dealing principally with the Sanitation of Barracks and of other Public Buildings. After the Address the Medals and Certificates awarded at the Worcester Exhibition were presented to the successful Exhibitors.

LENT LECTURES FOR LADIES.

A course of Lectures on Domestic Hygiene, especially intended for

Ladies, was given during Lent by Dr. A. T. Schofield, and included the following subjects:

"The Training of Children."

"Flesh and Blood."

"The Ethics of Life."

"Nerves in Order and Disorder."

Her Royal Highness the Duchess of Albany, Patroness of the Institute, was present at all the Lectures, which were very largely attended, and at a special meeting held at the close of the course, Her Royal Highness presented Certificates to 27 Ladies who had written satisfactory reports upon the Lectures.

LECTURES FOR SANITARY OFFICERS.

Two courses of Lectures and Demonstrations for Sanitary Officers have been held during the year. The first course, held in February and March, comprised the following Lectures:—

Introductory Lecture. "Practical considerations for Sanitary Officers." E. C. Robins, F.S.A., F.R.I.B.A.

"Water Supply, Drinking Water, Pollution of Water." Dr. Louis Parkes, D.P.H. (Lond.)

"Drainage and Construction." Prof. H. Robinson, M.INST.C.E.

"Ventilation, Measurement of Cubic Space, &c." Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.

"Sanitary Appliances." Prof. W. H. Corfield, M.A., M.D. (Oxon.)

"Scavenging, Disposal of Refuse and Sewage." Charles Jones, ASSOC.M.INST.C.E.

"Food (including Milk), Sale of Food and Drugs Act." Charles E. Cassal, F.C.S., F.I.C.

"Infectious Diseases and Methods of Disinfection." Shirley F. Murphy, M.R.C.S.

"General Powers and Duties of Inspectors of Nuisances; Method of Inspection." J. F. J. Sykes, M.B., B.SC.

"Nature of Nuisances, including Nuisances the Abatement of which is Difficult." J. F. J. Sykes, M.B., B.SC.

"Diseases of Animals in Relation to Meat Supply." A. Wynter Blyth, M.R.C.S.

"Sanitary Law. General Enactments, Public Health Act, 1875, Model Bye-Laws." A. Wynter Blyth, M.R.C.S.

"Sanitary Laws and Regulations Governing the Metropolis." A. Wynter Blyth, M.R.C.S.

The second course, held after the revision of the Syllabus of the Examinations, was considerably extended, the following Lectures being added, and that on "Food" omitted as only partly applicable to the duties of an Inspector:—

"Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale."

"Sanitary Building Construction."

"Details of Plumbers' Work."

"Objects and Methods of Inspection."

"Trade Nuisances."

"Diseases of Animals in relation to Meat supply; Characteristics of Vegetables, Fish, &c., Unfit for food."

The sixteen Lectures comprised in the course were given by:—Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.; H. Law, M.INST.C.E.; Louis Parkes, M.D., D.P.H. (Lond.); Prof. H. Robinson, M.INST.C.E.; Keith D. Young, F.R.I.B.A.; Prof. W. H. Corfield, M.A., M.D. (Oxon.); J. Wright Clarke; Charles Jones, ASSOC.M.INST.C.E.; Shirley F. Murphy, M.R.C.S.; J. F. J. Sykes, M.B., B.SC., D.P.H. (three Lectures); A. Bostock Hill, M.D., S.SC.C.Camb., F.I.C.; A. Wynter Blyth, M.R.C.S. (three Lectures).

Two hundred and forty-seven Students entered their names for these Lectures. The Council desire to record their sincere thanks to the Lecturers for the great benefits they have conferred upon the Students by the preparation and delivery of these Lectures.

EXAMINATIONS.

During the year two Examinations for Inspectors of Nuisances and one for Local Surveyors have been held in London, and Examinations for Inspectors of Nuisances have also been held at Bristol and Leeds. At these Examinations 307 candidates have presented themselves for examination as Inspectors of Nuisances, and eighteen as Local Surveyors; 151 have received Certificates of Competency as regards their Sanitary knowledge to discharge the duties of Inspectors of Nuisances, and eight those of Local Surveyors.

Since these Examinations were first established, thirty-three examinations have been held, and 1,132 candidates have been examined, of whom 587 have passed the Examination for Inspectors of Nuisances, and 70 that for Local Surveyors.

The Council believe that the new practice of holding Examinations in the provinces has done much to strengthen the position of the Institute and to awaken Local Authorities to the necessity of appointing duly qualified officers. An increasing number of Local Authorities prefer that their Inspectors should hold the Certificate of the Institute.

During the year the Syllabus of the Examination for Inspectors has been revised and re-arranged to accord with the General Orders issued by the Local Government Board, and the Council have now under consideration a further development of the Examinations.

CONGRESS AND EXHIBITION.

The Annual Congress was held at Brighton (by the invitation of the Town Council) under the Presidency of Sir Thomas Crawford, K.C.B.

The Institute was very well received, and ample accommodation was provided for the meetings in the Buildings of the Royal Pavilion, which were placed at the disposal of the Institute by the Corporation. Nearly 200 Members and Associates of the Institute were present, as well as 240 holders of Congress tickets, and invited guests. Vol. XI. of the Transactions already issued to the Members contains a full account of the papers read in the various Meetings.

A Conference of Medical Officers of Health was held in connection with the Congress, and was well attended.

A Conference of Inspectors of Nuisances was also held in connection with the Congress, and was much appreciated by those Sanitary Officers as a means of discussing matters particularly connected with their duties.

The Exhibition was held in the Dome of the Royal Pavilion, and in the Corn Exchange, and was open eighteen days. It was visited by about 35,000 persons. There were 108 exhibitors, the Judges awarded twenty-three medals and sixty-seven Certificates, and sixty-seven exhibits were deferred for further trial.

PARLIAMENTARY WORK.

Suggestions with reference to the Draft Public Health Consolidation Bill were sent to the Local Government Board. It was also decided to petition against the Architects' Registration Bill and against the Sanitary Registration of Buildings Bill; and in favour of the Housing of the Working Classes Bill and of the Infectious Diseases Prevention Bill. Suggestions on the Public Health Amendment Bill and on the Urban Sanitary Authorities further Extension of Powers Bill were prepared for the promoter for him to bring forward in Committee.

ARRANGEMENT OF MUSEUM.

The International Congress of Hygiene and Demography will meet in London in August, 1891. This is the first time that this important Congress has been held in London, and it was on an invitation given jointly by the Institute and the Society of Medical Officers of Health that the meeting was arranged to be held in this country. This interesting meeting will naturally attract considerable attention to the Institute and the Parkes Museum, and the Council felt it very important to place the Museum in good order before the meeting. Want of funds has hitherto prevented the Council undertaking this much-needed work, and even now they would have been unable to devote an amount anything like adequate for the purpose. Under these circumstances Mr. Rogers Field, to whom the Council are indebted for much other assistance given to the Museum, has generously offered to place at the disposal of the Council the sum of £250, which will suffice, not only to put the Museum in thoroughly good order, but also to make several very desirable improvements and to prepare and print a Catalogue.

MUSEUM.

During the year the Museum has been visited by about 9,000 persons.

Several appeals have been received from India and the Colonies for assistance in starting Sanitary Museums.

Considerable use has been made of the Museum by Professors and Teachers for the purpose of practical demonstrations to their classes. Twenty-four classes of this kind have been held, mustering altogether 276 Students.

In July the Council decided to abolish all charge for admission, and to throw open the Museum entirely free to the public, except when meetings and lectures were taking place.

LIBRARY.

The use of the Library is steadily increasing; during the year there have been 475 readers.

252 volumes and pamphlets have been added to the Library during the year. A list of these will be found in Vol. XI. of the Transactions.

BY-LAWS.

A slight alteration has been made in the By-laws relating to the supply of publications to Associates, and revised copies have been issued.

EPITOME OF REGISTERS OF MEMBERS AND ASSOCIATES.

	Hon. Fellows.	Fellows.	Members.	Associates.	Total.
Dec. 31, 1889.....	—	134	416	211	761
Elected	+28	+19	+47	+128	+222
Transferred	—	—	−19	−5	−24
Resigned	—	—	−9	−4	−13
Erased	—	—	−8	—	−8
Dead	—	−2	−4	−1	−7
Dec. 31, 1890.....	28	151	423	329	931

The Council are glad to note this rapid and continued increase in the Institute.

It is with much regret that the Council have to report the death of the veteran Sanitarian, Sir Edwin Chadwick, K.C.B., and of Dr. W. Pearce Fellows, S. J. Barber, H. Branthwaite, Viscount Templetown, and J. H. Walker, Members; and T. Thomas, Associate.

FINANCIAL STATEMENTS.

The Council append to this report a complete statement of the Income and Expenditure for the year ended December 31st, 1890, with a separate statement of the Income and Expenditure connected

with the Brighton Exhibition, also a general Balance Sheet, December 31st, 1890.

With reference to the deficit on the working of the year 1889, shown in the last report, special donations were made by the members of Council and Officers amounting to £476 15s., and this, with a reduction made in the cost of the Transactions, has almost covered the deficit. The year's working for 1890 shows a profit balance of £234 6s. 11d.

The Council consider that this satisfactory improvement in its financial position is an evidence of the increasing utility of the work, and the status of the Institute.

DOUGLAS GALTON, K.C.B.,
Chairman of Council.

E. WHITE WALLIS, *Secretary.*

11*th March*, 1891.

STATEMENT of INCOME and EXPENDITURE, for the Year ended 31st December, 1890.

Dr.

Expenditure.	£ s. d.	£. s. d.
To Transactions, Cost of Printing, &c., less Sales and Advertisements—estimated	146 11 5	
„ Sessional Meetings	11 2 6	
„ Lectures, Sanitary Officers	19 2 6	
„ Domestic Hygiene	32 13 10	
„ Examinations	602 12 0	
„ Congress, Brighton	159 13 1	971 15 4
„ Rent, Rates, Taxes and Insurance	244 3 5	
„ Salaries and Wages	520 7 0	
„ Coals and Care of Offices	31 14 8	
„ Repairs and Alterations	13 7 3	
„ Arrangement of Museum	4 7 10	
„ Library, Cataloguing, and Binding	13 3 2	
„ Postage and Carriage	66 7 5	
„ Printing and Stationery	85 2 1	
„ Advertising	2 15 5	
„ Incidental Expenses	38 11 5	
„ Alfred Lass & Co., Auditing Accounts	10 10 0	
„ Depreciation of Leasehold	52 0 0	1082 9 8
		2054 5 0
„ Balance for the year 1890		234 6 11
		£2288 11 11

Cr.

Income.	£ s. d.	£ s. d.	£ s. d.
By Annual Subscriptions	595 8 0		
„ Entrance Fees	76 13 0		
„ Life Compositions	31 10 0		
„ Fellowship Fees	99 5 0		
„ Donations	2 2 0	804 18 0	
„ Museum Admissions	2 1 0		
„ Lectures, Sanitary Officers	93 2 6		
„ Domestic Hygiene	89 1 0		
„ Examinations	765 14 7		
„ Congress, Brighton	47 9 2		
„ Exhibition, Brighton—Balance	534 14 3		
„ Publications — Farr's and Simon's—Profit on Sales	1 11 5	1483 13 11	
			£2288 11 11

	£ s. d.	£ s. d.	£ s. d.
To Balance of Assets over Liabilities carried forward	2019 14 5	By Balance brought from last account, —Surplus 1888	1808 6 8
		„ *less* deficiency 1889	602 3 2
			1206 3 6
		„ Donations on account of 1889 deficiency	476 15 0
		„ Transactions Reduction on Cost of Printing 1889 Volume	102 9 0
			579 4 0
		„ Balance on Year 1890	234 6 11
	£2019 14 5		2019 14 5

Examined and approved,

ALFRED LASS & Co., Chartered Accountants,
MAGNUS OHREN, Assoc.M.Inst.C.E., } *Auditors.*

6th March, 1891.

STATEMENT OF INCOME AND EXPENDITURE connected with Exhibition at Brighton, 1890.

