Guide to the examinations in sanitary science, public health, and state medicine / by Herbert Jones.

A GUIDE
TO THE EXAMINATIONS
IN
SANITARY SCIENCE

JONES

GUIDE

TO THE EXAMINATIONS

IN

SANITARY SCIENCE, PUBLIC HEALTH

AND

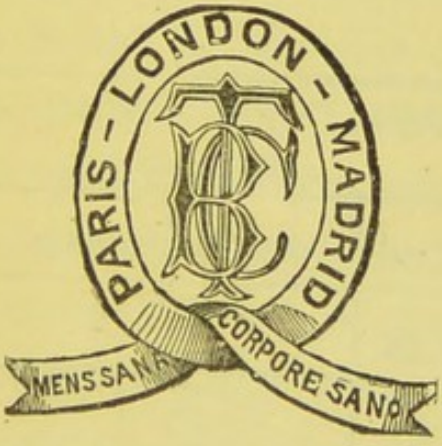
STATE MEDICINE.

WITH

EXAMINATION QUESTIONS,
AND COPIOUS EXPLANATORY NOTES.

BY

HERBERT JONES, D.P.H. CAMB.



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PREFACE

It is hoped that this "Guide" will be of some little use to those anxious to obtain a Diploma in Public Health.

Although every effort has been made to place before the reader reliable information, it must be remembered that the regulations of the examining bodies from time to time undergo alteration. Indeed, as these pages were being revised the Scotch Corporations submitted to the General Medical Council their conjoint scheme, the details of which are still under consideration.

Excluding the Universities there will be after October 1, 1892, one examination for each of the three divisions of the kingdom, and Diplomates would avoid much confusion if they styled themselves D.P.H. England, D.P.H. Ireland, and D.P.H. Scotland respectively.

The Questions in Chapters VII. and VIII. are chiefly taken from those given at the Examinations held at Oxford, Cambridge, Durham, the Royal University of

Ireland, and by the Royal College of Physicians, London, and the Royal College of Surgeons, England.

The Tables in the last chapter are by no means exhaustive, and are intended principally for use during the few weeks prior to the examination, when the completer text-books have already been thoroughly perused.

July, 1892.

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GUIDE TO

SANITARY SCIENCE EXAMINATIONS

CHAPTER I.

THE following recommendations, designed with a view of ensuring "the possession of a distinctively high proficiency—scientific and practical—in all the branches of study which concern the public health," were adopted by the General Medical Council in 1889. The regulations require that :

(1) A period of not less than twelve months shall elapse between the attainment of a first registrable qualification in Medicine, Surgery, and Midwifery, and the examination for a diploma in Sanitary Science, Public Health, or State Medicine.

(2) Every Candidate shall have produced evidence of having attended after obtaining a registrable qualification, during a period of six months, practical instruction in a laboratory approved of by the body granting the qualification.

(3) Every Candidate shall have produced evidence of having for six months practically studied the duties of Outdoor Sanitary Work under the Medical Officer of Health of a county or large urban district.

(4) The examination shall have been conducted by Examiners specially qualified, and shall comprise laboratory work as well as written and oral examination.

(5) The rules as to study shall not apply to :

(*a*) Medical Practitioners registered, or entitled to be registered, on or before January 1, 1890.

(*b*) Registered Medical Practitioners who have for a period of three years held the position of Medical Officer of Health to any county, or to any urban district of more than 20,000 inhabitants, or to any entire rural sanitary district.

The Local Government Act, 1888, section 18, requires that every Medical Officer of Health appointed after the passing of the Act shall be legally qualified to practise Medicine, Surgery, and Midwifery (in exceptional cases the Local Government Board may modify this part of the section). If appointed after January 1, 1892, to a district having at the last census 50,000 inhabitants or more, he must appear in the Medical Register as the holder of a diploma in Sanitary Science, Public Health, or State Medicine ; or he must have been during three consecutive years prior to 1892 a Medical Officer of a district with a population, according to the last census, of not less than 20,000 ; or have been for not less than three years a Medical Officer or Inspector of the Local Government Board.

The following Universities open their examinations to their own Graduates in Medicine only, with the two exceptions noted :

Dublin : Graduates in Medicine of Dublin, Oxford, or Cambridge.

Edinburgh : "Graduates in Medicine of a University of the United Kingdom, or of a Colonial, Indian, or foreign University specially recognised by the University Court."

London.

Oxford.

Glasgow.

Royal University of Ireland.

Aberdeen.

At Durham, if the Candidate is registered after January 1, 1890, he must have spent one year at the University before presenting himself for examination.

All the examinations are conducted in two parts, except those at Durham and the Royal Colleges of Physicians and Surgeons, Ireland.

The fees must be remitted to the Royal Colleges of Physicians and Surgeons, England, three days before the date of the examination ; to Victoria University, Manchester, on July 5 ; and to all others when giving notice of intention to be present at the examination.

After October 1, 1892, the Royal Colleges of Physicians and Surgeons of Edinburgh, and the Faculty of Physicians and Surgeons, Glasgow, will hold a conjoint examination (in place of the three separate examinations now held) for the diploma in public health.

The dates of the examination are not yet fixed, but they will probably be held alternately in Edinburgh and Glasgow. The other details of the scheme are the same as those under the heading "Royal College of Surgeons, Edinburgh," upon p. 10.

Application for admission to the examination in Edinburgh should be made to James Robertson, Esq., solicitor, 1, George Square, Edinburgh ; and in Glasgow to Alexander Duncan, Esq., B.A., 242, St. Vincent Street, Glasgow.

Examinations Open to Registered Practitioners of One Year's Standing.

	Date of Examination.	*Date to give Notice.*	*Fees.*	*Fees for Re-examination.*	*Length of Examination.*
Cambridge University - -	1st Tuesday in April and Oct.	7 days before.	£4 4s. each part.	£4 4s. each part.	4 days.
Victoria University - -	3rd Monday in July.	July 1st.	£4 4s. each part.	£2 2s. each part.	4 days.
Durham University - -	April and Oct.	28 days before.	£10 10s., £5 for the licence.		4 days.
Royal College of Physicians, Edinburgh - - -	2nd Tuesday in April and Oct.	7 days before.	£5 5s. each part.	£5 5s. each part.	5 days.
Royal Colleges of Physicians and Surgeons, England -	Jan. and July.	14 days before.	£5 5s. each part.	£3 3s. each part.	4 days.
Royal College of Surgeons, Edinburgh - - - -	Feb., May, and Sept.	7 days before.	£5 5s. each part.	£3 3s. each part.	4 days.
Faculty of Physicians and Surgeons, Glasgow - -	April and July.	7 days before.	£3 3s. each part.	£2 2s. each part.	4 days.
Royal Colleges of Physicians and Surgeons, Ireland -	Feb., May, and Nov.	7 days before.	£10 10s.	£5 5s.	3 days.

CHAPTER II.

THE following syllabus is issued by the conjoint Board of the Royal Colleges of Physicians and Surgeons, England. It differs but little from those of the other examining bodies. As some subjects here placed in Part II., however, are taken in a few of the examinations in Part I., it will be advisable for the Candidate, after deciding for which examination he will enter, to apply for a copy of the respective regulations.

PART I.

1. Physics in their application to Health, with reference to :
   - (*a*) Warming and Ventilation.
   - (*b*) Water Supply, Sewerage, and Drainage.
   - (*c*) Sanitary Construction.
2. Meteorology in relation to Health.
3. Chemistry, with special reference to Food, Air, Soil, and Water.
4. Microscopical Examinations, as applied to Air, Food, and Water.
5. Geology and Soil in their relation to Drainage and Water Supply.

PART II.

1. The origin, development, and prevention of Disease, with reference to :
   - (*a*) Special Pathology of Epidemic and Endemic Diseases, including the natural history of the Specific Organisms of Diseases.

(*b*) Influence of Climate, Season, and Soil.
(*c*) Effects of unwholesome Air, Water, and Diet.
(*d*) Diseases of Animals in relation to the Health of Man.
(*e*) Influence of Occupation and Lodgment.
(*f*) Isolation, Quarantine, Disinfection, Vaccination.

2. Sanitary Work and Administration, with reference to :

(*a*) Health requirements of Houses, Villages, and Towns.
(*b*) The Sanitary regulation of Households, Establishments, and Occupations, including the construction and arrangement of Hospitals.
(*c*) The prevention and control of Epidemic and Endemic Diseases.

3. Statistics in relation to Health.

4. Statutes, Orders, and By-Laws relating to Public Health.

5. Duties of Sanitary Authorities and their Officers.

Synopsis of the Course of Laboratory Instruction.

I. Physics :

Gases ; examination of their physical properties ; their weight and bulk under varying alterations of pressure and temperature, and the movements thereby set up ; diffusion ; with especial reference to warming and ventilation.

Anemometers and their use.

Liquids ; their physical properties ; their pressure and flow through tubes and conduits ; their action on gases.

Meteorological instruments, their construction and use. Barometers ; thermometers ; hygrometers ; rain-gauges.

II. CHEMISTRY :

The analysis of water for drinking purposes, including the qualitative and quantitative estimation of total solids (lime, magnesia, chlorides, sulphates, nitrates and nitrites, ammonia and lead), and loss on ignition of solids ; determinations of hardness, of organic impurities, and of acidity and alkalinity.

Chemical methods of treating sewage.

The examination of air for the detection of polluting gases.

Simple methods of eudiometry.

Estimation of the quantity of carbon dioxide in air.

III. MICROSCOPY :

The recognition of the constituents of food, such as starches and muscular fibre.

The recognition of the chief fibres of clothing, such as wool, cotton, and silk.

The recognition of constituents of ordinary dust and deposits from water.

IV. BACTERIOLOGY, including the cultivation and recognition of micro-organisms.

V. PARASITES AND OTHER ORGANISMS INFESTING FOOD-STUFFS OR THE HUMAN BODY.

The following gentlemen will supply full information respecting the various examinations :

Cambridge University : Dr. ANNINGSON, Walt-ham-sal, Cambridge.

Royal College of Physicians, Edinburgh : Dr. G. A. GIBSON, Royal College of Physicians, Edinburgh.

Durham University : HENRY FOX, Esq., R.N., College of Medicine, Newcastle-on-Tyne.

Royal College of Physicians and Surgeons, England : F. G. HALLETT, Esq., Examination Hall, Thames Embankment, London.

Victoria University : The REGISTRAR, Victoria University, Manchester.

Royal College of Surgeons, Edinburgh : Dr. F. CADELL, Surgeons' Hall, Edinburgh.

Faculty of Physicians and Surgeons, Glasgow : ALEXANDER DUNCAN, Esq., B.A., 242, St. Vincent Street, Glasgow.

Royal College of Physicians and Surgeons, Ireland : GREENWOOD PIM, Esq., M.A., 47, Dawson Street, Dublin.

CHAPTER III.

CHEMISTRY.

THE examination in chemistry is usually held upon the afternoon of the first day. Although water and air are the chief subjects dealt with, the candidates should be familiar with the methods of analysis adopted in regard to foods, especially milk and butter. Questions are frequently given, both written and *vivâ voce*, in these subjects.

It is absolutely necessary to do practical laboratory work previous to the examination ; for although there is not time to carry out many of the processes adopted by analysts, yet the oral examination is often confined to an explanation of these methods, and it is quite impossible to understand them intelligently unless they have been actually performed.

Every opportunity should be taken of criticising analytical reports of water-supplies.

Two Winchester quart bottles of water and three bottles of gases are given to examine and report upon.

The best scheme of analysis is that published in Allan's "Aids." The following is the least that will be expected :

Appearance.
Smell.
Reaction.
Total solids.
Solids after ignition.
Hardness.

Chlorides (quantitatively).
Permanganate test.
Nitrites.
Nitrates.
Free ammonia.
Albuminoid ammonia.
Lead.
Iron.
Copper.

There is rarely time to allow any deposit to settle for microscopic examination; but there is no reason why some water should not be put aside, and a note made of the fact.

A detailed account of each step that is taken is required, and negative results should in all cases be recorded.

There is rarely more than one gas given in each bottle.

The following scheme, more or less modified, may be adopted:

(*a*) Note first appearance and smell.

(*b*) Hang in the neck of the bottle blue and red litmus and lead acetate papers previously wetted. On noting the result, an acid, an alkaline, or H_2S may be excluded.

(*c*) Hang moistened KI and starch papers in the neck of the bottle. If a blue colour results, NO_2 or Cl are indicated.

(*d*) Place 20 cc. of water in the bottle, and shake up well. To a few cc. of the solution add a solution of nitrate of silver.

A white precipitate indicates Cl (HCl if acid).

A white precipitate becoming brown indicates SO_2.

A brown or black precipitate indicates H_2S.

Nesslerize a second portion of the solution for NH_3.

Add Metaptenyline diamine hydrochloride for NO_2.

H_2SO_4 and Zn with evolution of H_2S indicates SO_2.

(*e*) Carbonic acid gas is readily detected with either baryta or lime-water.

A knowledge of the quantitative estimation of CO_2 is requisite, although it is not often asked practically.

If the candidate is familiar with his subject, there is quite time to carry out all that is indicated above. Unless, however, he does know his work, he will find even double the time allotted too short.

CHAPTER IV.

MICROSCOPY.

THE afternoon of the second day is generally devoted to the microscope. It is usual to find a solution in a test-tube, and a powder, with instructions to mount specimens to draw and to describe what is seen.

In the powder are frequently different specimens of the starches, and the candidate should be familiar with the table in Parkes, where they are well differentiated (page 310). In addition to the starches, the following are among what may be expected :

Coffee and chicory.
Mustard.
Fungi.
Cotton, silk, and linen fibres.
Dust.
Epithelium.
Feather.
Hair.
Soot, etc.

In the test-tube may be, in addition to those mentioned above, sediment from water, including :

Desmids.
Anguillulæ.
Diatoms.
Entomostraca.
Confervæ, etc.

It is well to remember that starch grains can be recognised by allowing a drop of solution of iodine to run under the cover slip, the starch being coloured blue.

