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# AN INTRODUCTION TO HYGIENE

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BY

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# PREFACE TO SECOND EDITION

CONSIDERABLE additions have been made to the First Edition, but the original aim to render the book specially helpful to the Undergraduate has been maintained. Experience as a general practitioner, as well as an administrative officer and teacher, has prompted the author to offer information that will be of practical value to those who are about to embark on medical careers.

To Dr. Cristopher Clayson I am grateful for assistance in the revision of proofs.

W. ROBERTSON.

EDINBURGH, *April* 1936.

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# LIST OF ILLUSTRATIONS

# ERRATA

Last line of "Introductory" should read "£400 a year at the age of forty-five."

Page 10. Line 30, read "discrete" for "discreet."

Page 20. Add to "*Children Act*, 1908," "*Children and Young Persons Acts*, 1932, 1933."

Page 20. Line 25, read "infested" instead of "infected."

Page 20. Add to "*Education Act*, 1918," "*Education Act*, 1921."

Page 21. Add to "*Mental Deficiency Act*, 1914," "*Act of* 1927."

Page 25. "*Factories Act*, 1937," now takes the place of Acts quoted. See Appendix II, p. 315, for fuller details of changes.

Page 32. For New Milk Designations see Appendix II, p. 315.

Page 35. Line 10, read "9/-" for "8/-" as capitation fee.

Page 149. Third line from bottom, read "smokeless" for "non-smokeless."

Pages 218, 230. Substitute "sulphur dioxide" for "boric acid."

Page 221. Line 18, read "therm" instead of "calorie."

Page 223. Line 25, read "hyperchlorhydria."

Page 225. Line 13, read "must not contain more than 10 per cent. butter fat."

Page 239. Bottom line, read "Fat Soluble D." Fifth line from bottom read "Fat Soluble D."

Page 240. Line 5, include "Fat Soluble D."

Page 259. Line 20, read "65° F." instead of "68° F."

Page 300. Line 19, read "deaths of children under one year per annum per 1000 births."

# INTRODUCTORY

To encourage the student to give special consideration to the preventive side of Medicine, it may be of interest to indicate what that science has already been able to achieve. Space alone prevents one from referring to the past when men, women, and children actually consisted of what might be aptly termed the survival of the most fit. The weak succumbed ; and devastating epidemics swept away populations as a scythe cuts down grass. Centuries passed before the Health Conscience of this and other civilised countries was aroused. Laws and amending laws were introduced, but even with these the process of enlightenment was slow. Now there has come a great change, and every one, young and old, has materially benefited. People are living longer than they formerly did, because everything is being done to prolong the expectation of life. Water and food supplies are strictly and carefully safeguarded, and our citizens are coming to appreciate the importance of well-chosen foods. The principles of rational dietetics are also being taught and practised. Over-feeding, which was common in the Middle Ages, though still too much in evidence, is no longer a universal habit. The hours and the conditions of labour in and out of factories are regulated. The environment and housing of the people are being gradually improved. The value of rest and recreation are better understood. Starvation is unknown, because municipal and voluntary agencies are ever ready to assist those who are in need of sustenance

The child is supervised from the day of its birth until it leaves school. There still remains a gap in the pre-school period, but that will be filled, in the near future, when arrangements are made for the supervision of children in special schools, such as "Kindergartens." But there still remains much to be done in the domain of Preventive Medicine, and the well-informed practitioner has a big part to play in that direction.

The science of Bacteriology, so closely allied to Preventive Medicine, has materially advanced to help us out of the by-ways of doubt regarding the causes of many diseases that mystified our predecessors. No better illustrations need be cited than the successes which have attended the efforts of sanitary reformers in combating Malaria, Yellow Fever, Cholera, Dysentery, Plague, Malta Fever, Diphtheria, Relapsing Fever, Tetanus, Enteric Fever, and Typhus Fever. Countries that were formerly dreaded by white men have now been made comparatively safe for them, all because the preventive study of disease has indicated the directions in which epidemic and other maladies may be combated.

Every public health reformer has had to suffer ridicule at the hands of sceptics. Jenner, Pasteur, and many others before them were laughed at because they were actually thinking ahead of their times. How much the world is indebted to early pioneers, some of whom laid down their lives to help posterity, can best be appreciated by those who have directly or indirectly benefited. Reference to some of those early investigators is made throughout this handbook.

While every medical student cannot become a public health Administrative Officer, he should be able to command an intelligent knowledge of the things that really matter to him when he embarks on his career as a practitioner. When he knows his subject from that standpoint he will be able to assist the public health officials and he will be more fitted to advise his patients on many points that may steer them past difficulties concerning food, water supply, general sanitation, good housing conditions, and the general safeguarding of health.

The medical practitioner has only passing concern with the administrative aspect of Preventive Medicine, because specially appointed officers deal with that side of the work. But it is well that the doctor in practice should possess a knowledge of how things are done.

Books act as guides. Every Medical Officer of Health admits that he has profited more from seeing how things are done than from reading books, many of which are apt to convey the impression that Preventive Medicine and its operations are as simple as they have been described. Theory and practice in every branch of medicine are often very wide apart.

For those who desire to make a wide and intimate study of the theory of Preventive Medicine, excellent treatises are available. Modern teaching suggests that practical examples are most needed by students who want to know how Preventive Medicine may be applied to the best advantage.

If the student, after qualification, is anxious to secure a Diploma in Public Health, he must devote himself for the better part of two years to the practical study of the various subjects that are specified. For examination purposes a theoretical knowledge plays, it must be confessed, a large part. After securing his diploma the medical man usually finds that he only begins to learn his subject when he is brought face to face with the varying problems that present themselves. Books will possibly tell him what is required to solve difficulties, but they do not say how long and how difficult it often is to overcome them. Two illuminating examples may be given. The aspirant to a public health qualification, after reading the Rivers Pollution Prevention Acts, will almost come to the conclusion that the sections of the Acts have but to be applied to put an immediate end to the gross pollution of streams that flow through many of our counties and towns. A look round will make him wonder why so little has been done. The milk supply of the country is far from hygienically sound. The regulations learned for examinations indicate definitely what is necessary to remedy matters. Yet we know from authoritative sources that 40 per cent. of the dairy cows of this country suffer from Tuberculosis. Also, that much of the milk coming from many dairy farms is unsatisfactory and dirty. Examples of that kind could be multiplied, but general practitioners and more advanced students should command such knowledge of Preventive Medicine as to enable them to educate public opinion, which, after all, is the best driving force to apply to politicians and municipal rulers.

Those who are going to pursue Preventive Medicine as a special career are strongly advised to devote extra periods to the study of Bacteriology and Infectious Diseases of all types. A knowledge of these subjects will be found invaluable when one is placed in administrative control of any community. If Venereal Diseases attract him, the graduate may attach himself for a year or more as Clinical Assistant to that department. The same applies to the Maternity and Child Welfare Service, if it is to be made a special study. Tuberculosis Departments and the School Medical Services also offer opportunities for specialised work. By securing an appointment in an Infectious Diseases Hospital the graduate who desires to take the Public Health Diploma will possess a good asset when he seeks a post in the public health service. The student must not lose sight of the possibilities for advancement offered by the Army and Naval Medical Departments. Those in possession of a Diploma in Public Health, as well as one in Tropical Diseases, will generally secure preferment. Specialists in Bacteriology, Venereal Diseases, or Ear, Nose, and Throat work can also depend on securing advancement. And last, but by no means least, Army Medical Officers are able to retire on pension at sufficiently early ages to enable them to embark on civilian work after they leave the service. Superannuation (equivalent to pension) in Civil Service does not materialise until the municipal officer reaches the age of sixty-five. R.A.M.C. pensions begin at a much earlier stage. Good men are wanted in the Army and Navy, and for the well-qualified there is always room at the top. How many general practitioners are there who can accumulate enough to retire on an annual income of, say, £300 to £400 a year at the age of fifty-five ?

# AN INTRODUCTION TO HYGIENE

## CHAPTER I

## SANITARY ADMINISTRATION

### General Considerations

In England and Wales the Ministry of Health is the controlling body. In Scotland it is the Department of Health.

Formerly, Public Health, Poor Law, and Education Services were administered by separate authorities. Town or County Councils were responsible for the Public Health Services, while Poor Law matters were handled by Parish Councils or Poor Law Guardians; Education, including Medical Inspection of School Children, being administered by Education Authorities.

The Local Government Act, 1929, has so re-arranged administration that all the foregoing services are now under the direct control of Town or County Councils.

The advantage of such co-ordination ensures greater uniformity of administration with a better control over expenditure. Education and Poor Law Authorities incurred heavy outlays, which had to be defrayed by those who paid rates, yet the responsibility of collecting assessments was laid on the shoulders of the Town or County Councils. Now, however, the authority that collects the rates will also regulate how much and how the money is to be spent.

Another very important change introduced by the 1929 Act has been to render it possible for Local

Authorities in towns and in counties to treat other than infectious diseases. This, so far as Scotland is concerned, is new, though the power was included in the Public Health (Scotland) Act, 1867. The amending Act of 1897 only gave power to deal with infectious diseases. The new order of things, namely, the power to treat non-infectious diseases, will mean that Local Authorities may, in the near future, provide new or extended hospitals for the treatment of those who could not be specified as paupers. In other words, Municipal General Hospitals will come into being.

## Medical Personnel

Under the Ministries and Departments of Health in England and Scotland, Medical Advisers and Medical Inspectors are appointed. To the latter are delegated the duties of visiting and reporting on complaints that may have provoked dispute between a Local Authority and the Department of Health, or between a Local Authority and the authors of such public health nuisances as polluted streams, offensive trades, and so on.

After the Inspector has completed his investigations he reports to the Ministry or Department of Health, which may or may not take action in the matter.

Every city and county appoints a Medical Officer of Health with one or more Assistants to the Medical Officer of Health, as well as Tuberculosis, Maternity and Child Welfare, Venereal Diseases, and Veterinary Officers. In the Tuberculosis and Child Welfare sections, Health Visitors and Nurses are also appointed to attend clinics, to visit the homes of the people, and to follow up notified births.

Since the 1929 Act came into operation the Medical Officer of Health, with a staff consisting of qualified medical men and women, dentists, oculists, aurists, X-ray experts, etc., is made responsible for the medical examination of school children. This includes treatment of dental errors, eye defects, and certain skin diseases for which special clinics are provided. Veterinary officers examine meat at slaughter-houses, live animals exposed for sale and intended for human food, as well as cows yielding milk for human consumption. Samples of milk are periodically taken from cows suspected to be suffering from Tuberculosis of the udder or teats or both. Guinea-pigs are subsequently employed for testing the infectivity or otherwise of the milk.

At ports to which food is conveyed by ships the veterinary staff is kept continually busy. It should be mentioned at this point, and in connection with the inspection of food, that the Chief Sanitary Inspector is the official frequently responsible for carrying out the requirements of the Sale of Food and Drugs Acts, to which reference will presently be made (see page 29).

## Control of Infectious Disease

The Medical Officer of Health with his most immediate assistants concern themselves with the investigation of the causes of infectious disease and the control of municipal institutions where cases of infectious disease are treated (this includes sanatoria for Pulmonary and other forms of Tuberculosis). Epidemic as well as removal and disinfecting officers visit houses where cases of infectious disease occur, to make inquiries regarding possible milk and school connections, as well as other possible sources of infection. Special officers and nurses deal with the removal of patients to hospital, whereas disinfecting officers concern themselves with infected articles and houses.

## Nuisances

Under the Chief Sanitary Inspector of a big area—it may be a county or a city—special officers are allotted to districts which are systematically inspected, not only to investigate complaints that have been made, but to search for nuisances that may prejudice the health of the citizens.

Drains, water supply, damp, dark, overcrowded houses, and faulty construction of dwellings, or neglect to keep stairs and houses clean, all call for the attention of district inspectors, who must report to their chief so that the author of the nuisance, who may be the occupier or the owner of the property, will be called upon to "abate" the nuisance.

Drain-testing may be carried out by the sanitary staff, though in some districts that work is entrusted to the City Engineer's Department.

Reference to the association of disease with drains will be made when Enteric Fever and Diphtheria fall to be discussed.

## City and County Officials

As may be readily understood, the work of health officials differs considerably in cities and counties, because the problems affecting each are not always the same. In cities the numbers and types of infectious diseases brought under the notice of the Medical Officer of Health are much more numerous and varied than in rural areas. Children, who constitute the most susceptible section of the population, are also more numerous in cities. In towns there are more schools where the young come into contact with one another; therefore the opportunities for spreading infection are increased. Families are closely aggregated in crowded block-tenements, which system provides housing accommodation in many Scottish cities. In country districts, on the other hand, there may be only one school serving a wide area. Also, houses are scattered and separated from one another so that the children are not so liable to come into touch with one another after they leave the class-room.

Regarding nuisances, the questions that demand attention in rural areas will not be concerned so much with faulty drains, insanitary houses, offensive trades, or smoke emission from factory chimneys, as they will, or should, refer to pollution of streams, the keeping of cows under better conditions, and the rendering of miners' and rural workers' houses more suitable for human habitation than they often are.

## CHAPTER II

## ADMINISTRATIVE PROCEDURE

As has been indicated, the Medical Officer of Health acts as the adviser to the Public Health or Sanitary Committee on all matters pertaining to health. On the reports or recommendations of the Medical Officer of Health a Town or County Council will usually act.

A Public Health or Sanitary Committee, as it is sometimes called, consists of a specified number of a Town or County Council. All discussions of that Committee must be approved by the full Council before final action can be taken. By way of example, if the Medical Officer of Health advises the Public Health Committee to adopt a certain procedure, a discussion probably takes place, and after the Committee has arrived at a decision, the findings of the Committee are passed on to the next meeting of the full Town or County Council. Only on rare occasions is a decisive vote of a Committee upset by the full Town Council. But a Council may and often does refer a matter back for further consideration.

There are several Acts of Parliament that possess a distinct bearing on the daily work of the general practitioner. These should be known so that the responsibilities of the doctor may be better understood. Though the practitioner is only expected to know the spirit of the laws relating to health, a knowledge of the main enactments will make for better and more helpful co-operation between the practitioner and a Public Health Department.

**Notification of Infectious Diseases.**—The Notification of Infectious Diseases Act, 1889, is probably the first statute that brings the general practitioner into direct touch with the Medical Officer of Health. When he embarks on private practice, every medical man is provided with a book which contains notification forms, each of which must, as occasion requires, be properly completed and sent to the Public Health Department. The Act stipulates that any doctor who is called in to see a case of infectious disease must, "forthwith on becoming aware" of the existence of the disease, notify the fact to the Medical Officer of Health on one of the forms just mentioned. The "forthwith on becoming aware" proviso is made with the definite purpose of affording the practitioner time and opportunity to make up his mind regarding his diagnosis. Take, for instance, a suspected case of Scarlet Fever. The disease may be very mild, or the doctor may not have been called in during the acute stage of the malady, when a rash was probably present. In the absence of any characteristic signs he may consider it advisable to delay his diagnosis until he becomes "aware" of the actual condition. Having reached a decision, he must "forthwith" notify the case. In mild cases, for instance, it may be well-nigh impossible to give an opinion on first seeing the patient. A day or two may accordingly transpire before the notification can be dispatched to the Health Office. In cases of doubt, no matter what the infectious disease may be, several courses are open to the practitioner. First, he may state on his notification form "Doubtful Scarlet (or other) Fever" or, "For Observation Purposes." Thirdly, the Medical Officer of Health may be invited to see the case in consultation. In every well-administered district the infectious disease hospital or hospitals are provided with side-rooms, sometimes called observation wards, where doubtful cases are kept apart from the patients in the main wards until a definite diagnosis can be made.

Cases of suspected infectious disease, especially Scarlet Fever, occurring in households where there are several susceptible subjects, should be either isolated in their own homes, if there is a sufficiency of accommodation, or removed to hospital for observation purposes.

Now and again anxious or nervous parents express a strong disinclination to permit removal of an infected child to hospital. Under such circumstances, if the medical practitioner agrees to treat the patient at home, the other children, and particularly individuals engaged in handling food for sale, or employed as out-workers (see Factory and Workshops Act), should be compelled to leave the infected house to live perhaps with friends. The person primarily responsible for notification is the doctor. Even if several medical men are called in to see a case of infectious disease at different times, and independently, each must send a notification to the Medical Officer of Health.

A fee of half a crown is paid for each notification in private practice; but in public practice, such as in infirmaries, schools, clinics, or dispensaries, the fee is one shilling. Failing notification by the medical attendant or the head of the household, the obligation to notify rests on the nearest relative or those relatives or persons present in the building, or on the occupier of the building. If no one has notified a case of infectious disease attending school, it is the duty of the schoolmaster to do so.

Notification must be on the forms provided, but telephoned messages will be accepted as temporary or emergency expedients. A form must be filled up by the doctor who telephoned. The object of notification is twofold. First and foremost it offers early and accurate information to the Medical Officer of Health, who then tries to ascertain the source of infection. Notification also provides reliable data for compiling statistics. When "carriers" of Dysentery or Enteric Fever are discovered they must be notified to the Medical Officer of Health. "Carriers" should, in turn, be notified by the Medical Officer of Health to the manager of the business where the infected person is employed, with a view to the cessation of handling food or drink intended for human consumption. The "carrier" must also be apprised of his condition.

Though the Public Health (Scotland) Act of 1897 and the English Act of 1875 and its amending Acts refer to infectious diseases in general, the Notification of Infectious Diseases Act, 1889, applies only to certain specified infections. Thus Measles, Mumps, Chickenpox, and Whooping Cough are not compulsorily notifiable diseases. But they may be added to the following, which constitute the list of infectious diseases that are compulsorily notifiable :—

Acute Influenzal Pneumonia
Acute Primary Pneumonia
Acute Polio-Myelitis
Cerebro-spinal Fever
Cholera
Continued Fever
Diphtheria
Dysentery
Encephalitis Lethargica
Erysipelas
Malaria
Membranous Croup
Ophthalmia Neonatorum
Plague
Puerperal Fever
Puerperal Pyrexia
Relapsing Fever
Scarlet Fever
Smallpox
Spirochaetosis Ictero-haemorrhagica
Trench Fever
Tuberculosis—
  Pulmonary
  Non-Pulmonary
Typhoid Fever (Enteric)
Typhus Fever

All the foregoing, with the exception of cases of Tuberculosis, must be notified "forthwith on becoming aware." In the case of Tuberculosis, notification must be made within 48 hours. That implies 48 hours after diagnosis has been confirmed. This may not be until a biological test has been made. The withholding of a formal notification may be justified in cases where tubercle bacilli cannot be discovered after successive tests. Every doctor practising in a district is provided with outfits for examining sputa, as well as for taking swabs and for collecting blood. Care must always be taken when taking swabs from the throat and nose to refrain from using medicated wool. Also, gargling the throat with antiseptics should not be resorted to prior to taking swabs. All specimens are sent to the Medical Officer of Health, who, at the earliest possible opportunity, transmits reports received from a bacteriologist to the doctors who submitted specimens of sputa, blood, or swabs for examination.

### Chickenpox, Measles, and Whooping Cough

As has been indicated, none of these appears in the list of diseases that must be notified to the Medical Officer of Health.

Circumstances do arise, however, when a Local Authority, on the advice of its Medical Officer of Health, may desire to add Chickenpox to the list of compulsorily notifiable conditions. This addition can only be made with the consent of the Ministry or Department of Health of England or Scotland. It is generally when Smallpox is prevalent or threatens a district that Chickenpox is made notifiable. Modified and discreet examples of Smallpox being readily mistaken for Chickenpox, the addition of Chickenpox to the list of notifiable diseases makes it compulsory to notify every case of Chickenpox as well as every case of Smallpox, no matter how mild the latter may be. When that step is taken the onus is removed from the doctor to the Medical Officer of Health, who will be expected to decide which cases are Chickenpox and which are Smallpox. This is not always a simple matter.

Because typical Smallpox has become a rare disease in this country the recognition of the condition is not infrequently overlooked. Characteristic types of Smallpox are not commonly encountered. It is because the medical man expects to see text-book descriptions displayed by suspected sufferers that he is liable to ignore the very mild type that had been prevalent in England during recent years.

When a Local Authority has secured the consent of the Department or Ministry of Health to add Chickenpox to the list of compulsorily notifiable diseases, it must advertise the fact in the press, and every practitioner is notified that on and after a certain specified date all cases of Chickenpox must be notified " forthwith," etc. Notification of Chickenpox may, with the consent of the controlling body, be retained or it may be departed from at the expiry of a specified period. It is always wise to look upon Chickenpox among adults with suspicion. Chickenpox does now and again attack adults, but it is mainly a disease of childhood. As has been indicated, the prevalence in this country of *Alastrim* and *Amaas*, two mild forms of Smallpox occurring especially in South Africa and South America, has upset long-established ideas regarding the severe type of disease that one had been taught to expect.

*Alastrim* and *Amaas* are exceptionally mild. They are nevertheless capable of spreading Smallpox, and can be controlled (when detected) by the same preventive agencies as arrest the spread of Smallpox.

## Measles and Whooping Cough

These two infections present almost insurmountable difficulties when notification of them comes to be discussed. Notification of infectious disease has for its main object the immediate recognition of the condition, the taking of steps to prevent spread, and the compilation of accurate statistics. But Measles and Whooping Cough are so insidious in onset and occur in such large numbers that the means to cope with them, as is done in the majority of other acute infections, by removal to hospital, are almost unattainable. To provide hospital accommodation for Measles and Whooping Cough would entail the erection of extensive institutions. Also, droplet infection in the early stages of these two diseases plays a bigger part than in the majority of other infectious maladies. That feature of insidious spread goes far to render the effective control of epidemics of Measles and Whooping Cough, especially in cities, extremely difficult.

It is the experience of every Medical Officer of Health, when either Measles or Whooping Cough become prevalent, especially when an appreciable population of susceptible children has come into being, that nothing can stop an epidemic. Like a prairie fire, it must burn itself out.

To combat the spread of these two deadly infectious diseases, notification of every case has proved futile. As a tentative measure, however, the plan introduced by the author in Leith and Edinburgh of notifying the first case in each house will probably achieve the desired end, by bringing under notice of the Public Health Department those houses or institutions where either Measles or Whooping Cough actually occur. As the system is a voluntary one, the co-operation of the general practitioner must be enlisted to notify the first case of Measles or Whooping

Cough occurring in each house—payment of half a crown being made for each notification. As much information is afforded to the Public Health Department by that method as by the notification of every case. The cost of wholesale notification must always be a big barrier against its general adoption.

The value of notifying the first case mainly consists in drawing the attention of the health authorities to houses which may be unsuited for the treatment of children who may have been attacked by the common complications of Measles and Whooping Cough, viz. Pneumonia, Broncho-Pneumonia, and Acute Bronchitis. Under such circumstances removal to hospital of all serious cases is strongly urged. In actual practice many Local Authorities now set aside special wards for receiving cases of Measles and Whooping Cough.

Just as in the case of Chickenpox, consent from the Ministry of Health in England, or the Department of Health in Scotland, must be secured before Measles or Whooping Cough can be made compulsorily notifiable. Because the scheme is a voluntary one, it is not necessary to secure sanction from the Department of Health for the notification of the first case occurring in different houses or institutions. It is nevertheless one calling for the close co-operation of the general practitioner with the Medical Officer of Health, because Measles and Whooping Cough are the most fatal of the infectious diseases occurring in this country.



## Compulsory Removal of Infectious Diseases to Isolation Hospitals

Only under certain circumstances does compulsory removal become necessary. But overcrowding as well as insanitary houses may necessitate such procedure. It is only when parents or guardians refuse to allow cases of infectious disease to be removed to hospital that the Medical Officer of Health may put compulsion into operation. This he may do by procuring a warrant or order for such removal from a Magistrate, who must be satisfied that it is in the interests of health that such removal should be carried out. Rarely is recourse had to compulsion, but occasions arise when the knowledge that such power exists will persuade obdurate parents to consent to removal. It should be explained that no warrant or order is required for securing the removal of cases of infectious disease occurring in common lodging-houses. The patients must go to hospital.

Cases of Smallpox are never treated in their own homes. When Typhus, now rarely encountered, occurs, the disease usually manifests itself in slum areas where dirt and overcrowding prevail. Under such circumstances removal to hospital follows as a matter of course.