Dr. *Expenditure.*	£.	s.	d.	Cr. *Income.*	£	s.	d.
To Printing and Advertising	241	11	9	By Rent for Space	855	16	9
„ Catalogues and Programmes	102	5	6	„ Admission	708	8	1
„ Bands and Entertainments	235	13	2	„ Catalogues and Programmes	165	10	9
„ Lectures	25	14	0	„ Fees for Further Trials	14	14	0
„ Curator's Salary and Expenses	202	11	6				
„ Wages	172	15	8				
„ Incidental Expenses	154	9	11				
„ Judging Expenses (Partly Estimated)	108	18	4				
„ Proceeds of Evening devoted to Hospital Fête	35	15	6				
	1279	15	4				
„ Balance	534	14	3				
	£1814	9	7		£1814	9	7

Examined and approved,

ALFRED LASS & Co., Chartered Accountants,
MAGNUS OHREN, Assoc.M.Inst.C.E., } *Auditors.*

6th March, 1891.

GENERAL BALANCE SHEET, 31st DECEMBER, 1890.

Liabilities.	£	s.	d.	*Assets.*	£	s.	d.	£	s.	d
To Subscriptions paid in advance for 1891	30	19	6	By Lease of Premises, 10 years unexpired				494	3	8
„ Sundry Creditors	403	4	4	„ Library and Contents of Museum, estimated value				500	0	0
				„ Furniture and Fixtures, estimated value				100	0	0
				„ Transactions and Publications, estimated value	484	14	6			
				„ Farr's Works, estimated value	39	15	0			
				„ Simon's „ „	102	10	0			
								626	19	6
				„ Sundry Debtors—						
				„ Members' Subscriptions and Arrears	83	9	6			
				„ „ „ from old Societies	17	17	0			
				„ Fellowship Fees	10	10	0			
				„ Entrance Fees	26	5	0			
				„ Exhibition Account	3	0	0			
				„ Donation promised	10	10	0			
								151	11	6
Balance of Assets over Liabilities	2019	14	5	„ Cash at Bankers				581	3	7
	£2453	18	3					£2453	18	3

Examined and approved,

ALFRED LASS & Co., Chartered Accountants,
MAGNUS OHREN, Assoc.M.Inst.C.E., } *Auditors.*

6th March, 1891.

MODEL DWELLINGS IN LONDON, AND OVERCROWDING ON SPACE.

By Louis Parkes, M.D.Lond.

Read at a Sessional Meeting, February 11th, 1891.

Every year in London, a larger number of people are being housed in blocks of Model Dwellings. Twenty years or so ago the number of such dwellings was comparatively small, but now —owing to the demolitions which have been, and still are being, carried out in the more central and crowded districts of the metropolis, and to the necessity imposed by Parliament upon the local authorities, railway and other public companies, to re-house a portion of the working classes displaced—model dwellings have sprung up, and are still being erected, at a rate which means that before very long a considerable proportion of the industrial classes will be housed in this kind of tenement. At the present time about 20,000 people are now housed in the buildings of the Peabody Trust, and about 30,000 in the buildings of the Improved Industrial Dwellings Company. These are two of the largest associations owning buildings in London, but there are many other blocks of model dwellings belonging to other companies and private individuals.

The crowding on space which these lofty blocks entails is at once understood when it is stated that in such dwellings in London the number of inhabitants per acre averages 1200, or nearly 30 times the number per acre for the metropolis as a whole. Dr. Farr, many years ago, pointed out the relationship which existed between density of population and a high death-rate. We now know that such a relationship is not invariable, and the statistics of certain of the large companies and

charitable trusts owning numerous blocks of Artizan Dwellings in London, show that a certain amount of crowding on space is permissible if the dwellings are well designed, well constructed, and well ventilated, and that a fair standard of health is maintained under such circumstances. The statistics, showing a very low death-rate, published by some of the companies can, however, only be accepted with a certain amount of reserve, as corrections are by no means generally made for an age-distribution of the population of the dwellings which is favourable to a low death-rate, and the numbers of the inmates who die away from their homes in hospitals and infirmaries is not always included. The favourable age-distribution is shown by the high birth-rate prevailing in the dwellings, which indicates a population consisting largely of adults of less than middle age, with their families of children. Thus in the Peabody Buildings the birth-rate for 1889 was 39 per 1000, which is 8·7 per 1000 above that of all London for the same period. The death-rate was 16·49 per 1000, which is 0·96 per 1000 below the average of London. This death-rate is inclusive of deaths in hospitals, which constituted 14 per cent. of the total deaths. The Improved Industrial Dwellings Company, for the year ending June 30th, 1889, show a death-rate of only 11 per 1000, which is 6·6 per 1000 below that of London, and a birth-rate of 35·2 (4·5 per 1000 above London generally), but the death-rate is apparently not corrected for deaths in hospitals. In these dwellings the correction for hospital deaths would probably raise the death-rate from 11 to 13 per 1000, and the correction for age-distribution would probably necessitate the addition of another 3 per 1000, raising the death-rate to 16 per 1000, when comparison may justly be made with London generally or other urban populations.

In return for the closer aggregation which the inmates of model dwellings are subjected to, they get generally a superior accommodation in rooms, in sanitary conveniences, in facilities for washing their bodies and clothes, in freedom from street noises, and in enclosed courtyards where the children can play free from the dangers of crowded streets. Whilst many very satisfactory blocks of model dwellings have been erected by such bodies as the Improved Industrial Dwellings Company, the Peabody Donation Fund, the Commissioners of Sewers, some of the Railway Companies, &c., there are still a considerable number now existing which are models only of what is bad in design and undesirable in arrangement.

In this paper it will be necessary to restrict myself to one aspect only of the subject, namely, the outside air space and ventilation of the blocks, as bearing most directly on the

question of overcrowding on space. I examined recently some parallel rows of blocks of model dwellings in Shoreditch. The buildings are five storeys in height, and front upon streets only nineteen feet wide. Between the backs of the blocks is a courtyard only 12 feet in width. The rooms on the two lower floors of these dwellings, which are let as separate tenements, are nearly dark even at mid-day in winter, and are entirely cut off from any wholesome current of air. These dwellings are by no means isolated specimens, and instances might be multiplied from all over the metropolis of lofty blocks placed close together, and surrounding on all sides scanty courtyards, which constitute immensely tall and narrow shafts or wells from which the inner rooms of the blocks derive all their light and air. In many cases that I have seen I have had no hesitation in condemning these tenements as unfit for human habitation by reason of want of light and air. The reason for this crowding of lofty buildings on inadequate sites is, of course, that the cleared land in the more central parts of London is so valuable, that unless a very large number of persons are housed on the site, the owner does not realise the profits he thinks himself entitled to.

As it is now generally conceded that back-to-back houses without through ventilation, and rooms facing narrow enclosed courts in which the atmosphere is always sunless and stagnant, exercise an unfavourable influence on health, and tend to produce an excessive mortality from phthisis, respiratory diseases, diarrhœa, and zymotic diseases generally, it will not be necessary for me to detain you on this subject, which has been very carefully investigated for the Local Government Board by Dr. Barry and Mr. Gordon Smith, in a report upon Back-to-Back Houses (1888), and by Dr. Ransome, F.R.S., in various papers on the relationship between phthisis prevalence and overcrowding in Manchester and Salford.

It becomes now necessary to inquire if the sanitary Acts applicable to the metropolis were, or are, capable of preventing this evil, which is an increasing one, and one threatening gravely the future public health of this city. It is also one with which the public generally is not yet acquainted, as the erection of model dwellings for the working classes is popularly supposed to provide the proper remedy for the unhealthy areas and dilapidated houses included in schemes of clearance.

Prior to the year 1855 there was nothing to prevent houses being built back-to-back, *i.e.*, without any intervening open space whatever. In 1855, the Metropolitan Building Act came into force, Section 29 of which enacts that every new building to be used as a dwelling-house must have in the rear, or on the side of it, an open space exclusively belonging to it of the extent of at least 100 square feet, unless all the rooms can be lighted and ventilated from a street or alley adjoining. That is to say, a mere open space, 10 ft. by 10 ft. it might be, no matter what the height or width of the building, whilst the corner houses of streets whose rooms can be lighted from two aspects, need not have any open space at the rear at all. The extent of open space here insisted on is of course ludicrously insufficient, yet this clause was the only one in force relating to the air space of dwellings until 1862, when an amending Act was passed containing a clause (Section 85), which enacted that no building was to be erected on the side of any new street of a less width than 50 feet, which exceeded in height the distance across the street from house to house, unless the consent in writing of the Metropolitan Board of Works was obtained. Here, then, at last is a recognition of the principle that the height of a building must have some relation to the amount of open space in front of it; but at the same time nothing was done in this Act to increase the amount of open space to be compulsorily left in the rear of a building, and the clause itself only applies to streets newly laid out.

Matters remained thus until the year 1882 (twenty years later). when it came to be recognised that perhaps it would be as well for the open space in the rear of houses to have some relation to their width (not their height), and it was enacted in another amending Act (Section 14) that every new building to be used as a dwelling-house and erected upon a site not previously occupied by a building, shall have, unless the Metropolitan Board of Works otherwise permit, directly attached to the rear of it an open space exclusively belonging to it of the following extent.

Frontage of building—

Not exceeding	15	ft.,	open space	shall be	150	sq. ft.	at least.
„	20	„	„	„	200	„	„
„	30	„	„	„	300	„	„
Exceeding	30	„	„	„	450	„	„

It was also enacted that this open space shall be free from any erection thereon above the level of the ceiling of the ground floor storey, and shall extend throughout the entire width of each building at the rear of it.

This clause, then, enforces open space in the rear of houses built on ground not formerly built on before 1882, according to the amount of frontage width of the building, but specifies nothing in relation to the height of the building. At the present day in London, a builder who had bought land

cleared of buildings erected before 1882, could build blocks of model dwellings of any height up to 90 ft.,* provided the street was laid out before 1862, and could then build parallel blocks behind them of any height up to 90 ft. and separated from the first blocks by a number of wells 20 ft. by 10 ft. at the bottom, the front and back blocks being attached to each other back-to-back, except where the wells intervened, there being necessarily one well for each set of tenements divided from its neighbours by party walls (Metropolitan Building Act, 1855, Sect. 27). Not only would there be nothing to prevent a builder perpetrating such a building enormity as this, but the wells of 200 square feet could be covered by sheds extending as high as the ceiling of the ground floor storey.

We have, then, considerable reason to be grateful, that greater advantage has not been taken of the absence of any sufficient requirements in London for open space around dwellings, by the private individuals and companies who have undertaken the erection of Artizans' Dwellings. A great many faulty dwellings and blocks, obstructive of air and light, do exist, but matters might very well, in the absence of all reasonable restrictions, have been very much worse. It may be as well perhaps to consider the reasons why many industrial dwellings are not worse off for light and air than we know they actually are. In the first place, there is a limit beyond which the people who are to inhabit the model blocks will not permit themselves to go, even in their desire to be near their work. It is well known that the working classes themselves are averse to living in what they consider barracks, if they can get equally good accommodation in ordinary dwelling houses close at hand. The rules and regulations of the model dwellings are not always to their liking, and if in addition they find that artificial light has to be used by day all through the winter months they will not on any consideration become tenants of such rooms. Consequently a builder would make a financial mistake, who should construct a large number of tenements which he could not sell or let at any price. At present the people have a considerable choice of where they shall live; but it must not be forgotten, that with the increasing demolition of small insanitary house property, which will surely result from the operation of the new Housing of the Working Classes Act of 1890, under the direction of the London County Council and the Vestries, and from the immense extension of business premises in the

* By the London Council (General Powers) Act, 1890, Section 36, the height of buildings exclusive of roofs and turrets must not exceed 90 ft.

more central districts, a time will come when many of those who must live near their work will have no option except to become tenants of the model dwellings, and many will perforce be compelled to occupy the tenements which they now regard with so much aversion.

In the second place, although the sanitary authorities have no power to control the faulty building in course of erection, they can, as soon as the tenements are occupied, take steps to have them closed as unfit for human habitation, should the Medical Officer of Health consider the absence of light and air a sufficient reason for the case to be taken before a magistrate; and the fear of this being done must have operated in many a case where the owner was not influenced by any higher consideration than his own profit in the erection of dwellings.

Thirdly, a considerable proportion of the model dwellings in London have been erected by charitable Trusts, and by Companies presided over by men of eminence in the philanthropic world, whose desire has been to provide good accommodation, and to ensure no larger dividends than four or five per cent. on the outlay. The dwellings, also, now provided by the railway companies for people displaced to carry out their extensions or improvements, have to be surveyed and the plans passed by an official appointed by the Home Secretary, whose business it is to see that overcrowding on space is not carried to any great extent.

Still, notwithstanding these considerations, as has already been stated, many model buildings now exist, providing tenements absolutely unfit for human habitation by reason of want of light and air, and there is nothing to prevent the continued erection of such buildings, and their even closer crowding as land becomes year by year more and more valuable.