Do not hesitate to make several slides ; though much in the field of one may be difficult to distinguish, a second slide may be comparatively easy.

In a separate room are ranged six microscopes, under which is a different slide. The candidate is expected to "spot" these, and to describe what he sees. He is allowed three or four minutes at each microscope, and may expect to find amongst other specimens :

Tænia solium.
Tænia medio-canellata.
Tænia echinococcus.
Ascaris lumbricoides.
Oxyuris vermicularis.
Trichina spiralis.
Acarus scabiei.
Anthrax bacillus.
Tubercle bacillus.
Entomostraca.
Fat cells from butter.
Coffee.
Chicory.
Mustard.
Fungi—viz. :
  Yeast.
  Muco mucedor.
  Aspergillus glaucum.
  Penicillium glaucum.

CHAPTER V.

EXAMINATION OF PREMISES.

THIS is frequently left until the last day of the examination. Unless the district is well known, much time will be saved by taking a cab and driving straight to the place. A pencil, note-book, and a measuring-tape are required.

The examiners think far more of the manner in which the report is made, than of what it actually contains; at the same time accuracy should be aimed at.

The following heads are suggested, but may be amplified as required:

Name of occupier.
Address.
Name of owner.
Address
Rental
Surroundings.

Yard, garden, or area: size and shape; if flagged or otherwise; position and description of outbuildings.

Structure: brick, stone, etc.; presence of damp course.

Water supply.

Drains: If disconnected or not.

W.C.: description of pan and of water supply.

Ashpit: size and position.

Rooms: Number and size of each.

Windows: size and position, if made to open or not.

Fireplace: Position and size of outlet.

Other means of ventilation.

Number of persons in each bedroom, giving cubic feet for each person.

Bathroom and lavatories : position and size.

There is usually no difficulty in obtaining the information that is required from those in the house ; a judicious "tip" will work wonders.

CHAPTER VI.

BOOKS RECOMMENDED.

PARKES' Hygiene (Churchill).

This may be looked upon as the chief book to be read. There are many chapters of interest only to army-surgeons.

Wynter-Blyth's Manual of Public Health (Macmillan).

Offensive trades are dealt with very thoroughly.

Wilson's Hygiene (Churchill).

The duties of a Medical Officer of Health are given in a very concise and clear style. The whole book is most readable.

Whitelegge's Hygiene (Cassell).

This book deals in an interesting manner with statistics, and epitomizes the Public Health Acts very clearly.

Allan's "Aids" to Sanitary Science (Baillière, Tindall and Cox).

This little text-book contains much valuable information in a well-arranged and readily-referred-to form.

Willoughby's Hygiene (Collins).

The chapters upon food are most exhaustive; those, too, upon school hygiene are admirable.

Galton's Healthy Dwellings (Macmillan).

This work should be read, if only for the chapters upon warming and ventilation.

Latham's Sanitary Engineering (Spon).

Corfield's Treatment of Sewage (Macmillan).

Neither of these books is indispensable, but the Candidate who wishes to make sure of his diploma would do well to read them both.

Wanklyn's Water Analysis (Kegan Paul and Co.).

Thudichum's "Aids" to Public Health (Baillière, Tindall and Cox).

Hime's Practical Guide to the Public Health Acts (Baillière, Tindall and Cox).

With this book it is quite unnecessary to have the actual Acts of Parliament. The notes and comments upon the various statistics are very extensive and to the point. There are also some observations upon diseased meat, especially valuable to those who have not been able to obtain much practical knowledge upon the subject.

Griffith's Researches in Micro-Organisms: Recent Experiments on the Destruction of Microbes in certain Infectious Diseases (Baillière, Tindall and Cox).

Questions are so frequently asked upon the methods of bacteriological research that a special work is a necessity. This is eminently suited to the requirements of a public health officer, dealing, as it does, so fully with the microbes of infectious diseases. It is profusely illustrated.

Fleming's Translation of Neumann's Parasites and Parasitic Diseases of the Domesticated Animals (Baillière, Tindall and Cox).

Book VI., treating of parasites of the muscles, connective tissues, and bones, will be found of the greatest value. There are a large number of illustrations, and for future reference the entire work will be found invaluable.

CHAPTER VII.

VIVÂ VOCE QUESTIONS.

QUESTIONS are very commonly asked upon the papers that have already been set ; if the Candidate has given a meagre answer to any one question, he is frequently taken upon that.

The following are among the questions that may be asked :

Meteorology :

The construction of a rain-gauge.

How to calculate the amount of rain that has fallen.

Hygrometer, how constructed.

Describe cyclones and anticyclones.

What importance is attached to them ?

Describe a barometer, and how to set it.

The corrections that have to be made.

Water :

The different kinds of water that would be likely to be found from certain geological formations.

Lead poisoning, how caused, and how remedied ; the various theories required.

Water-pipes : the most suitable material. What is Angus Smith's solution ; and how does Barff's magnetic oxide of iron act ?

If lead or iron pipes are not suitable, what must be used ?

Cisterns, the most suitable material.

Filters: how they act; the various kinds; the requisites of a good filter.

Reports: criticise and offer an opinion.

Foods:

The various constituents in different kinds of food.

The amount of energy that is available.

Gelatine, its value as a food.

Disinfection:

Dry heat and moist heat.

Advantages of chemical disinfectants.

Bacteriology:

The difference between anthrax and tubercle.

Modes of cultivation.

Vital statistics:

How death-rates are calculated.

How populations are estimated.

Death-rates from various diseases in urban and in rural districts.

Statutes and by-laws:

Power of entry of Medical Officer of Health.

By-laws and statutes respecting lodging-houses, slaughter-houses, canal-boats, and offensive trades.

Compulsory removal to isolation hospital.

Duties of a Medical Officer of Health.

CHAPTER VIII.

EXAMINATION QUESTIONS.

1. GIVE an account of De Chaumont's experiments on the ventilation of inhabited rooms. What formula did he deduce from them, and of what use is that formula? (Page 59.)

2. Upon what principles does natural ventilation depend? Explain Montgolfier's formula. How far can it be relied on? (Page 61.)

3. It is proposed to warm and ventilate an occupied room by means of warmed air. Describe the means you would adopt, and the precautions you would take in effecting this.

4. Explain exactly how the amount of air required per head per hour has been determined. If the air of a room contained 0·85 part of carbonic acid per 1,000 volumes, what would be your opinion of the state of ventilation of the room? (Page 59.)

5. Show how the direction and velocity of currents of air in a room may be ascertained.

6. How is the ventilation of a living-room affected by its height? State the most desirable proportion of height to floor-space.

7. Describe fully at least two methods of ventilating a very small living-room, so as to avoid draught. Do you consider it better to occupy a small room with excessive ventilation, or a large room with imperfect ventilation, and why?

8. Describe and criticise the different natural methods and artificial appliances employed in the ventilation of dwelling-houses, hospitals, ships and mines.

9. Describe two methods of determining the amount of carbon dioxide in the air.

10. What constituents of coal-gas may prove noxious by escape into the air of a room, and how may they be detected? (Page 61.)

11. What are the properties of ozone? How is its presence in the air ascertained?

12. What are the methods of collecting and examining the suspended substances in the air?

13. What amount of fresh air does an adult of average weight require per hour? Upon what grounds do you base this estimate? Under what circumstances does it vary?

14. What is the amount of carbonic acid gas excreted per hour by an average man during sleep? If the atmosphere normally contains 0·4 volumes of CO_2 per 1,000 volumes, to what extent will this be increased at the end of eight hours in a bedroom of 1,000 cubic feet capacity occupied by two men when the room receives an influx of 60 cubic feet of fresh air per minute?

15. Describe some effective means for determining the relative amount of nitrogenous organic impurity in the air of a room.

16. What are the constituents, and the proportions by weight or by volume, of pure air? What are the "respiratory impurities" of vitiated air, and their respective amounts, stated in terms of any well-recognised system of weights and measures? (Page 59.)

17. In what respects as to the kind and quantities of its constituents does "ground-air" differ from ordinary atmospheric air, and how is it affected by the movements of the atmosphere and of the water in the soil?

18. Three men are working in a room 15 feet long,

13 feet wide, and 9 feet high, in which two common burners are burning gas. What amount of fresh air should be supplied per hour in order to keep the atmosphere of the room in a healthy condition? (Page 59.)

19. What dangers to health are attendant upon the use of gas-stoves for heating dwelling-rooms, and how may they be best obviated? (Page 61.)

20. In buildings uniformly heated throughout by hot air or water-pipes, by what methods may efficient ventilation be secured? State the suitable places for a portion of the heating coils, so as to prevent the passages and staircases forming a chimney which draws cold draughts through the rooms.

21. What is the comparative efficiency of the same length of piping when exposed in coils, and sunk in a trench on the floor? How is the proportion of radiated to convection heat affected by the temperature of the pipes, and to what extent?

22. Mention, with illustrative sketches, some kinds of apparatus for producing effective ventilation in rooms where a damp warm atmosphere exists, and explain why a much more vigorous motion of the air is required in these than in a dry atmosphere.

23. Describe the action of an ordinary fireplace in ventilating a room. How does the fire act in warming a room? What are the principal differences between the action of an open fire and the action of hot-water pipes in warming and ventilating a room? (Page 62.)

24. What precautions should be taken in collecting a sample of water for hygienic analysis? How much is required, and how much for each operation of the analysis? (Page 67.)

25. Describe any good method of determining the amount of nitrogen as nitrates in a sample of water. Of what importance is this determination?

26. Give a detailed account of the method of determin-

ing accurately the amount of "oxygen absorbed" by organic matter in a sample of water.

27. What are the sources and nature of organic impurities in drinking-water? How are they estimated?

28. What saline constituents of a drinking-water are most injurious, and how may they be removed from a public water supply?

29. Describe various methods of detecting the presence of nitrous acid in a sample of drinking-water, and the fallacies which should be avoided. What is the importance of such an examination?

30. A sample of water is obtained from a well in the chalk into which a cesspool leaks. State in detail the results you would expect from the chemical analysis of such a water.

31. What are the characters of waters from granite, magnesian limestone, new red sandstone, and clay respectively?

32. What is meant by "albuminoid ammonia"? How is it estimated in a sample of water? What does its presence in various quantities indicate?

33. Give an account of the chalk formation as a source of water-supply.

34. What are the advantages and disadvantages of the albuminoid ammonia and combustion processes respectively for the determination of the amount of organic matter in a sample of water for hygienic purposes?

35. Describe accurately how the amount of chlorine in a sample of water is estimated. Of what importance is this determination?

36. Discuss the importance, from a hygienic point of view, of the presence in a drinking-water of (*a*) colour, (*b*) turbidity, (*c*) excess of saline matter, (*d*) hardness, (*e*) ammonia, and (*f*) soluble nitrogenous organic impurities.

37. What metals are occasionally found in drinking-

water? From what sources are they derived? How may their presence be detected?

38. State what you know as to the solvent action of waters upon lead, and the means by which this action may be prevented. What is the maximum permissible quantity of lead in a drinking-water. (Page 63.)

39. How would you detect and estimate the amount of lead or of copper in a sample of water?

40. What is the nature of the chemical changes attending the action of water upon metallic lead? What natural waters would you expect to attack lead most easily? (Page 63.)

41. Discuss the value of chemical analysis in determining the wholesomeness of a drinking-water.

42. State exactly how you would proceed to examine by the aid of the microscope a turbid water-supply. Briefly describe the substances which may thus be discovered which may affect your judgment as to the fitness of the water for drinking purposes.

43. Write a report on the following analytical results of a sample of water, stating your reasons fully. (Page 66.)

	Grains per gallon.
Total Residue	26·76
Chlorine	4·17
Total Hardness	12·00
Free Ammonia	·186
Albuminoid Ammonia	·055
Nitrogen existing as Nitrates and Nitrites	·10

44. What is meant by an Artesian Well? What are the characters of deep well-water from various strata?

45. What is meant by "previous sewage contamination" in a water? How is the amount of it ascertained, and what is the importance of it?

46. How may a supply of wholesome water be con-

taminated after leaving the reservoir and before entering the houses ?

47. What is meant by the terms "temporary hardness," "permanent hardness," and "total hardness" as applied to water, and to what substances are these forms of hardness respectively attributable ? What degree of hardness would entitle a water to be termed "hard" ? By what means may hard waters be softened ? Explain exactly what takes place during the process of softening.

48. How are supplies of well-water affected by (1) the porosity of the soil, (2) the porosity of the subsoil, (3) the slope of the latter, (4) the presence of decaying vegetable matter on the surface of the soil, (5) the contamination of the soil by animal excreta ?

49. Point out the special hygienic advantages and disadvantages attending the domestic use of water-supplies derived from (*a*) upland streams, (*b*) lowland rivers, (*c*) wells sunk into deep alluvial gravels, (*d*) artesian wells. (Page 67.)

50. What quantity of water does an adult need per diem for drinking, cooking, ablution, and other domestic purposes ? (Page 64.)

51. Describe the materials used in the filtration of public water-supplies, their disposition in the filters, and the modes in which they act as purifiers of the water. (Page 65.)

52. On what principles are water-filters based ? Sketch and describe a good form of (*a*) filter for a rain-water supply, (*b*) a household-filter. (Page 65.)

53. When a town is to be supplied with water from gathering grounds, how is the available quantity estimated ? What are the chief dangers to which water in cisterns is subject in dwelling-houses ? (Page 76.)

54. You are called upon to inspect a well, the water of which is stated to have become impure ; what examina-

tion would you make of the well and its surroundings to ascertain its liability to pollution, and in what manner would you collect a sample for analysis ?

55. Mention some of the beneficial effects produced in towns and cities by efficient systems of drainage and water-supply.

56. What is the composition of human excreta from kidneys and intestinal canal ? How much urea is contained in the urine of a mixed population of 10,000 persons in a week. (Page 71.)