Cases of Diphtheria are invariably removed to hospital, not only because serum treatment is costly, but better control can be maintained over patients by the hospital nursing staff. Sudden deaths due to heart failure may occur in Diphtheria, if the patient is permitted too much liberty in the direction of movement. Parents are not always sufficiently stern disciplinarians when dealing with sick members of their families.

It should be kept in mind that a Medical Officer of Health cannot compel the removal of cases of infectious disease to hospital when the medical attendant signifies his desire to treat a case in its own home. But it will be only when the practitioner is satisfied that such a procedure may be followed without fear of spreading infection that he will suggest home treatment. This is a point where discretion must be brought into play. Now and again a garrulous or indiscreet epidemic officer has been known to express decided opinions regarding the all-pervading powers of the Medical Officer of Health. These powers exist only in the mind of the officer. A Medical Officer of Health will not insist on removal to hospital when a practitioner deliberately expresses his desire to treat a case of infectious disease in its own home.

Many cases of Scarlet Fever are now treated outside of infectious diseases hospitals, with none of the disastrous results that used to be dreaded. As will be shown in a subsequent section, the infectivity of Scarlet Fever is now assessed at a comparatively low level.

**Exposure of Infected Persons and Infected Articles.**—Anyone suffering from infectious disease who wilfully (that is, knowing himself to be suffering from an infectious disease) exposes himself, without taking proper precautions to prevent the spread of infection, in any street or public place, may be punished. A penalty also applies to those in charge of infected persons who expose them to the danger of others. (This will apply to parents in charge of children suffering from infectious disease.) Such penalties are not confined to the diseases that are compulsorily notifiable, but extend to any infectious disease. It is penal to lend, sell, or pawn infected articles. It is also punishable to wash infected articles in a wash-house used by others. If, however, the articles had been previously disinfected to the satisfaction of the medical practitioner, or the Medical Officer of Health, the stricture does not apply.

It is illegal to hold " wakes " over the bodies of those who have died of an infectious disease.

Children suffering from any infectious disease are prohibited from attending school. Children who have been in contact with infectious disease in their own homes cannot attend school without a medical certificate.

Those who have been in contact with infectious disease are not allowed to handle food (milk, meat, fish, fruit, etc.) unless proper precautions are taken to prevent the spread of infection (see also Factory and Workshops Act, dealing with " Home Work ").

Sufferers from infectious disease are forbidden to use public conveyances, cabs, taxis, buses, tramway cars. If any vehicle has been inadvertently used for conveying a case of infectious disease from one place to another, the owner of the vehicle must apprise the Medical Officer of Health, who will insist on the disinfection of the conveyance.

Infected dead bodies must not be kept in a work-room or sleeping apartment longer than 48 hours, without the written consent of the Medical Officer of Health. The dead bodies of infected persons must be taken from the infectious diseases hospital directly to the place of burial, unless the Medical Officer of Health gives consent to the contrary effect. This may apply to deaths from Erysipelas and Tuberculosis. Seldom, if ever, is a dead (coffined) body allowed to be taken to its former home from the isolation hospital.

Occasionally a corpse may be transported a considerable distance (with the consent of the Medical Officer of Health) when it has been encased in a shell of lead.

Only hearses must be used for the transport of dead (infected) bodies.

If infectious disease is suspected to exist in any premises without notification having been duly made on a specified form, the Medical Officer of Health has power to enter the premises to examine the suspect. But in no case should that official visit a case where a doctor is already in attendance, without first securing the consent of the medical attendant. Though the householder has the right to disinfect his house, that line of action is seldom followed. Every well-organised Public Health Department employs a staff of men, ambulances, and disinfecting apparatus for the purpose of carrying out any disinfections considered necessary.

Friction is now and again provoked when a medical attendant, animated perhaps by a spirit of perversity, urges a householder to ignore the Public Health Department and advises him to carry out his own disinfection. Under such unusual circumstances the Medical Officer of Health will probably require the householder to provide a certificate to the effect that the house and its contents have been disinfected to the satisfaction of the Health Department. Reliance cannot be placed on amateur disinfection, especially when it applies to such bulky articles as mattresses and wearing apparel.

If, therefore, an obstinate householder refuses to afford access to the Public Health Department, he will be expected to produce a medical certificate to show that adequate steps have been taken to complete the process of disinfection.

No charges are made by a sanitary authority for disinfection of premises or infected articles. But the authority must make good any damage done to disinfected clothing, bedding, or household contents. Preposterous claims are sometimes made, but if accurate records have been taken before infected articles are removed to the disinfecting station, such claims can be refuted.

It is not necessary for any medical attendant to grant certificates to school children regarding their freedom from infectious disease. That task may be left to the Medical Officer of Health or a qualified member of his staff.

Under the new arrangement of co-ordination of School Medical Services with those of the Public Health Department, certificates will probably be granted by school medical officers.

**The Public Health (Ophthalmia Neonatorum) Regulations, 1926.**—These regulations make it compulsory to notify all cases of Ophthalmia Neonatorum to the Medical Officer of Health. Ophthalmia Neonatorum is defined as a " purulent discharge commencing within 21 days of the birth of the child."

The main points to be observed are that each notification must give (1) the date of the birth, (2) the name and address of the parents or other person, if any, having charge of the child, and (3) the date of the onset of the disease. Failure on the part of a certified midwife to notify the existence of a purulent discharge may lead her into trouble, as she is required to notify the condition to the Medical Officer of Health. Neglect to give immediate attention to an inflammatory or purulent condition of the eyes may result in permanent injury to the sight, ending perhaps in total blindness.

**Public Health (Venereal Diseases) Regulations, 1916.**—These were framed under the Public Health Acts after the issue of the report of the Commission on Venereal Diseases. They made arrangements for providing facilities for diagnosis and treatment. Expenditure may be incurred by Local Authorities to spread information regarding Venereal Diseases. So far no general notification has been adopted (see under Venereal Diseases).

The *Venereal Diseases Act*, 1917, makes it illegal for anyone who is not a qualified practitioner to treat Venereal Diseases. The Act also forbids advertisement of treatment or of remedies. This is aimed at Quackery.

**Notification of Births and Other Acts.**—The *Notification* *of Births Act* was first introduced in 1907. Since then various amending Acts have been passed, each of which extends the scope of Maternity and Child Welfare activities. These are the *Notification of Births (Extension) Act*, 1915; *Maternity and Child Welfare Act*, 1918; *Milk (Mothers and Children) Order*, 1919; *Employment of Children Act*, 1903; *Children's Act*, 1908; *Education Act*, 1918; *Fabrics Misdescription Act*, 1913; *Mental Deficiency Act*, 1913.

*Notification of Births Act*, 1907.—Anyone in attendance within 6 hours of a birth must notify the M.O.H. in writing within 36 hours. This is additional to, and not in substitution of, registration of the birth. Notification also applies to any births after 28 weeks of pregnancy, whether the child is born alive or dead (*i.e.* Still-Births).

*Extension Act*, 1915.—Empowers Local Authorities to make any provision under the Public Health Acts for the health of expectant mothers and young children.

*Maternity and Child Welfare Act*, 1918.—Empowers Local Authorities to make provision for the health and nourishment of expectant and nursing mothers, and of children up to 5 years of age, not attending school, and to establish Maternity and Child Welfare Committees. Arrangements are to be sanctioned by the respective Departments of Health of England or Scotland.

*Milk (Mothers and Children) Order*, 1919.—Gives power to Local Authorities to supply milk to expectant and nursing mothers and to children under 5 years. Milk may be given free or at reduced rates and in specified quantities. "Milk" under this Order includes any preparation prescribed by the M.O.H. or M.O. of a Child Welfare Centre.

*Employment of Children Act*, 1903.—Some sections empower Local Authorities to make bye-laws regulating the employment of children and for the regulation of street-trading by children under 16.

*Children Act*, 1908.—Persons undertaking the nursing and *maintenance of one or more infants under* 7 for longer than 48 hours apart from parents, or having no parents, must give notice within 48 hours to the Local Authority. Notice to Local Authority must give name, sex, date and place of birth, person receiving infant, dwelling where infant is kept, name and address of person from whom infant was received. Changes of address and deaths to be notified within 48 hours. A Local Authority may appoint inspectors.

Penalties are imposed on those over 16 who have charge of children if they are guilty of wilful assault, neglect, abandonment, ill-treatment, or exposure to the detriment of health. Where it is proved that death by suffocation was caused to an infant under 3 years (apart from disease or foreign body) whilst in bed with another person under the influence of drink, that person will be deemed to have neglected the infant. Penalty is imposed on any person over 16 who having custody of child under 7 allows it to be in a room with an open fire not sufficiently protected against the risk of scalding or burning.

*A school M.O. may examine any child and its clothing.*—If the M.O. thinks the child is infected with vermin the parent is given notice in writing to have his child and clothing cleansed within 24 hours. If parent fails then M.O.H. may have it done in suitable premises. No warrant is necessary for removal of child. Local Authorities must afford facilities for disinfection.

*Education Act*, 1918.—This Act forbids employment of children under 12 and the employment of children of 12 or over for more than two hours on Sunday; or on any school-day before the close of school. The Education

Authority may make bye-laws as to employment of children. The employment of children in factories, workshops, mines, and quarries is prohibited.

*Fabrics Misdescription Act*, 1913.—An Act prohibiting the sale of flannelette as "non-inflammable" unless it complies with certain standards which ensure its non-inflammability.

*Mental Deficiency Act*, 1913.—Makes provision for the care of feeble-minded and other mentally defective persons.

Defines "Idiots" as persons so defective in mind from birth or early age as to be unable to guard themselves against physical dangers.

"Imbeciles" are persons in whom there exists from birth, or from an early age, mental defectiveness not amounting to idiocy, yet so pronounced that they are incapable of managing themselves or their affairs, or, in the case of children, of being taught to do so.

"Feeble-minded" are those, not imbeciles, in whom from birth or early age mental defect is such that they require care, supervision, and control for their own protection or for the protection of others, or, in the case of children, those who appear to be permanently incapable of receiving instruction in ordinary schools.

"Moral Imbeciles" are those who from an early age display some permanent mental defect, coupled with strong vicious or criminal propensities, on whom punishment has little or no deterrent effect.

This Act provides for the detention of all mental defectives under guardianship or in institutions.

**Midwives' Acts, 1902 and 1918.**—The 1902 Act was designed to secure the better training of midwives and to regulate their practice. The chief provisions are as follows: All Midwives must be certified (C.M.B. Certificate). Unless certified a midwife must not attend a childbirth without a doctor being in attendance. No woman shall be certified unless she has complied with rules and regulations laid down in this Act. Uncertified substitutes are prohibited. Certified women are not authorised to grant medical or death certificates. Certification implies the possession of a certificate of the Central Midwives Board or other similar certificate. Appeal from a decision of the C.M.B. by an aggrieved person is to be made to the High Court of Justice within 3 months. There shall be a roll of Midwives. *The Local Authority is the Local Supervisory Body which administers the Act* (*the M.O.H. being the executive officer*). *A midwife shall give notice in writing to the local supervisory body of her intention to practise in January of every year.*

*Midwives' Act*, 1918.—The chief provisions in this Act relate to the C.M.B., to the midwives, and to the local supervising authorities. A midwife may be *suspended* for a time in lieu of striking her name off the roll ; also she may be suspended during the time any case against her is being examined. If the case or appeal is decided in favour of the midwife the local supervisory body pay compensation for loss during suspension. The C.M.B. in addition to striking a midwife off the roll may prohibit her from attending maternity cases. *Every change of address of midwives must be notified within 7 days to the M.O.H.*

*The Rules of the C.M.B.*—These are framed under the Act. Section A. deals with the *proceedings of the Board*. Section B. regulates the *issue of certificates* and admission to the Roll of Midwives. Section C. the *course of training* and examinations. Section D. the *removal and restoration of names* from the roll. Section E. lays down the *practical points* that the midwife must observe in her practice. It emphasises cleanliness in person, clothing, appliances, and house. The requirements for her bag and armamentarium.

Hands and arms to be washed each time before vaginal examinations. Instruments to be boiled. Temperatures and pulse to be taken and recorded at each visit. She must not follow out any occupation likely to prove infective and must record any drug given except a simple aperient. Conditions are detailed in which medical assistance must be sought, the conditions being described under Pregnancy, Labour, Puerperium, and the child. Section F. decides the conditions under which midwives may be suspended from practice.

**Vaccination Acts.**—Dealt with in Scotland by the Vaccination Acts, 1863 and 1907, and Public Health (Scotland) Act, 1897, Sec. 77; in England and Wales and London by the Vaccination Acts, 1867, 1898 and 1907, the Vaccination Order, 1930; in Ireland by the Vaccination Act, 1863; also by the Public Health (Ireland) Act, 1878, Sec. 148.

In England, Wales, and London the chief provisions of the Vaccination Acts are:

Medical practitioners are appointed as public vaccinators. A parent or guardian must have a child vaccinated *within* 6 *months* of its birth by the public vaccinator, or by any doctor. If requested, the *public vaccinator must visit the house for the purpose of vaccinating the child.* If vaccination is not performed *within* 4 *months*, the public vaccinator must, *after giving* 24 *hours' notice*, visit the house and offer to vaccinate the child. The public vaccinator is not to vaccinate if he considers the condition of the house or the existence of infectious disease would render the operation unsafe. When vaccination is postponed for any of these reasons the vaccinator must notify the M.O.H. The public vaccinator may, for the above reasons, or because the child is not fit, postpone vaccination for *not more than* 2 *months*. He must then send a certificate of postponement to the vaccination officer. If after three attempts the vaccinator finds the operation unsuccessful, or if the child has already had Smallpox, he must within 7 days deliver to the vaccination officer a certificate to that effect. Within 7 days of ascertaining that the vaccination has been successful, a certificate of successful vaccination must be sent to the vaccination officer. *If within 4 months from the birth of a child a statutory declaration is made that the parent conscientiously believes that vaccination would be prejudicial, he must within 7 days thereafter deliver or send the declaration to the vaccination officer. The penalty for neglecting to have the child vaccinated is a fine of 20/-.*

If a child under 14 has not been successfully vaccinated the Justice may summon the parent or custodian to show cause why. If not satisfied he may demand vaccination within a specified time. Inoculation of Smallpox is forbidden. *By the 1907 Act the conscientious objector must make his declaration before a Justice of the Peace (instead of sending a signed declaration through the post).*

In Ireland all children must be vaccinated within 3 months of birth. There is no conscientious objection clause. The provisions for public vaccination, etc., are similar to the English Acts.

In Scotland children must be vaccinated within 6 months of birth. The conscientious objector must make the declaration before a J.P. By Sec. 77 of the Public Health (Scotland) Act, 1897, a Local Authority is empowered to defray the cost of vaccinating or re-vaccinating. That provision usually applies when epidemics or threatened visitations of Smallpox occur. It will be observed that the law in England and Wales and Scotland differs in several respects. There are no vaccination officers appointed in Scotland, nor are there specially appointed public vaccinators. In Scotland those who are too poor to defray the cost of vaccination may have the operation performed by the medical officers who formerly acted under the Parish or Poor Law Authority. Defaulters may also be vaccinated by those officers at the public expense.

At dispensaries, whether public or run by provident institutions, facilities for free vaccination are frequently provided.

During epidemic periods Vaccination Centres may be established, when private practitioners are frequently invited to co-operate with the Public Health Department in the carrying out of vaccination and re-vaccination on a big scale.

It should be understood that such a thing as compulsory vaccination does not exist, because no one can be forced to have the operation performed on him or on his children. Fines may be inflicted for refusal to have vaccination carried out, and such fines may be repeated. Vaccination may be postponed for 2 months, but if further postponement is deemed necessary by the medical attendant another certificate of postponement for 2 months must be completed. Children insusceptible to vaccination, as ascertained after three unsuccessful attempts, may be certified as being insusceptible.

The latest English enactment relating to vaccination came into force in 1930. It is now required to make only one mark a quarter of an inch in extent in place of four smaller separate marks. But more than one mark may be made if the parent expresses the desire for additional protection for a child. That recommendation was not applied to Scotland. Only glycerinated calf lymph is permissible for vaccination. Arm-to-arm vaccination is illegal. (See also preparation of Calf-Lymph.)

**Factory and Workshops Acts, 1901 and 1907.**—Factories and Workshops are regularly visited by inspectors appointed by the State. Workshops are inspected by officers acting under the Medical Officer of Health; but Government inspectors also have powers to examine workshops.

The chief aim of systematic inspection is to enforce cleanliness, good sanitation, and to prevent overcrowding. With none of these matters, however, does the general practitioner have any concern. Certifying surgeons are appointed in every district from among the doctors practising in the area. Their duty is to examine young persons desiring to begin work in factories. They also report on accidents occurring among operatives.

*Notification of Industrial Diseases.*—Part IV of the Factory and Workshops Act, 1901, deals with dangerous and unhealthy industries. It is enacted that every doctor who sees a case of poisoning by *Lead, Phosphorus, Arsenic, Mercury, Toxic Jaundice, Chrome Ulcer, Carbon Bisulphide, Aniline,* and *Chronic Benzene Poisoning,* or *Anthrax,* must make notification of the fact to the Chief Inspector of Factories, Home Office, London. The State pays 2/6 for each notification.

Much could be said regarding the value of medical inspection in connection with factories, because the subject is a vital one to the worker and of engrossing interest to those who are attracted by such questions as industrial efficiency and the prevention of industrial fatigue. Within recent years these problems have been carefully investigated and much valuable information gained (see Industrial Diseases).

*Home Work and Out-workers.*—Sections 109 and 110 impose a penalty on any owner of a factory or workshop or any place from which any work is given out, and on any contractor employed by any such occupier, who causes any wearing apparel to be cleaned or repaired in any dwelling-house or building whilst any inmate is suffering from *any* infectious disease. Every occupier is served with a notice making him aware of the provisions of the foregoing sections, which defines what is known as "Home Work," where shirts, blouses, and wearing apparel may be made or repaired or cleaned by workers engaged in their own homes. Lists of these "Out-workers," as they are called, must be in the hands of a Local Authority, the lists being provided by those who engage "Out-workers."

## CHAPTER III

# THE CONTROL OF FOOD SUPPLIES

UNDER the Public Health Acts of England, Wales, and Scotland, a Medical Officer of Health, a Sanitary Inspector, or Veterinary Officer, or any other designated officer who may be a constable or special food inspector appointed by a Local Authority, may examine any animal alive or dead, exposed for sale, or intended for sale, or in course of transmission for sale, if he considers the food is unfit for human consumption. Shops may be visited for this purpose, and hawkers' barrows held up for the examination of their contents, which, if found unfit for human food, may be seized and destroyed by order of a Magistrate. Though it may not be generally known, horseflesh is sold in this country for human food. The sale of this article is controlled by the **Sale of Horseflesh Regulation Act**.

*Sec.* 1.—No person shall sell horseflesh for human food elsewhere than in a shop or stall over which there is painted in a conspicuous position, and in characters not less than four inches long, words indicating that horseflesh is sold there. *Sec.* 2.—No person shall supply horseflesh for human food when some other kind of meat was requested. *Sec.* 3 empowers any M.O.H. or S.I. to seize any meat he suspects may be horseflesh in a place *other than a horseflesh shop*. *Sec.* 4.—On a complaint made *on oath* by an officer of a Local Authority, *e.g.* M.O.H. or S.I., a Justice may grant a warrant to search for and seize any horseflesh which is believed to be kept in other than a horseflesh shop. *Sec.* 5 empowers the Justice to order such horseflesh to be destroyed. *Sec.* 6 deals with penalties. *Sec.* 7 defines horseflesh as that of horses, asses, mules, cooked or uncooked alone or mixed with any other substance.

**Foods and Drugs** are controlled by several Acts of Parliament, the chief provisions of which are that "No person shall sell to the prejudice of the purchaser any article of food or drug which is not of the nature, substance, and quality of the article demanded (any ingredient added which is necessary for the manufacture of the article, but does not conceal the inferior quality of the article, and does not injuriously affect the consumer is not to be considered a fraudulent addition)."

By way of example, if pure coffee is specially requested from a shopkeeper it is fraudulent on his part to sell a mixture of chicory and coffee. If butter is asked for it is fraudulent to sell margarine, because in neither instance is the article of the nature, substance, and quality demanded by the purchaser.

Every Local Authority must appoint a public analyst, to whom all samples are sent for examination and report.

Any citizen can demand an analysis on tendering a payment of 10/6 for the examination. Samples must be taken in a proper manner and the seller must be informed that the sampled food or drug was being taken for analysis by the Public Analyst, or words to that effect. Without such an announcement the taking of the sample is rendered invalid.

It is permissible for a shopkeeper to announce that he does not keep or sell the article asked for by the sampling officer, but he must make that declaration before and not after payment is tendered by the purchaser.

Having made his purchase the official divides the sample approximately into three equal parts, each of which he places in a special receptacle, which is sealed, labelled, dated, and described, but omitting the name of the seller. One part is left with the seller if he desires to accept it, so that he may have it examined by his own analyst; the other two parts are taken away by the sampling officer, who retains one in his safe, under lock and key, and the third part he sends to the Public Analyst.

Should the results of the two analyses differ, the Magistrate before whom the case of presumed adulteration is heard may order the third sample, which was placed in the safe, to be sent to the Government Analyst, Somerset House, London. The Government Analyst will, under such circumstances, act as arbiter, and on his analysis the Magistrate will make his decision.

Samples are paid for in the ordinary way by the sampling officer, but milk may be taken without payment, if it is in the course of delivery at shops or institutions. Deputies cannot take samples in the course of delivery.

By virtue of the Food and Drugs Acts, the Board of Agriculture is empowered to make regulations dealing with standards for milk, butter, cream, margarine, and other articles, including whisky, brandy, and gin.

For instance, when margarine is sold over the counter in packets, each packet must have printed on it the word "Margarine," and no other lettering, *each letter being a half-inch capital.*

When exposed on the counter or shelf of a shop, margarine must have affixed to it labels with letters clearly readable to the purchaser, *each letter to be one and a half inches square.*

When margarine is in wooden kits, these must be marked on top, bottom, and sides with letters *each three-quarter inch square* square.

The standard laid down for margarine is that it must not contain more than 10 *per cent. of butter fat*, margarine being made either from animal or vegetable fat (coco-nut or palm oil).

The standard for butter, stipulated in the *Sale of Butter Regulations*, 1912, is that it must not contain more than 16 *per cent. of water*.

Milk-blended butter must not contain more than 24 *per cent. of water*.

*Sale of Milk Regulations*, 1901.—These were issued by the Board of Agriculture and state that **cow's milk** shall not be presumed to be genuine if it does not contain—

| | |
|---|---|
| Butter fat . . . | 3 per cent. |
| Solids other than fat . | 8·5 per cent. |
| Total solids . . . | 11·5 per cent. |

**Skimmed milk** must not contain less than 8·7 per cent. solids.

**Milk and Dairies Acts and Orders** have been introduced to make the registration of milk-sellers compulsory.

Local Authorities may be required under Statute to appoint veterinary officers to carry out periodic examinations of cows yielding milk. All dairies must be inspected once a year. Local Authorities are expected to make arrangements for the bacteriological examination (including the keeping of guinea-pigs for the purpose) of milk samples.

It is now stipulated that a dairyman must make known to the Local Authority the presence of any cows in his premises suspected or actually suffering from Tuberculosis or from any disease likely to contaminate his milk supply.

Also, the dairyman must notify the Medical Officer of

Health regarding the presence of any worker at his farm or dairy who is suffering from infectious disease or suppurative sores.

Provision has been made for the sale of the undermentioned grades of milk; but modifications of these will probably be introduced in the near future (see Appendix).

**The Milk (Special Designations) Order** prescribes the standards for the various grades of milk.

**"Certified Milk."**—Such milk must come from a herd which is tuberculin-tested every six months, and clinically examined three times a year. In England it is every six months. The milk is immediately to be cooled and put in bottles previously sterilised on the premises by steam. The bottles must be sealed and the cap is to bear the name and address of producer, the day of production, and the words "Certified Milk." The milk is not to be removed from the bottles before delivery to the purchaser. The bacterial count should not be more than 30,000 organisms per c.c., and *B. coli* should be absent in $\frac{1}{10}$ c.c. It should contain not less than 3·5 per cent. of butter fat. This amount of fat does not apply to England.