The operation of the Housing of the Working Classes Act is likely to increase and perpetuate the evil in this way, viz., that houses closed and subsequently demolished by the action of the Vestry alone, will very likely be replaced on the old site or sites by model dwellings of a bad kind; for Section 34 of Part II. of the Act is too vague in its terms to be of much use to prevent the erection of such structures. The section reads:—"Where a building has been so taken down and removed, no house or other building or erection which will be dangerous or injurious to health shall be erected on all or any part of the site of such building; and if any house, building, or erection is erected contrary to the provisions of this section. the local authority may at any time order the owner thereof to abate the same, and in the event of non-compliance with

the order, may at the expense of the owner abate or alter the same." Of course if the owner demolishes of his own accord, without waiting for the Vestry's order, this section does not apply at all.

With regard to the unhealthy areas cleared by the action of the London County Council and compulsorily acquired, there is no reason to fear that the evils got rid of will be replaced by others, for which they are intended to provide a remedy. The County Council, in the case of the Boundary Street area in Bethnal Green, will only sell the land under certain conditions. These conditions are that the blocks of dwellings to be erected shall not exceed 40 ft. in height (four storeys), and that parallel blocks shall be separated from each other by an open space clear from the ground of at least 40 ft. in width (the height of the buildings). The new streets will be forty feet in width, and the blocks will run almost due north and south, so as to admit the maximum amount of light to all the tenements equally; also the courtyards between the blocks will be left entirely open at each end, unobstructed by any cross buildings. Of course the land sold under these conditions cannot fetch anything like the price which would accrue if sold free from restrictions. Hence the cost of the scheme to the ratepayers. A precedent having been created in this respect by the present London County Council, we may well hope that future Councils will not depart from it. It is far better in every way that the present generation should provide the proper remedy for the evils in housing which it finds to exist, and not leave a further legacy of sanitary neglect to future generations, which they may well find even more difficult to cope with than the present population does those handed down by its predecessors.

In 1885 the Royal Commission on the Housing of the Working Classes had under consideration the statutory provisions in force in the metropolis with regard to the height of buildings and the space about buildings for the purpose of securing a free circulation of air. The Commission recommended (1) That upon the lines of the existing enactments in the Acts of 1862 and 1878, rules of more general application be framed to control the height of buildings in relation to the open space which should be required to be provided in front of the buildings, either in the form of land exclusively belonging to each building and kept free from erections, or in the form of an adjoining street. (2) That in the rear of every new dwelling house or other building, and whether in old or in new streets, there be provided a proportionate extent of space exclusively belonging to the dwelling house or building; that this space be

free from erections from the ground level upwards; that it extend laterally throughout the entire width of the dwelling house or building; that for the distance across the space from the building to the boundary of adjoining premises a minimum be prescribed; and that this minimum increase with the height of the dwelling house or building.

Thus six years ago the Royal Commission well and concisely summarised the pressing requirements for securing adequate open spaces to houses in London; but since then nothing has been done. Neither the old Metropolitan Board of Works nor the new County Council ever had, or now have, the power to frame bye-laws for the open spaces about new houses, which was conferred upon all Urban Sanitary Authorities outside London, sixteen years ago by the Public Health Act of 1875 (Sect. 157). By the Metropolis Management Act Amendment Act, 1878, the Metropolitan Board of Works was given power to make bye-laws for the foundations, sites, and materials of new houses, so as to secure stability, prevention of fires, and for purposes of health, but the amount of open space around houses was not included; and this, be it remembered, three years after the passing of the Public Health Act, which expressly gave such powers outside London.

Why should London have been so long neglected in this way? Surely, with its immense population and enormous area, it ought to have as much air space around its houses as provincial towns. The air of London generally is not so pure that we can put up with a very small amount of it, on the principle that quality makes up for quantity. The necessity for sufficient air space has been recognized for fifteen years by the Legislature, but London is allowed to drift on in the old manner. The land, perhaps, is more valuable in London than in most provincial towns, but if reasonable restrictions on the rights of property are necessary in provincial towns to safeguard the health of their populations, they are surely equally desirable in the interest of public health in the metropolis.

An opportunity will be afforded this year, let us hope, of rectifying the disability so long cast upon the metropolis. In the Public Health Act for London, which is to consolidate and amend all existing metropolitan sanitary legislation, a clause should be inserted giving the County Council power to frame and enforce bye-laws for all new buildings, "with respect to the sufficiency of the space about buildings to secure a free circulation of air, and with respect to the ventilation of buildings." The bye-laws, when made, would have to be confirmed by the Secretary of State, and then London would stand

very much on the same footing as regards its new buildings, as the hitherto more fortunate provincial towns.

The accompanying table shows the bye-laws* for open space around new domestic buildings now in force in five cities (Manchester, Brighton, Birmingham, Liverpool, and Newcastle), which have probably done more than any other towns in this country in clearing unhealthy areas, and providing for the erection of improved dwellings for the industrial classes, Glasgow excluded, but Glasgow has not at present any bye-laws bearing on this question. It will be seen that the bye-laws of Brighton and Manchester are founded very closely upon the model bye-laws of the Local Government Board, but those of Brighton actually require more open space than is suggested by the Local Government Board as desirable. The Birmingham bye-laws are similar, but there is the very important limitation of the regulations to houses the net rateable annual value of which will not exceed £20. Consequently, model dwellings will be excluded from the application of the bye-laws, as the rateable annual value of a block of tenements included between two party walls would far exceed the £20 limit. There is also a clause in the Birmingham bye-laws which the Local Government Board very rightly objects to on principle, namely, the discretionary power on the part of the Town Council to modify the application of the bye-laws in particular instances, thereby introducing an element of uncertainty prejudicial to the carrying out of the regulations, and exposing the Town Council to charges of unfairness in its dealings with individuals. It should also be noted that a possible considerable sacrifice of property is made a reason for not enforcing the regulations. These limitations are contained in the older Bye-laws of 1876, and are not in those of 1887, and it is very probable that the Local Government Board refused to sanction them when re-introduced into the new bye-laws for 1887; hence the retention of these clauses in the form of an appendix to the new bye-laws.

The Liverpool bye-laws provide for a less open space in the rear of new domestic buildings, and exclusively belonging to them, than is sanctioned by the Local Government Board, and allows nine feet of the prescribed minimum width to be taken into account from an adjoining street. In certain cases also the open space may be at the side, and not in the rear of the house. In most bye-laws the height of the house is to be measured from the ground level to the level of half the vertical

* Copies were kindly sent me by the Medical Officers of Health of Manchester, Brighton, Newcastle, Glasgow, and Birmingham, and by the City Engineer of Liverpool.

	ove gh- ceed- t.	*Limitations.*
Model Bye-laws of Local Government Board.	st .	
Manchester.	.	
Brighton.	500 .)	
Birmingham.		* These regulations only apply to houses, the net rateable annual value of which will not exceed £20; and when thorough ventilation of such open is secured, or when on the re-erection of buildings within the Borough, these dimensions cannot be adhered to without considerable sacrifice of property, they may be modified in special cases at the discretion of the Town Council.
Liverpool.		The open space may be at the side of the house, and not in the rear, when the back of the house has a window in each storey, opening to a street not less than 9 ft. wide. Unless the open space at the rear is of an aggregate extent of 500 square feet, it must on three sides adjoin an open space of another dwelling-house, or adjoin a street.
Newcastle-upon-Tyne.		These regulations do not apply to new dwelling-houses erected on a site previously occupied by a dwelling-house, unless the former house had an equal or greater extent of open space at the side or rear. Where the open space was less in extent than that required by the regulation, then the open space for the new house must not be less than that which previously existed. In the case of dwelling-houses built prior to 1871, and having open spaces not greater than that required by the regulation, these open spaces are never to be built upon, except with the approval of the corporation.

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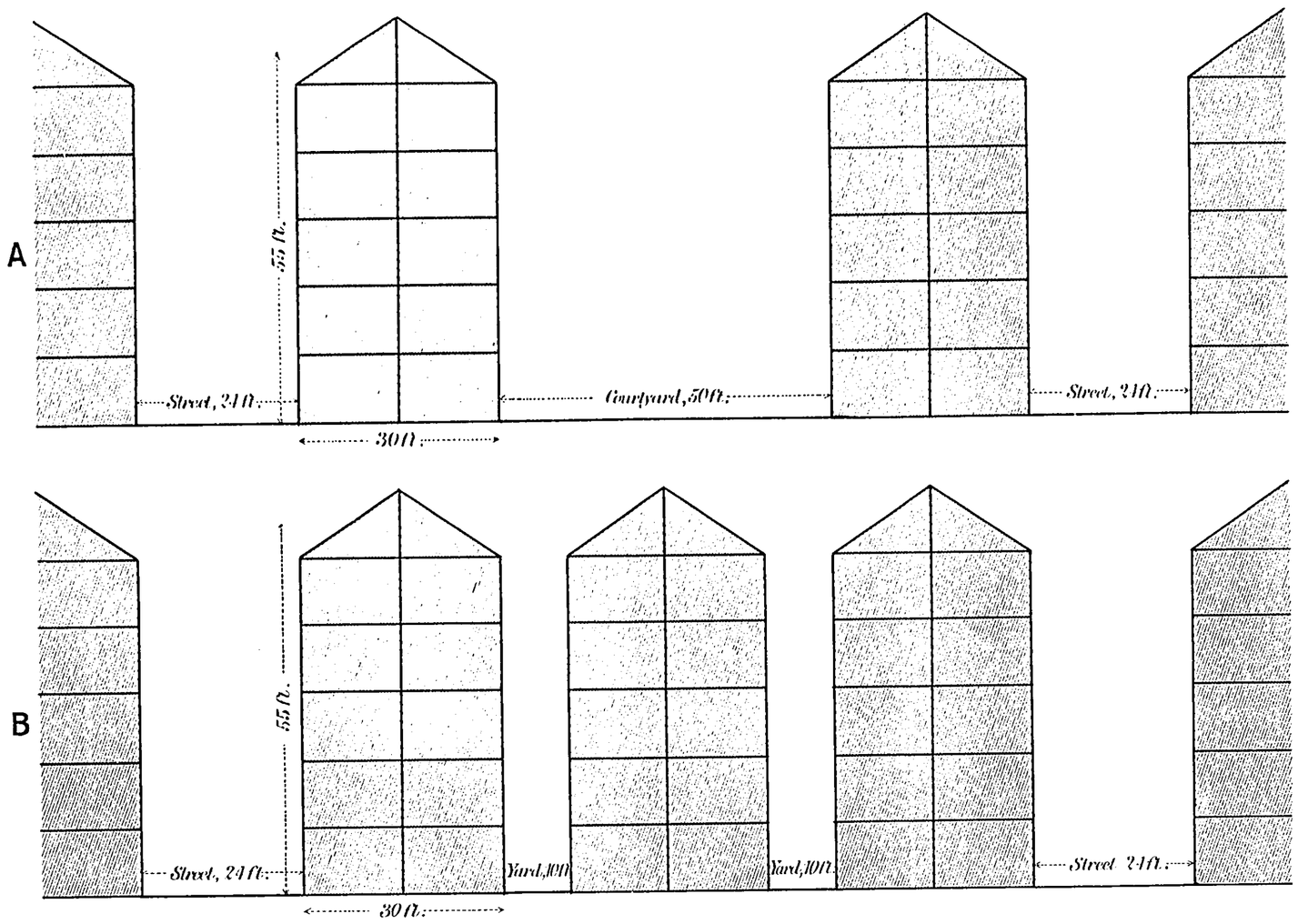
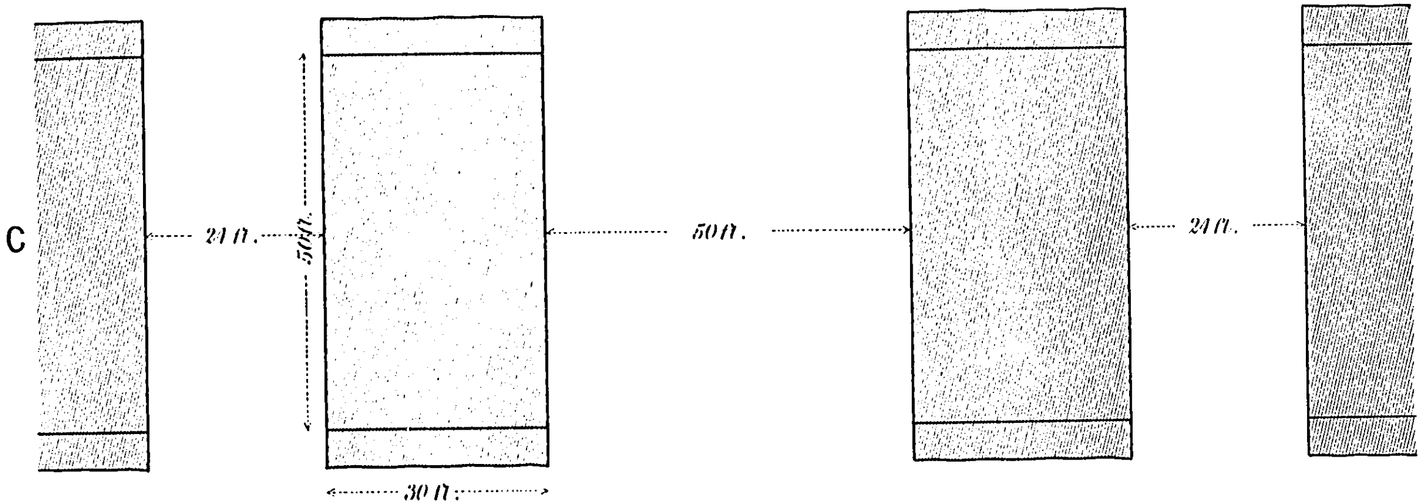
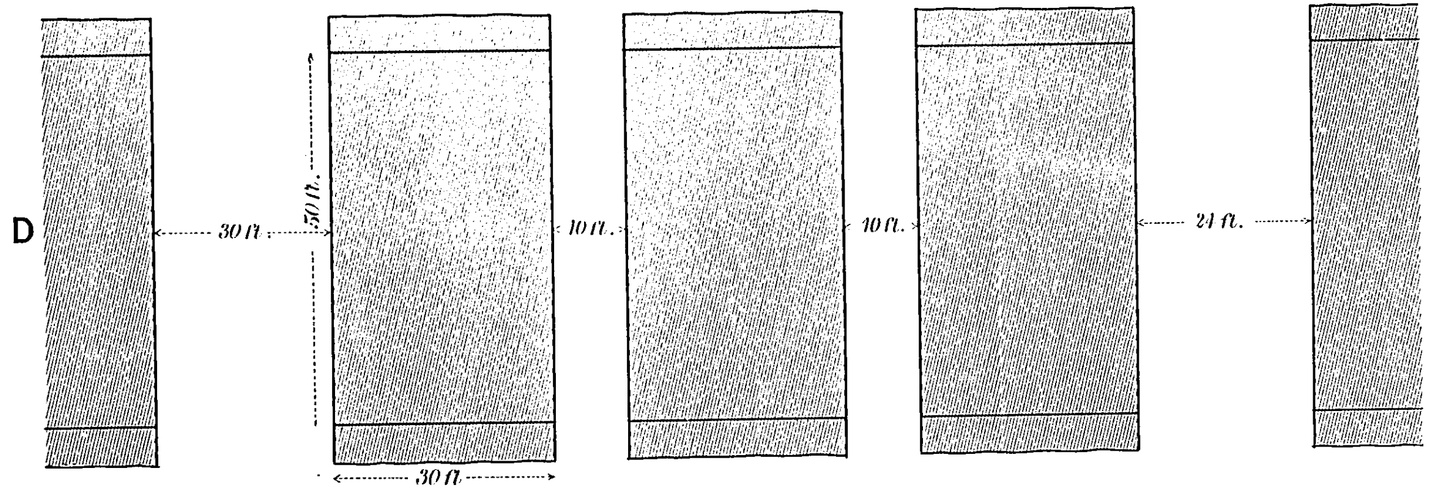
Bye-laws for Open Spaces around new Dwelling-houses.