57. State the proportions of the chief constituents of average sewage from a water-closeted town. How does such a sewage differ from the sewage of a town without water-closets ? What is the theoretical annual pecuniary value of the excreta of an average adult, and how has this value been estimated ? (Page 72.)

58. What is the composition of urea, and what becomes of it after excretion ? (Page 71.)

59. What are the normal daily quantities of urine, of dried urine, of fæces, of dried fæces, and of nitrogen in urine and in fæces respectively, yielded by a population of 1,000 persons ? (Page 71.)

60. Give an account of any two methods for the chemical treatment of sewage, and state how they act. How does lime act as a precipitant of sewage ?

61. What are the conditions necessary to secure a good effluent in "intermittent downward filtration" of sewage ? What extent of ground, under favourable conditions, should be allowed for a town of 20,000 inhabitants ?

62. State fully by what chemical and biological processes sewage is disposed of and rendered innocuous, (*a*) in streams, and (*b*) in the soil.

63. What materials have been used for constructing drains ? What are the advantages and disadvantages of each ?

64. A circular sewer having a diameter of 24 inches is

laid with a fall of 16 feet per mile. Calculate the velocity of flow, and the amount of discharge, the pipe running full. (Page 73.)

65. What should be the diameter and what should be the fall of a house-drain? If a sufficient fall cannot be got, what should be done? What is the relation between fall and velocity of flow in pipes? (Page 74.)

66. What are the advantages and disadvantages in the use of small and large sewers respectively for the drainage of a small community? How may the defects of such sewers be best obviated?

67. What is meant by "Hydraulic Mean Depth"? What is it in the case of a circular pipe running half full? Show that it is the same when the pipe runs full. (Page 73.)

68. Discuss the desirability of ventilating sewers. What are the circumstances favouring the formation of foul gases in sewers? Describe the various methods of ventilating sewers, and give your reasons for preferring any particular method.

69. Describe and illustrate by rough diagrams some efficient means of ventilating and trapping the soil-pipes and drains of a house. What are the constituents of "Sewer-Air"? (Page 60.)

70. What ill results may ensue from the omission to place a trap at the outlet of a house-sewer into the main-sewer, although the end of the former at the house is properly trapped?

71. What is meant by a water-trap? Upon what principles should it be constructed? Describe, with diagrams, some good and bad forms of water-traps.

72. How do water-traps in and about a house act? Under what circumstances may they become useless? How may their defective action be obviated or remedied?

73. What are the different ways in which siphonage of water-traps may occur, and how may it be prevented?

74. Two outlets, each provided with a siphon (or S) trap, discharge into the same vertical pipe one above the other. Explain under what circumstances the discharge from the one may empty the trap of the other, and show by means of a diagram how this may be prevented. Illustrate your answer by reference to experiments which bear on the point.

75. Sketch and describe a good form of hopper-closet and its connection with a house-drain. What are the advantages of this form of closet? How should it be supplied with water?

76. Describe the usual forms of water-closet. Explain their action, and state the respective advantages and defects of the kinds of closet described.

77. Sketch and describe a trough water-closet, and explain how it is worked. Under what circumstances are trough-closets the best available form of water-closet, and what are their disadvantages?

78. What are the best materials for the construction of the walls and roofs of dwelling-houses in towns and in villages respectively, having regard to the cost and accessibility of materials? State the grounds on which such materials are preferred. (Page 71.)

79. Describe the methods usually adopted for keeping walls dry in houses built upon a damp soil, and their relative degrees of efficiency.

80. It is proposed to lay out a cemetery on a low-lying site near a tidal river. State fully what objections there are to such a situation, and the means by which, in the event of the site being adopted, those objections may be best obviated.

81. What are the chief causes of the difference between the climates of Great Britain and Labrador, which are in the same latitude?

82. Describe the climate of Davos or some other health resort at a high altitude.

83. What is the nature and cause of the Föhn wind which blows in Switzerland?

84. How does the nature of the subsoil affect the meteorological conditions of a locality?

85. Distinguish between an inland and an insular climate. Give a general account of the shape of the isothermal lines on the earth's surface.

86. What is a tornado? How does it differ from a storm in the temperate zone?

87. Account for land and sea breezes.

88. Explain exactly how (*a*) height above the sea, and (*b*) distance from the sea, affect the climate of a place.

89. Describe what conditions other than disease affect the death-rate of a district, and how they so affect it.

90. What effects are produced upon the functions of the body by (*a*) considerable and (*b*) slight variations in the pressure of the atmosphere?

91. Describe a rain-gauge, and explain how its measuring-glass is graduated. What is the average annual rainfall in various parts of this country? (Page 76.)

92. State what is known with respect to the water and humidity of the soil at various depths, and discuss the influence on the public health of the varying hygrometric condition of the soil.

93. Describe any form of calorimeter, and state exactly how you would make a determination by it.

94. Compare and contrast the uses of the thermometer and the thermopile as indicators of changes in temperature.

95. Explain the presence of the white fumes which appear over the liquid on opening a bottle of lemonade.

96. Why does frost come only on clear nights? Does it usually freeze under an open shed?

97. What is the scientific measure of *dryness* of the air?

98. Why are mountains so often capped with cloud?

99. How is the amount of aqueous vapour in the air determined and how expressed? How does humidity of the air affect health? (Page 75.)

100. How is the dew-point ascertained? Explain its relations to the humidity of the atmosphere and to the evaporation of liquids. (Page 75.)

101. The temperature of the air is 65° Fahr., the dew-point 56°, and its degree of humidity 73° (sat. = 100). Under these conditions the air contains 6·8 grains of aqueous vapour per cubic foot. How much aqueous vapour would the air contain at 65° (1) when it is fully saturated, (2) when its humidity is reduced to 63°?

102. What is meant by the hygrometric state of the atmosphere? Give two methods by which this state may be ascertained and measured. (Page 75.)

103. Describe the apparatus for measuring the weight, temperature, and humidity of atmospheric air, and indicate the errors to be guarded against in each case. (Page 74.)

104. Describe the simple barometer. Such a barometer is set up over a tall cylinder of mercury, and is found to contain a small quantity of air. What will be the effect of moving the tube up and down in the cylinder?

105. Describe in detail the methods of ascertaining the state of ventilation of a room (1) by observations on the movements of the air; (2) by determining the amount of carbonic acid; which is the more accurate? (Page 61.)

106. Explain the action of Tobin's ventilating tubes, and show how they would be best applied to a living-room measuring 20 × 15 feet, and 10 feet high, heated by a fire situated in the centre of the longest side of the room.

107. Under what heads may food-substances be classified? What is the average chemical composition of those of each class? State the amount of each required in the average dietary of a man. (Page 76.)

108. State the elementary composition of an average proteid. What amount of potential energy is contained in the following alimentary substances: dry albumen, starch, fat, cane-sugar? (Page 77.)

109. What are the proportions of carbon and of nitrogen present in lean beef, butter, milk, and bread respectively? State the chief forms in which those elements are found in these foods. (Page 78.)

110. What is the composition of the egg of a bird? In what food substances is it deficient? What changes occur in eggs when kept in the air? (Page 78.)

111. What are the respective amounts of albuminoids, fats, carbo-hydrates, salts, and water required by a man weighing 170 lb., and doing ordinary mechanical work? Give a dietary furnishing those amounts. (Page 79.)

112. What are the proportions of the respective alimentary constituents contained in (1) milk, (2) potatoes, (3) rice, (4) butter, (5) bread? How much milk would be required to supplement the daily dietary of a man eating 3 lb. of potatoes? (Page 78.)

113. How much available energy may be expected from a daily diet of 8 oz. lean beef, 20 oz. bread, 10 oz. potatoes, and 1 oz. butter, with water *ad lib.*? What is your opinion of such a diet? (Page 79.)

114. What is the amount of mechanical energy expended by a man in doing an average day's work, and how much must be obtainable from the food to enable him to perform it? How much do you allow for the internal work of the body? (Page 80.)

115. A man (weight, with clothes, 150 lb.) walks 40 miles on level ground, at the rate of 4 miles an hour, and eats only bread and butter; how much would he require to do the work? (Page 80.)

116. Discuss the value of gelatine as a food substance. (Page 80.)

117. What known chemical substances may injuriously

contaminate tinned articles of food, and how may they be introduced into these? (Page 81.)

118. By what methods may meat be preserved, and upon what principles does each depend? (Page 81.)

119. Describe how you would determine the "total solids," the "fat," and milk sugar in a sample of milk.

120. What is meant by "ground-water"? What are its relations to the soil and to watercourses? Explain the general character of its movements.

121. What physical and what hygienic influences has a damp soil upon the air in houses built upon it? How may such influences be counteracted or obviated, if desired? (Page 69.)

122. What are the respective merits and demerits of clay, gravel, and chalk soils, when it is desired to build a large establishment in the country; and how may the disadvantages attending the choice of a site upon one or other of these kinds of soils be obviated? (Page 69.)

123. Name the structural defects and other intrinsic conditions which impair the hygienic value of private houses and tenement dwellings, and show how they may be rectified.

124. Explain the connection which has been observed to exist between a high infant mortality among the labouring classes in our large towns and the way in which the families of these classes are ordinarily lodged.

125. Mention the chief causes of excessive mortality amongst infants in large towns. What is the average rate of infant mortality from all causes in England and Wales, and what is the express meaning of the expression, "Rate of Infant Mortality"? (Page 96.)

126. In what ways does residence in a close and crowded court affect the nutrition and health of children?

127. How do atmospheric conditions affect the spread of Measles, Scarlet-fever, Whooping-cough, Enteric-fever, and Small-pox? (Page 95.)

128. State what you know about the special pathology of Infantile Summer Diarrhœa.

129. What are the elements which go to form your notion of Climate? State how they influence, separately or conjointly, the prevalence of Phthisis, Ague, and Yellow Fever.

130. What are the conditions of soil which tend to the production of Infantile Summer Diarrhœa? Give your views as to the methods by which these conditions severally act.

131. Discuss the question of the fitness for habitation of "back-to-back" houses, and give some evidence respecting the mortality in them from different classes of disease. (Page 82.)

132. What diseases besides certain infectious fevers are found to be excessively prevalent in badly ventilated apartments? Give authority for your answer. (Page 81.)

133. What special dangers to health may be associated with the use for drinking purposes of (*a*) pond-water, (*b*) well-water, and (*c*) river-water? State what circumstances in connection with each of these waters may give rise to such dangers.

134. Enumerate the diseases that have been shown to be especially prevalent on certain soils and sites; and state how they may be prevented.

135. Describe the influence exerted upon health by each of the principal factors of "climate." Mention, in illustration, some prevalent diseases of British India.

136. How is the prevalence of Pulmonary Phthisis influenced by (*a*) Climate, (*b*) Soil?

137. Give an outline of the influence of Climate, Season, and Soil upon diseases attributable to "Malaria."

138. What are the duties imposed upon a Rural Sanitary Authority by the Public Health (Water) Act?

139. A village is situated on a deep clay soil bounded on one side, at a distance of two miles, by a range of

chalk hills. Another village on a similar soil is situated in the middle of an extensive plain of similar geological character. The inhabitants of both villages resort to superficial wells and to ponds for their drinking-water. What objections attach to such a method of water-supply ; how would these objections be likely to manifest themselves ; and what is the nature of the advice you would give to (*a*) the Sanitary Authority and (*b*) the heads of families, with regard to these villages respectively, in order to obviate these objections ?

140. What diseases would lead you to suspect the water-supply of any community ? Mention the duties that are now laid upon the Medical Officer of Health with regard to the purity of drinking-water. (Page 63.)

141. Are you of opinion that a running stream of water which has become unfit for drinking purposes on account of the admission of town sewage into it, may, after a flow of some miles, again become fit for drinking, and that it may be safely used as an ordinary town supply ? Give the reasons for your opinion *pro* or *contra*.

142. How would you proceed, with regard to the Sanitary Authority, and with regard to the several available sources of water, to cause a rural village situated upon a deep layer of sub-soil clay to be supplied with a sufficiency of wholesome water ?

143. State the ranges in duration of periods of (*a*) incubation, (*b*) fever, (*c*) infectivity, in each of the following diseases ; and show how the knowledge may be applied for the prevention of these diseases, viz. : Cholera, Plague, Yellow-fever, Typhus, Enteric-fever, Scarlet-fever, Small-pox, Measles, Diphtheria. (Page 83.)

144. Diphtheria prevailed during the seven months, October to April, in a town of some 4,000 inhabitants. There were fifty-six attacks, twenty-three occurring in November ; and some of the earlier ones were diagnosed as " Croup." The town is divided into two parts by a

stream. To the north of the stream the ground, mainly formed of new red sandstone, rises sharply; there are crowded courts and yards, and also a market-place where nuisances from pig-keeping, slaughtering, and privies are numerous. Here, also, are the three elementary schools, including the infants' school. To the south of the stream the town lies low on alluvial gravel liable to flooding, and a number of the dwellings are old and damp.

The incidence of the disease was essentially on children under six years of age attending the infants' school. Of those attending this school seventy-three lived north of the stream, forty-two lived south of it; but recognised attacks of diphtheria were limited to those living on the north side. No question of infection from milk and animals arose.

Discuss the conditions which may have been concerned in the beginnings and spread of this outbreak.

145. Describe the manner in which Milk may become an agency for the spread of Scarlet-fever, Enteric-fever, and Diphtheria. Enumerate the features which characterize a Milk Epidemic. Describe any such outbreak that has come within your knowledge. (Page 84.)

146. Measles threatens to become epidemic in a town of 25,000 inhabitants. What measures would you recommend and adopt in order to prevent the spread of the disease, and what powers—statutory and other—may be resorted to for that purpose? (Page 85.)

147. A member of a family of school children is attacked by Scarlet-fever. The patient is nursed at home although the house is too small to allow of his satisfactory isolation, and therefore the other children are temporarily forbidden to attend the day-school. For what period after the complete recovery of the patient, the disinfection of the house, etc., would you consider it necessary to keep his brothers away from school? State the reasons for your answer. (Page 83.)