**Grade A (tuberculin-tested) Milk.**—The tuberculin testing and clinical examinations are as for "Certified" milk. The milk, however, is not bottled at the place of production, but must be delivered to the retailer in unventilated, sealed containers, bearing name and address of producers, day and time of production, and the words "Grade A (tuberculin-tested) Milk." The milk is to be delivered by the retailer to the consumer in the container with the seal unbroken, or in sterilised bottles or in sealed and labelled containers of not less than two gallons. If bottled, the caps should bear the name and address of the dealer, the day of production, and the milk is to be marked "Grade A (tuberculin-tested) Milk." The milk is not at any stage to be treated by heat, and it should not contain less than 3·5 per cent. butter fat. The total organisms should not number more than 200,000 per c.c., and *B. coli* should be absent in $\frac{1}{100}$ c.c.

**Grade A Milk** must be derived from a herd examined clinically three times a year. Animals showing evidence of disease must be removed from the herd, and if T.B. are found in the milk, the producer must find out the animals responsible and remove them from the herd. Milk to be delivered to retailers in sealed containers marked with name and address of producer, day and time of production, and the words " Grade A Milk." The milk is then delivered to the consumer in the same way as Grade A (tuberculin-tested) Milk, but is marked " Grade A Milk." The milk is not to be subjected to any heating process other than pasteurisation by a method described in the Order. It is then to be labelled " Grade A (pasteurised) Milk." Grade A Milk must also contain 3·5 per cent. butter fat, should not contain more than 200,000 organisms per c.c., and *B. coli* should be absent in $\frac{1}{100}$ c.c. When Grade A Milk is pasteurised it must not contain more than 30,000 bacteria per c.c. and no *B. coli* in $\frac{1}{10}$ c.c.

**Pasteurised Milk.**—The milk is to be retained at a temperature not less than 145° F. or more than 150° F. for at least half an hour, and is to be passed at once to a covered cooler and the temperature reduced to 59° F. in Scotland, and 55° F. in England. The type of apparatus and the methods followed must satisfy the Local Authority. The milk is not to be heated more than once, and is not to be treated otherwise than by heat. Every container is to be labelled " Pasteurised Milk " and bear the date of pasteurisation. After treatment it should not contain more than 100,000 organisms per c.c.

The milk standard laid down by the Board of Agriculture must not be confused with the percentage composition of milk. The undernoted chemical composition of human milk is compared with that of the cow :—

| | Human Milk. | Cow's Milk. |
|---|---|---|
| Water . . | 87–88 per cent. | 87–88 per cent. |
| Protein . . | 1–2 ,, | 3–4 ,, |
| Fat . . . | 3–4 ,, | $3\frac{1}{2}$–$4\frac{1}{2}$ ,, |
| Sugar . . | 6–7 ,, | 4–5 ,, |
| Mineral Matter . | 0·1–0·2 ,, | 0·7 ,, |
| Reaction . . | Alkaline | Acid. |

The excess of protein in cow's milk is to be noted. Cow's milk has slightly more fat, whilst human milk contains more sugar. The reactions differ.

**Public Health (Shell Fish) Regulations, 1915.**—If there is evidence to show that shell fish are causing disease or are a danger to health, a Local Authority can deal with the shell-fish layings. Oysters are now cultivated in carefully selected layings, which are not subject to contamination. But should suspicion be directed to oysters the layings may be dealt with. Oysters kept in fresh water for a fortnight will, it is generally believed, rid themselves of **bacillus typhosus.** Suspicious illness believed to be due to the eating of shell fish should be reported to the Public Health Department.

**National Health Insurance Act, 1924.**—Requires that all persons over 16 who are employed, and who earn less than £250 per annum, shall be insured in a State Scheme. All manual labourers, whatever their earnings, must be insured.

Benefits are :—

(1) *Medical Benefit*—*i.e.* provision of medical treatment, including proper and sufficient medicines and certain pre-

scribed medical and surgical appliances. Medical treatment is defined as comprising: all proper and necessary medical services other than those involving the application of special skill and experience of a degree or kind which general practitioners as a class cannot be expected to possess. No restrictions as to drugs which may be ordered, but the appliances and dressings permitted are limited to those prescribed, and prescriptions for food preparations or disinfection for general use are not permitted. A capitation fee (8/- per annum) is paid to Insurance practitioners.

(2) *Sickness Benefit.*—Periodical payments are provided whilst insured persons are rendered incapable of work by some specific disease or mental or bodily disablement, commencing on the fourth day after being rendered incapable of work for a period not exceeding 26 weeks. Normal sick pay is 15/- a week for men and 12/- for women.

(3) *Disablement Benefit.*—Periodical payments are provided after cessation of sickness benefit so long as the insured person is rendered incapable of work by disease or disablement. Normal payment is 7/6 per week and stops at the age of 70.

(4) *Maternity Benefit.*—Payment of 40/- in case of a confinement of wife (or where child is posthumous) or widow of insured person or of *any other woman* who is an insured person.

(5) *Additional Benefits.*—Approved Societies whose funds disclose surpluses on valuation grants give their members additional benefits in form of extra cash payments in respect of sickness, disablement, and maternity, and in some cases a payment towards dental and ophthalmic treatment or other special service. Local Insurance Committees which consist of three-fifths of re-

presentatives of insured, one-fifth of representatives of Local Authority, and one-fifth of doctors and representatives of Central Authority, administer all the medical benefits. The approved Societies administer sick, disablement, and maternity benefits for their members.

## CHAPTER IV

## INFECTIOUS DISEASES

Many alterations in the methods of dealing with infectious diseases have been introduced within recent years.

The student should give this subject very careful study, because much of his future work in practice will be concerned with the handling of cases of communicable diseases. For instance, the removal of all cases to hospital—more especially Scarlet Fever—is not now insisted on. Desquamation in Scarlet Fever is no longer believed to play a conspicuous part in the spread of the disease, and the release of patients from hospital or from home treatment is not guided entirely by desquamation but by the absence of discharges, open sores, and other complications, as well as by the general condition of the individual.

Another change that will probably develop when the value of the principle is better appreciated by practitioners and parents, is the more general employment of vaccine therapy, either for treating or preventing Scarlet Fever, Diphtheria, Measles, or Enteric Fever. What the future may bring should Tuberculosis come to be dealt with by vaccines, remains to be seen. The indications are that vaccine therapy may yet play a prominent part in defending men and animals against attacks by the Koch bacillus.

### IMMUNITY

Immunity affords powers to the individual to resist attack not only by micro-organisms but also by the harmful consequences of their products, known as Toxins. After recovery from most infectious diseases, a patient "acquires an immunity" because certain specific resisting powers are developed in his blood stream. In some diseases such an "Acquired Immunity" may last a lifetime. That is why second attacks of certain infections are almost unknown. Basing their practice on that knowledge, bacteriologists and research workers have introduced methods for producing "Acquired Immunity" by artificial methods. This may be effected by inoculating an animal with a virus so changed as to be incapable of reproducing the typical disease, but yet capable of creating an immunity reaction. That method of protection against a specific disease is known as "Active Artificial Immunity." On the other hand, "Passive Immunity" is induced by introducing the serum of an actively immunised animal into a non-immune one (*vide* under Diphtheria). Generally speaking, "Active Artificial Immunity" may be produced—

(1) By introducing living organisms in a state of attenuated virulence. To secure that degree of attenuation the following methods are employed :—

(*a*) By drying the organisms or virus, as is done in the case of Rabies.

(*b*) By cultivating the organisms above the optimum temperature actually required for cultivation.

(*c*) By passing the organism or virus through different animals. Vaccine Lymph is prepared in this way.

(2) By Bacterial Vaccines. This entails the injection of suspensions of organisms which have been killed by heat or antiseptics. This is the principle followed in Anti-typhoid vaccination, and also in the treatment of some chronic infections. Bacterial Vaccines are also used in animals for the preparation of Anti-bacterial sera.

(3) Toxins may be administered in progressively increasing doses, each dose being in itself harmless. Horses are employed in this way to produce antitoxins in their blood serum.

Arising out of the foregoing methods, Anti-bacterial serum is produced on the one hand and Antitoxic serum on the other. The latter contains anti-bodies which are capable of neutralising the toxin aimed at.

In future it should be the aim of every practitioner to protect susceptible children against Diphtheria. Though protection does not always prove to be absolute, an attack by the disease may be greatly modified. Protection against Scarlet Fever has not yet reached such an advanced stage as that directed against Diphtheria. Measles can be averted, or its attack considerably modified, by the employment of blood serum drawn from those who had been attacked by that disease. Even those who have passed through an attack some years previously may yield a serum capable of averting or modifying attacks of Measles. As may be understood, the exhibition of Measles Convalescent Serum in institutions, or where large numbers of susceptible children are collected under one roof, offers great possibilities for doing good. Reference to that subject is made later.

**Infectious Diseases** are *sporadic* when they occur here and there in an area and have no apparent connection with one another. When an *epidemic* prevails it means that large numbers of cases suddenly arise in the district invaded. Not infrequently epidemics are excited by drinking infected milk, water, or the eating of infected shell fish. *Endemic* conditions prevail when diseases habitually cling to a special area or part of the globe. Cholera is endemic in India. *Pandemic* conditions refer to the simultaneous prevalence of infectious disease in many parts of the world. Influenza offers a typical example of a disease that has repeatedly occurred in pandemic form.

**Scarlet Fever.**—Caused by the *Streptococcus scarlatinae.* The disease is encountered in almost every country but Japan. It is rarely seen in Africa or Asia.

*Incubation.*—From 12 hours to 7 days, the usual being 3 to 5 days.

*Case Mortality.*—Below 5 years—10 per cent. to 15 per cent.—over 5 years about 5 per cent.

*Incidence.*—Chiefly those under 10 years of age are attacked. Breast-fed infants usually escape.

*Season.*—Autumn and while schools are in session—lowest during holiday periods, an exception being during milk epidemics.

*Quarantine.*—Those who have been in contact or living in the same house are kept away from school or from work especially where food or the making of clothing (out-workers employed by shirtmakers, etc.) is concerned, for a period of 10 days.

*Spread.*—By personal contact: infection from ear, mouth, nose, or other discharges from sores. Feeding dishes, spoons, etc. Milk.

*Milk Epidemics.*—The characteristics of a milk outbreak are its suddenness, the large number of simultaneous cases, the rapid decline of the epidemic, the general mildness of the cases, and the preponderance of milk users attacked—*e.g.* children and domestic servants, the latter being usually the first to sample the milk after it is delivered.

Medical men should exercise special care when attending Scarlet Fever cases and childbirths, since infection is very readily conveyed from Scarlet Fever cases to lying-in women.

*Prevention.*—Removal to hospital of cases that cannot be effectually isolated or separated from their fellows at home. This may be either because the house is too small for the needs of the rest of the family, or because it is insanitary. Systematic examination of school children may result in the detection of suspects suffering from nasal or ear discharges, etc. School closure is seldom resorted to, but susceptible scholars, as ascertained by the Dick Test, should receive protection by active or passive immunisation.

Scholars suffering from nasal or ear discharges, inflamed fauces, or those who have recently suffered from catarrhal conditions of the nose or throat, should be excluded from school as they may be actual "carriers." These should be swabbed, but some days may elapse before it is possible to declare that the *Scarlatinal streptococcus* is present. Until the report is received, daily gargling of the throat with chlorine water may be resorted to (see under Chlorination of Water).

When an epidemic has been traced to milk, the Medical Officer of Health usually recommends his Committee to compel the milk seller to cease supplying milk. The question of compensation for loss of business is subsequently dealt with by the Local Authority. "Carriers" may infect milk at its source, as also may those suffering from mild forms of Scarlet Fever in which the throat may be only slightly involved. Individuals who have perhaps recovered from an attack of Scarlet Fever may return to work at a dairy and may still suffer from sores about the nose, mouth, fingers, or from ear discharges. Each of these sources is capable of transferring the *Scarlatinal streptococcus* to milk. Desquamation is no longer believed to be a potent cause of spread of infection. Exceptions to that statement may, however, be found when scales of skin become infected by the fingers of a patient who is still suffering from excoriations on the face or fingers or from nasal or ear discharges.

Some text-books on Public Health still refer to what was for many years believed to be Scarlatina of bovine origin. It came to be known as Hendon Disease, because an epidemic of Scarlet Fever occurred in connection with a milk supply at Hendon. Investigation showed that cows yielding the suspected milk were suffering from ulcerated teats. Bacteriological examination supported the view that the micro-organisms recovered from the throats of human beings were the same as those isolated from the ulcers and that they produced a similar train of symptoms.

The conclusion mistakenly arrived at was that the cows had been suffering from Scarlet Fever, of which the ulcers on the teats were outward manifestations. That theory has now been discredited. The ulcers were probably the vesicles of cowpox that had been ruptured by the fingers of the milkers, some of whom had suffered from or were actually suffering from Scarlet Fever. It is a common and reprehensible custom for some workers (who may be "carriers") to moisten their fingers with their tongues or lips before proceeding to draw milk from the teats and udders. In this way streptococci may be directly conveyed to the ulcerated surfaces from the human "carrier."

As an alternative to removal to hospital, the other susceptible members of the family may be requested to leave the house to live with friends. This will, after the ten days of quarantine have expired, enable the non-attacked children to return to school.

The hanging of a sheet soaked in disinfectant is illusory so far as protection goes, but its use need not be discouraged, because the presence of such a display suggests the avoidance of the sick-room.

Some years ago the late Dr. Milne, who acted as medical adviser to Dr. Barnardo's Homes in London, instituted a method for which he claimed superior results. This consisted in anointing the external surfaces, including all flexures and scalps of those boys who were attacked by Scarlet Fever. He used eucalyptus oil. He also painted the fauces of each patient with carbolic oil in the strength of 1 in 20. This procedure enabled Dr. Milne to treat cases of Scarlet Fever in wards alongside patients who were suffering from other non-infectious conditions.

While all his claims could not be fully substantiated by other observers, it remains to be said that the Milne Treatment, as it had come to be called, was employed by several Local Authorities, especially when the accommodation in their isolation hospitals was being heavily taxed.

The author, with the co-operation of Leith practitioners, tried the Milne method in 200 consecutive cases of Scarlet Fever, with astonishing success, in so far as the non-spread of Scarlet Fever to other members of the invaded households was concerned. In not a few instances the housing accommodation would not, under ordinary circumstances, have been considered satisfactory or adequate for the treatment of any case of infectious disease.

The Milne Treatment went far to prove that the infectivity of Scarlet Fever was very weak and that the employment of simple precautions sufficed to reduce the risk of spread of infection to a minimum.

It can still be recommended for dealing with cases of Scarlet Fever in private houses, because the mere fact that eucalyptus oil and carbolic oil are being used, prompts others in the household to keep at what may be aptly termed a "safe distance."

Disinfection will be discussed in a separate chapter.

*Return cases* of Scarlet Fever appear to be unavoidable and rarely fall below 3 per cent. of the cases dismissed from hospital. A return case is reckoned to include a second case occurring in a house after another case from the same house has been discharged from hospital, and the limit of the period for return cases is fixed at six weeks from the date of dismissal from hospital. This period is taken from the practice followed by the Metropolitan Asylums Board infectious diseases hospitals.

**Immunisation against Scarlet Fever.**—In 1923 Dr. Dick and his sister showed that they could produce Scarlet Fever by introducing a culture of a haemolytic streptococcus into the throat of a volunteer who submitted himself for experiment. The culture had been taken from a typical case of Scarlet Fever. The Dicks subsequently found that there was a diffusible toxin contained in the fluid cultures of Scarlatinal streptococci. When this toxin was intradermally injected in suitable dilutions it produced an erythema in susceptible subjects. But when injected into those who were convalescing from Scarlet Fever no erythema resulted. That discovery led to the announcement of what is now known as the **Dick Test.**

**The Dick Reaction** is developed by the intradermal injection of 0·2 c.c. of a 1-in-1000 filtrate from a broth culture. The right forearm is generally used for this injection, the left forearm being selected for the control. But the control dilution is previously heated for an hour at a temperature of 100° C. (212° F.) to destroy the toxin present in the filtrate. If the reaction on the right forearm is positive a red patch of erythema appears in the course of 6 to 12 hours at the site of the injection. The redness remains for 24 hours and gradually fades. On the control forearm only a passing redness shows itself. A characteristic reaction produces an area of erythema usually between 2 c.m. and 3 c.m. in diameter. The diagnostic redness should never be less than 1 c.m. in diameter. By means of that reaction, susceptible subjects can be separated from those who are insusceptible to attacks of Scarlet Fever. *Pseudo-reactions* occur when both arms show an erythematous area, but such results (probably caused by protein reaction) are rarely encountered among children.

The Dick Test is of great value when it is desired to test inmates of hospitals, institutions, and school children (see under Diphtheria Immunisation scheme of operations). *Active Immunisation* among Dick-positive subjects may be carried out by injecting Saline solutions of Toxin, 1 c.c. of which is equal to 500 skin-test doses. Three injections at weekly intervals are given. The first dose measures 0·2 c.c., the second 0·5 c.c., and the third, for children under 12, is 0·5 c.c., while for those over 12 it is 1 c.c. Adults receive 2 c.c. for their third dose.

**The Schultz-Charlton Reaction** is used as an aid in the diagnosis of Scarlet Fever. It has been shown that serum taken from a person convalescing from Scarlet Fever, when injected intradermally at an early stage of the disease, will cause a blanching or actual disappearance of the rash round the seat of injection. But the difficulty presented is that in doubtful cases of this disease the rash is so slight and so quickly fades that the test becomes inapplicable since the presence of a rash is essential for demonstrating the effect of fading.

**Diphtheria.**—Caused by the *Klebs-Löffler Bacillus.* It is usually a winter and cold-weather disease and is always most prominent when schools are in session. It declines during holiday periods.

*Incubation.*—From 2 to 3 days.

*Age Incidence.*—The majority of cases occur under 10 years of age.

*Case Mortality.*—At all ages (in pre-antitoxin days) 30-40 per cent. Now reduced to 9 per cent.

The case mortality of those under 5 before antitoxin came into use was over 50 per cent. After antitoxin began to be employed the case mortality was lowered to 13 per cent. This could be further reduced if all cases were recognised and treated at an early stage of the illness.

*Quarantine.*—This will depend upon securing negative swabs from contacts. Generally a period of 10 days is considered ample as a quarantine period if two negative swabs are proved.

*Spread.*—" Carriers "—contact in and out of school—(using pencils in common) sucking and interchanging sweets—musical instruments, *e.g.* mouth organs, kissing, infected dishes, implements, towels, etc. School attendance is the main source of the regular stream of notifications that reach the Medical Officer of Health.

Milk-borne epidemics are not common. They may be traced to boys carrying milk in pitchers or unsealed bottles or " carriers " employed at a dairy.

Ulcers on cows' teats have also, as in the case of Scarlet Fever, been held to be evidences of Diphtheria in the bovine. That view no longer holds. If ulcers are infected and Klebs-Löffler or Hoffman bacilli have been recovered from the sores on the teats, the human " carrier," the milker, is believed to be the original source of these micro-organisms.

*Prevention.*—" Carriers " among children can only be discovered and separated from others by systematic and careful swabbing.

Every Local Authority makes adequate arrangements for the bacteriological examination of swabs. Specimens submitted by practitioners and sent in during the day are invariably reported on within 24 hours. Reports may be sent to the doctor from the Public Health Office in writing, but the telephone may be used to avoid loss of time. " Carriers " must not handle food or resume school attendance until two successive negative swabs have been secured from them.

Few cases of Diphtheria are treated at home, partly because the cost of treatment is heavy and also because the responsibility of nursing such a disease is onerous, whilst close supervision of the patient is often demanded. After a case of Diphtheria has been removed to hospital, it is a good practice to administer 500 units of antitoxin to the other members of the household. This confers " passive immunity " for a period of 3 weeks. But the injection of antitoxin does not affect " carriers " who may be present among those who have been passively immunised. Swabbing of contacts should never be neglected. A person may give a negative swab one day and a positive the next. This feature constitutes one of the difficulties encountered when effort is being made to control the spread of the disease in schools.

To deal with Diphtheria in an effective way, the Schick Test should be systematically employed. Following on the separation of susceptibles from insusceptibles, immunisation by toxoid-antitoxin should be advised.

A difficulty sometimes arises when a " carrier " remains infective for prolonged periods. Under such circumstances a bacteriological investigation may reveal whether the bacilli from the " carrier " are virulent or a-virulent. A-virulent " carriers " may be allowed to return to work or to school, but it is advisable to recommend the systematic use of a gargle and nasal douche such as chlorine water. Two negative swabs with at least two-day intervals between the swabs are held to be necessary prior to the dismissal of hospital patients

**Diphtheria Immunisation.**—Since Zingher and Park introduced their scheme for immunising the school population of New York, the merits of Schick Testing (see page 50) and subsequent immunisation have become firmly established. But much has yet to be done to make the scheme of operations a systematised procedure in this country. Neglect to include protection as an administrative step is regrettable, because the results achieved have fully justified the principle. Immunised children under 15 years of age in Edinburgh presented a Diphtheria incidence of 1·8 per 1000. The rate for the five preceding years among non-immunised children of the same ages had been 5·3 to 6·9 per 1000. In New York City the death-rate from Diphtheria before immunisation was 22·7 per 100,000 in 1918. It fell to 7·3, 12·0, and 10·7 in subsequent years after immunisation had been introduced.

In the City of Edinburgh Fever Hospital, among 148 of a nursing staff in 1920, there occurred 10 cases of Diphtheria, equal to 6·75 per cent. In 1921, in a staff of 144, those attacked numbered 14, equal to 9·58 per cent. In 1922 Schick Testing and immunisation began, and in 1923 only 5 cases, or 3·65 per cent., occurred. The nurses who were attacked developed the disease in a mild form and before immunity had time to establish itself. In 1926, with an increased staff, the percentage had fallen to 1·30, and it has been maintained at that low level as a result of systematised practice. Immunity begins to manifest itself between the sixth and ninth month after the last dose has been administered. Edinburgh and Aberdeen were the first cities in this country to undertake systematic protection of their school populations. Not a single evil result was recorded among the thousands who were "Schicked" or immunised. This is mentioned because in America and on the Continent several accidents occurred after immunisation. In each instance faulty technique, erroneous labelling, or over-freezing of the Toxin-Antitoxin preparations had been the causes of the mishaps. Basing their arguments on such accidents, the opponents of vaccination, and of everything that pertains to treatment by sera or vaccines, have done their utmost to decry immunisation against Diphtheria and all other diseases.

Under the therapeutic substance regulations of this country, the reagents in the Schick Test are known as "Schick Toxin" and "Schick Control," and the methods of manufacturing the Toxins must conform with the regulations.

Prior to embarking on any immunisation scheme among a school population, the consent of the Education Committee must be secured. The next step must be the issue of printed "consent slips," which are handed to the scholars so that the assent of their parents may be gained. The majority of parents agree to the procedure. A card-index system is a necessity. On each card the name, age, date of "Schicking" and immunisation, with positive or negative results must be carefully noted. It is eminently desirable to marshal the children so that the teaching work of the school will be interrupted as little as possible. Since the co-operation of school staffs is invariably a hearty one, the maintenance of discipline by the teachers is assured. One medical man is generally able to perform the Schick and the control tests on 150 scholars in an hour. If the control is omitted, 300 scholars can be overtaken. Also, if one medical man performs the Schick Test and another administers an immunising dose, it is possible to pass through 300 children every hour.

The following time-table employed in Edinburgh and Leith will provide a guide for future action :—

1st Day. Application of Schick Test. (This may be omitted among very young children.)
8th Day. First reading of results, and, if necessary, the first immunisation dose.
15th Day. Second reading and second immunisation.
22nd Day. Third immunisation dose.
29th Day. Final visit to complete laggards or absentees.