	Date of Adoption.	Acts under which Bye-laws are framed.	*Open Space in Front*, extending throughout whole line of frontage, to be at least.	*Open Space at Rear of Building*, exclusively belonging to it, and free from any erection above the level of the ground, except a W.C., E.C. or a privy and ashpit, extending laterally throughout entire width of building.						*Limitations.*
				Aggregate Extent not less than	*Distance across or depth of open space everywhere to be according to height of building.*					
					In any case.	Height 15 ft.	Height 25 ft.	Height 35 ft.	Height exceeding 35 ft.	
Model Bye-laws of Local Government Board.		Public Health Act 1875, Section 157.	24 ft.	150 sq. ft.	At least 10 ft.	At least 15 ft.	At least 20 ft.	At least 25 ft.	At least 25 ft.	
Manchester.	1890	Local (Manchester) Improvement Acts.	36 ft. [24 ft. if street is less than 36 ft. wide].	150 sq. ft.	10 ft.	15 ft.	20 ft.	25 ft.	25 ft.	
Brighton.	1886	Public Health Act; Towns Improvement Clauses Act, 1847; Brighton Improvement Act, 1881.	12 ft. to centre of street, if street laid out before Local Government Acts. 15 ft. to centre, if street laid out before 1886. 18 ft. to centre, if laid out after 1886.	200 sq. ft.	10 ft.	15 ft. (300 sq. ft. aggregate extent.)	20 ft. (400 sq. ft.)	25 ft. (500 sq. ft.)	25 ft. (500 sq. ft.)	
Birmingham.	1876* 1887†	Public Health Act; Local (Birmingham) Consolidation Act, 1883.	24 ft.†	150 sq. ft.*	10 ft.*	*2 storeys.* 15 ft.*	*3 storeys.* 20 ft.*	*More than 3 storeys.* 25 ft.*		* These regulations only apply to houses, the net rateable annual value of which will not exceed £20; and when thorough ventilation of such open is secured, or when on the re-erection of buildings within the Borough, these dimensions cannot be adhered to without considerable sacrifice of property, they may be modified in special cases at the discretion of the Town Council.
Liverpool.	1890	Public Health Act.	30 ft. [12 ft. 6 in. from centre of street, if street is less than 25 ft. wide, and was laid out before 1890].	150 sq. ft.	5 ft. [Open space must be equal in depth to the height of the back wall of the house, but this may include 9 ft. of the adjoining street.]	*Height of wall between 20 and 30 ft.* 10 ft.	*Height of wall exceeding 30 ft.* 15 ft.			The open space may be at the side of the house, and not in the rear, when the back of the house has a window in each storey, opening to a street not less than 9 ft. wide. Unless the open space at the rear is of an aggregate extent of 500 square feet, it must on three sides adjoin an open space of another dwelling-house, or adjoin a street.
Newcastle-upon-Tyne.	1866 1870 1871	Bye-laws, 1866; Newcastle Improvement Acts, 1870, 1871.		One-fourth the area of ground belonging to building: may be at the side instead of the rear, applies to corner houses.						These regulations do not apply to new dwelling-houses erected on a site previously occupied by a dwelling-house, unless the former house had an equal or greater extent of open space at the side or rear. Where the open space was less in extent than that required by the regulation, then the open space for the new house must not be less than that which previously existed. In the case of dwelling-houses built prior to 1871, and having open spaces not greater than that required by the regulation, these open spaces are never to be built upon, except with the approval of the corporation.



A *Elevation of Model Dwellings, showing minimum open space required for new domestic buildings under Model Byelaws*
B *Elevation of Model Dwellings, showing possible arrangement in London.*





C *Plan of Model Dwellings under Byelaws.*
D *Plan of Model Dwellings in London.*

height of the roof, or to the top of the parapet, whichever is the higher; but in Liverpool the height of the back wall from the ground to the eaves of the roof need only be taken into account. It is preferable to measure the open space in front of the house to the centre of the street, as is done in Brighton and Liverpool; otherwise the sacrifice of land falls only upon the owner, who rebuilds first on one side of a street of less width than twenty-four feet, and the owner of the opposite houses retains his original line of frontage when his turn comes to rebuild.

The Newcastle-upon-Tyne Bye-laws are very deficient, as there is no regulation for a minimum open space in front of a house, nor for the depth of open space in the rear according to the height of the building. The limitations also practically restrict the amount of open space to be left in the rear of new dwellings upon old sites to what existed prior to the passing of the Acts, and the regulation for preventing the building over open spaces in the rear of old buildings is bad in law if included in bye-laws for new buildings, as such regulations are *ultra vires* when included in such bye-laws, as the case of Tucker *v.* Rees shows.

The diagrams A, B, C, D, are intended to show (A and C) the minimum amounts of open space in front and rear of new model dwellings allowed by the model bye-laws of the Local Government Board, such as have been adopted in Brighton and Manchester, whilst in London the possible arrangement of such buildings on the same amount of space is shown (B and D). Each block is 30 feet deep, has a frontage of 50 feet, and is five storeys in height—the height of the building measured from the ground to half the vertical height of the roof is 55 feet. Each block might have four sets of tenements of two rooms each on each floor—two tenements in front and two at the back of the block; allowing for a family of four in each tenement, this would give the population of each block as 80, or in the two blocks 160, or in three blocks 240. In the two blocks erected on such a site in Brighton or Manchester, the density of the population per acre would be 1040, whilst in London the three blocks would give a density of 1560 per acre —in each case half the area of the adjoining streets is included. In Brighton and Manchester 54 per cent. of the area included between the front walls of the opposite blocks would be covered by buildings, whilst in London 82 per cent. of the area would be covered by buildings. In the London blocks 40 per cent. of the rooms would be so devoid of light and air as to be practically uninhabitable, that is to say, all the inner rooms facing the 10 feet wide shafts below the two upper storeys.

	Percentage of site covered by buildings.	Density per acre.	Percentage of uninhabitable rooms.
Brighton or Manchester	54	1040	0
London ...	82	1560	40

This diagram illustrates a defect in the requirements of the Model Bye-laws, viz., that whilst the open space at the rear of the new buildings must vary with the height of the buildings up to 35 feet, and can in no case be less than 50 feet wide for opposite buildings exceeding 35 feet in height, the minimum open space in front is fixed at 24 feet, and in streets so narrow as this there is no limitation of the height of the buildings. The tendency in large towns is to increase the loftiness of the buildings, and it is surely desirable that in all streets less than 40 or 50 feet in width, the height of new buildings should bear some proportion to the width of the street.

In this diagram the London model dwellings are supposed to be erected on the sides of streets laid out previously to 1862, and on sites formerly occupied in whole or in part by buildings, such for instance as constitute nine-tenths of the sites on which model dwellings have been, and are likely to be, erected for many years to come in the metropolis.

Dr. PARKES, at the conclusion of his paper, moved:—

"That this meeting, recognising the necessity for securing a greater amount of open space around new buildings in London, in the interests of public health of the metropolis, hereby recommends the Council of the Sanitary Institute to petition the President of the Local Government Board to insert in the Bill for amending and consolidating the Sanitary Acts in London, a clause empowering the London County Council to frame and enforce bye-laws for new buildings in London in respect of sufficiency of air space, to secure a free circulation of air about them, and the proper admission of light to the rooms."

Sir DOUGLAS GALTON, K.C.B. (London), in putting the resolution, observed that he thought the high rents asked in London arose in a considerable measure from the license allowed to property owners to crowd lofty buildings on a small space of ground.

Mr. R. M. BEACHCROFT (London), Vice-Chairman of the Housing of the Working Classes Committee of the London County Council, seconded the resolution, and suggested as an alternative that a petition might, if thought desirable, also be presented to the London County Council urging an amendment of the Building Acts. He

quite agreed with the mover that considerable objection was entertained among the working classes to barrack buildings, but thought the only practical remedy for overcrowding on space was the removal into the suburbs of a large proportion of the population from the congested districts, and the immediate provision, on a comprehensive scale, of satisfactory cottage accommodation under proper regulations in the outskirts of London.

Mr. SHIRLEY MURPHY (London), thought that the author of the paper had put forward very clearly what the wants of London really were, and he thought it would be very desirable if we could have in London the power of dealing with the question of air space about houses by bye-law. At present it is permitted, under certain conditions, to build houses without any space at their rear and without through ventilation. He could assure the meeting that the London County Council were not unmindful of the importance of the question of air space about houses, and in Mr. Ritchie we had a minister who had shown great interest in public health questions; he hoped, therefore, London would not continue long in the disadvantageous position it now occupied. The height of rooms was also a question that needed attention. With regard to the price of land in London, which had been referred to, he had been informed on good authority that with the exception of the city and special districts such as Charing Cross, it was not higher than in other large towns.

He ended by proposing a vote of thanks to Dr. Parkes for his paper.