148. State what you know about the ordinary mode of origin, causes of spread, and mode of arresting contagious ophthalmia in schools.

149. What powers do Sanitary Authorities possess with a view to prevent the spread of infectious diseases through the agency of elementary schools? Under what circumstances is it desirable that they should be severally exercised? (Page 84.)

150. What is the usual course of an epidemic of Scarlet-fever, as to season, fatality, its incidence upon certain localities, and upon different classes of persons? State, in detail, the measures to be taken to prevent its spread.

151. What steps would you, as a Medical Officer of Health, take or advise to be taken, to arrest the spread of Scarlet-fever broken out in a populous village surrounded by other smaller villages, the children from all the villages frequenting the same elementary school? Mention especially the circumstances which would govern your action or advice in respect of the school attendances.

152. Give some account of the circumstances under which Scarlet-fever is believed to be capable of communication to the human subject through the agency of milk.

153. Give some account of the prevalence of typhus in this country during the past quarter of a century. Explain the sanitary circumstances with which such prevalence has been associated, and how they may be influenced by efficient sanitary administration.

154. Give the differential symptoms of Epidemic Influenza and Dengue, to prove that influenza is not a form of dengue, modified by climate.

155. Give a short historical account of Epidemic Cholera, as far as regards the British epidemics. Discuss the question of its causation.

156. Describe, fully, the effects, immediate and remote

acute and chronic, special and general, on human life and health, produced by the inhalation, for longer or shorter periods, of atmospheric air, polluted by :

(*a*) Overcrowding.
(*b*) Sewer gas.
(*c*) Town's refuse used as manure.
(*d*) Noxious trades (specifying three of such trades.)

157. At what seasons of the year are the following diseases most prevalent : (*a*) Small-pox, (*b*) Measles, (*c*) Scarlet-fever, (*d*) Whooping-cough, (*e*) Enteric-fever, (*f*) Typhus, (*g*) Pneumonia, and (*h*) Diarrhœa ? State what you know about the etiology of pneumonia apart from its origin in exposure or cold. (Page 95.)

How does the age of the patient affect the prognosis in Typhus, Pneumonia, and Diarrhœa ?

158. What are the characteristic features of "Relapsing fever" ? State what you know about its pathology and causation. What steps may usefully be taken—both by the Sanitary Authority under statute, and otherwise—to check the progress of an epidemic of the disease in a town ?

159. Give a short historical account of Leprosy. With what diseases may Leprosy be confounded ? Give the differential diagnosis of the diseases mentioned.

160. In a large village of a Rural Sanitary District, situated on the slope of the Cotswold Hills, where the much-fissured oolite rock was but thinly covered by superficial earth, a case of enteric fever was introduced into a house at the highest level of the village. In the course of a few weeks the disease had spread extensively through the village, and among the children who attended the parish school both from the village itself and from a distance. Common pit-hole privies were in use univer-

sally ; the water-supply was from wells sunk in the rock to a depth of from 20 to 40 feet, and the milk-supply of the villagers was from various sources both within and outside the village. Comment fully on this statement, and say, further, what advice you would have given to the Sanitary Authority for the arrest of the epidemic, and with a view to preventing a recurrence of a similar epidemic in the future.

161. During a great depression in the building-trade towards the end of the autumn quarter of a particular year, an epidemic malady of low fatality broke out and spread chiefly in the families of Irish bricklayers and bricklayers' labourers, but also among other destitute families residing in a group of close unwholesome courts in the north of London. The attacks commenced with rigors, followed by sharp fever, vomiting, and epigastric tenderness ; these symptoms subsiding with copious sweating about the fifth to seventh day, but mostly recurring after the lapse of about a week, being then sometimes accompanied by jaundice or hæmorrhages ; the symptoms again disappearing after copious sweating. What was the disease ? What measures should have been adopted to arrest its spread ? and in what order would you place those measures in point of urgency ?

162. Describe the leading characters of Rickets, and the changes of structure observable after death.

163. Describe the morbid appearances commonly observable after death in the algide stage of Asiatic Cholera.

164. Explain the principal ways in which lead-poisoning may be brought about in man ; and as regards each, state how you would propose to obviate the danger.

165. State what you know about the special pathology of Infantile Summer Diarrhœa.

166. Describe the measures—administrative and medical —that have within recent years been adopted for the

prevention of Hydrophobia in man, and give your opinion as to the value of each of such measures.

167. Give a general account of the information available on the subject of the communication of tubercle from the lower animals to man. State how far you concur in, or dissent from, the views you refer to.

168. Give facts to prove that tubercle is independent of latitude and longitude, of heat and cold; and that it is impossible to point out any constant relation between its prevalence and the co-existence of any of the chief meteorological features which constitute climate.

169. Mention any well-known Entozoal disease in the Dog which is liable to communicate disease to the human subject. Describe fully how such communication may occur, and the nature of the human disease produced; and state what by-law, among the Model By-laws issued by the Local Government Board, may be adopted by an Urban Sanitary Authority with a view to lessen the danger.

170. State what you know about the occasional unwholesomeness of the following kinds of preserved food, how this occasional unwholesomeness is manifested, and to what you believe it is due—viz., ham or bacon, tinned lobster, and tinned fruits.

171. Describe the symptoms that may be produced by eating putrid meat. How may they be accounted for?

172. Give a short account of the diseases which have been known to result from eating the flesh of the pig in this country.

173. State what you know about diarrhœal or choleraic attacks consequent upon the eating of apparently wholesome sausages, pork, or ham.

174. Enumerate the diseases of animals which may accidentally become communicated to man; and, as respects any four of them, describe briefly the way in which they may become communicated, and the character of the resultant diseases.

175. What diseases may be communicated to man by the cow, dog, and cat respectively, and in what ways?

176. Give an account of the natural history of three of the parasites which infest the interior of the human body. Describe the symptoms to which they give rise.

177. Give some account of the information which is available as to the relation of Micro-organisms to the diseases of man.

178. Give a short account of the life-history of *Bacillus anthracis*. State briefly what you know about the results of recent observations (1) as to the influence of (*a*) heat, (*b*) ozone, (*c*) corrosive sublimate, on the vitality and pathogenic energy of this Bacillus; (2) as to their influence on ordinary putrefactive bacteria; and (3) as to any antagonistic or other relation between pathogenic and non-pathogenic Bacteria. (Page 87.)

179. How do you account for the fact that certain infectious diseases are liable to recur in the same individual, and others are not? What circumstances have been found to cause an increase in the virulence of infection? (Page 85.)

180. What rules should be observed for ensuring the most efficient and protective kind of vaccination, and for safe-guarding the vaccinee against any dangerous sequelæ of the operation? Let your answer be given under the following headings:

(*a*) Selection of the vaccinifer.
(*b*) The use of preserved lymph.
(*c*) The health of the vaccinee.
(*d*) The health of other members of the family of the vaccinee.
(*e*) The prevalence of disease in the vaccinee's neighbourhood.
(*f*) The instruments used.
(*g*) The mode of performing the operation, and the result to be aimed at.
(*h*) The safe-guarding of the vesicles.

What is your opinion of the practice habitually adopted by some vaccinators of puncturing all vesicles on the eighth day ?

181. On June 1 four infants, named respectively A, B, C, and D, were vaccinated at a Public Vaccination-station with lymph taken from the arm of a child named X. At the date of inspection on June 8, no unusual results presented themselves. On June 18 an excess of redness appeared around the vaccinated places on the arm of the infant A ; this zone extended, and definite erysipelas ensued. To what causes may such a case of post-vaccinal erysipelas be due, and what inquiries would you regard it necessary to institute in order to form a judgment as to the actual cause ?

182. Describe a "normal vaccine vesicle." What is known with certainty about vaccination in infancy as safeguarding against small-pox ? How is this safeguarding liable to be modified by lapse of time and by varieties of Small-pox epidemicity ? (Page 85.)

183. What powers do Sanitary Authorities possess to check the spread of Small-pox through the agency of Canal Boats ? Specify the statutes under which they would act. (Page 90.)

184. It has been stated that the remarkable diminution in the Small-pox mortality of this country during recent years has been due to the general improvement in the prevailing sanitary conditions, and not to the universal practice of vaccination. Discuss this statement critically. (Page 86.)

185. What are the steps that should be taken in view of a threatened extension of Small-pox, (*a*) by the Poor-Law Authority, (*b*) by the Sanitary Authority.

186. What is the evidence as to the relation of vaccination marks to : (i) Attacks from Small-pox, (ii) Deaths from Small-pox. (Page 86.)

187. What is the incubation period of Small-pox and

vaccinia respectively? How would your knowledge in this respect influence your practice when persons unprotected, or not fully protected by primary vaccination, are exposed to the infection of Small-pox?

188. Give an account of the various ways in which post-vaccinal erysipelas may be occasioned. Describe the ordinary course of the erysipelas and of the vaccinia when the former commences within the first two or three days after vaccination.

189. Give some account of the history of Small-pox in this country during the present century; explaining the influence of the several measures by which it has been sought to stay its prevalence.

190. Draw out a Dietary Table adapted to a large school for children from 5 to 15 years of age. (Page 82.)

191. A large Public School for 200 resident boys, of the middle class of society, has been erected, and has been provided with satisfactory structural arrangements. You are asked to advise on certain matters of *domestic regulations* for the maintenance of the health of the boys. What advice would you tender as to (*a*) dormitory arrangements, (*b*) meals and dietary, (*c*) bathing and personal cleanliness, (*d*) recreation, (*e*) and the prevention of the spread of Infectious disease?

192. What are the amounts per head of cubic space and floor space required in Elementary Schools? What is the height proper for the rooms? How are the lighting and warming of such schools best effected? Describe the forms, and position with respect to the school buildings, of urinal, closet, and latrine which you would advise.

193. Mention any diseases to which persons engaged in the following occupations are especially liable: Millers (flour), Coal-cutters (in mines), Cotton-weavers, File-cutters, Printers, Bakers, Jewellers, Carpenters and Joiners.

194. What are the principal occupations with which an

excess of Pulmonary Disease is associated? How is the mischief induced in each of the occupations mentioned, and what advice would you give with a view to its prevention?

195. To what diseases are the following classes of operatives especially liable: File-cutters, Knife-grinders Painters, Brass-workers, and Lace-makers? Why is the mortality amongst Cornish miners so much heavier than amongst the miners of Lancashire?

196. Enumerate the trades and occupations you know of that occasion disease in the workpeople by reason of the elimination of *dust*, and specify the nature of the diseases occasioned. Do this in a tabular form under the following headings:

Trade or occupation, or branch of trade or occupation.	Nature of the dust.	Morbid condition induced.

dealing separately with (*a*) Inorganic dust, (*b*) Vegetable dust, (*c*) Animal dust.

197. What is the essential difference between an antiseptic and a disinfectant? Give examples of each of these substances, and state shortly in what circumstances they, severally, are useful. (Page 86.)

198. What do you consider to be the best method of disinfecting woollen materials after exposure to contamination by Small-pox? What practical objection has been urged against the employment of dry heat for purposes of disinfection?

199. Assuming that all known means of efficient disinfection are at your disposal, how would you proceed to deal, by way of disinfection, with: (1) a large wool and hair mattress, (2) blankets and bed-linen, (3) enteric fever discharges, and (4) a room recently occupied by a scarlet-fever patient?

State in each case your reasons for the action which you advocate.

200. Describe and explain the method of action of the best apparatus you are acquainted with, for public use, in the disinfection of infected articles of clothing, bedding, etc.

201. State your views regarding efficient disinfection of (1) the sick-room, (2) the clothing and bedding, (3) the dead body, (4) empty houses, (5) sinks and sewers.

202. Explain the actions of peroxide of hydrogen, chlorine, ozone, and sulphurous acid upon refuse organic matters in the air.

203. Discuss the various methods of disinfecting, pointing out the advantages and disadvantages of each.

204. What are the different methods in which Sewage may be disposed of; and what are the circumstances under which you would advocate the adoption of one or the other method?

205. Describe one of the systems of so-called Dry-removal of excreta adopted in towns, and give an account of the principles that should be held in view in order to ensure its success from a health point of view.

206. State the circumstances under which drainage by means of cesspools is permissible, and enumerate the points as to which by-laws may properly regulate their construction.

207. How is the removal of excreta and refuse from closets, ashpits, and cesspools provided for under the Public Health Act, 1875; and under what circumstances may one or other provision be properly urged or enforced?

208. What are the statutory provisions relating to the sanitary regulation of Bakehouses, and what are the responsibilities of Medical Officers of Health with regard to their enforcement?

209. Enumerate the requirements for a wholesome dwelling-house.

210. Define the terms "drain" and "sewer" under the Public Health Act, 1875. State precisely to what extent control and responsibility, as regards each respectively, rests with the Sanitary Authority or with private owners. Show the powers and duties of a Sanitary Authority, and the rights of private owners with respect thereto. (Page 88.)

211. What obligations with respect to the condition of artizans' and labourers' dwellings are imposed by Statute Law on Medical Officers of Health and on Sanitary Authorities respectively?

212. An undue prevalence of pulmonary phthisis in a small town is held to be in part due to faulty construction of houses. What are the points to which you would direct attention with a view of reducing the prevalence of this disease, in so far as the construction of new dwelling-houses is concerned?

213. What are the statutory requirements under the Public Health Act, 1875, for permitting the occupation of a cellar-dwelling, and what is the legal definition of the term "occupation" when thus applied? (Page 89.)

214. What are the powers of Urban Sanitary Authorities for dealing with "unhealthy areas"? What evidence is required to show that a locality is an "unhealthy area"?

215. Under what circumstances may overcrowding be dealt with under the Public Health Act, 1875? Assuming that a party has been proceeded against under section 91, what further powers are possessed by a Sanitary Authority for the prevention of overcrowding?

216. What are the restrictions which should be applied to the construction of dwelling-houses in order to obtain such sufficiency of open space as shall secure the free circulation of air about them and the adequate ventilation of the dwellings?