The susceptibility rate among children of different ages was strikingly brought out by the Schick Test. In the poorer districts of Edinburgh the susceptibility rate was as high as 100 per cent. between the ages of 1 to 5. In no Edinburgh school did the susceptibility rate fall below 73 per cent. But there was a variation of rate between 34 to 88 per cent. among children between the ages of 5 to 10 years. Because the susceptibility rate was so high among very young children, the need for the application of the Schick Test disappeared.

If the immunisation scheme is to be thoroughly well done it is good practice to " re-Schick " those who had already received three immunising doses. Should the final Schick Test still remain positive, a fourth immunising dose may be administered. It is usual to issue Certificates of Immunisation, but such should not be granted until six months have elapsed since the last dose was administered. Better still, the certificate should be withheld until a final " re-Schick " has left a negative reaction.

**The Schick Test.**—The test is applied by injecting intradermally $\frac{1}{50}$th of the M.L.D. (minimum lethal dose) of Diphtheria Toxin for a guinea-pig. The toxin is previously diluted to 0·2 c.c. with 10 c.c. sterile solution, which is known as a " buffer." The control test of the same dose and dilution is previously heated for ten minutes at a temperature of 75° to 85° C. A positive Schick reaction reveals itself by an area of redness and swelling between 24 to 48 hours after the injection. The redness reaches its maximum on the fourth day, and measures about 2 c.m. in diameter. This persists for a period varying between 7 to 15 days. Surface desquamation and slight brownish pigmentation persist after the erythema fades. Absence of reaction on both forearms indicates a negative (non-susceptible) result.

*A Pseudo-reaction* occurs within 6 to 12 hours. Its area of redness is not so wide or intense as the positive reaction and disappears in 2 to 3 days. Both areas produce the same appearances among Schick-negative subjects.

The results of Schick tests should be read after 7 days. This allows pseudo-reactions to fade. Positive reactions do not fade.

*Immunising Agent.*—For this purpose Toxoid-Antitoxin is now employed. The quantity used for each dose is, in a dilution of the Toxoid with Antitoxin, up to 1 c.c. The Toxoid is now preferred to the Toxin which was formerly administered, because the Toxoid is devoid of toxic reaction. The toxicity is reduced by the addition of Formalin or Iodine.

An *Antitoxin Unit* is that amount of Antitoxin Serum which will suffice to neutralise 100 M.L.D. of Toxin. And the M.L.D. is the minimum amount which will kill a guinea-pig of 250 grammes weight in 4 days.

**Enteric or Typhoid Fever.**—Caused by *Eberth's Bacillus.*

*Incubation.*—7 to 14 days and up to 21 days.

*Season.*—Usually late summer and autumn.

*Case Mortality.*—18 per cent. Under 5 it is 9 per cent. ; between 10–14 it is 8·5 per cent. ; 15–19, 14·9 per cent. ; 45–49, 36·0 per cent.

*Age Incidence.*—Most cases occur at the age periods 10 to 20. Most common among males.

*Means of Spread.*—"Carriers," and specifically polluted water, which may contaminate milk when the dishes for storing milk are washed at the farm. "Carriers," on the other hand, may directly infect milk to excite an epidemic. But widespread epidemics, though rarely encountered in this country, are invariably caused by water. This is scarcely possible in cities, but in rural areas where wells or streams may be used for drinking water, risk to the consumer exists, especially where human dejecta may have gained access to the source of supply.

The disease is now becoming rare in this country, chiefly because water supplies have been improved by drawing them from safe sources and by requiring careful filtration and possibly chemical treatment of the water. The disease often clings to those districts where privies and privy-middens prevail. In such areas "carriers" may play a conspicuous part by polluting the ground in the neighbourhood of the houses. Dust, mud, and flies may infect food.

Milk-borne epidemics are not unknown, and within recent times such outbreaks have been traced to "carriers." The author had a "carrier" of 19 years' duration under his observation in Edinburgh. This was a woman employed at a country dairy from which milk came to the city, to excite a minor outbreak. Repeated examination of her urine and dejecta corroborated the presence of the bacillus typhosus, and to make the evidence conclusive the woman's history indicated that she had been under treatment for Enteric Fever in Leith Isolation Hospital 19 years before her discovery as a "carrier." "Carriers" of this type have been pensioned by Local Authorities as a safeguard.

The student must keep in mind that "carriers," when ascertained to exist, must be notified to the Medical Officer of Health, who in turn is required to inform the employer as well as the " carrier." The same stipulation as to notification also applies to Dysentery " carriers."

Should a water or milk supply be under suspicion during an outbreak of Enteric Fever, the advice to pasteurise milk and to boil, chlorinate, or filter water should be followed.

Filtration must be through a reliable apparatus such as a Pasteur-Chamberland or Berkefeld Filter. Charcoal Filters are valueless.

Shell fish of various kinds, notably oysters, whelks, and mussels, have caused outbreaks of Typhoid Fever.

No better example of the value of improved sanitation in reducing the incidence of Typhoid Fever can be cited than the experience of Paisley, where the author once acted as Medical Officer of Health. When he first went to Paisley, Enteric Fever was endemic, and every autumn recrudescences of the disease occurred. The Local Authority then embarked on a determined campaign for getting rid of the abominable privies that existed and in demanding the paving of back yards. The water-closet system was gradually introduced to replace privies. In the course of ten years the incidence of Typhoid Fever in Paisley had declined to vanishing-point.

As in the case of other milk-borne diseases, the Medical Officer of Health can recommend the stoppage of the distribution of suspected milk, the sale of which must not be renewed until the Medical Officer of Health certifies that it is safe to do so.

Outfits for taking samples of blood for the *Widal* reaction are provided by every Public Health Department. In cases of doubtful diagnosis, such as obscure examples of suspected Influenza with continued gastric manifestations with malaise and headache, samples of blood should be submitted to the Medical Officer of Health.

It should be explained that the recovery of the bacillus typhosus from faeces is a difficult and tedious proceeding.

When cases of Typhoid Fever are treated in their own homes, "concurrent" disinfection must be carried on. That is to say, each day the dejecta and other infected articles must be adequately treated. Stools must have equal parts of a solution of 1 in 10 carbolic acid or 1 in 500 corrosive sublimate added to them. The ultimate strength of the respective disinfectants will be 1 in 20 and 1 in 1000, after admixture with urine and stools has taken place. The disinfectant should be left in contact with the stools for several hours, and when mercury is employed some sulphuric acid should be added to the stools to counteract the tendency of the mercurial salt to coagulate any albuminous protecting coverings of typhoid bacilli. In country districts dejecta should be buried with an addition of chloride of lime—care being taken to keep away from any water supply.

Bedclothing and towels should be steeped in disinfectant for several hours, and then washed, and exposed to sunlight or fresh air.

Vaccine therapy is now an accepted measure of protection, and many of those going out to the tropics are subjected to active immunisation.

**Paratyphoid Fevers.**—These are difficult to differentiate from Typhoid Fever, though the courses of the diseases may not be so long as Typhoid itself. The onset may be more acute than Typhoid Fever. The mortality in Paratyphoid is small. The main point of difference is in respect of their causal organisms. Three varieties of bacillus, designated A, B, and C, have been associated with paratyphoid fever, though the last is now regarded as being atypical.

**Blood Culture in Enteric Fever.**—In the earliest stages of the disease the diagnosis of Enteric Fever may be made by isolating the organisms from the blood of the patient. The best time for blood culture is during the first seven to ten days of the illness. Blood is removed from a vein made prominent in the bend of the elbow by using a tourniquet round the biceps muscle. Between 5 to 10 c.c. are taken by means of a syringe. If the blood is to be sent through the post a sterile flask, stoppered with a previously boiled rubber cork, should be used, the cork being inserted with sterilised forceps.

**For the Widal Reaction.**—Blood is taken from a puncture made in the skin at the base of the nail, care being taken to clean the skin and to use sterile needles or other puncturing instruments. The characteristic reaction (Agglutination) does not usually take place until the seventh or tenth day of the disease. Occasionally it may be seen on the fifth day; but a negative *Widal* reaction does not necessarily rule out the diagnosis of Enteric Fever. It is helpful to know that Enteric "carriers" almost invariably offer positive results.

Since normal serum may bring about the agglutination of Enteric and Paratyphoid bacilli in low dilutions, a diagnostic significance of the reaction can only be relied on for Enteric Fever in a dilution of 1 in 60 or over it. In Paratyphoid A, 1 in 30 or greater dilution; and for Paratyphoid B, 1 in 120 or more.

**Diagnosis of "Carriers."**—In the case of suspected "carriers" of Enteric Fever the faeces and urine should be examined on three occasions before a negative report can be made. Because the bacilli are numerous in the bile and in the small intestine, a calomel purge is advised and the third stool taken for the search.

**Cholera** is endemic in the Delta of the Ganges, Northern Persia, and some other Eastern countries. The malady was at one time prevalent in the United Kingdom, but the intrusion of the disease is rendered almost impossible by the precautionary measures adopted at every port of call, where only safe water supplies are taken on board.

The vigilance of Port Sanitary Authorities has also gone far to prevent the spread of Cholera by immigrants and other passengers. The short incubation is also an indirect protection against the invasion of the malady, because cases occurring on board ships coming from the East can be recognised before this country is reached.

*Causative Organism.*—*Vibrio cholerae* (Vibrio comma or Comma Bacillus). The organisms, which multiply in large numbers, are present in the intestinal contents and their dejecta. The gall-bladder is frequently invaded. Convalescents may act as "carriers." Diagnosis depends on the isolation and identification of the vibrio. There is a useful agglutination test as in the case of Enteric Fever.

*Incubation.*—Varies between a few hours to 3 days.

*Case Mortality.*—May be as high as 50 per cent.

*Age.*—Has little influence.

*Quarantine.*—Ten days.

*Spread.*—By water, milk, vegetables, or flies. "Carriers" may persist for a year, but their danger as "carriers" is usually limited to 2 to 3 weeks.

*Prevention.*—Port Sanitary surveillance and the safeguarding of water and food supplies are essentials to success. All cases of the disease are sent to hospital, and the dejecta carefully treated with chemical disinfectants. Haffkine's anti-cholera vaccine has been used with success. One half c.c. containing dead vibrios is given as a first dose, and this is followed in ten days by 1 c.c. containing 8000 millions of dead vibrios. This procedure has been found to confer immunity for four months.

Should a vessel arrive with Cholera on board, the cases are removed, and latrines thoroughly treated with chloride of lime or other suitable disinfectant. Water tanks are sealed and afterwards emptied, the tanks being treated with formaldehyde or bleaching powder.

A serious outbreak of Cholera occurred at Hamburg in 1892, when immigrants from Russia were housed in huts while awaiting shipment to America. The immigrants' dejecta infected the River Elbe with disastrous consequences to Hamburg, which used unfiltered water from the river (see under Water Purification). In 1885 a Cholera outbreak caused 150,000 deaths in the Nile Delta. Cholera invariably follows the routes taken by mankind, as evidenced during the pilgrimages to Mecca. In their wanderings the pilgrims infected almost all the available water supplies along the routes taken. When Cholera was encountered in this country, mendicants and other itinerants left trails of infection behind them as they moved from place to place. A definite line of infection was traced all the way from England to Scotland along the routes followed by these wanderers, beginning from Berwick-on-Tweed and continuing along the towns and villages of the east of Scotland, as far north as Aberdeen.

**Dysentery** is most prevalent in tropical countries. In the case of temperate climates, Dysentery is recognised as Infantile Diarrhoea and Asylum Dysentery.

*Incubation.*—2 to 3 days and may be 8.

*Age and Sex.*—No differentiation in attack.

*Case Mortality.*—Depends on type and severity of attack. May be as high as 30 per cent.

*Season.*—In the tropics during the cold season. In temperate climates during the summer.

*Spread.*—Water, milk, vegetables, and flies.

Two types of dysentery have come to be recognised, the Bacillary and the Amoebic.

**Bacillary Dysentery.**—This type caused a great many fatalities during the Great War. In fact, it has been said that this form of the disease has caused more deaths in great wars than bullets. It is also one of the chief causes of Diarrhoea among infants. The causative organism is *Bacillus dysenteriae,* and there are two main types—Shiga, Flexner Y. But there are no clinical differences produced by the different types. "Carriers" play a big part in continuing the spread of Bacillary Dysentery. The bacilli usually disappear from 2 to 6 weeks after the patient has recovered from all clinical manifestations of the disease. Chronic "carriers" have rarely been recorded. When the causative organism cannot be isolated from the stools, agglutination tests may assist in clearing up the diagnosis. But they cannot be depended on as being certain.

*Incubation Period.*—2–8 days.

*Prevention.*—Exactly the same precautions must be adopted as those directed against other water-borne diseases.

The administration of Polyvalent anti-Dysenteric sera has reduced the mortality in Bacillary Dysentery. The serum should be intravenously given at the very earliest moment after the disease has been diagnosed in 20 to 80 c.c. doses. Sodium sulphate should also be given by the mouth.

**Amoebic or Tropical Dysentery.**—Chiefly a tropical and endemic disease. It is rarely encountered in epidemic form.

*Causative Organism.—Entamoeba histolytica.*

*Spread.*—The entamoebae are discharged from the bowels in large numbers. Between attacks, the entamoebae form cysts which are also expelled. If these are ingested by human beings they become entamoebae, which reproduce the disease. Active entamoebae, when discharged from the bowels, die without forming cysts. Individuals in apparent health may suffer from chronic amoebic ulceration of the intestines, in which are entamoebae and excretory cysts. As an aftermath of the Great War, amoebic " carriers " persisted in the United Kingdom.

The two types of Dysentery differ in several noteworthy respects. Bacillary Dysentery is an acute febrile condition. Amoebic Dysentery is insidious, non-toxic, and usually afebrile. Bacillary Dysentery has few sequelae. In the amoebic form liver abscess is not uncommon. The incubation period in the bacillary type is 2 to 8 days, in the other it is prolonged and inconstant.

Vaccines do protect against the bacillary type, in the other they do not. Temporary active " carriers " are found in the bacillary type, but " carriers " are chronic and play a big part in the spread of Amoebic Dysentery.

Water, milk, and food outbreaks are almost unknown in the amoebic type.

**Typhus Fever.**—Causal organism not definitely known. It is a dirt and poverty disease. Was formerly known as Ship Fever and Gaol Fever. During the Great War the prisoners' camp at Ruhleben was a hotbed of Typhus Fever and offered an object-lesson of the evils of faulty sanitation, lack of cubic space, and overcrowding.

*Incubation Period.*—From a few hours to 21 days, usually 12 days.

*Season.*—Winter especially, when the poorer classes huddle together in houses to overcrowd them and to encourage the conditions that excite the spread of the disease. Typhus is now uncommon in this country.

*Case Mortality.*—Under 5, 2·1 per cent. (uncommon amongst young children). Between 15–19, 7·4 per cent.; 20–24, 20·1 per cent.; 35–39, 35·7 per cent.; 55–59, 75 per cent.

*Age Incidence.*—The incidence is highest between the ages of 10–19.

*Means of Spread.*—Dirt, overcrowding, lack of ventilation. During periods of depression, when food is scarce, spread is much more likely to occur, provided the infecting agent is introduced amongst the poor in the slum areas. The disease is spread from one person to another by body lice—through the agency of *Rickettsia prowazeki.* It is generally believed that the lice harbour the infecting virus in their intestinal tract, so that when the insects bite the human subject the faeces of the lice infect the person through the minute wounds caused by the bites. The period of infectivity among lice varies from 2 to 10 days.

The **Weil Felix** reaction in Typhus may be likened to the *Widal* reaction in Typhoid Fever. The *Weil Felix* reaction demonstrates the power of the blood of a Typhus Fever sufferer to agglutinate a proteus-like organism. The peculiar feature of the reaction, as compared with the *Widal,* is that, though the *Weil Felix* reaction is diagnostic, the proteus-like organism is not the cause of Typhus Fever.

The blood of Typhus Fever patients will agglutinate the bacilli of Enteric Fever and Dysentery. On more than one occasion, in Scotland, Typhus Fever has been associated with stores which imported rags from Russia and other continental countries. The author experienced two such outbreaks in Leith. Aberdeen has also suffered in the same way.

An interesting but unusual occurrence happened when a patient, diagnosed as a case of acute Pneumonia, was sent into Leith Hospital. The patient died. The body was taken home, where a "wake" was held. Within a fortnight several cases of mysterious and acute illness came under the notice of a practitioner who very correctly diagnosed the condition as Typhus Fever.

It is illegal to hold a "wake" over the body of anyone who has died of infectious disease. And as has already been stated, it is most irregular to permit an *infected* corpse to leave any hospital, save for burial. But in the instance just cited, no one was aware that the suspected pneumonia case was infectious, consequently permission to allow the body to be removed to its home was not denied. For the same reason, ignorance regarding the true nature of the disease prevented the taking of proceedings against the householders who held the "wake." But the case illustrated the highly infective character of Typhus Fever.

*Prevention.*—Free ventilation and cleanliness. Removal of cases to hospital, where Typhus wards have liberal cubic space provided. Those who have been in close touch or intimate contact with the disease are kept under continual observation, either in their own homes or in a quarantine house.

*Quarantine* must be for 17 days at least. Longer incubation periods have been encountered.

*Disinfection* must be very complete and may be carried as far as the burning of all infected bedding and apparel. This is a fairly common proceeding, because it is usually the houses of the poor that are invaded. Special pains must be taken to deal with body lice and their resistant eggs, by means of carbolic acid in concentrated solution, or by chloride of lime. To reach these insects and their eggs, wooden skirtings may have to be removed and old wall-papers stripped. The flour paste used to affix wall-papers may and not infrequently does provide a refuge and breeding-place for bugs, fleas, and other insects. A preliminary fumigation with sulphur—6 lb. to 1000 cubic feet of air space—may be practised. Weaker fumigation is not reliable. If the houses in which cases have occurred are worth the cost of a rejuvenation, their walls may be re-covered with paper or limewashed, or painted with suitable water-colours.

**Trench Fever** is a specific infectious disease which has lost much of its importance since the Great War, when it was commonly encountered.

*Incubation.*—About 8 days.

*Causative Organism.*—Believed to be *Rickettsia quintana*, found in the bodies of lice that have fed on persons suffering from Trench Fever.

Infection takes place through scratches or broken skin surfaces. The patient's blood remains infective for 18 days. Lice remain infective for 23 days.

*Prevention.*—Cleanliness of the body and wearing apparel. Destruction of infected clothing. Treating clothing to high-pressure steam and using hot irons directed at armpits and linings to kill the more resistant eggs. When the hot iron is slowly used, and not hurried, it is more destructive to " nits " and eggs than steam.

**Smallpox.**—Cause unknown, possibly a filterable virus.

*Incubation.*—Usually between 12 to 14 days. An incubation of 21 days may occur in exceptional cases.

*Season.*—Chiefly winter with, however, a somewhat peculiar and deceptive curve of seasonal incidence. In the majority of epidemic outbreaks the notifications keep rising until they reach a high level during January and February. In March there usually comes a rapid drop which at first suggests a sudden arrest of spread of the disease, but in April the notifications again show an upward tendency. Then comes a well-defined decline towards the middle or the end of June, when the outbreak dies down.

Apart from the foregoing variations of incidence, the energetic pursuit of a vaccination campaign will exert a tangible effect in arresting the spread of infection.

Smallpox spreads rapidly in winter and in the most densely populated districts of cities.

The prodromal period of Smallpox is of particular interest to the student, because the early signs and symptoms of that stage somewhat simulate the manifestations of other acute infectious diseases. Severe headache, shivering, and intense backache suggest Influenza, more especially when that disease chances to be prevalent in the district. Some of the prodromal rashes of the severe forms of Smallpox are like Measles. Purpuric patches now and again precede a severe attack of Smallpox. The characteristic " bathing pant " eruption is one that is occasionally encountered. It is becoming more difficult nowadays to diagnose Smallpox at first sight, as many of the older physicians were able to do, because typical cases are not commonly seen. Such conditions as modified and discreet Smallpox, as well as *Alastrim* and *Amaas*, may readily be overlooked, though they are actually benign forms of Smallpox.

In some very mild and highly modified cases there may be only a few isolated hard papules showing no vesiculation. Some text-books advise a search for vesicles with umbilication, the latter phenomenon usually distinguishing the Smallpox vesicle from that of Chickenpox. But that is not a reliable indication. Lengthy experience alone will help one to diagnose Smallpox, and even those who have passed many cases of the disease through their hands are sometimes unwilling to be dogmatic when called upon to declare whether a case is Smallpox or Chickenpox. We had occasion to treat a man who suffered (it chanced to be while cases of Smallpox were in the district) from a papular eruption, with headache and pains in his back and limbs. He was isolated and re-vaccinated. He had been vaccinated in infancy, and in ordinary circumstances should have developed a characteristic form of Smallpox. The re-vaccination took, and the patient was put on anti-syphilitic treatment. The re-vaccination test is always a good one to apply in cases of doubt. Vaccination will not take if the disease is really Smallpox.

The advice may be safely repeated to look upon Chickenpox among adults with suspicion, because Chickenpox is not common among grown-up persons. Re-vaccination in cases of difficulty will clear away any doubt, especially if the patient had not been recently protected.

*Case Mortality.*—The case mortality at all ages among the unvaccinated averages 35 per cent. Among vaccinated over 20 years of age it is 9 per cent.

Within recent years England and Wales were invaded by a very mild form of Smallpox, which is like the *Alastrim* (Mild Smallpox) of South Africa or the *Amaas* of South America.

*Alastrim* or Mild Smallpox can be prevented by vaccination. It is rarely, if ever, fatal, but its mild character constitutes its danger to others, because those who are attacked rarely suffer any inconvenience, but move about freely to spread infection.

In this country, in the year 1796, out of every 100 deaths that took place 18·5 per cent. were caused by Smallpox. It was not until 1840 that inoculation of

Smallpox was made illegal. The barbarous custom aimed at producing a mild attack in order to prevent a more severe form. Unfortunately, now and again the crude practice caused deaths in place of mild attacks.

*Incidence.*—In this country Smallpox used to be a disease of childhood, but with the more general employment of vaccination the incidence among children has been greatly reduced.

The student will frequently encounter those who are strenuously opposed to vaccination or to the employment of any serum treatment. He must therefore be prepared to meet his antagonists who quote figures that cannot on the spur of the moment be refuted.

The anti-vaccinist declares that as sanitation has improved so has the incidence of every infectious disease. In regard to certain diseases that is admitted, but while vaccination has altered the rate of incidence of Smallpox in childhood, improved sanitation has practically done nothing to reduce the numbers of children attacked by Measles and Whooping Cough.

In pre-vaccination days Smallpox was nine times more fatal than Measles and seven and a half times more fatal than Whooping Cough. Nowadays, however, despite all the improvements that have taken place and the administrative efforts exerted by removal to hospital and home visitation, these two diseases of childhood show far higher death-rates than Smallpox, which can be eliminated from a district by systematic vaccination or re-vaccination.

The example of Germany was striking in that Smallpox was only encountered on the frontiers of that country, whereas in the interior of Germany the disease was unknown. In Germany itself vaccination was compulsory, being enforced at babyhood, at school age, and in the case of men when they joined the army. They did not even provide special Smallpox Hospitals in Germany, so confident were they of the protection afforded by vaccination and re-vaccination.

No matter which town is selected, the proofs in support of vaccination are unanswerable.

*Attack Rates among Vaccinated and Unvaccinated.*

| | *Vaccinated.* | *Non-vaccinated.* | *Vaccinated.* | *Non-vaccinated.* |
|---|---|---|---|---|
| | *Under* 10. | | *Over* 10. | |
| Dewsbury | 10·2 | 50·8 | 27·7 | 53·4 |
| Gloucester | 8·8 | 46·3 | 32·2 | 50·0 |
| Leicester | 2·5 | 35·3 | 22·2 | 47·6 |
| Sheffield | 7·9 | 67·6 | 28·3 | 53·6 |
| Warrington | 4·4 | 54·5 | 29·9 | 57·6 |

The foregoing figures are conspicuous for their uniformity. They also show how with advancing years the protective influence of vaccination declines.

In one Smallpox Hospital five of the nursing staff refused to be protected by vaccination. All became patients; the other members who had been protected escaped Smallpox.