Mr. KEITH YOUNG, F.R.I.B.A. (London), seconded the vote of thanks, and said that he considered that the height of buildings should be so proportioned to the width of the street, that the light could enter all the windows, at an angle of not less than 45 degrees. He pointed out that many of the larger blocks of model dwellings are to all intents and purposes back to back houses, which are so universally condemned. In some cases buildings were 60 feet high and separated by courts only 18 feet wide, and these courts were "culs-de-sac." The bye-laws made under the Building Act Amendment Act require, in all cases of new buildings, that the site, if not previously built upon, should be covered with concrete, but if a man pulls down an old house when the ground is contaminated by all sorts of accumulations, he can re-build it without being bound to protect the inhabitants by such an impervious stratum.

Dr. G. V. POORE (London), thought that the overcrowding on space was the most important of all sanitary questions. The cause of the overcrowding on space in large towns was, he said, water under pressure which enabled people to get water to the top of large buildings and also to wash away the refuse from the town. Huge blocks of buildings were being erected in all our towns, nobody interferes, and it is thought that the public health will not suffer. But it must be

perfectly evident that in all cases of air-borne infection, the putting of people on the top of each other and under one roof, must enormously increase the risk. Take for example the influenza in the beginning of 1890, which was essentially an air-borne disease. From a table of corrected death rates given in the *British Medical Journal* for May 10th 1890, for the first three months of 1890 it would be found that the death-rate for the whole of London was only slightly raised, while in the seven central districts of London, having a population of 270,000, it ranged from 20·7 to 38·8, and the total births in these districts during the three months was 2,012, and the deaths 2,153, showing that in this metroplis of ours during those three months the deaths, in the central districts, exceeded the births by 141. He then pointed out some of the evils likely to arise from cases of infectious diseases in the fashionable mansions or flats. He next alluded to the absence of light in London, which made it necessary to burn candles in the day-time, which was another evil caused by overcrowding on space, as these enormous buildings of mansions and flats largely increased the amount of smoke poured into the atmosphere within a given area. He believed that this question had a very considerable relation to social and labour questions. Most people, he said, were of opinion that there ought to be no underground dwellings, but, as a matter of fact, the servants of those who held such opinions were housed below the level of the street. What he thought should be the rule was that the curtilage of every house should bear a definite proportion to the cubic contents.

Mr. Percival Gordon Smith, F.R.I.B.A. (London), said that in London it was not impossible, under the present Acts, to build new back-to-back houses. The only provision on the subject is, that all rooms must be lighted and ventilated from a street or alley adjoining, and thus, if a common lodging house, for example, were built with rooms of excessive depth and lighted and ventilated from a street in front only, it could not be condemned, although it would be actually, or equivalent to, a back-to-back dwelling. As to the height of houses, he was very much amazed at the provisions of the Act of last year, as he could hardly understand it being necessary to place a limit on the height of buildings, while allowing anyone to erect them so high as 90 feet, with two storeys in the roof *in addition*.

Mr. Francis Hooper, A.R.I.B.A. (London), considered that the diagram exhibited amply illustrated the impotence of existing building legislation in London to secure curtilage around the lofty tenement buildings sufficient to ensure their enjoyment of a full complement of light and air. When houses are reconstructed in old streets, it is at present the habit to leave to adjacent private owners of property the vindication of prescriptive rights to light and air, and to ignore the public interest in these necessary commodities. Hence it follows that when private owners agree to pecuniary compensation for their losses, the public become the sole losers. Mr. Hooper contended that

the plans of buildings to be erected specially for the occupation of artisans in crowded districts should be submitted for the approval of some competent authority, such as would forbid the erection of buildings the like of which are a disgrace to the metropolis. It should be more generally recognised that abundant light and ventilation is as indispensable in staircases and approaches as in the actual living rooms of such thickly populated buildings, both for the moral and physical well-being of the tenants.

Mr. W. White, F.S.A. (London), thought that some definition was needed with regard to the amount of light and air. In Wakefield they have rules which limit the smallness of windows to the tenth part of floor area. In all habitable rooms windows must have half their area made to open, and they must open to at least 7 feet 6 inches from the floor. He thought that this point had not hitherto received the attention of those concerned in framing the Building Act. He thought that if the angle of 45 degrees for light were insisted upon, it would be most desirable. But he did not see how it would be possible. This alone would soon spread London into the country.

Mr. H. B. Collins, R.N. (London), said that the fittings of windows and doors, and smoky chimneys, in the large workmen's buildings were very much complained of, and he thought it strange that Architects could not build dwellings with chimneys that would not smoke.

Mr. D. Richards (London) thought it was a question whether the density of the population was better upwards or spread over the ground. In the matter of ventilation he thought, that in high blocks of buildings the open windows of the upper rooms would necessarily receive the impure air coming out of the lower windows, and he thought that smaller houses and narrower streets were better. Shorter hours of labour and a cheaper railway system were wanted to get the people into the country.

The resolution was then put by the Chairman and carried unanimously, and a vote of thanks to Dr. Parkes was also carried.

Dr. Louis Parkes (London), in acknowledging the vote of thanks, said he thought that the power to frame bye-laws, if entrusted to the London County Council, would meet the necessities of the case better than the insertion of clauses in amended Building Acts. The standard suggested by Mr. Keith Young, that all living rooms should receive light from the sky at an angle not greater than 45 degrees, was a valuable one, and was one to be striven for, even if it was necessary to be content with something less for the present. He did not think it was practicable to endeavour to abolish the occupation of

cellars and underground sleeping rooms, but something might now be done to increase the stringency of the clauses regulating the condition and construction of such dwellings. He agreed with Mr. Gordon Smith, that the present limit of the height of houses in the metropolis to 90 feet, with two storeys in the roof and excluding turrets and towers, was allowing far too great a height. The new block of buildings at Knightsbridge was an instance of the extensive overshadowing of neighbouring structures, produced by buildings of such enormous altitude. More or less lofty blocks of artisans' dwellings in large cities were a necessity of the times. That such buildings could be made into healthy houses for the working classes was evident from the experience of the Peabody Trust. What was required was, that suitable restrictions should be in force to prevent the too great aggregation of the blocks, and the excessive overcrowding on space with all its sanitary evils.

THE PREVENTION OF INFECTIOUS DISEASE,

By A. Wynter Blyth, Professor of Hygiene at the College of State Medicine.

Read at a Sessional Meeting, March 11th, 1891.

ABSTRACT.

The origin or cause of "communicable" disease is alike in animal and plant, the cause in each being minute life-forms preying upon larger and higher lives. These microscopic parasites are known by the general term of "micro-organisms," and include a vast number of genera and species. The great majority of micro-organisms which swarm in air, water, and soil, are not disease-producing, but others are, and it can be proved that a few, originally innocent, may, by being placed under certain conditions, in the course of a few generations produce a parasitic, malignant race, endangering the life of the animal which they attack. Since the origin of communicable disease is practically the same throughout the world of life, so the laws of communicability, and the methods of prevention, are in their essence ever the same.

Communicable human diseases cannot in the present state of science be classified as yet on a really scientific basis, but the following may serve the purpose for a time: 1, *Eruptive fevers, e.g.*, small-pox, measles, scarlet fever, typhus; 2, *Diseases affecting the Nervous system, e.g.*, rabies, tetanus, whooping cough; 3, *Diseases affecting the Organs of Respiration, e.g.*, pneumonia; 4, *Septicæmic maladies, e.g.*, septicæmia, erysipelas, diphtheria; 5, *Tubercular diseases;* 6, *Malaria;* 7, *Diseases affecting the Intestines, e.g.*, cholera, typhoid fever, diarrhœa, dysentery.

There are three ways by which communicable diseases can enter the system: the infective particles must be either breathed, swallowed, or inoculated. If infectious diseases were classified simply from the point of view of contagion, they might be arranged thus:—1, those which enter with the breath and

attack the lungs or the mucous surfaces of the throat and air passages: phthisis, small-pox, measles, typhus, whooping cough, diphtheria, malaria, pneumonia; 2, those that are swallowed: scarlet fever, pneumonia, cerebro-spinal meningitis, (cancer?) tuberculosis, cholera and diarrhœa, dysentery, leprosy; 3, diseases inoculated: rabies, tetanus or lock-jaw, erysipelas, anthrax, tubercle, cancer, syphilis, leprosy.

It will at once be noted that some of the maladies appear in more than one group. For instance, tubercle may be acquired by sucking it in with the breath, by taking it into the stomach in tuberculous meat or milk, and by inoculation. Nor is this a mere idea, it is founded upon experiment; Koch has produced a tuberculosis of the guinea pig by causing it to breath dust impregnated by tubercle. In a similar way it has been proved that milk drawn from the tuberculous udder of a diseased cow is likely to produce tuberculosis. And lastly, tubercle inoculated under the skin of almost any animal promptly shows its effects.

In these experiments it has also been shown that, as a rule, when tubercle-contaminated dust is breathed the disease primarily affects the lung; when tuberculous matters are swallowed the first beginnings of the malady are to be found in the intestines, or the membrane covering them (Tabes mesenterica); and when the infectious matter is inoculated the tubercle is generalised. Hence from these experiments we obtain important information as to the way in which a person has probably been infected, if the seat of the beginning of the disease is ascertained at a sufficiently early stage.

I have also put pneumonia under two headings, believing that it may be acquired by the breath, and also by taking food which is in some way specifically infected. That the infectious pneumonia is communicable by food may be suspected, by the experimental fact that mice fed on bread contaminated with pneumonic sputum become affected with pneumonia. I have also seen a limited and extraordinarily fatal outbreak of pneumonia sweep away almost all the members of a family, and had good evidence to suspect contamination of their food.

It ought, on theoretical grounds, to be easiest to prevent the class of diseases which are conveyed by inoculation; next, those which are most commonly swallowed, such as cholera and typhoid; and lastly, most difficult of all to prevent, those in which (*e.g.*, typhus) the disease we may presume is inhaled.

The records of epidemics do not, however, lend much support to this theory, possibly because until quite recently no preventive measures have been taken on these lines. For example, if we hold that phthisis is mostly inhaled, tabes swallowed, it ought to be far easier to prevent tabes than phthisis. The

records of mortality of phthisis and tabes for three decades are as follows:—

	1851—60.	61—70.	71—80.
Phthisis ...	1305 ...	968 ...	767
Tabes ...	1920 ...	2267 ...	2250

That is to say, in the first ten years the deaths from tabes are a little more than 1·6 times those of phthisis; in the next ten years the proportion had increased to more than twice: and in the ten years ending 1880 they were more than three times the deaths from phthisis.

What is the meaning of this increasing disproportion? Is it from the feeding of the young on tuberculous milk or meat? From the one or the other, or both? Or is it again from the general advance in the art of diagnosis, tubercle in the bowels being more frequently detected than formerly? No answer can be given to these questions, but what we can affirm is that tubercle in all its forms is communicable; and the time has therefore come for measures of isolation and prevention to be taken in all those cases in which there is a fair possibility of danger to the healthy.

It is now a well-ascertained fact that certain fatal and infectious diseases produced by micro-organisms can only be propagated in certain animals, the one class of animals being "susceptible," the others "immune." So again, it is known that a person having had scarlet fever once is to a considerable extent protected from a second attack. Previous to the first attack he was "susceptible," after the attack he has become "immune." Thus immunity may be natural, hereditary, or acquired. Mice and rats are naturally immune against diphtheria, frogs are naturally immune against tuberculosis. Immunity against small-pox may be artificially acquired by a previous attack or by vaccination; immunity against rabies may be also obtained by a similar process. Careful experiments are being made with the object of ascertaining whether the blood, or some substance separable from the blood, of animals which are either naturally or artificially immune, may be used as an agent to confer immunity, or even work as a curative agent, and much is in the future to be hoped from this channel of experiment. There is likewise some evidence that certain definite chemical compounds—like quinine, trichloride of iodine, and corrosive sublimate—may confer a temporary or complete immunity against a few zymotic diseases. Quinine has long been used as a preventive of malaria, and used with a fair amount of success.

1. Hence one of the methods of preventing the zymotic class of diseases is by scientific means to obtain "immunity."

2. Pure air, free from dust and suspended matters and the contaminations caused by overcrowding; light is also good. Sunlight is fatal to some of the disease-producing organisms.

3. Pure or uncontaminated water; water being largely concerned in the spread of typhoid fever.

4. Pure, sound, healthy food. The meat supply of the present day is practically uninspected, and a large amount of diseased meat is consumed. Important under this heading is the preservation of food, and sterilising of food, such as the storing of food in proper and suitable places, thorough cooking, and the boiling of all milk.