217. What are the conditions which you would hold in

view in deciding whether in a given case there was unwholesome overcrowding or not?

How does overcrowding affect health injuriously?

218. What is the meaning of the words in the Public Health Act "a nuisance or injurious to health"? Mention some kinds of nuisances which cannot be dealt with under that statute. (Page 89.)

219. Enumerate in due order the several steps that have to be taken under the Public Health Act to obtain the abatement of "a nuisance." In the course of your answer explain fully the powers of entry upon premises conferred under that statute upon a Medical Officer of Health or an Inspector of Nuisances.

220. Describe the way in which nuisances are apt to arise in the conduct of the business of a Bone-Boiler, and the way in which such nuisances may be prevented.

221. What are the provisions of the 114th (or candle-house) section of the Public Health Act? Describe any methods you are acquainted with for preventing nuisance in the process of fat-melting. (Page 93.)

222. As to what matters have Sanitary Authorities power under the Public Health Act, 1875, to make by-laws for the safe-guarding of the public health? In respect of any one of these matters mention the principal provisions of the Model By-laws issued by the Local Government Board.

223. What are the most important points to be observed with a view to cleanliness, ventilation, and the prevention of nuisance to the neighbourhood as regards the business of slaughtering: (*a*) in the construction of the slaughter-house; (*b*) in the management of the business of slaughtering?

224. It is desired in a given urban district to bring the Common Lodging-houses under proper control. What are the powers as to this under the Public Health Act, 1875? Give a summary account of the several matters

which can be regulated, and explain as to each what regulation should be adopted.

225. What considerations would influence you in advising a Sanitary Authority as to the necessity of providing fever-hospital accommodation for a combined district, mainly rural in character, but containing important village communities within its area?

226. What are the special points to be observed in the construction of a ward in a pavilion infectious disease hospital? Refer, in the course of your answer, to the shape of the ward; to the construction of the floor, walls, ceiling, and windows; to the provision for warming and ventilation; to the bath and closet accommodation; and to the furnishing of the ward.

227. It is proposed to establish a hospital for infectious diseases for a town of 25,000 inhabitants, chiefly of the wage-earning class. State the principal points to which you, as Medical Officer of Health, would give attention in advising as to: (*a*) the choice of a site, and (*b*) the size, arrangement, and construction of the several buildings.

228. What are the diseases the notification of which is required under the "Infectious Diseases (Notification) Act, 1889"? What are the provisions of the Public Health Act against the spread of infection? (Page 84.)

229. Enumerate briefly, but as completely as you can, the provisions of the Public Health Act, 1875, against the spread of infection from infected persons and things.

230. A vessel with cholera on board is expected shortly to arrive at a seaport for which you are responsible as Medical Officer of Health. You are therefore required to take immediate steps for the protection of the port against infection. What action would you take?

231. What are the principal objections that are urged against the system of Quarantine? Give your reasons for concurring in or dissenting from them.

232. Give an account of the methods adopted in the systems of (*a*) Land Quarantine, (*b*) Maritime Quarantine, and give the grounds on which you would regard them as applicable or otherwise to this country in case of cholera on the continent of Europe.

233. Give a general account of the duties of a Medical Officer of Health on the occurrence in his district of an outbreak of dangerous epidemic disease.

234. Enteric fever has broken out in a small town of 5,000 population, and is spreading in the western half of it, only a few attacks having occurred in the eastern half. Describe at length how you, as Medical Officer of Health, would proceed *systematically* with the object of discovering its origin and the cause of its spread.

235. By what microscopic and other signs would you establish the proof of the presence of (*a*) Anthrax, and (*b*) Tuberculosis in the flesh of the ox in different parts of the carcase, and in various stages of development? State what you would cause to be done with such flesh in each of the respective circumstances.

236. You are called upon as a Medical Officer of Health to decide whether the carcases of a number of sheep affected with the Distoma hepaticum (liver fluke) may be passed as fit for food. Describe the appearances you would expect to find and indicate the grounds on which you would form your decision.

237. You are called in to condemn a carcase intended for human food. On the one hand it is contended to be that of a healthy ox, on the other that of an ox in the first stage of epizoötic pleuro-pneumonia.

How would you decide between the two contentions? In the event of your considering the flesh to be unfit for human food, what steps should be taken?

238. Describe in detail the legal process by which a carcase of Beef, unfit for human food, may be dealt with. Show the liability of the owner and other persons.

239. Write out a programme of an ordinary day's work of a Medical Officer of Health of a large town, provided with a sufficient staff of subordinate sanitary officers; stating what part of the work he should reserve for himself, and what part he may properly depute to his subordinates.

240. What are the duties of a Medical Officer of Health as laid down under the Order of the Local Government Board?

241. Give an outline of a Model Annual Report (including statistical tables) of a Medical Officer of Health for a large Urban Sanitary District.

242. Define and compare the following terms: "Mean age at death," "Average duration of life," "Duration of a generation," and point out their values as criteria of health. Describe in detail the usual modes of computing Infant Mortality, and show the relation borne by births to deaths under one year of age. (Page 96.)

243. How are death-rates calculated? If you know the population and death-rates of two districts, how can you calculate the death-rate of the combined district? If the population of one district be 21,575, and the death-rate 18 per 1,000 per annum, and that of another 29,864, with a death-rate of 20, what is the death-rate of the combined district? (Page 96.)

244. If appointed to determine the annual death-rate of a large town, explain the methods which you would adopt, and the sources of fallacy to which you would be liable. How would these fallacies be best avoided? (Page 95.)

245. In a town of 25,700 persons, the average number of births per week is 17, and of deaths 10. Calculate the annual birth-rate and death-rate. What would be the population at the end of five years? (Page 95.)

246. Draw up a table giving the usual death-rates in urban and rural populations respectively from (*a*) all

causes, (*b*) Small-pox, (*c*) Scarlatina, (*d*) Typhoid Fever, (*e*) measles, (*f*) phthisis.

247. What is meant by the expressions, (*a*) "Mean duration of life," (*b*) "Probable duration of life," (*c*) "Expectation of life"? Which of these furnishes a true test of the health of a people? How are the "sick population" and the "number of cases treated" in a hospital to be respectively ascertained? (Page 96.)

248. A town in a mining district in the North of England, having a population of 13,906 persons, gave the following mortality statistics for 1889:

Deaths in children under 1 year of age per 1,000 births.	Annual rate per 1,000 living from										
	All causes.	Principal zymotic diseases.	Small-pox.	Measles.	Scarlet Fever.	Diphtheria.	Whooping-cough.	"Fever."	Diarrhœa.	Phthisis.	Other respiratory diseases.
207	23·37	4·39	0·00	0·93	0·93	0·07	0·36	0·29	1·80	4·0	5·82

Comment generally on the above figures; point out where the rates are markedly in excess of the corresponding rates for England and Wales; and indicate your views as to the probable causes of each such excess.

249. Show in what ratio Population increases. If P represents the population of a town at the census of 1871, and P^1 its population at that of 1881, what will represent its calculated population for Midsummer, 1890? (If you prefer to use numbers, let P = 10,000, and $P^1 = 11,000$.) (Page 95.)

250. What do you consider to be normal birth-rates, marriage-rates, and death-rates in (*a*) agricultural villages, (*b*) manufacturing towns?

251. In what ways is the apparent death-rate of an

urban community affected by (*a*) a rapid increase of the population by immigration, (*b*) emigration, (*c*) an excessive birth-rate? What are the available means, under such circumstances, of correcting the apparent death-rate, and arriving at a true rate of mortality?

252. What explanations have been offered of the excess of male over female births?

253. State what you know relative to the influence of seasons upon the prevalence of zymotic diseases. (Page 95.)

254. What relationship is generally exhibited between the zymotic death-rate and the total death-rate? And what is approximately the ratio of the zymotic to the total death-rate? (Page 94.)

255. State in what manner the death-rate is influenced by "density of population" and pauperism. (Page 82.)

256. The years 1860 and 1879 were both remarkable for their low mean atmospheric temperature (47° and 46° Greenwich) and excessive rainfall (32 in. and 31·3 in.), as well as for their comparatively low annual death-rate (22·4 and 22·6 per 1,000 population); the year 1877 was remarkable for its low mean temperature (47·8°) and its very small rainfall (19·9 in.), as well as for its still lower annual death-rate (19·6 per 1,000). Comment on this statement, and state further in what respects these data are deficient for making a useful comparison between the death-rates of 1860 and 1879 and the death-rate of 1887.

257. State concisely what is the influence of *age constitution* on the death-rate of a community. What is meant by

(*a*) A recorded death-rate,
(*b*) A corrected death-rate?

258. The table of vital statistics submitted to each Candidate represents that compiled by the Medical

Officer of Health of an Urban Sanitary District, and annexed by him to his Annual Report for 1889.

The attention of the Candidate having been directed by the Examiners to the mortality experienced from certain specified causes, the Candidate is to regard himself as an expert who has been called in to advise how the amount of deaths from the several specified causes may be reduced in the town.

For this purpose he will in the first instance write down, under separate headings, the points as to which he will require antecedent information ; and having obtained this in conference with the Examiners, he will proceed to advise in the matter in the manner in which the Examiners may direct.

CHAPTER IX.

NOTES ON QUESTIONS.

Dr. De Chaumont's formula for determining the volume of pure air necessary to maintain a certain standard of purity :

d = the volume of air to be delivered per hour in cubic feet.

ϵ = the quantity of CO_2 that each person is assumed to evolve per hour.

ρ = the amount of impurity in a cubic foot of air.

$$d = \frac{\epsilon}{\rho}$$

Composition of Atmospheric Air.

Oxygen	209·6 per 1,000 vols.
Nitrogen	790·0 " "
Carbon dioxide	0·4 " "
Watery vapour	Varies with temp.
Ammonia	Trace.
Organic matter, Ozone, Salts of Sodium, Other mineral substances	Variable.

Sewer Air.

	Per 1,000 vols. CO_2.	Oxygen.	Micro-organisms.
Sewer air - -	0·75	7·2	8·9
Outside air - -	0·37	2·2	15·9

(*Carnelley and Haldane.*)

Cubic Space Per Head.

	Cubic feet.
Education Act (8 square feet floor space) -	80
London Board Schools (10 square feet floor space) - - - -	130
Common lodging-houses - - -	240
Poor-law - - - - -	300
Poor-law for the sick - - -	1,000

Velocity of Air.

The angle assumed by the flame of a candle affords a fairly accurate index according to the following table :

Velocity of Flow of Air. Feet per Second.	Angle of inclination of Flame of Candle with Horizon.
1·6	30°
1·0	40°
0·75	50°
0·50	60°
·40	65°

(*Galton.*)

The velocity of air at the inlet or outlet of a room should not exceed 1 foot or at most 2 feet per second,

(*a*) To prevent a sensible draught,

(*b*) Because a low velocity favours uniform diffusion.

Montgolfier's Formula.

v = the velocity in feet per second.
g = the acceleration due to gravity, 32·18 feet per second.
x = height of shaft.
t = internal temperature.
t' = external temperature.
·002 = co-efficient of expansion for 1° F.

$$v = \sqrt{2g\left(x - \frac{x}{1 + \cdot 002(t - t')}\right)}$$

Air Vitiated by Combustion.

Coal-fire.	*Coal-gas Partly Burnt.*
Carbon.	Nitrogen.
Carbon dioxide.	Carbon dioxide.
Carbon monoxide.	Carbon monoxide.
Sulphur, sulphur dioxide and sulphuric acid.	Sulphur dioxide.
Carbon disulphide.	
Ammonium sulphide or carbonate.	Ammonia.
Hydrogen sulphide (sometimes).	
Water.	Water (with perfect combustion little carbon monoxide).

Air Vitiated by Certain Trades.

	Source.
1. Hydrochloric acid -	Alkali works.
2. Sulphur dioxide and sulphuric acid - -	Copper-works — bleaching.

3. Hydrogen sulphide	-	Chemical works (especially of ammonia).
4. Carbon dioxide „ monoxide and Hydrogen sulphide	}	{ Brickfields and cement works.
5. Carbon monoxide	-	Iron and copper furnaces.
6. Carbon disulphide	-	Indiarubber works.
7. Zinc fumes -	-	Brass-founders.
8. Arsenical fumes -	-	Copper smelting.
9. Phosphoric fumes	-	Match-making (formerly).
10. Organic vapours -	-	Glue-refiners, bone-burners, slaughter-houses.—(*Parkes.*)

To Test for Gas-leakage.

Every burner is plugged up save one, and to that is attached a tube in connection with an air force-pump and gauge—the meter having been previously disconnected. Air is then pumped into the whole system of pipes, and the stop-cock turned, and if, after working the pump for some time, and stopping it, the gauge shows no signs of sinking, the pipes may be taken as in safe condition ; but if the mercury in the gauge falls owing to the escape of air from the gas-tubes, there is a leak in them, which is discoverable by pouring a little ether into the pipe close by the gauge, and recommencing pumping. Very minute holes can be detected by lathering the pipes with soap and water, and making use of the pump to create soap bubbles.—(*Eassie.*)

One cubic foot of gas requires 1,800 cubic feet of air. An ordinary burner consumes between 3 and 4 feet of gas per hour.

Open fires and gas-fires give out warmth by radiation.

Hot air gives out warmth by convection.

Stoves and hot water-pipes give out warmth by convection chiefly ; a little by radiation.

Teale's Recommendations Regarding Open Fire-grates.

1. Use as little iron and as much firebrick as possible.
2. The "throat" of the chimney should be small.
3. Let the back of the fire-place lean over the fire.
4. The bars in front and the slits in the bottom should be close together.
5. The bottom of the grate should be near to the floor, and closed in with an "economizer."

Diseases Traceable to Impure Water.

1. Dyspepsia.
2. Diarrhœa.
3. Dysentery
4. Malaria.
5. Enteric-fever.
6. Cholera.
7. Calculi.
8. Goitre.
9. Entozoa.
10. Lead, Mercury, Arsenic, Copper, and Zinc poisoning.
11. Probably yellow-fever.
12. Possibly Scarlet-fever and Diphtheria.