*Spread.*—By personal contact; infected clothing and bedding. It has been contended that Smallpox may be aerially spread from the wards of a Smallpox Hospital when a certain number of cases are being treated in the institution. That view is not generally accepted. It is declared that laxity of administration, by permitting too much unrestricted coming and going to and from the Smallpox Hospital on the part of message carriers, nurses, and visitors, has given encouragement to the theory of aerial spread. Our own experience at Leith did not support the aerial convection doctrine. Nor did the late

Dr. Claude Ker, a well-known authority, believe in the aerial theory.

Mild cases are often a menace, especially during epidemic periods. It is a characteristic of Smallpox that the victim is usually acutely ill for a few days at the outset of his attack, but as soon as the true eruption of Smallpox makes its appearance, the patient feels better, and if his attack be a mild one he may, and not infrequently does, move freely about to spread infection among his fellows. Infection appears to be most acute during the eruptive stages. During epidemic periods Chickenpox, for reasons that have already been given, is usually added to the list of diseases that are compulsorily notifiable.

Smallpox cases are always removed to a special hospital which is separated from the ordinary isolation hospital.

Since Smallpox invariably invades the poorest quarters, stern measures must be adopted and every possible pressure brought to bear to encourage vaccination or re-vaccination. Under epidemic conditions the general practitioner is usually invited to co-operate with the Public Health Department in conducting a sustained and resolute campaign of vaccination or re-vaccination. Each medical man is paid a fee for every successful vaccination performed by him. Vaccination stations may be established at schools or in the various buildings where Municipal Clinics are held.

Calf lymph is supplied free by the Local Authority. Contacts must be carefully kept under observation for seventeen days. After successful re-vaccination of contacts they may be permitted to return to work. Consent to vaccination or re-vaccination may be secured by refusal to permit an objector to return to work, or by informing the employer that an employee refuses to be protected.

*Disinfection.*—Must be thoroughly carried out. Often the bedding taken from slum areas is destroyed by burning, compensation being paid.

**Vaccinia (Cowpox).**—This was the disease that led Jenner to declare his faith in the efficacy of Vaccinia as a preventive of Smallpox. He noticed that dairymaids in the district where he was in practice escaped attack by Smallpox after their fingers or hands had been infected by the vesicles (Cowpox) which usually appeared on the teats of milk cows every spring.

In this connection it is very necessary for the student to compare the short incubation period of Vaccinia (4 to 5 days) with that of Smallpox (12 to 14 days). The importance lies in the fact that a person who has been in contact with Smallpox may have the disease averted if he submits to vaccination within three days of exposure to Smallpox. Even at the end of four or five days recourse to vaccination may modify an attack of Smallpox. The short incubation period of Vaccinia enables it to overtake and anticipate the longer incubation period of Smallpox.

**Calf Lymph.**—Arm-to-arm vaccination is now forbidden, and only glycerinated calf lymph may be used.

To prepare the bovine virus, which is subsequently employed to vaccinate the human subject, young, healthy calves are selected. They are tested for Tuberculosis by tuberculin, and for Glanders with mallein. They are also carefully examined by veterinary officers to eliminate the risks of skin affections, Tetanus, Diarrhoea, or Foot and Mouth Disease.

Having successfully passed all these tests and examinations, the abdominal surfaces of the calves are shaved and cleansed. Long, superficial scarifications, about a quarter of an inch apart, are then made and the bovine virus carefully rubbed into the light incisions.

The seed virus may be derived from (1) Cowpox ; (2)

from Smallpox itself; or (3) by what is known as retro-vaccination. The latter consists in removing Vaccinia from the vesicles on the child and implanting the serum on the calf. Still another and somewhat circuitous method is to transfer the virus from the human subject to the monkey, and from the monkey to the calf.

It is believed that by changing the type of the virus its activity will be kept at a higher level for a longer period.

After the calves have been vaccinated, the animals are carefully kept by themselves, away from flies and dust.

On the fifth day of its vaccination the calf has the virus removed. If the vesicles are permitted to be over-mature, contaminating micro-organisms may appear in the lymph. Lymph taken from the calf vesicles after the seventh day is not reliable.

When the "pulp" (the entire vesicle with its contents) is taken from the calf, the scraping is done under chloroform. The calf is killed, and carefully examined.

Glycerine in the proportion of 1 in 4 is added to the pulp. The mixture is ground finely down. The glycerinated calf lymph is permitted to ripen with age. After the added glycerine has exerted its purifying influence the calf lymph is put up in capillary tubes and is ready for use.

**Post-Vaccinal Encephalitis,** associated with vaccination, is rarely encountered. Infants and adults are usually exempt. Post-Vaccinal Encephalitis prefers to attack children and adults who have been vaccinated for the first time. The mortality rate due to complications arising from this post-vaccinal condition may be as high as 30 to 40 per cent. The Rolleston Committee, specially appointed to investigate the subject, came to the conclusion that Post-Vaccinal Encephalitis was due to a "Co-operation of Vaccinia with the viruses of Polio-myelitis or Encephalitis lethargica, or possibly that some unknown neurotropic virus had been harboured by a vaccinated subject."

**Chickenpox.**—Cause unknown. Believed to be due to an ultra-microscopic virus.

*Incubation Period.*—17 days.

*Case Mortality* is negligible.

*Spread.*—Chickenpox is highly infectious and difficult to arrest once it gains a foothold among susceptible subjects in hospital wards, schools, or other institutions where there are numbers of young children.

*Quarantine Period.*—3 weeks, and infected children should not be allowed to return to school until all the scales have completely removed. This may be expedited by hot baths.

**Measles.**—Cause unknown.

*Incubation Period.*—12 to 14 days.

*Season.*—Usually winter and spring, but summer epidemics occasionally occur. Epidemic waves are supposed to come every two or three years. This is because an epidemic attacks the majority of those who are susceptible. Another susceptible generation then comes into being, after which a further epidemic wave spreads over a community. But experience has shown that, in cities especially, annual outbreaks may be expected, some more severe than others.

*Age Incidence.*—Between 2 to 7.

*Case Mortality.*—Varies with severity of epidemic. May be as high as 15 per cent., but the average is 5 per cent.

*Spread.*—By coughing and sneezing, fomites, droplet infection. Mouth contact, direct or indirect (*e.g.* playing musical instruments, etc.).

*Prevention.*—Notification has already been discussed.

Closure of Infant Departments is generally recommended when 30 to 40 per cent. of the scholars are absent.

But the procedure is mainly of value in country districts where the children are diffused. In towns the children are more or less kept in touch with one another in streets or playgrounds, back yards, and in the common passages leading to blocks of houses. It is extremely difficult to arrest the spread of this disease, because it is highly infectious before it can be recognised to be Measles.

Voluntary notification of the first case in each house has been successfully practised in Edinburgh. Such a method affords a guide to the houses where the disease exists, with a view to visitation by members of the Public Health Department.

**Sero-prophylaxis of Measles.**—In the year 1918 Nicolle and Conseil published the results of their method of using Convalescent Measles Serum for conferring immunity among susceptible subjects. Because second attacks of Measles rarely took place, it was concluded that anti-bodies were developed in the blood of those who had been infected. Proceeding along that line of deduction, Nicolle and Conseil, and others, established the routine practice of employing serum taken from convalescing Measles patients.

The serum was collected by drawing 200 to 300 c.c. of blood from the median basilic veins of those who had recovered from attacks of Measles. As a precautionary step, the Wassermann Test was applied before any blood was removed. The blood was collected under aseptic precautions. And the time for taking the blood was between the seventh and tenth days, after the temperature of the patient had fallen. After clotting had taken place, the serum was drawn off by pipette and tested for sterility. The serum was kept on ice. But when it is intended to preserve the serum for an extended period the addition of Oxy-Quinoline (Chinosol) is necessary.

The proportion of the Chinosol recommended is 0·3 grm. to 500 c.c. of blood. One adult convalescent can supply enough plasma to protect, with an average dose of 10 c.c., ten susceptible children. Experience has shown that the activity of the serum as an immunising agent is maintained for a period of six months from the date of the withdrawal of the blood.

It is recommended to employ the serum within three days of exposure to infection, if immunity is to be effected. Serum used on the eighth day subsequent to exposure has proved abortive. The serum is injected intramuscularly and without harmful results. The "passive immunity" conferred by Convalescent Serum in Measles lasts for two to four weeks. As has been indicated, the value of Measles Convalescent Serum in institutions, where there are many susceptible subjects, is very great, and at the first suggestion of an outbreak of the disease in a ward the spread of the malady may be averted. The same applies to schools.

The outstanding difficulty so far has been the inadequate supply of Convalescent Serum. Only a limited number of convalescent patients will consent to offer blood, since Venesection appears to hold a dread for many people.

It has been suggested that the collection of a supply of immunising serum might be assured if donors of blood were rewarded by payments.

The sero-attenuation of Measles need not be discussed in these pages.

The doses used vary. For infants, 5 c.c. may be given; for children between 1 and 4 years of age, 10 c.c.; while for those over 4 the dose reaches 15 c.c.

Dr. Harries, of Birmingham, believes in administering uniform doses of 10 c.c. He also prefers to use the pooled serum of several convalescents. He does not think it advisable to depend on the blood of only one or two donors, because he argues that pooled serum gives the most reliable immunising results.

**Whooping Cough.**—Cause: *Haemophilus pertussis*, a small oval cocco-bacillus.

*Incubation.*—8 to 10 days.

*Season.*—Winter and spring—highest in March. Measles and Whooping Cough frequently occur at the same time, especially during epidemic periods.

*Age Incidence.*—Under 7. Highest between 1 and 3. After 3 the incidence begins to show a decline.

*Case Mortality.*—4 to 5 per cent. During the age period between 1 and 2, 10 to 12 per cent. After 5 years of age it is under 1 per cent.

*Methods of Spread.*—Droplet infection from coughing and by sputum. Most infectious during its first week.

*Prevention.*—The same steps may be adopted as in the case of Measles, but the results are not encouraging. A vaccine has not been uniformly successful.

In Measles and Whooping Cough complications referable to the lungs are the usual causes of death.

If the mortalities caused by Measles and Whooping Cough could be materially reduced, a great step forward would be made in preventive medicine.

The practitioner can do much to assist the Public Health Department by inspiring parents, especially in the poorer districts, with a dread of these maladies and with the urgent need of exercising care with children who are attacked. It is now the usual practice to remove severe and ill-housed cases of Measles and Whooping Cough to an Isolation Hospital.

**Cerebro-spinal Meningitis.**—Caused by *Diplococcus intracellularis* (Weichselbaum); resistant to sunlight, 7 to 8 hours' direct exposure being required to kill it.

*Incubation Period.*—Very short, 2 to 10 days, shorter in young children.

*Case Mortality.*—In very young and old as high as 90 per cent.

*Paths of Infection.*—Nose and throat.

*Spread.*—By droplet infection from "carriers." "Carriers" are particularly dangerous in this disease, because they harbour the diplococci in their throats and noses and cough or spit infection about. Among the poorer classes the existence of dirt and overcrowding render the presence of a "carrier" a serious menace. Dock labourers in Leith, working in the holds of coal carrying vessels that had come from continental ports, became "carriers," because the holds had been infected by the sputa of "carriers" on the continental side. A violent epidemic of Cerebro-spinal Fever invaded Leith, with disastrous results, the infection being at its outset traced to dockers' houses.

*Prevention.*—Gargling with chlorine water for "carriers" or those who have been contacts. Removal to hospital rarely prevents the spread of the disease, but hospital treatment may be necessary because the nursing of some patients is most harassing. Recovery now and again leaves permanent ill-effects in locomotion or in the nervous system.

Flexner serum injected into the cerebro-spinal cavity has given favourable results. Little can be done in the direction of disinfection, apart from the treatment of "carriers" with antiseptic gargles or nasal douches.

Those who nurse cases of Cerebro-spinal Fever rarely are attacked by the disease, but they may act as "carriers."

**Encephalitis Lethargica** (called **Sleepy Sickness**).—A communicable disease which is yet very little understood.

The basal ganglia of the brain are affected. The disease was first noted in connection with an epidemic of influenza.

Ophthalmoplegia occurs in 75 per cent. of the cases.

The Parkinsonian (chronic) form of the disease is often a most distressing condition and special accommodation must be set aside for its various types. Thieving, arson, assault, filthy habits, and mental deficiency amounting to lunacy constitute some of the phases of the chronic disease.

Local Authorities make special arrangements for dealing with these frequently troublesome cases, and the practitioner who is called upon to deal with Parkinsonian types is advised to approach the Medical Officer of Health.

**Mumps**—sometimes known as Epidemic Parotitis—is a highly infectious disease, chiefly confined to children, though adults do not escape.

*Incubation.*—Extends to 3 weeks.

The prevention of spread is complicated. A widespread epidemic dislocates school work and, to add to the difficulty, a quarantine period of 3 weeks prevents children who have been in contact with infected brothers or sisters from returning to school during that period. Since the saliva of infected patients has produced the disease among monkeys, the use of mouth and throat antiseptic gargles is indicated.

**Plague.**—Is endemic in China and India and is occasionally encountered in Africa, Egypt, and Australia. Visitations of Plague to this country are rare and are quickly arrested. Such seaports as London, Liverpool, Glasgow, and Leith have experienced minor outbreaks of the disease. The ravages of Plague were at one time so severe in Europe that a quarter of its population was swept away by death. The Black Death, as it was called, also killed over 10,000 inhabitants of London, and the epidemic was only arrested when the Great Fire destroyed some of the worst slums and congested areas of that city. The fire destroyed the rats and their breeding-places.

*Incubation Period.*—Varies from 3 hours to 15 days; but the average is 2 to 8 days.

*Age.*—Has little influence on the incidence of the malady.

*Sex.*—Women are more frequently infected in the tropics, owing to their living more indoors and therefore more liable to attack by infected fleas.

*Season.*—Usually checked by cold and by excessive heat, accompanied by dry weather.

*Quarantine Period.*—8 to 12 days.

*Method of Transmission.*—The fleas that infest infected rats leave their host in numbers when the animal dies. Natives are more liable to be attacked, because they sleep on floors and are within easier reach of fleas. Also their bare feet and legs are exposed to attack. Sleeping on beds raised two or three feet from the floor is a defence, because the distance of a flea's jump is limited to 2 feet.

*Types.*—The Bubonic form is the most prevalent type and usually the least dangerous. The Septicaemic and Pulmonary forms are very fatal.

*Case Mortality.*—At the height of an epidemic the mortality may be as high as 95 per cent. It is now and again 60 per cent. The average is 50 per cent. Asiatics suffer more fatalities than whites.

Bubonic Plague is only slightly communicable. But when the buboes burst, the disease may be spread by the pus. The pulmonary form is highly infectious and very fatal. The sputum contains the bacilli.

*Prevention of Spread.*—Notification and removal to isolation wards. Isolation, or, quarantine of immediate contacts, who should receive Haffkine's Vaccine. The employment of Haffkine's Vaccine on a systematic and widespread scale should be practised in areas exposed to Plague visitations. House-to-house inspection may be found necessary in times of epidemicity.

In foreign countries the complete evacuation and burning of villages or sections of them may be found necessary. War against rats is a *sine qua non*, but its success is not easily accomplished. Rat-proofing of buildings is carried out by the use of belts of cement at wall bases to prevent the entrance of rodents. Basement floors must also be covered with concrete. A mongoose living in a warehouse is an excellent weapon of protection against the incursion of rats. The pumping of cyanide gas into the burrows of rats is an effective lethal device, but its danger to the user must be kept in mind. Danysz virus has been used with varying success. This virus is the bacillus *Typhi murium*. It is grown on agar in tubes. When salt solution is added to the culture in the tubes and shaken, the subsequent emulsion is poured over bait (cubes of bread) and scattered about for the rats to consume. It is claimed that the rodents are infected with rat typhus and spread the disease to others. The author tried the virus with unequal results during a visitation of Plague to Leith in 1903. Rats that had eaten the active virus came to the surface with their bodies greatly swollen, and soon afterwards those districts that had been baited were freed of rats. But, as has been said, the results were not uniformly good.

One should refrain from handling the bait with the naked fingers, as the rat is extremely cunning and suspicious. The same advice is applicable to the distribution of any other poisoned bait. Other substances that have been employed for poisoning rats are phosphorus paste, arsenic, barium carbonate, and red squills. Phosphorus and arsenic must be laid beyond the reach of other animals.

**Deratisation of Ships.**—The method most dangerous to rats and to human beings is the application of cyanide gas. Before the gas is used, extra precautions must be adopted to ensure that every part of the ship has been evacuated by human beings. And, after the gassing is completed, air must be blown through the treated sections of the vessel, since pockets of poisonous gas may linger in cul-de-sacs, etc. The pumping in of air clears away any accumulation of the gas. At some ports deratisation by sulphur dioxide gas is preferred. This may be carried out with the aid of the Clayton Apparatus, which is really a steel chamber in which sulphur rolls are burned while a fan is set in operation to blow the gas into different parts of the ship being treated. Neither of these gases is to be relied on for the disinfection of ships. In their concentrated forms (if carefully used) both are lethal to rats, mice, and fleas; but the destruction of the eggs of the insects is not easily accomplished.

**Generation of Cyanide Gas.**—For holds of ships an ordinary wooden barrel may be requisitioned; for smaller compartments earthenware crocks. One and a half ounces of commercial sulphuric acid and two ounces of water are placed in the barrel or crock, after the receptacle has been placed in the hold or other part to be treated. One ounce of sodium or potassium cyanide enclosed in a piece of cheese-cloth is then lowered into the sulphuric acid mixture. As the evolution of the cyanide gas is immediate, hatches and all possible outlets should be quickly covered. For dealing with mosquitoes the mixture recommended is one and a half ounces of cyanide to every 1000 cubic feet of air-space. The exposure should be for half an hour. For killing fleas, two and a half ounces are advised, with the same exposure. But for rats the strength is increased to five ounces of the cyanide, and the exposure prolonged to one and a half hours. When a ship is "gassed" with a cargo on board, a double exposure is advisable—especially if rats have been reported or are suspected to be present.

A *Registered Ton* contains 100 cubic feet. Accordingly, a ship of 5000 tons has 500,000 cubic feet of air-space in the cargo holds alone. The *Gross Tonnage* of a ship is its actual cubical capacity, whereas the *Net Tonnage* signifies cargo capacity. Forty cubic feet of merchandise are reckoned to be the equivalent of a ton. The difference between the gross and net tonnage is equal to the space taken up by the engine-room and all above-deck structures.

**Yellow Fever** or **Yellow Jack** at one time held a dread for many who went to the West Indies and West African coasts, as well as to Central and South American regions. Nowadays that danger has been almost completely removed.

*Incubation.*—Usually 3 to 6 days.

*Season.*—Rainy season with hot temperatures are most favourable for the spread of epidemic waves, through the activities of mosquitoes.

*Age Incidence.*—Adults usually attacked.

*Race.*—Whites are most susceptible.

*Case Mortality.*—Among acclimatised individuals it is 7 to 8 per cent. Among the unacclimatised it varies from 25 to 80 per cent.

*Mode of Spread.*—The spreader of the disease is a mosquito, Aedes ægypti—(*Stegomyia fasciata*). It is now established that mosquitoes which had sucked the blood of Yellow Fever sufferers, in the early stages of that disease, can infect healthy persons. The virus takes 10 to 12 days to incubate in the mosquito. At the expiry of that period the insect can pass on the infection, and 3 to 6 days elapse before the attacked individual begins to show symptoms of Yellow Fever.

For many years the making of the Panama Canal was brought to a standstill because Yellow Fever and Malaria had wrought such deadly havoc among those employed on the isthmus. Not until an American Sanitary Commission set out to eradicate mosquitoes was it possible to proceed with the completion of this great undertaking.

*Prevention.*—It becomes obvious, therefore, that the prevention of Yellow Fever can be best achieved by attacking the breeding-places of mosquitoes. This is best effected by land drainings and the eradication of pools, ditches, and unnecessary watercourses. By creating an oily film over collections of water, the larvae of the mosquitoes, which live at the surface, are killed, because they can no longer breathe. Kerosene and similar preparations are used for this purpose, spraying being the method usually adopted.

**Malaria** is a specific infective disease caused by the presence of one of three varieties of *Plasmodium* in the blood of the victim. It is a tropical disease, but there was a period when Malaria prevailed in the United Kingdom, more especially in the Fen districts of England.

*Incubation.*—8 to 10 days, but this may be prolonged.

*Age Incidence.*—More severe among children than among adults.

*Sex.*—No disparity.

*Season.*—This depends on the activity of the mosquitoes, but July and August are favourable.

*Case Mortality.*—Improved methods of treatment have completely altered that feature, so that definite figures cannot be stated.

*Spread.*—By mosquitoes. The plasmodium completes the sexual part of its existence in the body of the insect, and female mosquitoes alone spread the disease.

The study of Malaria is a most fascinating one, so that a brief history of it may be offered. In 1853, Beauperthuy, a French physician, was the first to affirm that Yellow Fever and Malaria were spread by mosquitoes. But he was derided. Next came another Frenchman, Laveran, who, aided by a microscope, saw the plasmodium in the red blood corpuscles of Malaria sufferers. But it was left to Manson to declare that the mosquito was actually the disease transmitter. Manson urged Ronald Ross to pursue the study, which he did. He allowed himself to be bitten by mosquitoes, and after many fruitless searches, during which he injured his health and endangered his eyesight, he found the black granules in the stomach of a mosquito. But it was left to Grassi, an Italian, to trace the life-cycle of the human parasite in the mosquito. The final proof came when Dr. Louis Sambon and Dr. Low went to a Malaria-infested part of Italy and lived there in a mosquito-proof tent for four months on end. That precautionary step enabled them to escape attack, while new-comers to the district, who had no net protection, became victims of infected mosquitoes. Ultimately female mosquitoes were taken in special boxes to England, where two volunteers allowed themselves to be bitten. Both were infected, and subsequent examinations of their blood completed the cycle of proof.

Male mosquitoes do not transmit Malaria. But a few days before the female lays her eggs she gorges herself with the blood of a human being, and if the person chances to be a carrier of Malaria, the insect sucks the gametocytes or sexual forms of the parasite into her stomach. These gametocytes may be males or females. In course of time the male forms throw out flagella which break away to fertilise the female forms. Then the female changes to become a mobile Oökinete. Oökinetes next penetrate the walls of the mosquito's stomach to form cysts, called Oöcysts, and large numbers of Sporozoites develop in these cysts. Ultimately the cysts burst, to release the Sporozoites, which find their way to the salivary glands of the mosquito. When the insect bites a human the Sporozoites are introduced.

*Prevention.*—What has been said of an anti-Yellow Fever crusade applies to Malaria, and in both diseases, as has been indicated, mosquito-netting should always be used over one's bed, since the insects are always active after sundown.

An interesting sidelight on prevention was revealed by the island of Barbados, which kept free from Malaria while its neighbouring islands continued to suffer. Barbados had pools, ditches, and watercourses like the other islands. Investigation ultimately solved the puzzle when it was discovered that myriads of tiny fish, common to Barbados, lived in the pools and lakes. These fish fed on the mosquito larvae and kept their numbers down. The value of prevention was seldom more forcibly demonstrated than in the case of the Panama Canal, to which reference has already been made. It cost the American Government £4,000,000 to fight the mosquito, which had killed between 15,000 to 20,000 French workers. France had meantime wasted £50,000,000 in her attempt to make the waterway. The various types of Malaria can be much more appropriately studied from books dealing specially with the subject.

**Ankylostomiasis (Hookworm Disease).**—Is encountered in tropical and subtropical countries. It is endemic in the coal mines of Wales, Germany, Belgium, France, Spain, and the Netherlands. The incidence of the disease is as high as 90 per cent. among the population of Dutch Guiana ; in American Samoa between 60 and 80 per cent. are affected. In Germany 30 to 60 per cent. of the miners have been discovered to be infected.

*Spread.*—Through the skin in 90 per cent. of the cases. The embryo may also be swallowed in drinking-water or food or by contaminated fingers. Infection leaves the body in the faeces.