5. Lastly must be mentioned "the prevention of spread"; and communicable diseases are prevented from spreading by—firstly, isolation; and secondly, the proper use of disinfecting substances. This proper use differs according to the main channels of infection, which are not in all diseases the same. In cholera, diarrhœa, and typhoid, the discharges from the bowels are most dangerous; in typhus, the volatile emanations from the skin; in phthisis, the matter coughed up; in septicæmia, the fluids of the body generally, and so on.

The above short summary amply shows that much infectious disease can be prevented by cleanliness in food and habit, and by simple common sense precautions, possible in most households.

The Chairman, Sir Douglas Galton (London), said physicians say that all diseases are due to attacks of microbes, which surround us in innumerable quantities; but, fortunately, the body when in a healthy state is able to repel their attacks; if it were not so we could not live on the face of the earth. However facts may be with regard to recent investigations in diseases, they have not shaken the broad principles of sanitation, namely, that our surroundings should be as healthy as possible.

Mr. T. W. Maule (London) asked whether the microbes in Thames water are destroyed by the filters of the water companies; and whether the storage of water in cisterns is likely to contaminate the water.

Mr. F. R. Dockay (Croydon) said the boiling of milk was frequently suggested as a precaution against disease, but what could be done with cream, which, of course, could not be so treated?

Mr. H. B. Collins (London) said in some old buildings inhabited by the working classes he had three cases of pneumonia in one family following one upon another, two recovered but the last died.

Since these old buildings had been pulled down, scarlet fever had decreased, and he did not remember a single case in any of the new buildings; all the infectious diseases were much more rare than formerly.

Mr. J. Young (London) asked if all cases of typhus reported under the Infectious Diseases Act were accepted as such.

Sir Douglas Galton (London) asked whether in lofty blocks of artizans' dwellings children's sickness is greater than in the dwellings formerly occupied by this class.

Mr. Collins said that it was not so in his experience, the general sickness among the children being much less in the model lodgings.

Dr. P. W. G. Nunn (Bournemouth) thought that the causation of diphtheria was a question that required consideration. The disease may be caught from the breath of others, but it is frequently taken in other ways, and is more probably due to bad air from the sewers. At a house where some alterations were being made the workmen broke into the old soil-pipe on a Saturday and left it open until Monday, so that sewer gas in the meantime came into the house: on Tuesday one girl was ill with a bad throat, her sister also caught it, and both died of diphtheria. Three weeks previously there had been a case of diphtheria in a house in the rear, and the germs had probably remained in the sewer. Pneumonia appears to be infectious, as, in a house where there were seven children, one after another was ill with the disease, probably due to using the same handkerchief or food-vessel. It was surely possible as a means of prevention to kill the germs of diphtheria, typhus, and other infectious diseases while in the drains. Liquid disinfectants were not however sufficient alone, gaseous ones were also required, as the germs might be in the air or on the upper portion of the sewer-pipe.

Mr. H. C. Soper (London) said there appeared to be very little disease or illness among the flushers of sewers, and if sewer air were so deleterious how was this to be accounted for?

Mr. J. Cave (Kensington) asked whether parasites in meat could be killed by freezing.

Mr. Wood (London) said that Anthrax germs brought to the laboratory in cold weather when inoculated into animals took some days longer than usual to develop.

The Chairman moved a vote of thanks to the Lecturer.

Mr. Wynter Blyth (London), in reply to the several questions that had been asked, said that Thames water must often be much polluted, at the time of the Henley Regatta for instance. A great

deal of the pollution was destroyed by fish, micro-organisms, and oxydation, and about nine-tenths of the remainder was arrested by the water companies' filters. Cisterns for the storage of water are undesirable if they can be avoided, and the water is often polluted by the cisterns being contiguous to closets, stables, &c. Cream can be sterilised by heating intermittently to a lower temperature than boiling, for example about 80° centigrade. It is a remarkable fact that although there is evidence of cream being contaminated with disease, there is no definite evidence that butter or cheese have been contaminated in the same way. Cases of typhus fever are probably sometimes wrongly reported, but mistakes of diagnosis are sure to happen where the patient is only seen once at the commencement of the disease. Probably, however, more are overlooked than wrongly certified. The causation of diphtheria is very obscure, and the case given by Dr. Nunn was of real use in considering the question. It would appear in this case to have been breathed, as no doubt it may be, but it can also be swallowed. Disinfection of sewers could not be perfectly carried out, but in cases of infectious disease house drains might be disinfected by carbolic acid or corrosive sublimate. This, however, should not be done as an ordinary proceeding. The immunity of sewer flushers proves that most of the infectious maladies are swallowed and not breathed. Then again, sewer flushers have only short hours of work, and in many sewers the air is not very bad. With regard to the freezing of microbes, experiments show that activity is only arrested and not destroyed.

THE SEWERAGE OF THE TOWN OF MALDON, ESSEX,

WITH SOME OBSERVATIONS ON RECENT PRACTICE IN SEWER VENTILATION,

By Richard F. Grantham, M.Inst.C.E.

Read at a Sessional Meeting, December 9th, 1891.

Maldon is situated on the River Blackwater about ten miles from the sea, and contains a population of about 5500 in about 1250 houses. The river, which is here tidal, flows round the north and east sides of the town. The main part of it stands at a level varying from about 120 to 40 ft. above the sea. It is approached on the north by a steep hill rising at the rate of about one in eight, while on the south side the land gradually slopes down to the marshes lower down the river. An outlying and perfectly flat portion within the Municipal Boundary, with only a few houses on it, extends on the north side of the river.

Hitherto the larger portion of Maldon has drained towards the south through ditches into a creek, joining the river about a mile and a quarter below the bridge by which the town is approached on the north side, the other parts of it draining direct into the Blackwater at various points higher up.

After the usual preliminaries in preparing plans and obtaining the sanction of the Local Government Board, a contract was entered into in 1889 for the execution of the works, as designed by the Author's firm, to sewer only that larger portion which falls towards the south, the other parts, which must drain into a low-level sewer, not being taken in hand at present. The works of main sewerage, as well as of the house connections, have been carried out accordingly for the drainage of about 1000 houses, containing a population of about 4500.

A general description will suffice for these main works. The house connections have been carried out strictly in accordance with the law, as the author understands it, so that a reference

to them may form a basis for comparison with work done in other places.

The separate system of sewerage was adopted, except as regards gullies at the backs of the houses, through which a good deal of rain-water finds its way into the sewers.

The sewage is discharged from storage tanks through a cast-iron outfall pipe into a creek, passing through saltings, and joining the main channel of the river about 400 yards outside the river tidal walls, and about a mile and a quarter below the town. The high tides generally cover the saltings, but the sewage is not discharged into the creek until the tide has fallen below their level, or about one hour after high water. It is then discharged until the time of low water at Scales Point, at the mouth of the river (about ten miles below the creek), that is between four and five hours from the commencement of the discharge, when the penstocks in the tanks are closed.

The tanks which store the sewage during the flood tide, are built of concrete, and contain 115,000 gallons up to the level of the overflow. They are divided into two compartments by a wall down the middle, and are covered with brick arches for the greater part of their length. The iron outfall pipe is 15 in. in diameter, and 460 yards in length. It has a gradient of 1 in 1380, and one ventilating shaft on the inner side of the river wall. Beyond being strained through a wrought-iron grating, with half inch spaces, the sewage is not filtered or treated. The sludge is taken out of the tanks and deposited and dug into the land enclosed for the tanks. From the tanks upwards the 15 in. cast-iron pipe is continued across the fields for 600 yards as far as the main road out of the town.

The subsoil in the marshes, through which the iron outfall pipe is laid, is soft alluvial deposit with beds of drift gravel from 4 ft. to 5 ft. below the surface. Where there was no gravel, the iron pipes were embedded in concrete 1 ft. 6 in. to 2 ft. thick up to half the diameter. The subsoil in the town for the most part is London clay with fine green veins in it, making it extremely slippery. The streets were found to be riddled with old drains of very imperfect construction, and leaky water and gas pipes, so that a large quantity of timber shoring had to be left in the trenches. At the highest part of the town clean gravel and sand, containing water, were found a few feet below the surface. Where the depth at which the stoneware pipes were laid exceeded 11 ft. concrete was filled in round them up to half their diameter. In the course of his experience in other places the author has come across pipes split longitudinally, apparently by the weight of the superincumbent earth. He, therefore, thinks they should always be embedded in concrete where the depth exceeds a certain limit.

The sewer pipes in the town vary from 6 in. to 15 in. in diameter, and the back sewers are mainly 6 in., the separate connection of a house with a back sewer being 4 in. in diameter. The total length of main sewers is 7700 yards; of 6 in. pipes in house connections 5670 yards; of 4 in. pipes 1854 yards; and the number of manholes is 59; of lampholes 33; of ventilating columns and shafts on the main sewers 11; of syphon traps 259; of ventilating pipes to house connections 146; of inspection chambers 27.

The flattest gradient on the main sewers above the tanks is 1 in. 451 on a 15 in. pipe for a length of 537 yards, but the flow of sewage in it has been sufficient to keep the sewer perfectly clear. Where necessary, flushing valves and storm overflows have been built into the manholes.

The larger number of houses was found to be connected with sewers carried round at the back, and communicating with the shallow and imperfect old town sewers. These back sewers consisted in some cases of old brick drains with flat bottoms or no bottoms at all, pipes with imperfect joints, butt-end pipes all more or less choked with deposit.

In the new house connection works, two principles were acted on, viz: that where single houses were already connected with the old shallow system, new connections as far as they crossed the public streets were made with the new sewers at the expense of the Corporation; that new connections were made across the public streets with the back sewers, and each of these if found defective within private property was taken up and relaid as far as it was connected with more than one house drain, or as far as the last gully used by more than one house at the expense of the Corporation. Defective drains of single houses within the boundaries of private property were regarded as nuisances and notices were served on the owners to abate them and make good the drains. To make the distinction clear according to the Parliamentary definition, the conduit from a single house or from a gully used by a single house is a "drain," while the conduit from more than one house, or from one gully used by more than one house, is a "sewer." All the gullies at the backs of houses covered with bell traps were done away with, and stoneware gully traps inserted in their places.

Just outside the boundary of private property, syphon traps with air inlets were fixed on all new connections, and have been found to answer fairly well, but owing to a deficiency of water supply a few have been choked with deposit. At the upper ends of most of the back sewers 4 in. heavy round rain-water

pipes, or 6 in. by 4 in. square pipes, were connected, and fixed to the walls of houses and carried for ventilation from four to five feet above the roofs with conical hoods on top.

Changes of opinion and practice in regard to sewer ventilation have taken place since Messrs. Boulnois and Collins' papers* on the subject at the Congress of the Sanitary Institute at Dublin in 1884, and important changes seem to the author to be foreshadowed in the paper read by Mr. Crimp and Mr. Read at the recent International Congress of Hygiene. It will perhaps be of advantage to consider in what direction investigations in the future should be undertaken.

The primary conditions now fully recognised, which cannot be too strongly insisted upon, for preventing the accumulation of foul air, are sufficient falls in the sewers, construction of the best kind, proportions to suit the expected volume of sewage, so as to give a self-cleansing velocity, flushing where necessary, and as many openings into the outer air as practicable. But while open gratings at the street level, placed at intervals as frequent as possible, have hitherto been considered essential, and in the absence of any other method sufficient for the ventilation of sewers, the foul air occasionally escaping from them is offensive, and they are frequently rendered useless by being stopped up in response to complaints.

At one time trays and baskets containing charcoal were introduced into the buckets under the gratings to deodorise and purify the air from the sewers. At the best the charcoal was effective for only a short time, and moreover it was found to retard the free passage of air.

Mr. Boulnois in his paper at the Dublin Congress† described the various methods and contrivances introduced since 1848 for the improvement of the ventilation of sewers. All these, however, whatever their merits, have fallen into disuse, so that no further allusion to them need be made. Destructors involving the burning of gas have been and are now being used, but so far the results have not been better than those obtained from the simple shaft.

Recent investigations and experiments show that tall shafts carried well above the house tops cause an improvement in the air of sewers, although, as it was tersely put by Mr. W. Haywood, Engineer to the City Commissioners of Sewers, in 1858, before a Select Committee of the House of Commons, "instead of your having the stink in the streets you have it at the house tops." There is, however, this difference, that in the

* Transactions of the Sanitary Institute, Vol. VI.
† Transactions of the Sanitary Institute, Vol. II.

streets the air is confined between buildings and its circulation is influenced by draughts and eddies, while sufficiently high above the house tops it is at once dispersed by the wind.