Waters that Act upon Lead.

1. Soft moorland waters.
2. Those containing organic matter.
3. „ „ nitrates.
4. „ „ nitrites.
5. „ „ chlorides.
6. „ „ carbonic acid in excess.

Theories Respecting the Solvent Action of Soft Waters upon Lead.

1. Due to organic acids in the water (Acetic, humic or ulmic).
2. Due to inorganic acids.
3. Due directly or indirectly to organisms.
4. Due to absence of silica from the water.

Water-Supply in Different Localities.

	Gallons per head daily.
London (average of eight companies)	30
New York	83
Paris	55
Glasgow	50
Edinburgh	40
Dublin	35
Liverpool	23
Manchester	20
Berlin	17·6

(*Notter.*)

Daily Amount of Water Required for All Purposes Per Head of Population.

	Gallons.
Domestic supply (excluding baths and W.C.)	12
Baths	4
W.C.	6
Unavoidable waste	3
Total house-supply	25
Town and trade purposes Animals in non-manufacturing towns	5
Exceptional manufacturing towns	5
	35

(*Parkes.*)

Principal Forms of Filters.

1. Animal charcoal.
2. "Carferal" (charcoal, iron, and clay).
3. Maignen's (powdered charcoal and lime supported on asbestos cloth).
4. Spongy-iron.
5. Unglazed porcelain.

Essentials of a Good Filter.

1. Every part of the filter should be easily got at for the purposes of cleaning or of renewing the medium.
2. The medium should have a sufficient purifying power both as to chemical action on organic matter in solution and arrest of organisms or their spores in suspension, and be present in sufficient quantity.
3. The medium should yield nothing to the water that may favour the growth of low forms of life.
4. The purifying power should be reasonably lasting.
5. There should be nothing in the construction of the filter itself that would be capable of undergoing putrefaction, or of yielding metallic or other impurities to the water.
6. The filtering materials should not be liable to clog, and the delivery of the water should be reasonably rapid. (*Notter.*)

Construction of Filter-Beds of the London Water-Companies.

	Inches.
1. Upper layer—fine sand - -	15—18
2. Lower layers—gravel increasing in size from that of a small pea to a middle-sized potato - -	20—24

Sixty gallons of water are allowed to pass through each quare foot in twenty-four hours.

Classification of Waters (Parkes).

	(1) Pure.	(2) Usable.	(3) Suspicious.	(4) Impure.
Physical characters.	Colourless, or bluish tint; transparent, sparkling, and well aërated; no sediment visible to naked eye; no smell; taste palatable.	As in (1), but may be of a greenish tint. If any sediment, easily separated by filtration.	Yellow or strong green colour; turbid; suspended matter considerable; no smell, but any marked taste.	Yellow or brown colour; turbid, not easily purified by coarse filtration; large amount of suspended matter; marked smell or taste.
Chemical constituents (in parts per million):				
1. Total dissolved solids	Under 75	Under 450	450 to 750	Above 750
2. Loss in do. on ignition	Under 15; no blackening on ignition	Under 45; may blacken but no nitrous fumes	45 to 75; blackening and nitrous fumes	Above 75; much blackening and nitrous fumes
3. Chlorine	Under 15	Under 45	45 to 75	Above 75
4. Nitrites	None	None	Present	Marked
5. Nitrates	None, or trace only	Present	Marked	Large
6. Hardness (permanent)	2° Clark	Under 4° Clark	Above 4° Clark	Above 6° Clark
7. Ammonia (free)	Under 0·02	,, 0·05	0·05 to 0·1	,, 0·1
8. Ammonia albuminoid	,, 0·05	,, 0·1	0·1 to 0·125	,, 0·125
9. Organic carbon	,, 1	,, 2	Above 2	,, 3
10. Organic nitrogen	,, 0·2	,, 0·3	,, 0·3	,, 0·3
11. Oxygen taken from acid permanganate	,, 1	,, 1·5	,, 1·5	,, 2
12. Sulphides	None	None	None	Present
13. Metals	None	Trace of iron	Trace of iron	Iron, or lead
Microscopic characters.	Mineral matter; vegetable forms with endochrome; large animal forms; no organic débris.	As in (1).	Vegetable and animal forms, more or less pale and colourless; organic débris; fibres of clothing, or other evidence of house refuse.	Bacteria of any kind; fungi; vegetable and animal forms of low types; epithelia or other animal structures; evidences of sewage; ova of parasites.

Amount of Water Required for Analysis.

One Winchester quart.

Seventy cc. is used for each distinct operation, with one or two exceptions.

A gallon contains 70,000 grains.

Seventy cc. is styled a "miniature gallon."

Qualities of Waters Founded upon their Respective Sources.

I. In respect of wholesomeness, palatability, and general fitness for drinking and cooking :

Wholesome.	1. Spring-water.	Very palatable.
	2. Deep well-water.	
	3. Upland surface-water.	Moderately palatable.
Suspicious.	4. Stored rain-water.	
	5. Surface-water from cultivated land.	Palatable.
Dangerous.	6. River-water to which sewage gains access.	
	7. Shallow well-water.	

II. According to softness :

1. Rain-water.
2. Upland surface-water.
3. Surface-water from cultivated land.
4. Polluted river-water.
5. Spring-water.
6. Deep well-water.
7. Shallow well-water.

III. In respect of the influence of geological formation in rendering water sparkling, colourless, palatable, and wholesome by percolation, the following water-bearing strata are given as the most efficient :

1. Chalk.
2. Oolite.

3. Greensand.
4. Hastings sand.
5. New red and conglomerate sandstone.

(*Rivers Pollution Commissioners.*)

GASES ABSORBED BY 1 LITRE OF WATER AT 59° F. AND 30 INCHES PRESSURE.

	Litres.
Ammonia	782·7000
Hydrochloric acid	457·8000
Sulphurous acid	43·5642
Carbonic acid	1·0000
Oxygen	0·0299
Nitrogen	0·0148

(*Galton.*)

DISEASES ATTRIBUTED TO TELLURIC EFFLUVIA.

Paroxysmal fevers.
Enteric fever.
Yellow fever.
Epidemic diarrhœa.
Cholera.
Dysentery.
Diphtheria.

One ton of the following will average in cubic feet :

Night-soil	18
Clay	18
Coarse gravel	19
Earth	21

(*Hime.*)

Cubic capacity of a cube = length × breadth × height.
Cubic capacity of a cone or pyramid = area of base × $\frac{1}{3}$ height.
Cubic capacity of a cylinder = area of base × height.
Cubic capacity occupied by a man = $\frac{1}{4}$ his weight in stones.

	Slope.	Permeability to Water.	Emanations into Air.	Substances into Water.
1. Primitive and metamorphic rocks (when unweathered)	Great usually.	Slight.	None.	Few.
2. Clay slate	Ditto.	Ditto.	Ditto.	Ditto.
3. Millstone grit. Hard oolite formations	Moderate.	Ditto.	Ditto.	Ditto.
4. Gravel and loose sands without impermeable subsoils	Slight.	Great.	Slight.	Variable.
5. Chalk (not marly)	Moderate.	Ditto.	Ditto.	Lime; a little magnesia.
6. Sandstones (old and new)	Ditto.	Variable, but usually considerable.	Ditto.	Variable, often great; alkaline and earthy salts; organic matter.
7. Limestones (old and new)	Considerable.	Moderate.	Ditto.	Rather considerable; lime salts.
8. Magnesian limestone, dolomite, etc.	Moderate.	Ditto.	Ditto.	Considerable; lime, magnesia.
9. Sands with impermeable subsoils	Slight.	Arrested by subsoil.	Considerable.	Variable, often great; alkaline salts; lime.
10. Clays, marls, mixture of sand and clay; most alluvial soils	Ditto.	Slight.	Ditto.	Often great; alkaline and earthy salts; organic matter.
11. Marshes (when not peaty)	Ditto.	Ditto.	Ditto.	Great; salts; organic matter.

(*De Chaumont.*)

The Conditions Requisite for a Healthy Site.

To be avoided :

1. Clay soils.
2. The foot of a slope or deep valley receiving drainage from higher levels.
3. High positions exposed to winds blowing over low marshy ground.
4. Elevated sites situated on the margin or at the head of steep ravines, up which malaria may be carried by air-currents flowing upwards from the low country.
5. Ground covered with rank vegetation, especially in tropical climates.
6. Muddy sea beaches or river banks if subject to periodical flooding in warm climates.

A porous subsoil not encumbered with vegetation, with a good fall for drainage, not receiving or retaining the water from any higher ground, and the prevailing winds blowing over no marshy or unwholesome ground, will afford the greatest amount of protection from disease.

(*Galton.*)

Daily ranges of temperature do not affect the soil to a greater depth than 3 feet, varying with the daily range of temperature.

The following table shows the relative power of soils to retain heat ; sand being the worst conductor, 100 is allotted to it as the standard :

Sand, with some lime - -	100
Pure sand - - -	95·6
Light clay - - -	76·9
Gypsum - - - -	73·2
Heavy clay - - -	71·11
Clayey earth - - -	68·4

Pure clay - - -	66·7
Fine chalk - - -	61·8
Humus - - - -	49

(*Schübler.*)

The volume in cubic feet of air which passed per hour through a square yard of wall-surface of equal thicknesses; outside temperature being 40° F.; inside, 72° F.:

Sandstone - -	4·7	cubic	feet.
Quarried limestone -	6·5	„	„
Brick - - -	7·9	„	„
Limestone - -	10·1	„	„
Mud - - -	14·4	„	„

(*Galton.*)

AVERAGE AMOUNT AND COMPOSITION OF EXCRETAL MATTER DISCHARGED BY A MALE ADULT DAILY:

	Fresh Excrements.	Dry Substances.	Mineral Matter.	Carbon.	Nitrogen.	Phosphates.
Fæces - - -	4·17	1·041	0·116	0·443	0·053	0·068 oz.
Urine - - -	46·01	1·735	0·527	0·539	0·478	0·189 oz.
Total - -	50·18	2·776	0·643	0·982	0·531	0·257 oz.

(*Lawes.*)

AMOUNT OF EXCRETA IN A MIXED POPULATION.

	Fæces.	Urine.
Daily amount per head -	2½ oz.	40 oz.
Daily amount 1,000 persons -	156 lb.	250 gallons.
Yearly amount 1,000 persons -	25 tons.	91,250 gallons.
Yearly amount 1,000 persons (water-free) - -	6¼ tons.	16½ tons.
	Urea ($CO(NH_2)_2$).	Nitrogen.
Daily amount per head -	500 grains.	153 grains.

This corresponds to 10 lb. of ammonia per head per annum, giving a theoretical manurial value of 6s. 8d., to which the urine contributes six-sevenths, the fæces one-seventh.

The manurial value of sewage is dependent upon combined nitrogen, potash, and phosphoric acid. The theoretical money value of average sewage is about 17s. per 100 tons. The dissolved matters contribute 15s., and the suspended matters 2s.

The annual amount of sewage per head is about 100 tons. (*Whitelegge.*)

Average Composition of Sewage.

Total solid residue	-	750 parts per million.
Dissolved solids -	-	700 " " "
Suspended solids	-	50 " " "
Chlorine - -	-	100 " " "
Organic carbon -	-	50 " " "
Organic nitrogen	-	20 " " "
Ammonia -	-	70 " " "
Phosphoric acid -	-	25 " " "
Potash - -	-	15 " " "
Oxidized nitrogen	-	Very little.

(*Rivers Pollution Commissioners.*)

Effluent from Sewage Works.

Any of the following characters are held by the Rivers Pollution Commissioners to render an effluent inadmissible to a stream :

1. Suspended Matter.—More than 1 part dry organic matter or more than 3 parts dry mineral matter in 100,000. Perfect rest in subsidence ponds for at least six hours is also required.

EFFLUENT FROM SEWAGE WORKS (*continued*).

2. DISSOLVED MATTER.—More than 2 parts of organic carbon or 0·3 of organic nitrogen in 100,000.
3. COLOUR.—Any distinct colour in depth of 1 inch when examined by daylight in a white vessel.
4. METALS.—More than 2 parts of any metal (except calcium, magnesium, potassium, or sodium) dissolved in 100,000 parts.
5. ARSENIC.—More than 0·05 of arsenic in any form per 100,000.
6. CHLORINE.—More than 1 part of free chlorine (after addition of sulphuric acid) per 100,000.
7. SULPHIDES.—More than 1 part of sulphur as sulphides per 100,000.
8. ACIDITY.—More than that caused by 2 parts of hydrochloric acid per 1,000.
9. ALKALINITY.—More than that caused by 1 part of caustic soda per 1,000.
10. OILY MATTER.—More than 0·05 part of petroleum or hydrocarbon oil suspended in 100,000 parts, or any film of oil upon the surface.

FORMULA FOR CALCULATING THE DISCHARGE FROM SEWERS.

v = Velocity in feet per minute.
55 = Empirical constant.
D = Hydraulic mean depth in feet.
F = Fall in feet per mile.
A = Sectional area of current of fluid.

$$v = 55 \sqrt{2\,D\,F}.$$

vA = Discharge in cubic feet per minute.

The "wetted perimeter" is that part of the circumference of the pipe wetted by the fluid.

"Hydraulic mean depth" is the sectional area of the current of the fluid divided by the wetted perimeter. In circular pipes it is always one-fourth the diameter.

Head of Water.

A head of water is made up of a head of pressure and a head of elevation.

1. A head of pressure is the intensity of the pressure exerted by the particle expressed in feet of water.
2. A head of elevation is the actual height of the particle above some fixed or datum level. (*Rankine.*)

Fall of Drain-Pipe.

4-inch drain - - -	1 in 40.
6 „ „ - - -	1 in 60.
9 „ „ - - -	1 in 80.

Humidity of the air is the weight of aqueous vapour in a given volume of air expressed as a percentage of the weight of vapour at saturation which would occupy the same volume at the actual temperature.