*Causative Organism.*—The Hookworm. It is a nematode belonging to the *Strongiloides* family. The adult hookworm usually inhabits the small intestines, and attaches itself to the gut. The female hookworm produces large numbers of eggs, which are excreted in the faeces. They then reach full development. The embryo becomes a larva 24 hours after it has been discharged. It lives in moist soil, where it feeds. After it has loosened its skin for the second time it lives as an encysted parasite, and at this stage it is able to pierce the human skin. It can live outside the human body for 5 to 12 months. Two of the moults of the larvae occur inside and two outside the human body. Usually the parasite pierces the skin between the toes, and in its passage through the cuticle produces a certain amount of irritation known as "gravel itch." Six weeks after the hookworm pierces and enters the skin the disease is fully developed in man.

*Prevention.*—There are two directions of attack, the more important being the prevention of soil and water pollution, the other the suitable treatment of infected persons. Pollution of soil can only be avoided if properly constructed privies are used and the dejecta buried in trenches. Humans may be treated by the administration of thymol or chenopodium. Prior to giving the drug, a full dose of Epsom-salts is prescribed. This gets rid of the mucus in which the worms are embedded. The next procedure is to give 30 grains of thymol in capsules on the following day. Two hours later another 30 grains are swallowed, and in two hours a second dose of salts is administered. Usually two or more courses of treatment are required to get rid of all the eggs. As idiosyncrasy to thymol occurs, it must be judiciously prescribed. It has been found that 50 per cent. of the cases clear up after three treatments and 90 per cent. after four courses.

**Malta, Mediterranean,** or **Undulant Fever.**—Encountered on the shores of the Mediterranean, South Africa, India, and China.

*Incubation.*—Averages about 14 days, but varies from a few days to four weeks.

*Causative Organism.—Micrococcus melitensis.*

*Prevention.*—Since goat's milk contains the virus, attention must be directed to milk-yielding animals. On a few occasions suspicion has been directed against mosquitoes as disease spreaders. With the radical reduction of the number of goats at Gibraltar, Malta Fever has practically disappeared. Pasteurisation of goat's milk is a half-way step towards the arrest of spread of the disease.

**Dengue.**—This is a disease known to warm climates, especially East and West India, North and South America, and Australia. It occasionally occurs in epidemic form, and when that happens the flare-up is quick and widespread.

*Causative Organism.*—A *Leptospiral* organism has been recovered from the blood of those suffering from Dengue. Sand-flies are suspected to be the spreaders, just as body lice pass on *Rickettsia* in Typhus. But mosquitoes are also under suspicion.

*Incubation.*—3 to 5 days. Because the onset of the disease is striking it may be briefly described. The acute symptoms occur with great abruptness in a joint, often in a finger. The pain flits about from point to point and invades the bones. The pain is so severe that the name "Break-bone Fever" has been applied to the disease. Another peculiarity is the rash. It begins with sore throat, redness and congestion of the eyes, with a general erythema over the whole surface of the body. At the expiry of 24 to 48 hours the rash and temperature subside. This subsidence holds good for 2 to 4 days. Then the temperature and scarlatinform rash reappear. When this gradually disappears, fine desquamation results. After recovery, the stiffness left in the joints gives rise to a peculiar walk called the "Dandy Gait," caused by "Dandy Fever."

*Prevention.*—If sand-flies are the cause the difficulty of eradicating them will be great. If mosquitoes are to blame the problem will not be insurmountable.

**Yaws** or **Framboesia** is a chronic infection encountered in the tropics. It is clinically and pathologically like Syphilis.

*Incubation Period.*—Varies between a fortnight to two months.

*Causative Organism.*—The *Treponema pertenue* is found in the skin lesions which are characteristic features of the disease. The disease is contagious, infection taking place through the broken skin by insects or infected clothing.

*Prevention.*—Local applications to prevent the diffusion of scabs or pus, with destruction of infected clothing.

**Venereal Disease.**—Assumes the forms of Soft Chancre and Gonorrhoea.

**Syphilis** is a specific infective disease caused by the *Spirochaeta pallida.*

*Incubation Period.*—Varies between 3 to 5 weeks, but may be 2 to 6 weeks.

*Spread.*—By means of sexual intercourse, by the fingers, or, to the fingers of the accoucheur, by tattooing, by buccal contact. Indirect methods of spread are by instruments, knives, forks, towels, and drinking-vessels. A mother infected after conception may not pass the disease on to her child, especially if infection takes place late in pregnancy.

**Gonorrhoea.**—Incubation, 3 to 5 days.

The symptomatology of Syphilis and Gonorrhoea need not be dealt with in this volume. But their prevention and control may be conveniently discussed.

It remains to be said that the far-reaching ill-effects of Venereal Diseases call for a firmer control of those who are known spreaders of the maladies.

The author was instrumental in securing the introduction of clauses into an Edinburgh Municipal Bill that sought power to deal with those who submitted themselves for treatment but who failed to continue it to its completion. Patients who have come to be known as " defaulters " are many. This specially applies to sufferers from Gonorrhoea, which is actually much more difficult to cure than Syphilis. Syphilis is less serious from the point of view of danger of spread, since after the infected person has undergone even an incomplete course of treatment, enough medication may have been administered to kill the spirochaetes. In the case of Gonorrhoea, however, the Gonococci are liable to persist in the urethral discharges for many months.

A very strong case was made out to support the introduction of clauses which would have enabled the Local Authority to deal with defaulters, but no progress was made in Parliament. Yet, the Trevethin Commission, specially appointed to investigate the problem of prevention, had indicated that when a good case was made out, a trial should be given to some system of control in a prescribed area. The value of Commissions is therefore doubtful. Compulsory notification must not be confused with the power to compel defaulters to complete their treatment. Compulsory notification has been tried in New Zealand, Australia, and in some American States, but the desire to conceal the disease tends to defeat the value of compulsory notification. The anomalous position is that the Public Health Acts of this country definitely state that all infected persons or those suspected to be suffering from any (not merely notifiable) infectious disease are subject to penalties if they do not adopt every practicable means to prevent the spread of infection. It is difficult to understand why defaulters, the known spreaders of such infectious conditions as Syphilis or Gonorrhoea, who do not always adopt precautions, should escape.

Another striking anomaly is that every case of Ophthalmia Neonatorum, frequently of Gonorrhoeal origin, must be notified to the Medical Officer of Health, but no power is given to compel the presumably infected parent to submit to examination or treatment. Experience has shown, in Edinburgh, that both requests are not infrequently bluntly refused. In no city are the visitations of defaulters more persistent. Patients often default because they know they cannot be compelled to complete treatment. All Ophthalmia Neonatorum cases are visited by lady health visitors, and a lady almoner, who is attached to the Venereal Diseases Department, follows up the nurses of the Child Welfare Department, to reach the parents of children suffering from Venereal Disease.

*Prophylaxis.*—The prompt application of disinfecting substances before and immediately after sexual intercourse has given excellent results. Rubber sheaths and calomel cream inunction are also valuable. Lavation centres, where the urethra and glans may be washed with permanganate of potassium lotion immediately after intercourse, have also been employed.

The American Naval Authorities recommend the following procedure. Scrubbing the penis with green soap and water. Washing the penis thoroughly, especially the frenum, with 1 in 2000 bichloride of mercury. After passing urine a 2 per cent. solution of protargol is injected into the urethra and retained there for 2 minutes. The following favourable statistics were offered in support of the foregoing procedure. When applied 8 hours after exposure there were 19 infections in 1385 cases, equivalent to 1·37 per cent. When used 8 to 12 hours after exposure there were 25 cases out of 741, or 3·31 per cent. After 12 to 16 hours there were 44 infections out of 940 exposures, equal to 5 per cent.

It should be explained that the advocacy of preventive or precautionary measures is objected to by its opponents, who say that it does nothing to encourage continence. This is like gazing at one side of a wall instead of attempting to see beyond it.

During his studies when visiting institutions where children or adults or the insane are under treatment, the student will appreciate the mischief which Syphilis and Gonorrhoea have been able to work in the direction of causing crippling conditions. In spite of all the efforts that have been exerted, and the large sums of money that have been spent in treatment alone, the spread of Venereal Disease still continues. In point of fact, Gonorrhoea is on the increase. It is certain that more patients are presenting themselves at the various well-organised clinics that have been established throughout the country.

**Beri-beri** is a disease that is found principally in Japan, Malay States, Burma, and Brazil. The disease can be countered by preventive measures.

*Cause.*—Is due to the absence of water-soluble B Vitamin from white or polished rice which is milled. During the milling the pericarp and germ which contain the necessary vitamin are removed. The disease has also occurred among sailors and casual labourers who had been almost exclusively fed on tinned vegetables, meal, and white flour.

*Prevention.*—An immediate correction of the dietary, with the provision of fresh food.

**Scurvy.**—Was for many years a deadly enemy of the seafaring population. Captain Cook, the explorer, found, when fresh vegetables formed part of the rations, Scurvy could be obviated. In one of Captain Anson's round-the-world voyages, thirty years before Captain Cook undertook one of his overseas trips, 600 out of 900 members of his crews died from Scurvy. Whereas, when Captain Cook returned after a three years' voyage, only three deaths occurred and none of them from Scurvy. It is now compulsory to serve out oranges or lemon juice to all sailors after they have been continuously on the high seas for fourteen days. Nowadays, however, the vast majority of ships can keep foods fresh for prolonged periods in cold stores on board.

*Prevention.*—The consumption of fresh fruit and vegetables. The latter should not be cooked with soda added to the water. It should also be noted that preserved lime juice is devoid of Vitamin C.

**Infantile Scurvy** (**Barton's Disease**) is encountered among infants who have been exclusively fed on certain proprietary foods. In these cases fresh fruit juices and cod-liver oil should be given.

**Trypanosomiasis** (**Sleeping Sickness**), which must not be confused with Encephalitis lethargica, is a tropical disease.

*Causative Organism.*—Protozoa of the flagellate category. Three species attack human beings—*T. gambiense, T. rhodesiense,* and *T. cruzi.* The tsetse fly (*Glossina palpalis*) transmits the disease to man. The antelope in Africa harbours this type, and from that animal the tsetse fly passes the malady on to humans. *Glossina morsitans* is the vector of the acute form of Sleeping Sickness in Rhodesia.

*Diagnosis.*—When the superficial glands are enlarged, these may be aspirated by a syringe. When this is not possible, blood or gland juice may be examined for the parasite.

*Prevention.*—This will depend on the destruction or riddance of tsetse flies, and constitutes a difficult problem. Since the flies feed on the blood of animals, it would not be easy to rid Africa of its wild game. Crocodile blood is believed to be a favourite food of the flies. Sick persons should be isolated in wards screened against tsetse flies, or in a district where the flies are absent, for there are belts of territory which are free from the insects. Those who carry the infection in the early stages of the disease should be isolated, whether they feel sick or not. In the absence of enlarged glands the blood of suspects should be carefully examined.

**Rheumatic Fever.**—This disease is included because preventive measures may be adopted against it. Since the tonsils are the sites most commonly invaded by a specific *micrococcus,* gargling as a routine procedure is indicated. The crippling and disabling character of the disease is well known, and in industry much sickness with consequent loss of wages is caused by rheumatic affections. Advisory clinics have been established in some areas so that affected children may be set on the road that may assist them to keep clear of the consequences of overstrain and other dangers of the principal disease. A municipal clinic was established in Edinburgh; but to make an anti-rheumatic scheme complete there must be special accommodation set aside for the appropriate treatment, especially of children, whose hearts may be saved from organic developments by regulated rest. Among the poorer classes it will not be easy to put into practice the advice offered at the clinic. The time may come when acute cases of Rheumatism among the younger section of the population may be made compulsorily notifiable. This step would necessitate regular visitation by members of the Public Health Department, with perhaps removal to special "Rheumatic Wards" in an institution.

**Foot-and-Mouth Disease** is communicable to man from affected animals, either by contact or through the agency of milk. The risk to the milk consumer is minimised by the fact that under the Contagious Diseases (Animals) Act infected animals are immediately destroyed. No virus has yet been isolated, but the infectiousness of the disease has been repeatedly demonstrated to an alarming extent.

**Tuberculosis.**—This malady, so aptly described as the "White Man's Scourge," still continues to deserve that evil reputation. Though the incidence of the disease is on the down-grade in almost every civilised country, it still levies a heavy toll on every section of the population.

*Cause.—Bacillus tuberculosis.*

*Mode of Spread.*—By inhalation of dust containing bacilli, especially in overcrowded, badly ventilated houses in which cases of open tuberculosis exist or have existed. The same applies to workshops or other indoor working-places. By ingestion of sputum, infected milk or meat

—the latter is only probable when the flesh is raw or partially cooked. But this method of infection is being rendered less possible because the inspection of tuberculous meat, especially in this country, has become very rigid. The bacilli may pass through the tonsillar tract to reach the cervical or mediastinal glands. Thence the bacilli may pass to the lungs, or into the general circulation. The possible infection of the intestinal tract must not be overlooked.

*Prevention.*—Compulsory notification with early detection at or before school age, with appropriate segregation in "preventoria" or open-air schools. A radical improvement of the whole milk supply (which see). As a safety measure, tubercle-free milk. Failing which, properly pasteurised milk. It has been computed that over 30 per cent. of tuberculous infections have been contracted by the consumption of milk derived from tuberculous cows. Advisory clinics, and follow-up of contacts with a view to offering advice regarding home conditions and home treatment—through the agency of open windows, cleanliness, and rational feeding. Sanatorium treatment. Above all, better conditions of housing and of indoor work, with control over overcrowding and free ventilation of houses. Systematic propaganda bearing on the aforementioned agencies.

**Leprosy.**—In Europe it is found chiefly in Southern Russia, Turkey, Greece, and Norway. It is also encountered in tropical and subtropical countries.

*Incubation.*—Indefinite. Two to four years have been mentioned.

*Cause.*—The *Bacillus leprae.*

*Spread.*—Believed to be spread by contagion. The bacilli escaping from discharges from the skin, mouth, and nostrils probably spread the disease, which is frequently found associated with overcrowding, insufficient or wrong food, together with poverty.

*Incidence.*—All ages and sexes are subject to attack, though children under 5 seldom suffer.

*Prevention.*—Segregation in colonies where better environment and good feeding will be assured. Once there, such remedies as chaulmugra oil in 10 to 40-minim doses, given thrice daily, may be used. Intramuscular injections of gynocardate of soda have also been successful when administered in 24-grain doses in 12 c.c. Specific treatment with vaccines has not proved successful.

**Actinomycosis** occurs in cattle more commonly than in men.

*Cause.*—*Streptothrix actinomyces*, " Ray fungus."

*Spread.*—May be by food, but more frequently by infected straw, or by inhalation of dust during threshing or chaff-cutting operations. If there be a carious tooth or broken surface in any part of the mouth, the " ray fungus " may find a lodgment to cause lesions in the jaws, tongue, neck glands, larynx, lungs, or intestinal tract.

*Prevention.*—No specific method can be stated, but the abstention from chewing straw and the wearing of suitable respirators to protect the nostrils and mouth suggest themselves.

**Blackwater Fever** or **Haemoglobinuric Fever.**—Found in Central Africa as well as in some parts of India.

*Cause* is not definitely known. Natives are not usually affected, but those who have passed through one or more attacks of Malaria are most readily struck down by Blackwater Fever.

*Prevention.*—So long as mosquitoes are under suspicion as possible transmitters of the disease, appropriate measures must be taken to deal effectively with the insects. Those who suffer from attacks of Blackwater Fever frequently benefit when they remove to temperate climates. But recrudescences or recurrences of the disease are not unknown.

**Trachoma.**—This is an infective disease which affords Port Sanitary Authorities much concern, since every effort is made by them to prevent entrance of the malady into their respective countries. This inflammatory condition of the conjunctival surfaces of the eyelids is widespread in Europe. That being so, it is the constant aim of inspecting officers at the chief seaports of this country and the United States to detect cases. The Glasgow Authority has made Trachoma a compulsorily notifiable disease.

*The Causative Organism* is believed to be a visible bacterium discovered by Noguchi.

*Method of Spread.*—By discharges from the eyes, or by handkerchiefs, fingers, and wearing apparel.

*Prevention.*—Early detection of cases, notification, concurrent disinfection of discharges, and infected clothing. The prohibition of the use of roller towels. Special treatment of known cases at dispensaries and education of the public.

**Quarantine.**—Owing to the vigilance displayed by Port Sanitary Authorities, all vessels from foreign ports, especially Plague-infected or suspected countries, are visited and questions asked about suspicious illness as well as actual disease among rodents on board. Port Sanitary Authorities also demand evidence of disinfestation—which includes deratisation—to prove that efforts had been directed against rats. When ships reach ports where Plague is known to have existed, mooring-ropes are fitted with guards to prevent the passage of rodents to and from the vessels. The guards are circular discs, 2 or 3 feet in diameter. Through a hole in the centre of the disc the hawsers or mooring-ropes are passed. The discs offer effective obstacles to the rats when they attempt to reach the ship by clambering along the ropes or hawsers. As a further precaution, gangways connecting a ship with the shore are smeared with tar.

The principle of quarantine is acknowledged by International agreement. But its methods of operation are not identical. In the United Kingdom complete quarantine is not practised. That is to say, when an infected ship arrives at London, Liverpool, Glasgow, or other port, it is not kept in quarantine as is done in some foreign countries. In the United Kingdom effort is made to reduce the period of detention of ships to the smallest possible time. This obviates the holding up of traffic and saves money to the shipowner. The British system is the following. On the arrival of any vessel from a foreign port the first and only officials permitted to board the ship are the Customs Preventive staff and the Port Sanitary officers. If there is no infectious disease on board, the ship is declared clear and the work of disembarkation of passengers with the unloading of cargo is allowed to proceed. If, however, any infectious disease is on board, the patients must (if fit to be removed) be taken off the ship. In the case of Plague, Cholera, and Smallpox extra precautions are demanded. In these diseases the patients are removed to hospital. The names of all the passengers and their addresses are taken, and any other preventive measures considered necessary are adopted. After the passengers have supplied the necessary information and have, in the case of Smallpox, permitted themselves to be vaccinated, they are allowed to leave for their destination; but the Port Sanitary Authorities send all the names and addresses to the Medical Officers of Health of the respective districts to which the passengers are going.

Once at their own homes, the passengers are regularly visited during the incubation period of the disease. In some foreign countries, where strict quarantine is enforced, infected vessels and all the passengers are detained until the end of the quarantine (incubation) period of the disease. This, as may be realised, leads to much inconvenience to everyone. At every port a *quarantine mooring-place* is always provided. If it should become necessary to detain a ship for any special period demanded by the Port Sanitary and Customs Authorities, it is sent to the mooring-place. In this country such a procedure is uncommon.

*Quarantine Detention Periods.*—The following are the agreed-upon periods for the detention of those who have come from infected ports or where actual infection has prevailed on board vessels. In the case of recent successful vaccination or re-vaccination the detention is not enforced:—

| | |
|---|---|
| Cholera | 5 days. |
| Yellow Fever | 5 to 6 days. |
| Plague | 7 days. |
| Typhus Fever | 12 to 14 days |
| Smallpox | 14 days. |

# CHAPTER V

## DISINFECTION

ADMINISTRATIVE practice has considerably changed within recent years in the direction of employing disinfecting fluids and gases. More often than one cares to confess it, disinfectants of various kinds are scattered about on haphazard lines. Disinfectants appear to lull many people into a sense of security because they smell the odours of chemicals. Present-day practice inclines to do as little chemical disinfection as possible, for the simple reason that rooms formerly occupied by infected persons do not reveal the existence of pathogenic organisms. An exhaustive examination conducted in Leith about twenty years ago indicated quite conclusively that from Petri dishes exposed in a large number of houses in which such infectious diseases as Scarlet Fever, Diphtheria, and Tuberculosis had been nursed, no semblance of pathogenic organisms could be recovered. Even in the wards of the Infectious Diseases Hospital the same negative results were revealed by exposed Petri dishes. There may be instances where the stirring up of dust in houses where cases of open Tuberculosis have been treated may reveal the presence of Koch's bacilli. And keeping that possibility in mind, many Sanitary Authorities now apply some form of disinfectant to homes where cases of Tuberculosis have been nursed for long or short periods (see under Tuberculosis).

Where insects are suspected to be the vectors of disease, as in the case of Typhus, it is always advisable to use germicides of such strength as will kill the insects and their eggs. In the case of such an elusive disease as Smallpox it is always wise to apply a liquid disinfectant. It is now recognised that few pathogenic micro-organisms can survive for any length of time after they leave the infected person, the bacillus of Anthrax being a notable exception.

As has been indicated, when the methods of spread of infectious diseases were described, "droplet" infection, personal contact, feeding-dishes, infected wearing apparel, towels, soiled rags, and handkerchiefs were considered to be mainly responsible. Disinfection must therefore be directed at these different agencies.

Because disinfectants were being used in a more or less slipshod manner, Rideal and Walker in 1903 introduced a system which sought to standardise disinfectants. They took carbolic acid as the best chemical to gauge the strength of other disinfectants. And when they produced the results of their experiments they rated other substances on the basis of their "carbolic coefficient." They used the *Bacillus typhosus* as their test micro-organism. Their experiment consisted in employing one drop of the culture of *Bacillus typhosus*, to which was added 1 c.c. of the disinfectant under test. Since that time, however, modifications of the test have been introduced, chief among them being the substitution of phenol for carbolic acid.

Such a test is a guide to the administrative officer, but it must be remembered that disinfectants when applied in actual practice do not deal with naked micro-organisms, as happened during the tests already mentioned. The tests were conducted under uniform conditions of temperature, media, times of exposure, accurate dilution, and the known ages of the micro-organisms, together with their cultural conditions.

Exposure to sunshine and fresh-air currents, together with the application of soap and scrubbing-brush, will provide the best weapons for a thorough disinfection.

When the author first announced at a Public Health Conference, held at Eastbourne in 1902, that he had given instructions for the use of plain water to spray interiors, in place of chemicals, as a test, the wisdom of the procedure was doubted. There are now many administrative officers who have given up routine methods of disinfection.

Where insects are suspected to play an important part in the spread of disease, or where houses are found to be particularly filthy, the liberal application of appropriate chemicals is strongly recommended. Typhus Fever is a case in point. Also, as has been indicated, when cases of open Tuberculosis have been allowed to remain at home for "Domiciliary Treatment," disinfection is advised. The tubercle bacilli may have been freely coughed about over floors or carpets, or contamination by purulent discharges may have occurred. Under such circumstances the careful spraying of all surfaces and corners, together with the destruction of soiled bedding and clothing, will probably offer the safest protection against the risk of infecting the other members of the household.

The system practised in Edinburgh consisted in lending a scrubbing-brush and pail to every householder in whose dwelling a case of open Tuberculosis had been treated. Previous to the scrubbing process, the interior of the house was freely sprayed with formalin solution.

The modern method of carrying out disinfection consists, in the first place, in dealing with the person suffering from the infectious disease. This may be by removal to hospital or by isolation at home. When removal takes place, only the immediate wearing apparel and bedding are taken to the disinfecting station, though that does not apply to Measles, Whooping Cough, or Chickenpox.

Lending libraries expect Sanitary Authorities to disinfect books before their return. Books belonging to an infected household may be destroyed ; but picture-books or toys should be sent to the Infectious Diseases Hospital, where many of the patients will appreciate them.

When curtains, rugs, cushions, or dressing-gowns are removed to the disinfecting station, steam need not be used. Rather should the various articles be subjected to the influence of formic acid, which is generated by adding 7 ounces of potassium permanganate to 16 ounces of a 40 per cent. solution of formaldehyde. This combination is placed in a metal pail, which is surrounded by water, because the mixture excites great heat with the evolution of volumes of dense vapour. The chemical action consists in the evolution of formic acid accompanied by oxidation. Besides being very potent this is a clean disinfectant, and neither tarnishes metals nor decolorises fabrics as sulphur dioxide frequently does.

Formic acid has greater penetrative powers than sulphur dioxide, though no gaseous disinfectant excels in penetrative capacity.

When the formic acid method is used the articles to be disinfected are hung over ropes or other supports in an apartment having its doors and windows closed. Contact with the formic acid should be permitted to continue for some time before doors or windows are opened.