Mr. Santo Crimp has clearly shown by his experiments at Wimbledon* that the measurable movements of the air in sewers are due to the force of the winds, and not, as has been supposed, to the difference of temperature between the sewer air and the air above ground, and that the direction of the currents of air is as likely to be downhill as uphill. He concludes that the street ventilators should be reduced to a minimum, and he is in agreement with Mr. Read, the City Surveyor of Gloucester, that ventilating pipes should be carried as high as possible.

Experiments made also by Mr. G. R. Strachan, at Chelsea,† with three ventilating shafts—12 in., 15 in., and 12 in. in diameter, and 31 ft., 32 ft., and 22 ft. high above the level of the street, respectively—showed that in a brick sewer, 3 ft. 9 in. by 2 ft. 6 in., the air was changed every 31½ minutes during 44 days, and that the beneficial influence of the fresh air admitted was observed for at least 100 ft. on each side of the downcast or centre shaft. No complaints, says Mr. Strachan, have been made as to air passing out of the upcast shafts, either by the occupiers of the houses, or by the neighbours, or by persons using the street.

It will be remembered that Col. G. E. Waring, junr., in a paper‡ read before the Sanitary Institute, in 1880, described the system of ventilation he had carried out in the sewerage of the City of Memphis, U.S. For the size of the city, which contained 40,000 inhabitants, comparatively small pipes were used for the main sewers, but the fixing of an unobstructed ventilator, 4 in. in diameter and reaching to the top of the house, was made compulsory in every case of house connection. At the lower end of each connection a fresh air inlet was placed. The house branches were restricted by law to 4 in. in diameter. By this means there was on an average one 4-in. ventilator to every 30 ft. of sewer, besides the air inlets at every lateral. There were, moreover, no manholes or lampholes and a disregard of alignment in the sewers.

Connection with tall furnace chimneys has been tried and a powerful current thereby induced, but its effect for any distance has been found to be destroyed when there are many inlets in the sewer, the supply of air being drawn with great force through

* Min. of Proceed., Inst.C.E., Vol. XCVII.
† Min. of Proceed., Inst.C.E., Vol. LXXXIV.
‡ Transactions, Sanitary Institute, Vol. II.

them. In reporting upon the ventilation of the Brighton Sewers, the late Sir Joseph Bazalgette found that by means of flaps which had been placed across the outfall sewer at Roedean to prevent air from the lower end of the outfall from passing above this point, a continuous current was drawn down the sewer by means of the furnace kept constantly burning at the bottom of the lofty ventilating shaft erected there, and that the current was perceptible at the Steine. The distance is about two miles, but there are only four small openings all the way. The furnace ventilation, however, is interrupted in Seasons when the sewers become charged with storm-water. The conditions in this case were, however, especially favourable, for where there are many inlets into sewers, the draught induced by factory or tall chimneys can reach only a little way along the sewer so that isolated shafts of this kind produce very little effect.

At Hornsey, Croydon, and Twickenham, numerous upcast shafts have been erected to improve the ventilation of the sewers, and Mr. de Courcy Meade, of Hornsey, finds that in his district there is now seldom a complaint of smell from the road ventilator, although the street gratings are left open.

Mr. Thomas Walker of Croydon, in a paper read in 1890, before the Municipal and Sanitary Engineers, testifies to the general cessation of smells from the street gratings on the fixing of pipe shafts. He also states that a greater volume of air (31 cubic feet per minute) passed up an ordinary shaft per hour than through a Keeling's destructor (25 cubic feet per minute). By the year 1890, about 250 upcast shafts (6 in. and 8 in. round pipes, and 8 in. by 6 in. rectangular pipes) had been erected, and more were constantly being put up. The manhole gratings were not closed except in a few instances where they were near the footpaths. In his opinion the ordinary shaft is as effective as a Holman's gas destructor and more economical.

The position of the pipe shafts must be most carefully chosen, and they must be carried up to a proper height; but any risk of nuisance (and according to the author's experience it is very small) is obviated by there being a good number of them.

In Mincing Lane, London, where complaints of effluvium from the street gratings had formerly been made, two ventilating pipe shafts about 60 feet high were erected, another about 70 feet high, and another about 90 feet high, measuring from the ground level, all 5 in. in internal diameter. Since their erection no complaints have been received, but the gratings in the street have been closed.

In Liverpool the system of ventilating the sewers by means of shafts carried up the sides of buildings has been extensively adopted, and is found to answer very satisfactorily. There are

about 890 already fixed, the larger number 6 in. in diameter, and the remainder 9 in. by 6 in. rectangular. Here also the street gratings have been closed.

In Birmingham some difficulty has been experienced in getting owners to consent to the erection of shafts. About 15 have been fixed of 6 in., 9 in., and 12 in. in diameter, and 9 in. by 6 in. rectangular in the higher parts of the town. Since their erection complaints with regard to smells in the neighbourhoods in which they have been fixed have been less frequent.

Similar difficulty in getting the consent of owners of houses has been found in the district of Willesden. About 45 upcast shafts have been fixed up to the present time. The pipes are connected with the manholes, the connecting pipe graduating from 15 in. or 12 in. to 6 in. At the foot of the upright pipe a small chamber is constructed to receive any scaling that might occur from the iron pipe, and to afford facilities for cleansing. A series of daily tests of the air currents have been instituted, and the velocity has been found to be equal to 550 feet per minute, and the volume 108 cubic feet per minute.

At Maldon, besides the gratings at the street level, cast-iron columns 22 ft. high and 5 in. in diameter at the top, were erected in open spaces, and in other places heavy rectangular rain-water pipes, 6 in. by 4 in., carefully jointed, were connected with the main sewers and fixed against the sides of houses and carried 4 ft. and 5 ft. above the roofs without a bend in their height. Where there have been complaints of bad smells from the street gratings the nuisance has generally been traced to a deposit either discharged from, or remaining in, the old and generally offensive connections.

The air inlets to the new house connections, which were only carried across the road to be connected with the old pipes, proved excellent detectors of stagnation in the old drains. Where bad smells were noticed the old drain was traced up and, if necessary, re-laid, and the smell ceased.

In the foregoing examples and experiments there is a unanimity of opinion and practice in regarding upcast shafts as necessary adjuncts to sewers. The author, however, does not go so far as to advocate the abolition of open gratings at the street level over manholes and lampholes, inasmuch as with the erection of a sufficient number of shafts offensive smells from the gratings have been found to cease, and these openings act as air inlets. He would, therefore, prefer that they should be made to open and close at will. At Maldon the covers are fitted with Latham's cover and bucket, without the spiral trays for charcoal. By the raising or lowering of the bottom of the inner

cylinder of the bucket by means of a small handle the passage of air from the sewer can be stopped if it is found offensive. Nearly all, however, are kept open.

Hitherto upcast shafts and other contrivances have been added from time to time to the systems of sewerage, but there is sufficient evidence of their efficiency to suggest their forming a part of the designs of all new systems. It is not always possible to find suitable places for them at regular intervals especially in large towns, but in the smaller towns there is not much difficulty in getting permission to erect them.

Mr. J. W. Brown, Borough Surveyor at West Hartlepool, in his Annual Report states that he has been very successful in getting leave from various property owners for erecting them in positions corresponding to the open gratings in the street. He adds that the system is "working very satisfactorily, as in all cases when a pipe is erected a strong current of air is found coming from the sewer, and the smells previously complained of at the street level cease."

Mr. T. Walker, of Croydon, says that there was very little difficulty in getting permission to put up a ventilating pipe where there was a bad smell from the street grating. It was obtained on the understanding that it is to be taken down in twenty-four hours if the owner or occupier request it. 146 ventilating pipes to the back sewers were erected at Maldon out of 165 proposed to be fixed, there being only nineteen objections.

If stagnation and consequent deposit in the sewers be avoided, the translation of the sewer air from open gratings at the street level to above the roofs of houses, so far as present experience goes, is not accompanied by either nuisance from bad smells or danger to health, provided the shafts are sufficiently frequent, and are carried up well above the roofs.

Any material or contrivance introduced into the manholes or shafts through which sewer air passes has served only to retard the passage of the air without a sufficiently compensating advantage. In the author's opinion the upcast shaft should be as straight and as clear of any obstruction as it is possible to make it.

The practice of establishing upcast shafts for the ventilation of main sewers is obviously increasing, and no doubt it will in time be generally adopted. Also much work has been done in improving both the laying and ventilation of house drains, which at the present time are necessarily trapped to prevent the air from the main sewers passing up them, and are provided with air inlets and ventilating pipe shafts.

This system is practically a defence, and in the present day a

very necessary one, against the imperfections of the main sewers, and sometimes of the house drains themselves; and as the practice of more thoroughly ventilating the main sewers becomes more general, a dual system of upcast shafts will be established, for which there does not appear to be sufficient reason in a perfect system of sewers.

The beneficial effect observed from the increasing practice of erecting upcast shafts on the sides of houses and elsewhere, to ventilate the main sewers, coupled with the absence of any danger or prejudice to the public health if they are carried sufficiently high, suggests the consideration whether the main sewers might not be advantageously ventilated through the house drains, omitting the syphon traps now usually fixed in those drains outside the houses.

No artificial and costly means of exhausting, purifying, or burning the air would be required.

There is a passage in a paper* read some years ago before the Royal Institute of British Architects which very clearly points out the true aim of sewer ventilation:—"I regard it," the writer says, "as a preventive and not a curative agent; that is, it is intended not to permit sewer gas and effluvia to escape without doing injury, but to prevent sewer gas and effluvia coming into existence;" and he goes on to say, "Where practicable, it is desirable the ventilation of drains should assist in the ventilation of sewers, so that the circulation of atmospheric air in sewer and drain may be as copious as possible." As we have seen in the examples given, the powerful currents created by a number of upcast shafts undoubtedly promote a circulation practically sufficient in well constructed and properly laid out sewers to keep the air inodorous and harmless when passing up the house drains into the air above the roofs.

Mr. J. C. Bayles, of New York, remarks†:—"If every manhole cover in our streets were replaced with a grating as open as might be consistent with strength, and these were kept free from ice, snow, and mud by men employed for the purpose, and every house owner were required to vent his soil pipe (unobstructed by any form of trap along its line) above his roof, the ventilation of our sewers would be accomplished."

Once more. Mr. Rogers Field has said‡:—"If sewers are properly constructed, properly flushed, and thoroughly ventilated, you will have practically no smell from them—no

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* Transactions R.I.B.A., 1831-1832.

† "House Drainage and Water Service." 4th Edition. J. C. Bayles, New York.

‡ Transactions R.I.B.A., 1880-1881.

appreciable smell. Where you get the smell is where the sewers do not carry the foul matter away, where it remains, and where it decomposes. It is, however, a great mistake to imagine that foul emanations come exclusively or principally from sewers. They come quite as much from defective house drains." And he proceeds to say that "the result of making the whole of the drainage arrangements self-cleansing is that foul gases are no longer generated, and the ventilating pipes no longer send forth foul emanations."

The author agrees with the foregoing remarks, and believes that with improved conditions in course of time the two systems of ventilation, one for the main sewer and the other for the house, may be amalgamated, and syphon traps in the house drain outside the house may be omitted.

He submits that in view of the evidence he has put forward future investigations should be conducted in this direction.

In conclusion, he desires to record his thanks to Mr. Thos. Walker, Mr. T. de Courcy Meade, Col. Haywood, Mr. Percy Boulnois, and others, for the valuable information they have given to him.

The Chairman, in opening the discussion, said that they would notice the great improvement that had taken place in the state of the Museum. This was entirely due to the liberality of Mr. Rogers Field, who had given a donation of £250 to the Institute, in order that the Museum might be put into a proper state, and to print a catalogue of the various articles which are disposed in the building. They all appreciated the great value of a Museum of this kind, and they all hoped to see from time to time its usefulness extended. In the state in which it was previously, without a catalogue, the Museum was of relatively little use. Now those who wished to consult what they might find there had every facility for doing so placed in their way. No one knew more the value of being able to have sanitary fittings properly arranged for inspection, and new inventions so exhibited that they could be examined and appreciated, than the donor.