Weight of Air per Cubic Foot under 30 Inches Pressure of Mercury.

Temperature, Fahrenheit.	Dry Air. Grains.	Air saturated with vapour. Grains.
0°	606·37	606·03
20°	581·05	580·26
32°	566·85	565·58
40°	557·77	556·03
50°	546·82	544·36
60°	536·28	532·84
80°	516·39	509·97
100°	497·93	486·65

Corrections for Barometer.

1. Index error.
2. Capillarity (always additive).

} Special to each instrument. Marked by maker.

CORRECTIONS FOR BAROMETER (*continued*).

3. Temperature: By Scott's tables, or ·0001001 of the length of the column are subtracted for each degree F. above freezing.
4. Altitude: By Scott's tables, or ·001 inch to be added for each foot.

TO CALCULATE THE DEW-POINT.

1. By Glaisher's factors. Take the difference of the dry and wet bulbs, and multiply it with the factor which stands opposite the dry-bulb temperature in the table, deduct the product from the dry-bulb temperature; the result is the dew-point.

2. By Apjohn's formula. A table of the elastic tension of vapour in inches of mercury at different temperatures must be used. From this table take out the elastic tension of the temperature of the wet thermometer, and call it f'. Let $(t-t')$ be the difference of the two thermometers, and p the observed height of the barometer. Apjohn's formula then enables us to calculate the elastic tension of the dew-point, which we will call f''; and this being known, by looking in the table we obtain, opposite this elastic tension, the dew-point temperature.

The formula is:

$$f''=f'-0{\cdot}01147\,(t-t')\frac{p-f'}{30}$$

The fraction $\dfrac{p-f'}{30}$

differs but little from unity, and may be neglected; the formula is then, for the temperature above 32° F.,

$$f''=f'-\frac{(t-t')}{87}$$

For below 32° it is $f''=f'-\dfrac{(t-t')}{96}$

(*Parkes.*)

To Ascertain the Amount of Rain.

$$\frac{\text{Area in sq. feet} \times 144 \times \text{rainfall in inches}}{1728} = \text{cubic feet.}$$

Cubic feet × 6·23 = gallons ;

or simpler, in which the error is 4 per cent. :

Area in sq. feet × half the rainfall in inches = gallons.

1 inch of rain delivers 4·673 gallons on each sq. yard.
" " " 22·617 " " " acre.
" " " ·101 tons " " "

The average rainfall for all England is 30 inches annually.

To Ascertain the Relation between a Rain-gauge and its Measuring-glass.

Determine the area in square inches of the receiving surface, or top of the gauge, by careful measurement. This area, if covered with water to the height of 1 inch, would give a corresponding amount of cubic inches. This number of cubic inches is the measure for that gauge of 1 inch, because when the rain equals that quantity it shows that 1 inch of rain has fallen over the whole surface.

Suppose the area of the receiving surface is 90 square inches. Take 90 cubic inches of water and put it into a glass, put a mark at the height of the fluid, and divide the glass below it into 100 equal parts. If the rainfall comes up to the mark, 1 inch of rain has fallen on each square inch of surface ; if it only comes up to a mark below, some amount less than an inch (which is so expressed in $\frac{1}{10}$th and $\frac{1}{100}$th) has fallen. (*Notter.*)

Classification of Foods.

I. Nitrogenous :

(*a*) Animal Albumins—

1. Egg Albumin.
2. Serum Albumin.

CLASSIFICATION OF FOODS (*continued*).

3. Myosin (muscle albumin).
4. Casein.

(*b*) Vegetable Albumins—

1. Vegetable Albumin.
2. Glutin.
3. Legumin (vegetable casein).

(*c*) Secondary Albumins—

1. Acid Albumin (Syntonin).
2. Alkali Albumin.
3. Peptones.

(*d*) Gelatinoids—

1. Chondrin.
2. Gelatin.

II. Fatty, or Hydro-carbons :

(*a*) Olein.
(*b*) Palmitin.
(*c*) Stearin (peculiar to the animal kingdom).

III. Carbo-hydrates :

(*a*) Glucoses, $C_6H_{12}O_6$.
(*b*) Sucroses $C_{12}H_{22}O_{11}$.
(*c*) Amyloses $C_6H_{10}O_5$.

IV. Salts, organic and inorganic.

V. Water.

ELEMENTARY COMPOSITION OF PROTEIDS.

Carbon - - -	50 per cent.
Oxygen - - -	25 „ „
Nitrogen - - -	15 „ „
Hydrogen - -	7 „ „
Sulphur - - -	3 „ „
Ash - - -	variable

MELTING POINTS OF FATS.

Margarine - -	31·3° C.
Butter - - -	35·8° C.

MELTING POINTS OF FATS (*continued*).

Beef Dripping-	- 43·8° C.
Lard - -	- 42° to 45° C.
Ox Fat -	- 48° to 53° C.
Mutton Fat -	- 50° to 51° C.

The specific gravity of genuine butter rarely falls below 910, the usual range being from 911 to 913, those of the ordinary animal fats ranging between 902·8 and 904·5. (*Willoughby.*)

CHEMICAL COMPOSITION ON FOOD SUBSTANCES.

	Per cent. of					Grains per lb.	
	Water.	Nitrogenous.	Fatty.	Carbo-hydrates.	Salts.	Nitrogen	Carbon.
Good meat, with little fat - -	75	20	3·5		1·5	190	1900
Cooked meat; no dripping lost -	55	28	15		3	260	3600
Fat pork - -	40	10	50		2	100	4000
Salt pork - -	45	25	7		25	290	1360
Salt beef - -	50	30	0·2		20	325	1115
White fish - -	78	18	3		1	200	875
Eggs - - -	74	14	11·5		1	180	1200
Cheese - -	37	33	24		5·5	300	3300
Butter - -	6	0·3	90		2·5		6500
Milk (new) -	87	4	3·5	5	·5	45	600
Milk (skim) -	90	4	2	5	·8	45	450
Bread - -	40	8	1·5	50	1·5	90	2000
Flour - -	15	11	2	70	1·7	120	2700
Oatmeal - -	15	13	6	65	3	140	2800
Green vegetables	90	0·2	0·5	6	0·7	14	420
Potatoes - -	75	1·5	0·1	23	1	22	770
Rice - - -	10	5	0·8	83	0·5	70	2700
Sugar - -	3			96	0·5		3100

(*Parkes.*)

Dietary for Male Adult.

	Nitrogenous.	Fatty.	Carbohydrates.	Salts.	Such a diet would contain	
					Nitrogen.	Carbon.
	oz.	oz.	oz.	oz.	grs.	grs.
Rest - - -	3	1½	12	1	200	4000
Moderate work -	4½	3	15	1¼	300	5000
Hard work- -	6	4½	18	1½	400	6000

Potential Energy contained in Food.

1 ounce of dry albumin	- -	yields 174	foot-tons.
,, fat	- - -	,, 378	,,
,, starch	- - -	,, 135	,,
,, cane-sugar	- -	,, 129	,,
,, glucose or lactose	-	,, 122	,,
,, cooked meat	- -	,, 106	,,
,, white fish	- -	,, 42	,,
,, bread	- - -	,, 88	,,
,, rice	- - -	,, 127	,,
,, oatmeal	- -	,, 130	,,
,, butter	- - -	,, 339	,,
,, eggs	- - -	,, 68	,,
,, milk	- - -	,, 27	,,
,, sugar	- - -	,, 126	,,

(*Parkes.*)

Changes Effected in Meat by Boiling.

	Water.	Albumin.	Fat.	Extractive.	Ash.
Raw meat -	70·88	22·51	4·52	0·85	1·23
Boiled meat -	56·82	34·13	7·50	0·4	1·15

(*Krauch.*)

Comparative Digestibility of Animal and Vegetable Diet.

Weight of food.	Vegetable diet.		Animal diet.	
	Digested	Not digested	Digested	Not digested
Of 100 parts of solids - -	75·5	24·5	89·9	10·1
Of 100 parts of albuminates -	46·6	53·4	81·2	18·8
Of 100 parts of animal fat and vegetable carbo-hydrates -	90·3	9·7	96·9	3·1

(*Hoffmann.*)

Internal Work.

The force exerted daily in respiration, circulation, and other internal work is estimated at 260 foot-tons. .In addition a man can do work equivalent to 300 to 500 foot-tons daily. Walking along a level road at three miles an hour is equivalent to climbing vertically $\frac{1}{20}$th of the distance traversed ; at four miles an hour $\frac{1}{17}$th.

w = the weight of the man in lbs.
x = the weight carried in lbs.
D = the distance travelled in feet.
2,240 = pounds in a ton.

$$\frac{(w+x)D}{20\times 2{,}240} = \text{force exerted in foot-tons.}$$

The larger the frame the more nitrogen is required.

The greater the exertion the more fats and carbo-hydrates.

The nutritive value of gelatin is about one-fourth that of albumin. It is converted into a peptone which does not gelatinize.

Preservation of Food.

1. Exclusion of air.
2. Exclusion of aerial germs.
3. Desiccation or withdrawal of water.
4. Application of germicides.
5. Extreme heat.
6. Extreme cold.

Contaminations of Tinned Foods.

1. Salts of tin.
2. „ zinc.
3. „ lead.
4. „ copper.

Due probably to the action of organic acids or chloride of sodium upon the tin, or solder.

Average Results of Analyses of Air in Sleeping Rooms between 12.30 and 4.30 a.m.

Cubic feet per head.	Temperature (Fahrenheit).	Carbonic acid per 1,000 vols.	Organic matter (vols. of oxygen required per million vols. of air).	Microbes — per litre.
100—180	55°	1·15	15·1	80
180—260	54°	1·07	15·1	49
260—340	53°	1·03	11·8	32
340—500	57°	·92	8·4	42
500—1,000	54°	·86	5·6	6
1,000—2,500	53°	·67	3·9	9
2,500—4,000	57°	·79	5·0	13

The above observations were made by Carnelley, Haldane, and Anderson, in Dundee, who also showed that the general death-rate was doubled, and at ages below five years was quadrupled in one-roomed houses

compared with four-roomed. The most marked increase was in diarrhœa, measles, whooping-cough, bronchitis, and pneumonia.

BACK-TO-BACK HOUSES.

	Average proportion of back-to-back houses.	Population.	All causes.	Death-rates from			Zymotic death-rate.
				Phthisis.	Other respiratory diseases.	Diarrhœa.	
District I.	0	8,713	27·5	2·8	6·6	1·4	4·5
„ II.	23%	11,749	29·2	2·3	7·8	1·6	4·8
„ III.	56%	11,405	39·5	3·6	7·9	2·1	6·2

(*Tatham's* statistics.)

DENSITY OF POPULATION AND DEATH-RATES.

Death-rates.	Persons to a square mile.
14 and under 15	253
15 „ 16	200
16 „ 17	258
17 „ 18	211
18 „ 19	194
19 „ 20	217
20 „ 21	458
21 „ 22	677
22 „ 23	1,301
23 „ 24	1,819
24 „ 25	2,166
25 „ 26	2,819
26 „ 27	2,944
27 „ 28	6,144

(*Ogle.*)

AVERAGE NUMBER OF PERSONS TO A HOUSE.

Westminster	9·1
Liverpool	6·0
All England	5·0

Quarantine Periods of the Association of Medical Officers of Schools.

	Quarantine to be required after last exposure to infection.	Earliest date of return to School after an attack.
Diphtheria	12 days	Three weeks, if convalescence is complete, and no sore-throat, albuminuria, or discharges remain.
Scarlet-fever	14 „	Six weeks, and then only if no desquamation or sore-throat.
Measles	16 „	Three weeks, if all desquamation and cough have ceased.
Rötheln	16 „	
Small-pox	18 „	When all scabs have fallen off.
Chicken-pox	18 „	
Whooping-cough	21 „	Six weeks from the commencement of the whooping, if the characteristic spasmodic cough and whooping have ceased. Earlier if all cough be gone.
Mumps	24 „	Four weeks, if all swelling have subsided.

Incubation of the Principal Zymotic Diseases.

Small-pox	12 days
Measles	8 „
Scarlet-fever	2 to 8 „
Diphtheria	3 to 8 „
Whooping-cough	7 to 14 „
Typhus-fever	2 to 21 „
Enteric-fever	5 to 21 „
Relapsing-fever	2 to 12 „
Cholera	a few hours to 5 „
Yellow-fever	2 to 6 „
Dengue	3 „

(*Quain.*)

The Seven Principal Zymotic Diseases.

1. Small-pox.
2. Measles.
3. Scarlet-fever.
4. Diphtheria.
5. Whooping-cough.
6. Diarrhœa.
7. "Fever" (Typhus, simple continued, and enteric).

Characteristics of an Epidemic due to Milk Supply.

1. Outbreak is sudden.
2. Simultaneous attacks.
3. Several members of the same household attacked.
4. Common milk supply.
5. Those households who consume most milk are most attacked.
6. Milk-drinkers (women and children) are attacked.
7. In scarlet-fever epidemics the type is mild, with a low mortality.

Infectious Diseases Notification Act, 1889. Diseases Scheduled.

Small-pox.	Scarlet-fever.
Cholera.	Puerperal-fever.
Erysipelas.	Relapsing-fever.
Membranous croup.	Continued-fever.
Diphtheria.	Enteric-fever.

Typhus.

Compulsory Closing of Schools. Article 88 of the Education Code.

"The managers must at once comply with any notice of the Sanitary Authority of the district in which the school is situated, requiring them for a specified time, with a view to preventing the spread of disease, either to close the school or to exclude any scholars from attendnce, but after complying they may appeal to the department if they consider the notice to be unreasonable."

This does not apply to private or Sunday-schools.

The student must remember that "notices" or "orders," such as the one indicated above, are not served by the Medical Officer of Health, but by the Sanitary Authority acting upon his advice.

Theories to Account for One Attack of a Disease Protecting Against a Second.