When cases are being nursed at home, every care must be taken to destroy soiled cloths used for swabbing discharging ears or nostrils. Similarly, handkerchiefs, towels, pillow-slips, soiled sheets, and night attire must be carefully treated by immersing them in a suitable disinfectant and subsequently subjecting them to boiling. Boiling is the safest and most satisfactory of all disinfecting systems. But all articles—such as blankets—cannot be so treated, because boiling injures the texture of blankets and indelibly fixes blood or albumen stains in the fabric.

Broadly speaking, disinfection may be of two types :

**Concurrent Disinfection** has just been described, and relates to the maintenance of disinfection day by day, as long as the patient is being nursed in his own home. For concurrent disinfection carbolic acid solution in a strength of 1 in 20, as well as izal and lysol, may be used for steeping infected handkerchiefs, etc. Sheets may be similarly treated. Sputum is received in special flasks, their contents being poured down the water-closet.

*Stools and Urine.*—Carbolic, lysol, izal, or corrosive sublimate may be employed to treat infected discharges from the bowels or bladder. But note must be taken of the strength of the standard solution. If equal parts of urine or faeces and disinfectant are to be employed, as is advised, then carbolic acid or other solution must have a strength of 1 in 10. This, when combined with equal quantities of discharge, will reduce the strength of the chemical to 1 in 20. Similarly, while a strength of 1 in 1000 of corrosive sublimate is urged, the stock solution must be 1 in 500. When corrosive sublimate is used to treat stools some hydrochloric or sulphuric acid should be added to counteract the tendency of the mercury salt to coagulate albumen which may offer protection to the bacilli it is desired to destroy. Contact between disinfectant and stool should be for an hour at least. Should no water-closets be available for the disposal of infected bowel discharges, burial in a trench after admixture with chloride of lime is recommended. Care must always be taken to safeguard wells or other sources of water supply.

*Books* and valuable documents may be dealt with by opening them out and subjecting them to formic acid gas in a closed press or small room.

*Boots, feathers, fans,* or other articles of wearing apparel of value should be sprayed with formalin solution. Spoons, forks, etc., and feeding dishes should be boiled. It is not necessary to employ chemicals if boiling is sustained.

**Terminal Disinfection** may include the foregoing procedure, but it differs from the concurrent process because terminal disinfection, as its name indicates, implies complete disinfection after the patient has recovered or when he has been removed to hospital.

**Gaseous Disinfection.**—Though this method is still practised, it is gradually passing out of favour, because it wastes time and money and is of doubtful value as a germicide.

As has already been stated, gas has poor penetrative power, so that it cannot be depended on to reach and kill pathogenic organisms that are below the surface.

Gaseous fumigation, notably with sulphur dioxide or hydrocyanic acid gas, has been found of value when dealing with vermin. But neither can be relied on for destroying the eggs of insects on account of the poor penetrative power of either gas. Rats and mice can be killed by sulphur dioxide gas in concentrated form. Cyanide gas is commonly employed at seaport towns for attacking rat-infested ships (see under Ship Disinfestation).

*Sulphur.*—For many years the most commonly used substance was sulphur dioxide gas generated by burning rolls or flowers of sulphur. Originally the advice was given to seal windows, chimney openings and all other apertures before disinfection was begun. Also the stripping of wall-papers was recommended. Now all these unnecessary details are ignored. The procedure wasted time, the amount of sulphur recommended to be used was totally inadequate, and it has been found quite impracticable to exclude the inmates of houses for six or more hours on end while the sulphur was supposed to be functioning as a germicide. Even when 6 lb. of sulphur were burned in rooms of known capacity, threads dipped in cultures of various micro-organisms were not completely sterilised by exposure to the concentrated gaseous fumes of sulphur dioxide, which is more active in the presence of moisture. This can be provided by sprinkling floors and surfaces with water. A proprietary article known as "Sulphume," which is $SO_2$ compressed into liquid form, is also valuable.

*Formic Aldehyde.*—This is a more powerful gaseous substance and ranks as a real disinfectant. It penetrates better than sulphur dioxide, and excels sulphur because it neither bleaches coloured goods nor tarnishes metals. Its disadvantage to those who employ it is that it has a most irritating effect on the conjuctival as well as the mucous membranes of the nose, throat, and bronchial tubes. It is not so potent as sulphur for dealing with insects. When disinfection by formic aldehyde is to be carried out, paraform tablets (30 to 35 to every 1000 cubic feet of air space) are volatilised in a metal container in the presence of moisture, the moisture being supplied by the methylated spirit used to vaporise the tablets into formic aldehyde gas. This gas operates best in a dry atmosphere. It is recommended to leave the gas undisturbed for several hours. But, as has already been suggested, this is not always feasible, especially in small houses and among the poorer classes. Ammonia may be sprinkled about a room that has been treated with formic aldehyde. This will permit of a quick reoccupation of the apartment after disinfection.

Similarly, acetic acid may be used for the dissipation of sulphurous acid gas. The apparatus used for diffusing formic aldehyde is called the Alformant Lamp.

Formic aldehyde, it should be explained, is formed when heated methylic alcohol is passed over asbestos which has been brought to red heat.

When formic aldehyde gas is dissolved in water, formalin is formed, formalin being a 40 per cent. solution of the gas. It is usually purchased in bulk as a 40 per cent. solution.

*Chlorine Gas* is seldom used nowadays. It is evolved by adding strong sulphuric acid to 2 or 3 lb. of bleaching powder to every 1000 cubic feet of air space.

*Formic Acid.*—The evolution of formic acid has already been described.

**Liquid Disinfection.**—The majority of Medical Officers of Health now prefer to apply surface disinfection in the form of a very fine spray, the chemical employed being formalin, which, as has been stated, is a 40 per cent. solution of formic aldehyde gas.

The outstanding advantage of spraying is that a disinfectant of known strength is used, and in the hands of a reliable and painstaking officer every inch of surface will be douched with the germicide. Formalin is reliable, clean, and does not destroy paint, carpets, hangings, nor will it tarnish metals. If 6 ounces of formalin are added to a gallon of water a 2 per cent. solution is formed. This is considered to be of satisfactory germicidal strength for house disinfection. When walls are being dealt with, care should be taken to wave the spray from side to side, and to progress slowly upwards towards the ceiling. In that way streaking is avoided, because the sprayed fluid flows down and over moist surfaces. Disfigurement of walls is to be guarded against to avoid complaints and claims from householders.

*Mercuric Chloride.*—This agent is rarely used as a house disinfectant in this country. It is poisonous and for its diffusion requires special apparatus with vulcanite or non-metallic tubes and nozzles. It was the chemical employed in Paris for many years, glycerine being added to the liquid so that the mercury would more readily adhere to the surfaces that were sprayed.

It must be kept in mind that pathogenic organisms have rarely been recovered in houses in which cases of infectious disease had been nursed.

Most of the acute infections are spread by intimate contact between infected and non-infected persons, the throat and nose being the usual routes through which infection enters the body, mucus and droplets being the usual vectors.

It will only be when patients have been nursed in their own homes for prolonged periods that thorough disinfection may be deemed advisable. Under such circumstances carpets may be lifted, walls and floors sprayed, and the interior well aired by keeping the windows wide open. The room may be left vacant for a day or more. Furniture that can be scrubbed should be treated with soap and water. Bulky articles such as rugs and mats should be suspended over ropes and subjected to formic acid disinfection.

When Smallpox and Typhus Fever occur they generally appear among the worst-housed and dirtiest sections of a community; consequently bedding and other presumably infected articles are burned, the destroyed goods being replaced by the Sanitary Authority.

If " contacts " are removed for a period of quarantine, occasion may be taken to repaint or thoroughly clean their vacated houses. In the case of Typhus, where body lice are concerned in the spread of infection, special care must be taken to destroy not only the insects but their resistant eggs, frequently deposited behind skirtings and in crevices, as well as underneath wall-papers. Removal of the skirtings and the swabbing of stripped surfaces with strong solution of carbolic acid or chloride of lime offer a satisfactory means for killing the pests.

No costly apparatus is necessary to spray interiors, since specially constructed nozzles attached to a metallic tube connected to a powerful pump will diffuse a fine cloud of chemical. These nozzles are employed by fruit- and flower-growers, and can be purchased in any shop where seeds, bulbs, and plants are sold. A pail may be used to contain the disinfectant. In country districts, or for ships, that is a very simple method to overtake any disinfection considered necessary. And in ships having cabins of comparatively small sizes, where aerial disinfection cannot be easily brought into operation, spraying of their interiors is a wise precautionary procedure to adopt.

**Steam Disinfection.**—Like other systems of disinfection, the employment of heat has passed through different phases. The original form of disinfecting apparatus was a square metal chamber called " Ransome's Stove." In this the presumably infected goods were placed and subjected to very high temperatures generated by gas. This was dry heat. It scorched and destroyed clothing and perishable goods, and, being a gas, was practically useless as a germicidal agent because heated air has feeble penetrating power. Only the surfaces were attacked and more often than not injuriously affected. When the ineffectiveness of dry (heated) air as a real disinfectant was recognised, Ransome's Stove was discarded. The next stage witnessed the introduction of steam disinfection, either by low pressure or by high pressure (saturated) steam.

**Low-pressure Steam,** in Public Health phraseology, means steam generated at the boiling-point of water, 212° F. Engineers speak of low pressures from totally different standpoints, since to them pressures of 60 lb. to the square inch imply low pressures. Low-pressure steam is not used to any great extent nowadays, because it is slow and it is not a trustworthy method where the destruction of spores is demanded. This comparative weakness of low-pressure steam is due to the fact that its temperature is not sufficiently high, nor does it possess the necessary pressure to effect the penetration that is desired in the case of bulky articles. This has been proved by the author by means of experiments made in a working apparatus with the spores of Anthrax.

**High-pressure Steam** (sometimes known as saturated steam) is also described as " confined " steam, because it is confined under pressure when it is being generated. It is now generally believed to be the most trustworthy disinfecting agent for dealing especially with mattresses and bundles of merchandise.

The steam used for a pressure steam disinfector is generated in a separate boiler, and to the pipe leading steam from the boiler a reducing valve is attached. The pressure required in a steam disinfector is only 10 lb. to the square inch. That gives a temperature of 239° F. as opposed to the temperature of 212° F. of the low-pressure steam disinfector.

As the boiler may be required to generate steam for driving laundry or other machinery at a hospital, the reducing valve just referred to is introduced to cut down the pressure of the steam to suit the actual needs of the disinfecting apparatus. A standard disinfecting apparatus is usually a circular or oblong-shaped steel chamber, having a door at each end. The chamber is set in an apartment which is divided by a wall, so that infected goods will not contaminate those that have been passed through the disinfecting apparatus from the opposite door. A hollow jacket surrounding the chamber may be provided to heat the interior of the chamber before disinfection is begun, and also to dry the clothes after they have been subjected to treatment by steam. The jacket should never be used to overheat (superheat) the steam admitted to the chamber. If the steam in the interior is superheated it is converted into a dry gas with the same unfortunate results as happened when dry air was used in Ransome's Stove. A much better system, and one less likely to lead to faulty use, is that in which a coil of pipes in the interior of the disinfecting chamber is employed to warm and dry the goods before and after the disinfecting process.

The student is apt to be misled by the use of the term *superheated*, since the name suggests something superior in the direction of disinfecting properties. The reverse is the case, since, as has been said, superheated steam is an invisible gas which is no better than hot air.

When goods are placed in a disinfecting apparatus the following steps are taken to complete their penetration and disinfection. First, the doors of the chamber are closed. Then steam is admitted into the jacket or into the internal coil of pipes in the apparatus. The heat from these sources warms the interior of the chamber and its contents. That proceeding prevents too much condensation and wetting of the goods when the steam comes into contact with them in the interior of the chamber. Having completed these preliminaries and before the process of actual disinfection is begun, the hot air contained in the interior of the chamber must either be sucked out by creating a partial vacuum or pushed out by introducing live steam into the chamber.

As the interior is gradually filled by incoming steam the contained air is expelled by an opening at the opposite end of the disinfecting apparatus. Some minutes elapse before the air is blown out. This can be appreciated by feeling the warm air issuing before the advancing steam. When the air is expelled pure steam emerges from the outlet. The exit is now closed and steam admitted to an *air-free chamber,* which is an absolute essential to successful disinfection by steam. Disinfection is a gradual process and is effected when the steam surrounding the goods to be disinfected parts with its latent heat. The latent heat of steam is the power (energy) possessed by steam to part with its heat. Inch by inch the articles are penetrated by heat until the whole contents of the disinfecting chamber become as hot as the steam itself. This gradual heating means that steam is step by step condensing on the goods. When the clothes are as hot as the steam no more condensation (parting with latent heat) takes place. *The desired temperature and pressure are maintained for* 30 *minutes.* At the end of that time the door on the disinfected side of the apparatus is opened and the bedding or other apparel taken out. If the procedure above described is closely followed, the clothes will be found to be dry after they have been shaken out once or twice.

Care has been taken to describe the process of steam disinfection in detail, because a similar procedure must be followed when surgical dressings are treated in a steriliser. The great secret of success in steam disinfection is to secure *air-free contents.* If air is allowed to remain in the steriliser or in the interstices of clothing or dressings, it will be difficult for the steam to reach every part of the articles that are to be treated. Pockets of air, when heated, will act as cushions to prevent effectual and complete penetration by the steam.

It is probably because air is kept on the move in disinfectors employing low-pressure steam that favourable results can be demonstrated. But, for effective penetration of bulky articles, high-pressure steam acting in sterilisers free from air is more rapid and more certain in action. The efficacy of steam sterilisers may be tested by employing threads previously steeped in such resisting cultures as *Bacillus subtilis* or *anthrax*.

**Ship Disinfection.**—(See also Deratisation of Ships.) Exactly the same methods as are used for houses are applicable to ships. The two substances most commonly employed are sulphur dioxide gas and gaseous formaldehyde. For disinfecting cabins, etc., formalin solution is superior. Gaseous formic acid is also good.

# CHAPTER VI

## HOSPITALS

In this country hospitals come under two categories, the one being supported by voluntary contributions, the other, the Municipal Hospitals, being maintained by local rates. Prior to 1929 there were General Hospitals which dealt with accidents and all non-infectious diseases; Municipals Hospitals, on the other hand, confined their attention to the isolation and treatment of all infectious maladies. But a third type existed in the form of Poor Law Hospitals, which, as the name suggests, treated paupers and those suffering from non-infectious diseases. Now, however, the Local Government Act of 1929 has placed all Poor Law Hospitals under the administrative care of Municipal Authorities, and instead of setting these hospitals aside for Poor Law cases alone, the power has now been given to provide accommodation for sick persons drawn from all sections of the community. This has enabled Local Authorities to accept patients who pay for treatment. The name Poor Law must not be taken too literally, because some of these institutions were, prior to being taken over under the Act of 1929, as well planned and equipped as many of the infirmaries of the present day. Glasgow and Aberdeen offer excellent examples of finely planned institutions which were formerly controlled by Poor Law Authorities. With modernly designed hospitals at their command, Municipal Authorities with teaching schools in their midst can now provide extended opportunities for educational purposes. The General Hospital, supported by voluntary subscriptions, still remains a separate entity. Over it a Municipal Authority has no direct control, the administration of its affairs being carried out by Boards of Managers. A Municipal Authority usually appoints one or more of its representatives to act on the Infirmary Board. Without exception, every Voluntary Hospital has a long list of waiting patients. The extensions that will probably take place in connection with some co-opted Poor Law Hospitals are likely to serve a valuable purpose by relieving the congestion in the voluntary institutions.

**General Hospitals (Voluntary).**—The situation of these is important, in a relative sense, since they must be convenient of access for the accidents and sudden emergencies that may occur in streets or public works. In teaching centres infirmaries are usually built near the universities. That being so, it is not easy to acquire extensive sites. The modern advances that have been made in the treatment of diseases now make heavy calls on the finances of Voluntary or General Hospitals. Electrical and other specialised departments are being improved and extended, and with these there follow additions to the staff. The arguments for and against State aid for Voluntary Hospitals need not be discussed. But it is true to say that Voluntary Hospitals, in almost every part of the country, lead what might be aptly termed a hand-to-mouth existence. This is apt to be reflected in too rigid a cutting-down of expenses. If, however, those who could afford to do so paid even a modified contribution for the skilled and specialised treatment they received at Voluntary Hospitals, a considerable amount of money would be collected by the institutions. Many grateful patients do give what they can afford, but far too many take for granted the treatment they receive. The style of an infirmary must be guided by local considerations. As a rule, however, the wards are arranged in blocks, each two to three stories in height. The wards should be well lighted by arranging them in such a way that they shall face east and west—for the rising and setting sun. Failing such " orientation," south-east and south-west exposures will prove satisfactory. It is always advisable to erect administrative quarters for nurses and any other resident staff in excess of the needs of the moment. When extensions to the infirmary are made, the well-conceived administrative block will be ready to answer the call for more accommodation for the staff. Long, rectangular wards each containing 24 patients are most commonly employed. Smaller wards, in large institutions especially, add to the difficulties of nursing and administrative control. Blocks or pavilions should be spaced to permit light and air to gain free access to all the windows of the different wards. The distance between the blocks should be at least three-quarters of the total height of each. Each patient should have 1500 cubic feet of air space. In teaching centres where students attend clinics a greater allowance, amounting to 2500 cubic feet, may be found advisable, because the attendances of students entail the using up of air space. To each bed a floor area of 120 square feet is set aside, together with 8 feet of wall space. The beds should be so arranged that windows are on each side of every two beds. The height of the wards should be between 12 and 15 feet. Wherever possible, natural ventilation is to be preferred, and to secure satisfactory results the window area should be in the proportion of 1 square foot for every 70 or 80 cubic feet capacity of the ward. Windows should also reach to within 12 inches of the ceiling. This arrangement counteracts any tendency towards the accumulation of pockets of stagnant air near the ceiling. In all cases the top section of each window should be constructed to open or close according to the needs of the moment. Sometimes air inlets are provided at the head of each bed and a foot above the level of the floor. If it is desired to warm the air from these inlets, incoming currents may be made to impinge against iron pipes through which hot water or steam circulates. Special fire-places on the Galton principle may be introduced to warm and assist in the ventilation of the wards. Radiators tend to encourage the collection of dust and add to the difficulties of keeping wards scrupulously clean, except when constructed as part of the ceiling.

When mechanical systems of ventilation have to be depended on, the Plenum method is usually employed.

The floors and walls of wards should be smooth and readily cleaned, and as few acute corners as possible should be permitted in the construction.

For convalescing patients, or for those likely to benefit by open-air treatment, roofed verandahs should be introduced at the ends of the wards.

Sanitary and other annexes are disconnected from the wards by passages having cross-ventilation provided by windows on each side wall of these passages. It is beyond the scope of this volume to enter into details regarding the erection of special wings or blocks for such departments as Gynaecology, Skin Diseases, Venereal Diseases, Electrical Treatment, and so on. But side-rooms, each providing accommodation for two or four patients, should always be introduced in connection with each ward. For observation purposes, as well as for delirious or special types of cases, side-rooms will be found of great value.

**Isolation or Fever Hospitals,** as they are often called, are (with the exception of those controlled by the Metropolitan Asylums Board in London) maintained and administered by Sanitary Authorities. And before such a hospital can be erected its site, design, with detailed plans and proposed cost, must be approved by the Ministry or Department of Health in England and Scotland respectively. The site selected need not be in the heart of the population of any community. Rather the reverse, because patients recovering from infectious diseases will have their period of convalescence materially shortened if they are privileged to enjoy some freedom of movement in the purest air. This desirable factor in treatment will be best secured if the Isolation Hospital is situated somewhere near the outskirts of any populous area. Transport has been so much accelerated by the introduction of motor-propelled vehicles that distance from the city or town being served is no longer of such great moment. Having fixed on the site and its extent, which should be on the generous side, never under one acre to 30 beds, the next point to consider is its capacity for patients. While the old rule was to allow 1 bed to every 1000 inhabitants, it is always advisable to grant 1 bed to every 800 of the population. For towns of moderate size 1 bed for every 1000 of the population may suffice. During epidemic periods the possession of a surplus number of beds will be found extremely valuable. The modern practice of treating serious cases of Measles and Whooping Cough in Isolation Hospitals is growing, so that during widespread epidemics of those two highly fatal maladies the demands on the hospital have often led to serious overcrowding of the wards. Influenza, with its complicating Pneumonia, is now a notifiable disease. There, also, during epidemic waves, the bed accommodation may be taxed to its utmost limits, because coincident with the prevalence of

Measles, Whooping Cough and Influenza, cases of other notifiable diseases may require to be isolated in hospital. The Ministry and Department of Health insist on the erection of boundary walls, 6 feet in height, to enclose the hospital territory. Also, at least 40 feet of free space must intervene between the wards themselves and the boundary walls. Whether the hospital is to be built of brick, stone, or of wood and iron, will be decided by local circumstances. Stone buildings are at least 25 per cent. more costly than those built of brick. When brick is employed, the hollow-walled system must be adopted. Hospitals of a more or less temporary nature, and constructed of corrugated iron and lined internally with wood, have a comparatively long life, especially if periodical painting of the external ironwork is practised. Their disadvantages may be exaggerated when the criticism is made that they are apt to be too warm in summer and cold in winter. These faults can be overcome by judicious use of windows and heating systems. Infectious Diseases Hospitals demand the same "orientation" as General Hospitals. The ideal Isolation Hospital should be built on what is known as the Butterfly plan, with 150 to 200 square feet of floor area, and 12 feet allowed for each bed. An allowance of 2000 cubic feet per bed is the rule in Infectious Diseases Hospitals. In Typhus and Smallpox wards the space aimed at is 3000 cubic feet. Window space should be 1 square foot for every 80 cubic feet of ward space. If such construction were adopted the ward kitchen, nurses' sitting-room and the observation-room for special or doubtful cases would take the place of the body of the butterfly, the wards acting as the wings incompletely expanded. That arrangement receives the full advantage of sunshine. Each ward block should command a recreation space for the convalescing patients.

Many authorities with liberal bed provision in their Isolation Hospitals set aside special wards for patients who have reached the convalescent stage. In connection with large cities, it is not unusual to find Isolation Hospitals built of two stories. This saves space in the lay-out of the various buildings.

If the hospital is on the outlying parts of a community, natural ventilation will fulfil the requirements of well-aired wards. The fewer mechanical devices embodied in connection with windows the less risk there will be of breakdown of levers, rusty and noisy screws, and dust collection. Heating by open fires provided with adequate fire-guards will always be found comforting and serviceable. The advantage of central heating consists in its uniform distribution of warmth and the avoidance of dust and noise when fireplaces are being cleaned or fed with fuel. Side-rooms are necessary adjuncts to every ward. Cases of cross-infection and of mistaken diagnosis demand immediate separation from the other inmates of a ward, and the side-room meets a difficulty that frequently arises.

As in the case of the General Hospital, and always keeping in view the possibilities of extensions, the administrative block should be of ample dimensions. This will enable extra staff to be engaged without inconvenience. Disinfecting, Laundry, Bacteriological, Ambulance Blocks, and accommodation for male attendants have also to be provided.

*Cubicle System.*—In some districts each patient is nursed in a cubicle separated from its neighbour by glass partitions. The advantages of this construction are claimed to be that the opportunities of cross-infection are greatly reduced. But the personal factor must always be taken into consideration when such an argument is advanced.

Careful nurses can be relied on to avoid risks. Those who are not so careful may "let the system down."

**Smallpox Hospitals.**—For the isolation and treatment of Smallpox the Ministry and Department of Health have issued special recommendations, because it is believed that there is danger of spreading the disease through the air to those living within specified distances from the hospital. That question has been referred to under Smallpox.

Smallpox Hospitals may with advantage be built of cheaper materials than permanent institutions. And in view of the fact that Smallpox is not so commonly encountered nowadays in the United Kingdom, the buildings primarily intended for the reception of Smallpox cases may, when not in use, be appropriately given over to the housing of Tuberculous diseases. Should Smallpox suddenly make its appearance, tuberculous patients may be evacuated almost at a moment's notice. The Ministry and Department of Health urge that no Smallpox Hospital should occupy a site where there will be within a quarter-mile of it either a hospital of any kind, or a workhouse, or a population of 150 to 200 persons. Alternatively, the Smallpox Hospital site must not have within half a mile of it a population of 500 to 600 persons. This includes inmates of institutions or dwelling-houses.