Mr. De Courcy Meade, M.Inst.C.E. (Hornsey), moved the following resolution:—"That this meeting desires to express its appreciation of the increased utility of the Museum for the purpose of giving information to the public, and desires to record its sincere thanks to Mr. Rogers Field for his generous donation, which enabled the Council to carry out the re-arrangement and prepare a catalogue of the Museum." He had great pleasure in adding his testimony to the usefulness of the Museum." Although he had just been introduced to the meeting, he had been in the habit of visiting the Museum in the daytime, and though that was the first meeting he had attended,

he hoped it would not be the last. He found the catalogue of the greatest use. The manner in which it was arranged enabled one to pick out exactly what he wanted to see in the least possible time.

The resolution having been seconded and cordially carried,

Mr. Rogers Field, M.Inst.C.E. (London), who was received with loud applause, said that he was very much obliged for the resolution passed, and certainly the best thanks that he could have were such observations as those which had just fallen from Mr. de Courcy Meade. He (Mr. Field) had felt for a long time that there was a great deal in the Museum that was exceedingly valuable, and that could not be used because of the imperfect arrangement, so that an undertaking which ought to have been creditable to the Sanitary Institute was discreditable to it, simply because there were no funds available for arranging the Museum properly. This feeling was intensified in view of the International Congress of Hygiene, as it would have been a disastrous thing for visitors to come to see our Museum and go away and report all over the globe that it was a miserable affair. He, therefore, determined to do what he could to help in the matter, and he was very pleased to hear from Mr. Meade that the re-arrangement and catalogue really rendered the Museum useful for the purpose for which it was intended.

Dr. Louis Parkes (Medical Officer of Health for Chelsea), referring to the medical aspect of Mr. Grantham's paper, said he disagreed with that part of it which advocated the abolition of the disconnecting syphon traps in house drains. He thought they were a very proper and necessary precaution to take, inasmuch as sewer air might at any time contain the poison of infectious disease —notably typhoid fever—in this country, and it was advisable to exclude such air entirely from house drains and soil pipes, which were not always perfect, even when newly laid and fixed. He argued that the sanitary authorities having constructed the sewers ought to ventilate them, and not expect the householder to do so. A householder should only be called upon to look after his own house, and leave all the other householders to do the same. Referring to the system of ventilation in Chelsea, Mr. Grantham had overlooked one fact. In the system of ventilating a dead-end sewer, 600ft. long, which had been in operation for some years, the air was brought into the sewer by means of a revolving cowl facing to the wind. The system had been tested, when there appeared to be no air whatever during fog and damp, and it had been found that a considerable quantity of air was entering the sewer, and that the whole of the air in the sewer could be drawn out and renewed every hour. He contended that they could not do away altogether with the roadway ventilators. They could do away with the offensive ones and substitute shafts, but if they did away with every roadway ventilator and substituted long and crooked shafts they would be merely reverting to the old system of unventilated sewers which everybody condemned. There were, in Chelsea, very few complaints of smell from the roadway ventilators

over local or parish sewers, the complaints mostly relating to main or County Council sewers. In these main sewers in London the sewage had often travelled great distances, and was stale and even putrid in hot weather, consequently the gases given off were copious and most offensive. On the embankment at Chelsea, over the low-level intercepting sewer, the smells were notorious, and interfered with the proper enjoyment of that picturesque promenade. He thought that in such cases roadway ventilators should be abolished, and the sewer air should be extracted by furnaces and cremated. The paper of Mr. Grantham was admirably adapted to bring out an interesting discussion on sewer ventilation, and he had listened to it with great pleasure.

Mr. DE COURCY MEADE (Hornsey) added his testimony to the value and interest of Mr. Grantham's paper, though the subject of sewer ventilation was by no means new. It was one which latterly they had been afraid to bring before another Association with which he was connected, because there was no stopping the discussion. Mr. Grantham had described a small town where the existing sewers were in a defective state, and many of them apparently at the back of the buildings. From his own experience he could say that these drains were most difficult to deal with, and often involved compensation. He would like to ask if compensation had been paid in the cases the lecturer had illustrated. He hoped not. He hoped the people of Maldon were more enlightened than some people he knew of. With regard to the flushing of sewers and drains, he said that in Hornsey they spend about a £1,000 a year for water for sewer flushing, but they are as yet unable to deal with the house-drains, although much sewer-gas was generated in them, and he thought that provision ought to be made for flushing all house-drains, either by automatic flushing tanks or by some other means. He thought that it would be a mistake to try and ventilate large sewers, such as described by Dr. Parkes, by means of small pipe-shafts only, as the amount of air space in the sewers varied considerably at different times of the day. Some of the City sewers, for instance, were running about three-quarters full at 2 p.m., and only about one-sixth or less at 11 p.m. In such sewers small pipes would have little effect, unless placed at short distances apart and supplemented by mechanical means. Mr. Meade incidentally mentioned that the street-lamp ventilating columns, though not handsome to look at, answered their purpose admirably when not in the immediate neighbourhood of houses.

Mr. E. BAILEY DENTON, M.Inst.C.E. (London), criticised the paper with some severity. He said that if the abolition of the disconnecting chamber between the house and the public sewer was aimed at he begged to entirely disagree with Mr. Grantham. He looked upon the provision of disconnecting chambers as most essential. When the millennium came, and they could be sure that workmen would do their duty and would not scamp their work, they might perhaps be able to do away with the disconnecting chamber, and rely on street

manholes and upcast shafts to effect all the necessary ventilation. But until then each house should have one, for by their provision the dangers of sewer gas entering our dwellings was minimised. In his opinion there was no place in England which should be more thoroughly and uniformly provided with the disconnecting chambers than Maldon, because, as Mr. Grantham had told them, the penstocks at the outfall were closed for four or five hours out of the twenty-four. In fact the town of Maldon was very similar *quâ* sewerage to Brighton. Mr. Grantham had "damned with faint praise" Sir John Hawkshaw's shaft at Brighton, but he (the speaker) could assure the meeting that it had never been of any good whatever. It did not draw as far as the town. In times of rain when the penstocks were closed, sewer gas escaped from the sewers into the streets, and where no disconnecting chambers were provided it could and did enter the houses. The same thing would certainly happen at Maldon as at Brighton. Mr. Grantham had spoken in favour of 6-inch sewer pipes. In his (the speaker's) opinion they should never have less than 9-inch pipes, for 6-inch pipes frequently got choked up. Then Mr. Grantham had told them that his firm had constructed thirty-three lampholes in Maldon. Unhappy Maldon! He regarded lampholes as a retrograde substitute, for in cases of accident they were practically useless, being inaccessible, and he insisted that manholes were the proper things in every sewerage system, for their cost was but little more than that of lampholes, and they were the means by which a sewerage system could be kept free from deposit and be under proper control and inspection.

Mr. READ (Gloucester) said there seemed to be an opinion prevalent, not exactly expressed but implied, that ventilation was the cause of sewer-gas. Ventilation never caused sewer-gas yet, and never would. It only made it apparent. Deposit in the drains and sewers and stagnation of the sewer air were the causes of sewer-gas. Replying to the observations of Dr. Parkes, he said that for the private owner to hide himself in his shell might be all very well for the private owner, but the general prevalence of that policy would never get rid of sewer-gas, but would increase it, because such policy rendered the proper ventilation of sewers impossible; the so-called interceptor being an obstruction, both to the flow of the sewage and to the ventilation. From experiments that he had made, he had come to the conclusion that when the flow of sewage equalled or exceeded three feet per second, the direction of the air-current in the sewer was nearly always the same as the flow, that is down hill. To ensure that there should always be a down-draught at the street-ventilators, it would be necessary to keep them comparatively small, say 30 to 36 square inches area and 60 to 100 yards apart, and to have an up-cast shaft on every house, but in any case the excess of ventilating area should always be on the side of the outlets, to allow for friction and bends. That is to say, the sum of the sectional areas of the outlet shafts between any pair of street inlets, multiplied by the average velocity of their several discharges, must exceed the

sectional area of the air-space of the sewer, multiplied by the velocity of the air-current in the sewer. When these proportions are established, the air-current will always enter at the upper of the pair of street inlets, travel down the sewer and up the shafts, and the same thing will occur with each 60 or 100 yards of sewer so treated, and every such length will be thereby isolated as far as ventilation is concerned.

Mr. THOMAS WALKER (Croydon), speaking on the "flushing" question, said that in Croydon they were flushing every house drain in the borough at every opening they could get at, and as a consequence the cessation of the smells in the roads had been most remarkable. Criticising the Keeling Destructor, he said that one of the ordinary columns in use at Croydon up a tree or a house was more effective. This was proved by exhaustive trials, using anemometers to measure the volume of air extracted.

Mr. ROGERS FIELD, M.Inst.C.E. (London), said he considered six-inch pipes amply sufficient for back drainage, but whether six-inch pipes were sufficient for town sewers was a different question. He drew attention to the City of Memphis, U.S., where the sewers were mostly six inches, and he thought the experience gained there with reference to sewers—ordinary sewers as distinguished from back drainage—was that it was not advisable to have them so small as six inches. But to say they should never be less than nine inches was wrong. Seven or eight inches would act very well, and get over most of the risks from choking. On the question of manholes, Memphis had also afforded them some valuable experience. At the Congress of the Sanitary Institute held at Exeter about ten years ago, the President, Sir Robert Rawlinson, made this observation with reference to Memphis: "He did not agree with the absence of manholes. He thought it would be found that there must be manholes, or there would most certainly be chokings, and with manholes there would be no necessity to break up the roads to find the spot." He (Mr. Field) made some observations to the same effect. Now the experience since gained at Memphis was that they had had to construct manholes in consequence of the frequent occurrence of stoppages. Memphis also had no disconnecting traps. He did not gather that the lecturer advocated the practice, but that he simply threw out the idea as a "feeler" and for discussion. Personally he (Mr. Rogers Field) held a strong opinion on the subject. As things existed now, and as they were likely to exist for some time to come, he considered they must have disconnecting traps, but it was essential that these traps should be well and properly made and always perfectly accessible. Even assuming that the sewers were perfect, he thought it was very doubtful whether it would be advisable to dispense with disconnecting traps, as disease germs would at times be carried into the sewers, and it was undesirable that these should pass into the house drains. With reference to the ventilation of sewers, he thought that ventilating shafts for town sewers were very valuable

if the street ventilators or most of them were left open, but to close all the street ventilators and substitute a few small shafts, as was sometimes done, was a great mistake. Absence of smell in the streets in such cases was really only due to the closing of the street ventilators, not to the erection of the shafts, and the closing of the ventilators simply meant bottling up the foul gases in the sewers.

Mr. G. B. CARLTON (London) did not know any case in London where compensation was being given out of the rates in respect of back drainage. As the representative of Penge he urged that it was the best drained and the best ventilated district south of the Thames.

The CHAIRMAN, in reference to intercepting traps, said he had put in many thousands of them, and nothing he had since learnt would prevent him putting in many thousands more. He did not think any town or individual house would be safe unless it had one, for however perfect the sewers were, there would always be the danger of communication between the houses. There was wide difference of opinion with regard to the effects of sewer air, and in this connection he quoted, to the evident amusement of the meeting, the remark of an authority at the recent International Congress held in London, that the air of sewers was found to be purer than the air of the street level. As long as these differences of opinion existed it was better to take the safe course recommended in the familiar motto, "Prevention is better than cure." He commended the observations of Mr. de Courcy Meade with regard to the flushing of sewers, and said a system of sewers should be designed for the purposes of the district thirty years hence. It was essential in all systems that the utmost power for flushing should be introduced. After a reference to the systems of drainage which are approved in India, the Chairman concluded by proposing a vote of thanks to Mr. Grantham for his able and interesting paper.

Mr. R. F. GRANTHAM (London), in reply to the discussion, said that inasmuch as he had laid 259 traps at Maldon he could not be considered as advocating the immediate abolition of traps in all house drains. He desired, however, to create discussion, and more especially to promote investigation into the improvement of the ventilation of sewers; and he thought, judging from what was being done, that ultimately, with due precautions, the abandonment of traps might assist in effecting that object. Nor did he stand alone, for in Chelsea, referred to by Dr. Parkes, the Surveyor, Mr. G. R. Strachan, in his paper to the Institute of Civil Engineers, made a similar suggestion, and as far as Mr. Grantham understood Mr. Rogers Field's reference to Memphis, the absence of disconnecting traps there did not appear to have any ill effect, but on the contrary, with the numerous up-cast shafts to every house and a system of constant flushing the ventilation of the sewers was extremely good, although it had since been found necessary to construct manholes. With reference to the question of compensation, mentioned by Mr. de Courcy Meade, he