1. *The Exhaustion or Pabulum Theory.*—The microbes during the first attack remove some chemical substance necessary for their growth.

2. *The Antidote Theory.*—The first attack leaves in the system some direct or indirect product of the growth of the microbes which prevents any further multiplication.

3. *The Modification Theory.*—The cells and tissues are in some way modified during an attack so as to be able to resist future invasions of the same microbe.

Sheffield, 1887-88—Small-Pox Attacks and Deaths (Per 1,000 Persons of Each Class Stated).

	Attack-rate.		Death-rate.	
	Vaccinated.	Un-vaccinated.	Vaccinated.	Un-vaccinated.
0-10 years -	5	101	0·1	44
Ditto, living in invaded houses - -	78	869	1	381
Over 10 years	19	94	1	51
Ditto, living in invaded houses - -	281	686	14	371
All ages - -	15·5	97	0·7	48
Ditto, living in invaded houses - -	230	750	11	372

	Immunity from Attack.	Security against Death.
0-10 years -	20-fold	480-fold
Over 10 years -	5-fold	51-fold
All ages - -	6-fold	64-fold

(*Whitelegge.*)

Case Mortality in Relation to Number of Vaccine Cicatrices (Marson's Statistics).

	Case Mortality (per cent.).
Unvaccinated - - - -	$35\frac{1}{2}$
Stated to be vaccinated, but no cicatrices - - - -	$21\frac{3}{4}$
One cicatrix - - - -	$7\frac{1}{2}$
Two cicatrices - - - -	$4\frac{1}{8}$
Three cicatrices - - -	$1\frac{3}{4}$
Four or more cicatrices - -	$\frac{3}{4}$

Disinfectants destroy microbes.
Antiseptics arrest their growth.

Koch's Experiments with Anthrax Spores.

The following solutions destroyed the spores within a day :

1. Chlorine water.
2. Iodine water.
3. Bromine water, 2 per cent.
4. Mercuric chloride, 1 per cent.
5. Potassium permanganate, 5 per cent.
6. Carbolic acid, 5 per cent.
7. Osmic acid, 1 per cent.

Antiseptics.

THE DEGREE OF DILUTION AT WHICH CERTAIN REAGENTS RETAIN THEIR ANTISEPTIC ACTION.

	Parts per million in aqueous solution.
Mercuric chloride - -	3
Allyl alcohol - - -	12
Oil of mustard - - -	30
Hydrocyanic acid - -	125
Chromic acid - - -	200
Hydrochloric acid - -	600
Potass. permanganate - -	700
Salicylic acid - - -	700
Carbolic acid - - -	1,200
Boracic acid - - -	1,200
Borax - - - -	1,400
Quinine - - - -	1,600
Alcohol - - - -	80,000

Spores of bacilli are destroyed by steam at 212° F. in five minutes.

Spores of bacilli are destroyed by hot air at 220° F. in four hours.

Mercuric chloride should always be prepared in an acid solution.

Fumigation.

1. *Sulphur.*—One lb. of sulphur is used for every 1,000 cubic feet of air-space, yielding theoretically 1·1 per cent. of sulphurous acid.

2. *Chlorine.*—For each 1,000 cubic feet of air-space 15 lb. of chloride of lime, 22 lb. of hydrochloric acid (or 7 lb. of crude sulphuric acid).

DEFINITIONS FROM THE PUBLIC HEALTH ACT, 1875.

"Parish" means a place for which a separate poor-rate is or can be made, or for which a separate overseer is or can be appointed.

"Owner" means the person for the time being receiving the rack-rent of the lands or premises in connection with which the word is used, whether on his own account, or as agent or trustee for any other person, or who would so receive the same if such lands or premises were let at a rack-rent.

"Rack-rent" means rent which is not less than two-thirds of the full net annual value of the property out of which the rent arises; and the full net annual value shall be taken to be the rent at which the property might reasonably be expected to let from year to year, free from all usual tenants' rates and taxes, and tithe commutation rent-charge (if any), and deducting therefrom the probable average annual cost of the repairs, insurance, and other expenses (if any) necessary to maintain the same in a state to command such rent.

"Street" includes any highway (not being a turnpike road), and any public bridge (not being a county bridge), and any road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not.

"House" includes schools, also factories and other buildings in which more than twenty persons are employed at one time.

"Drain" means any drain of, and used for the drainage of, one building only, or premises within the same curtilage, and made merely for the purpose of communicating therefrom with a cesspool or other like receptacle for drainage, or with a sewer into which the drainage of two or more buildings or premises occupied by different persons is conveyed.

"Sewer" includes sewers and drains of every descrip-

tion except drains to which the word "drain" interpreted as aforesaid applies, and except drains vested in or under the control of any authority having the management of roads, and not being a local authority under this Act.

Conditions respecting the Occupation of Cellar-Dwellings.

1. Must be 7 feet high, and 3 feet above the surface of the street.
2. Must be an open area 2 feet 6 inches wide.
3. Must be effectually drained.
4. Must be w.c., privy, or earth-closet, and ashpit.
5. Must be a fireplace, and window (9 superficial feet) made to open.
6. No steps must cross the area in front of the window, and must not be closer than 6 inches off the external wall.

(Any cellar in which any person passes the night shall be held to be occupied.)

Definition of Nuisances.

1. Any premises in such a state as to be a nuisance or injurious to health.
2. Any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain, or ashpit, so foul or in such a state as to be a nuisance or injurious to health.
3. Any animal so kept as to be a nuisance or injurious to health.
4. Any accumulation or deposit which is a nuisance or injurious to health.
5. Any house or part of a house so overcrowded as to be dangerous or injurious to the health of the inmates, whether or not members of the same family.
6. Any factory, workshop, or workplace (not already under the operation of any general Act for the regulation

of factories or bakehouses) not kept in a cleanly state or not ventilated in such a manner as to render harmless, as far as practicable, any gases, vapours, dust, or other impurities generated in the course of the work carried on therein that are a nuisance or injurious to health ; or so overcrowded while work is carried on as to be dangerous or injurious to the health of those employed therein.

7. Any fireplace or furnace which does not, as far as practicable, consume the smoke arising from the combustible used therein, and which is used for working engines by steam, or in any mill, factory, dyehouse, brewery, bakehouse, or gasworks, or in any manufacturing or trade process whatsoever ; and

Any chimney (not being the chimney of a private dwelling-house) sending forth black smoke in such quantity as to be a nuisance.

Compulsory Removal to Fever Hospital.

Any person suffering from a dangerous infectious disorder who is

1. Without proper lodging or accommodation.
2. Lodged in a room occupied by more than one family.
3. On board any ship or vessel.
4. Lodged in a common lodging-house.

Regulations may be made by the Local Government Board to Prevent the Spread of a Formidable Infectious Disease.

1. For the speedy interment of the dead.
2. For house to house visitation.
3. For the provision of medical aid and accommodation ; for the promotion of cleansing, ventilation, and disinfection ; and for guarding against the spread of disease.

Provisions against Infection.

Public Health Act, 1875.

Section 120: "Where any Local Authority are of opinion, on the certificate of their Medical Officer of Health, or of any other legally qualified medical practitioner, that the cleansing and disinfecting of any house or part thereof, and of any articles therein likely to retain infection, would tend to prevent or check infectious disease, it shall be the duty of such Authority to give notice in writing to the owner or occupier of such house or part thereof requiring him to cleanse and disinfect such house or part thereof and articles within a time specified in such notice."

Infectious Diseases (Prevention) Act, 1890.

Section 5: "Where the Medical Officer of Health of any Local Authority, or any other registered medical practitioner, certifies that the cleansing and disinfecting of any house or part thereof, and of any articles therein likely to retain infection, would tend to prevent or check infectious disease, the Clerk to the Local Authority shall give notice in writing to the owner or occupier of such house or part thereof that the same and any such articles therein will be cleansed and disinfected by the Local Authority at the cost of such owner or occupier unless he informs the Local Authority within twenty-four hours from the receipt of the notice that he will cleanse and disinfect the house or part thereof and any such articles therein to the satisfaction of the Medical Officer of Health within a time fixed in the notice."

Important Notification Clause in the Public Health (London) Act, 1891.

Section 55, sub-section 4 : "Where a Medical Officer of Health receives a certificate under this section relating to a patient within the Metropolitan Asylum district, he shall, within twelve hours after such receipt, send a copy thereof to the Metropolitan Asylum Managers, and to the head teacher of the school attended by the patient (if a child), or by any child who is an inmate of the same house as the patient. The Metropolitan Asylum Managers shall repay to the Sanitary Authority the fees paid by that Authority in respect of the certificates, whereof copies have been so sent to the Managers. The Managers shall send weekly to the County Council and to every Medical Officer of Health such return of the infectious diseases of which they receive certificates in pursuance of this section as the County Council require."

Power of Entry.

	Section.
Public Health Act, 1875 :	
For examination of drains - - -	41
" " water-meter - -	58
" " common lodging-house	85
" " houses let in lodgings -	90
Prevention of nuisance - - -	102
Examination of unsound meat - -	119
Prevention of epidemic disease - -	137
Infectious Disease (Prevention) Act, 1890 :	
For disinfecting premises - - -	17
Housing of Working Classes Act, 1885 :	
For examination of tent, van, or shed, upon suspicion of infectious disease - -	9
Canal Boats Act, 1877 :	
For examination of canal boat upon suspicion of infectious disease - -	5

Offensive Trades.

The following are specifically mentioned in the 112th section of the Public Health Act, 1875 :

Blood-boiler.	Tripe-boiler.
Bone-boiler.	Tallow-melter.
Soap-boiler.	Fellmonger.

Model by-laws are issued for the following trades in addition to the above :

Blood-drier.
Leather-dresser.
Tanner.
Fat-melter or fat-extractor.
Glue-maker.
Size-maker.
Gut-scraper.

"Candle-house" (114th) Section of the Public Health Act, 1875.

1st par. : "Where any candle-house, melting-house, melting-place, or soap-house, or any slaughter-house, or any building or place for boiling offal or blood, or for boiling, burning, or crushing bones, or any manufactory, building or place used for any trade, business, process or manufacture causing effluvia, is certified to any *Urban* Authority by their Medical Officer of Health, or by any two legally qualified medical practitioners, or by any ten inhabitants of the district of such Urban Authority to be a nuisance or injurious to the health of any of the inhabitants of the district, such Urban Authority shall direct complaint to be made before a justice, who may summon the person by or on whose behalf the trade so complained of is carried to appear before a court of summary jurisdiction."

Amount of food and drugs necessary to be purchased in order that one-third may be kept by the vendor, one-

third sent to the analyst, and one-third kept for future comparison :

Bread	4 lb.
Flour	2 lb.
Oatmeal	1 lb.
Tea, Coffee, Chicory, Mustard, each	¼ lb.
Pepper	2 oz.
Vinegar	1 pint.
Beer	1 gall.
Spirits	1 pint.
Aërated waters	3 bottles.
Milk	1 quart.
Butter	¼ lb. to 1 lb.
Lard	½ lb.
Sweet Nitre, or Tinctures	4 oz.
Citric Acid	4 oz.
Precipitated Sulphur, or Cream of Tartar	2 oz.

Medicines according to prescription.

(*Hime.*)

MARRIAGE, BIRTH, AND DEATH-RATES PER 1,000 LIVING.

1881-1885.

Marriage.	Birth.	Death.
15·1	33·3	19·3

ANNUAL DEATH-RATES PER 1,000 LIVING. 1881-1885.

Small-pox	0·08
Measles	0·41
Scarlet-fever	0·43
Whooping-cough	0·46
Diphtheria	0·16
Typhus	0·02
Enteric-fever	0·22
Simple continued fever	0·03
Diarrhœa	0·65
Cancer	0·54
Phthisis	1·82
Diseases of the nervous system	1·80
„ „ circulatory „	1·46
„ „ respiratory „	3·53
Zymotic diseases	2·46

Mean Age at Death in

Whooping-cough is a little under	-	2	years.
Measles	,, ,, -	3	,,
Scarlatina	,, ,, -	6	,,
Diphtheria	,, ,, -	6	,,
Small-pox	,, ,, -	12	,,
Enteric-fever	,, ,, -	26	,,

(*Willoughby.*)

Seasons of Highest Mortality (London).

Small-pox - -	January to May.
Bronchitis - -	January.
Pneumonia - -	January and March.
Phthisis - -	March and April.
Whooping-cough -	March and April.
Measles - -	June and December.
Diarrhœa - -	July and August.
Scarlet-fever - -	October.
Enteric-fever - -	November.
Diphtheria - -	November and December.
Erysipelas - -	November and December.
Typhus - -	January.

(*Whitelegge.*)

Birth and Death-rates.

A = number of births or deaths in the year.

P = the population in the middle of the year.

$$\frac{A \times 1{,}000}{P} = \text{the birth or death rate.}$$

To Calculate Increase in Population.

$$\log P' + 9\,\frac{\log P' - \log P}{10} + \frac{\log P' - \log P}{10 \times 4,}$$

or

Census 1881 - - - -	11,000
,, 1871 - - - -	10,000
Difference - - - -	1,000
Average annual increase - - -	100·0

Therefore estimated population for Midsummer, 1881 :

$$11{,}000 + (100 \times 9) + \frac{100}{4} = 11{,}925.$$

(*Question* 249.)

To Calculate Death-rates of Combined Districts

P = population of one district.
D = death-rate of same district.
p = population of second district.
d = death-rate of second district.

$$\left(\frac{P}{P+p} \times D\right) + \left(\frac{p}{P+p} \times d\right) = \text{combined death-rate.}$$

Definitions.

"Infant mortality" is the

$$\frac{\text{deaths of children under one year}}{\text{births registered during the year}} \times 1{,}000$$

"Expectation of life" is the average number of years a person is expected to live as calculated from life tables.

"Mean duration of life" is the expectation of life at birth.

"Mean age at death" is the sum of the ages divided by the number of deaths.

"Probable duration of life" is the age at which half of a given number of children will have died.

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