**Sanatoria.**—As may be understood, the site of a Sanatorium should be extensive. Open exposures to the south and west are necessary, and where belts of trees exist or can be grown these may be used to shield the Sanatorium from north or north-easterly winds. The butterfly principle of wards is eminently desirable for a Sanatorium. But the wards should not accommodate too many patients. Also, the window provision must be ungrudging. The more light, air, and sunshine entering a ward the better will it be for the patients. Buildings of a temporary character are eminently suitable for the treatment of Tuberculosis. One of the defects of our present system of dealing effectually with this disease is the shortage of beds for chronic and advanced cases. Only too frequently patients are discharged from a Sanatorium to make room for others who are considered to be in more urgent need of treatment. The discharged cases must therefore return to their homes, often unsuitable, to continue the spread of the insidious disease.

While the incidence of Tuberculosis is gradually falling, it will be many years before the need for Sanatoria will disappear. If the teaching given at school were followed out by the universal use of open windows in the dwelling-houses of the people, and if good, wholesome foods were available, a more rapid reduction of the disease might be confidently expected. The eradication of Tuberculosis among dairy cows will lead us a step further in prevention. Visitation by nurses and attendances at Tuberculosis Clinics only help us half the distance towards prevention. The education given must be translated into practice by contacts and sufferers from Tuberculosis. It is questionable if one bed for every 5000 inhabitants, as recommend by the Departmental Committee on Tuberculosis, is sufficient provision, especially in industrial and badly housed populations.

Where domiciliary treatment is necessary, a shed having one side open to the south or south-west should be fitted up in a garden or open space attached to the dwelling of the patient. Surprisingly good results have been recorded by this simple method, and the ever-present risks of spreading infection in the house are materially reduced.

## CHAPTER VII

## HOUSING

If individuals and Sanitary Authorities followed the ideal principles of housing and the selection of sites in their entirety, every street would face south or south-west and only dry soils would be selected. Obviously these ideals cannot be followed, because the expansion and rapid growth of our populous centres make it necessary to use every square yard of available ground for the development of housing schemes. And modern methods now enable the builder to protect the houses he is going to build against the inroads of damp and ground air.

**Sub-soil Water,** known as **Ground Water,** is found at depths varying between 3 and 300 feet. It is when this ground water is within 6 or 9 feet of the surface of the earth on which houses are to be erected that special methods must be adopted to prevent dampness in the soil from reaching or passing up and into the walls of dwellings by capillary attraction. The level of ground water fluctuates with rainfall, as well as with the character of the land, whether it be level or on the slope. A uniformly low ground-water level is more favourable than one which constantly fluctuates. High ground water in the soil excites rheumatism, as well as catarrhal and pulmonary affections, because the site is likely to be damp and cold.

**Ground Air.**—This is always found in the interstices of the soil. Carbon dioxide is ever present and also, according to the nature of the site, such other substances as ammonia, nitric acid, carburetted hydrogen, marsh gas and coal gas, the latter emanating from broken or defective gas pipes. Ground air is never stationary, being kept in motion by variations of temperature in the soil, by rainfall, by the rise and fall of the level of ground water, by barometric pressure, and by the variations of the slope of the ground itself. Loose, porous soils may contain as much as 40 per cent. of air in their interstices. How houses may be protected against the aspiration of ground air into their interiors will be presently described.

Reference to building sites on unfavourable soil suggests attention to the erection of houses on what is known as made-up or reclaimed land. City refuse from ash-buckets, especially when sorted out to leave only cinders and non-putrefiable materials behind, has been utilised to fill up ravines, ground undulations, and one-time waste land to provide level areas for building sites and open spaces. Every successive layer of such city refuse is top-dressed and levelled with clean soil taken from places where excavations are being prepared for the foundations, etc., of new buildings. Generally speaking, no buildings are begun until reclaimed ground has been allowed to settle for three or four years.

**Building Regulations.**—No new house or building may be erected until its plans, materials, and stability are approved by an appropriate tribunal, appointed by each Sanitary Authority. The width of streets, the distances of houses from one another, the heights of ceilings, the cubic space, the window space, water supply, and sanitary arrangements also must fulfil definite requirements which come under what is known as Building Regulations.

**House Construction.**—The full and intimate details of house construction need not be described. It will suffice if reference is made to the materials employed, and to the measures taken to render habitations fit for human occupation. Having selected the site, the next consideration must be whether stone, brick, concrete, or other material is to be used. Stone ranks first in order of merit, but this material is 25 per cent. more costly than brick. The stone selected may be granite, which is probably more durable than any other material. The proximity of granite quarries to it has enabled Aberdeen to provide buildings entirely composed of this ornate and lasting material. Sandstone is more usually utilised. It may be red or white. " Freestone " is the name frequently applied to describe sandstone, because it can, unlike granite, be easily chiselled and cut into the required shapes. A well-built and carefully designed house of granite or sandstone always commands a better price than one constructed of brick or other material. Brick is now entering into the composition of the vast majority of houses. And when brick walls are erected it is the rule to make them double, with a hollow space between them. In most districts it is now compulsory to build " hollow-walled " brick houses. The gap or hollow left between the inner and outer walls serves the dual purpose of protection against the inroads of damp and of acting as a seasonal regulator of cold or warmth. It acts as a sort of thermos cavity so far as variations of climate are concerned. Synthetic stone, possessing a very close resemblance to sandstone, has been introduced to provide frontages for houses so as to enhance their appearance of solidarity. Sufficient time has not elapsed to enable one to speak dogmatically regarding the durability of synthetic stone. But if well made and properly seasoned (allowed to dry), there is reason to believe that it will command a long life. Another durable material occasionally employed, especially in the erection of skyscrapers, has been ferro-concrete. Ferro-concrete buildings have, for instance, been requisitioned to withstand earthquake disturbances. Ferro-concrete has also been employed to form roadways and to resist the destructive effects of heavy traffic. As the name suggests, ferro-concrete consists of introducing strips of metal into concrete so as to form a stronger and more resilient element than stone or brick. Cheap buildings may be hurriedly put together by means of breeze blocks. These consist of mixtures of ashes and cement moulded into required shapes. The proportions of cement used vary between 1 of cement to 3 of ashes. For making partitions between different apartments of buildings, 1 of cement to 5 or 6 of ashes are frequently used. A hollow coffer of wood is temporarily put in position as a mould and the cement and ashes in a semi-liquid state are poured into the vacant space. When sufficient time for solidification has elapsed, the woodwork is removed and the solid breeze wall is left standing in its desired position. When brick or breeze blocks are utilised for building houses it is usual to coat the external walls with harling, sometimes called rough cast. The material used to rough-cast external wall surfaces is usually a mixture of cement and peanut gravel to which water has been added. When sprayed or spread over the walls, their appearance is enhanced. Also the rough casting, if well spread, provides a good protection against rain and the consequent menace of dampness. Too little originality and imagination have been introduced to render bungalows and other houses more attractive than they frequently appear to the naked eye. Different tints added to the harling go far to take away from the prevailing monotony of the many houses that are being so hurriedly put together all over the country.

*Foundations.*—The area of the ground on which a house is to be erected is usually known as its "solum." It is the area within and bounded by the four walls of the proposed building. The "solum" must be covered by a protecting layer of concrete or asphalt to guard against damp and ground air. Having decided on the materials to be used for constructing the walls, the first consideration is to prepare the foundations. When a house is about to be erected a trench is dug. This outlines the size and shape of the base of the structure. After the trench is dug, the next step is to cover the bed of the trench with a layer of concrete at least six inches in thickness. When this solidifies, it provides an impervious layer and a protection against damp. It also offers a firm base on which the beginnings of the walls are laid (see Fig. 1). After the brick or stone foundations have reached the top of the trench, and are on a level with the surrounding ground, two necessary features are introduced into the walls. When the wall is six inches or so above the level of the ground a damp-proof course is inserted into the walls throughout their whole thickness and extent. This, as the name suggests, creates another impervious barrier against any damp which may threaten to creep up into the walls from the underlying soil. The most commonly used material for a damp-proof course is a preparation of asphalt, which is sometimes laid on the

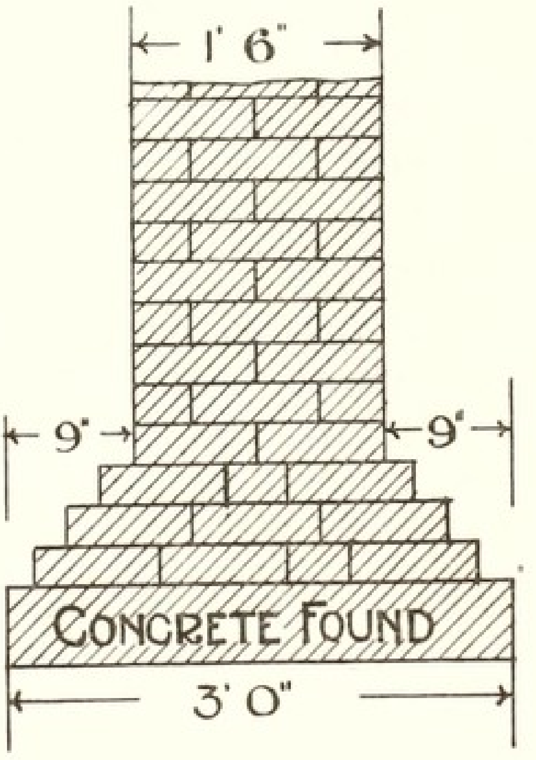


Fig. 1.—Concrete found on which the Wall is built.

wall in the form of sheets, impregnated with bituminous matter. The most commonly used damp-proof coursing consists of molten asphalt spread over the upper surface of the wall. This is allowed to solidify before any addition is made to the wall. Another damp-proof course is frequently laid on the surface of the wall before the roof is placed in position. The defect of asphalt is that the weight of the superimposed stones or bricks flattens out

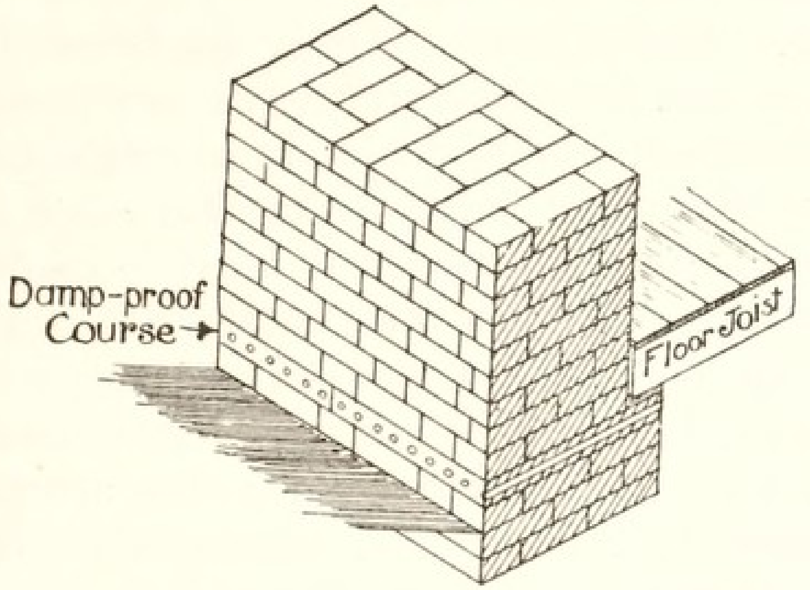


Fig. 2.—Damp-proof Course of Glazed Perforated Bricks which offer Sub-floor Ventilation.

the asphalt to make it a much thinner protecting layer than when originally laid. When glazed perforated bricks are used as damp-proof coursing they are more costly, but the perforations in the bricks supply the required openings for Sub-floor Ventilation (see Fig. 2), and the glazed bricks are sound defences against dampness. An excellent but also comparatively costly damp-proof course can be made by spreading wet cement over the surface of the wall and bedding ordinary slates in the cement. This is known as a damp-proof course of slates bedded in cement. It is not commonly employed in houses that are built cheaply to sell at moderate prices. Sheet lead has been recommended for the creation of a damp-proof course, but it is expensive.

*Sub-floor Ventilation.*—Reference has already been made to this essential feature. Between the earth surface (covered by a layer of asphalt or concrete spread over the "solum") and the floor boards of ground-floor rooms there is a vacant space. This is known as the sub-floor space. It must be adequately ventilated by perforated iron gratings introduced at different parts in the walls of a building. These gratings must be above the damp-proof course and may be noticed in every modernly constructed dwelling. "Dry rot" is a fungus-like growth which usually attacks floors, joists, and other woodwork. "Dry rot" occurs usually where there is dampness with lack of ventilation. Sub-floor ventilation is therefore a safeguard against the development of "dry rot." "Dry rot" in the oldest types of houses is very destructive, and frequently leads to their condemnation on account of their unhealthiness, insecurity, and consequent unfitness for human habitation.

*Disposition of Rooms.*—In planning a house, as many bedrooms as possible should face east, so as to ensure the benefits of the rising sun. Living-rooms should have a southerly or south-westerly aspect. Kitchens, larders, and sculleries should be on the northern sides of dwellings. Chimney flues placed on external, especially north and cold, walls will encourage "back-smoke," because the chimney is difficult to heat. Chimney flues with fire-places placed nearer the central sections of houses will tend to encourage warming and to prevent down draughts.

*Cubic Space.*—In the desire to provide a multiplicity of rooms in newly erected houses the tendency has been to construct dwellings with apartments, bedrooms especially, that are entirely inadequate so far as reasonable cubic capacity is concerned. The smallest room in a habitable house should never offer less than 1000 cubic feet of air space. As will be indicated under the section dealing with the subject of Ventilation, small rooms are more difficult to ventilate, because their air must be changed thrice in every hour. This leads to the creation of draughts. If small rooms are occupied by too many people, their health will be jeopardised. Each adult must have 400 cubic feet of air space allotted to him, and two children under ten are reckoned as one adult where cubic space is concerned.

*Cubical Contents.*—Too much reliance must not be placed on cubic capacity alone. A narrow apartment that is lofty is not nearly so desirable as one that has a good floor area together with the required cubic space. Each inmate of an occupied place must have what is known as "elbow-room." In the narrow and high-ceilinged room that is impossible.

The following figures offer a guide to the cubic capacities provided in different places for each occupant :

| | *Cubic Feet.* |
|---|---|
| General Hospitals . . . . . | 1200 |
| General Hospitals (where teaching is carried on) . . . . . . | 1500–2500 |
| Infectious Diseases Hospitals . . | 2000 |
| Smallpox and Typhus Fever (floor space 144 square feet) . . . | 3000 |
| Army Barracks . . . . . . | 600 |
| Common Lodging-houses (Scotland) . | 400 |
| Farmed-out Houses . . . . . | 400 |
| Houses Let in Lodgings . . . | 400 |
| Common Lodging-houses (England) . | 300 |
| Factories . . . . . . . | 250 |

| | Cubic Feet. |
|---|---|
| Workshops | 250 |
| (for overtime) | 400–500 |
| Seamen's Cabins | 120 |
| Canal Boats | 40–80 |
| Schools (floor space 12–15 square feet) | 120–150 |

*Doors.*—Faults could be found with the disposition of doors in many houses of the present day. When opened they encourage currents of incoming cold air to rush across a room to find ready escape by a fireplace placed in a direct line with the door. Even when the door is closed, and during cold weather, draughts blow through crevices along the floor to reach the fireplace and to chill those who are trying to seek comfort from the fire.

*Windows.*—It is necessary to provide windows in the proportion of one-tenth of window space to the total floor area of each apartment. On the Continent and in America double windows are often introduced to protect the inmates against the extremes of temperatures that frequently prevail during the winter months.

*Internal Walls.*—The internal surfaces of walls are best made of lath and plaster. Thin strips of wooden lathing are affixed to wooden uprights next the inner walls. Then plaster is spread over the laths. The small clefts left between the laths form a good anchorage for the plaster. When the first coat of rough plaster has been laid on with roughened surfaces it is allowed to harden. Then plaster of finer and whiter colour is spread over the first rough layer. In order to hasten the hardening of the second and finer coating, varying proportions of plaster of Paris are sometimes incorporated. When the final coat is dry it is ready to receive wall-paper or suitable paint.

*Roofs.*—Houses are covered by slates, or tiles. The latter, when of varied colours, add greatly to the ornateness of houses. Cheap tiles are not economical in the long run, because they are too readily broken when workmen climb over the roofs to effect repairs or to sweep chimneys. But that fault also applies to cheap and badly laid slates, which should always rest on a layer of felting material to prevent currents of air from penetrating any chinks left between the wooden roofing. Flat roofs, intended to provide open-air facilities during suitable climatic conditions, are difficult to construct, because rain too often finds its way through cracks or defective jointings. Flat roofs must be carefully made if they are to be perfect.

*Food Preservation.*—Apart from the need to place larders and food stores on northern aspects, every new house should possess a freezing-chamber. Several types are now available. Whether it be during summer or winter, the need for keeping milk, fruit, vegetables, meat, fish and other foods in a sound condition is of vital importance. The initial cost may appear heavy, but the electricity consumed is trifling, while much food wastage may be avoided.

*Drainage of Houses.*—Just as building regulations deal with the plans and structures of houses, so do drainage bye-laws, framed to suit the needs of different communities, demand sound design and construction. No house may be occupied until the drainage system has been officially tested and passed by officials of a Municipal Authority. And the test must be made before the trench for the drains has been filled in. Every drainage system must be exposed to the full view of the inspectors when the test is made. Another important point to be remembered is that all traffic conveying heavy goods, such as grates, baths, and weighty fittings, must not pass over newly filled-up trenches, because the joints of the drain may be damaged by the superimposed loads.

If there is no water led into a house (a rare event nowadays) a drainage scheme may not be required. In such cases *Dry Earth Closets* may be found necessary. Such conveniences should be placed at some distance from the dwelling-house and screened from general view by surrounding shrubs or trees. Should the water supply be derived from a well, the location of the earth closet or privy will require to be carefully chosen to guard against risk of pollution. In the case of houses having water supply, but devoid of the facilities of sewers, the alternative will be the construction of a *Cesspool*, which is described later. The cesspool, if required, must be 40 feet distant from any dwelling. If, however, a house is erected within 100 feet of an existing sewer, the proprietor of the dwelling may be called upon to construct suitable drains and to connect them with the sewers that have been provided. If a cesspool had been in use and a sewer was subsequently made available (that is to say, brought within 100 feet of the house), the owner will be required to discard the cesspool and to connect his drains to the sewer. A more detailed description of drains, traps, and sewers is given in another chapter.

**State-aided Housing Schemes.**—A serious effort is now being made to rehabilitate those who have been living in houses that were considered to be unsuitable or unfit for human habitation. And where dwellings are on the border-line between fitness and unfitness, the State and Local Authorities are prepared to assist owners in improving the habitable conditions of such houses. But, generally speaking, internal alterations which frequently entail entire gutting and reconstruction are seldom satisfactory. The costs involved are often great, and the situation of the old structure does not usually provide the amenity expected from improved housing conditions. State-aided schemes have suffered from too much State interference. Different political parties have striven to defeat one another with various alluring and vote-catching offers of financial assistance, and no well-organised scheme of well-planned " lay-outs " has been formulated to guide Sanitary Authorities. In some districts one may observe well-laid-out (town-planned) areas with wide roads, lined by trees, and with open recreation spaces and garden plots assigned to the houses. In other parts of the country ornateness has been forgotten or neglected, with the result that one is confronted with rows upon rows of three- and four-storied one-pattern blocks of tenements which have a close resemblance to barracks. This uninspiring system has been aptly called " warehousing the people." The one advantage possessed by these often densely populated blocks is that they have removed their occupants from less salubrious districts. It is satisfactory to realise that the former occupants of slums have, in the vast majority of instances, appreciated their changed circumstances by keeping their new houses and garden plots in good condition. Careful investigation has revealed that 10 per cent. of those who have migrated from slums to new houses still follow their former courses of carelessness and faulty behaviour. Constant and systematic supervision of these people by tactful female members of Sanitary Departments may gradually effect improvements. It is unfortunate that the rule which forbids lodgers in municipal houses is not more strictly enforced. While the lodger may help to pay the rent, he often promotes the overcrowding which it was desired to avoid.

The vital statistics of our country will tend to improve when slums are cleared, and the dispossessed afforded the opportunity to enjoy the benefits of sunshine, recreational facilities, and more pleasing outlook. Already the physical improvement, especially among the younger generation, has manifested itself in newly developed housing schemes. But if infantile mortality is to be reduced, the personal factor must play its part. The possession of a better house will not suffice to prevent deaths among infants. The mother must take a direct and intelligent interest in the general care of her offspring. The feeding habits of the people must be radically changed. The tin-opener is too often a standby when the greater use of fresh foods is indicated. Intimate contact with the people is necessary to effect these and other called-for alterations in the domestic and personal habits of divergent sections of our populations. The author has experienced the improvements effected by the employment of tactful and trained persons, who were able to enlist the interest of many artisan women in the selection and cooking of simple, nourishing, and economical meals. If our health authorities would give more attention to the practical side of preventive medicine, better results would be achieved than from the writing of elaborate reports replete with figures and statistics. Only a very few read such reports. And the very people who are in most urgent need of guidance pay little attention to discourses on vital statistics. An added impetus has been given to the provision of houses by the various agencies that are prepared to lend money to prospective house-owners. Building societies are now advancing loans all over the country, so that many citizens belonging to what is known as the middle-class section of the population are now in the position of becoming house-owners. Even in this direction, however, the sameness of architectural design and the lack of paint and roof-covering colour schemes have encouraged a monotonous appearance. Scotland especially has suffered. In England the variations of designs and elevation planning have, generally speaking, tended to render the lay-out much more pleasing to the eye.

In rural districts, housing schemes on a big scale are not so urgently demanded. But in mining villages there is need for vast improvements in the housing conditions of men whose underground calling demands the best available home environment that can be given to them. Grants amounting to £100 are now given for the improvement of individual houses in rural areas. This has, in many places, led to the introduction of water supply, drainage, and other improvements.

**Common Lodging-houses.**—In populous centres these institutions are necessities. Everywhere one finds what might be called a nomadic population. For them the common lodging-house offers a good refuge and temporary home. At seaport towns the lodging-house also serves a useful purpose, especially for dock labourers, many of whom are in receipt of casual employment and irregular pay. Common lodging-houses may be municipally or privately owned. Generally speaking, the former are under better and more strict control. They are also better equipped with baths, rest and recreation facilities. The lodgers usually sleep in cubicles, and each man must have 400 cubic feet of air space allotted to him. In another but less desirable type of lodging-house, dormitories are used, in which the inmates sleep in large apartments, the beds being ranged side by side, with, however, the 400 cubic feet of air space still a requirement. Each man does his own cooking at gas or other suitable ranges in a spacious kitchen. Suitable receptacles are provided for cooking and serving food. The lodgers purchase their own food. Hot and cold water for wash-hand basins and baths are also provided. The charge for a bed varies from 6d. to 1/- a night. Municipal lodging-houses, being under strict discipline, are not so attractive to those lodgers who desire full liberty of speech and movement. The cleanliness and sanitary arrangements of all common lodging-houses are controlled by bye-laws. A valuable insight into life is afforded when visiting and interviewing the inmates of lodging-houses, since among the occupants one encounters men who once occupied responsible positions in industry, as well as in the various professions.

**Hostels.**—Sanitary Authorities have not appreciated the full value of hostels. Where private enterprise has provided such places, immediate success has attended their adoption. A hostel is really another name for a working man's hotel. There are many single working men in steady employment and earning satisfactory wages to whom a well-administered hostel has proved a boon. It is preferred to the lodgings which are usually available. A hostel provides each man with a cubicle, a bed and bedding, a small wardrobe or chest of drawers, and chair. There are baths and wash-hand basins with hot and cold water constantly on tap. Writing, reading, and recreation rooms are included. Finally, each lodger, on payment of a weekly sum of 24/- to 25/-, has three good well-cooked meals served to him each day. If he is unable to return for his midday meal, suitable sandwiches and a thermos filled with tea or coffee are prepared for him. When he returns to the hostel, after his day's work is done, a substantial and hot meal is ready for the lodger. Hostels for women are run on similar lines, and with equal success.

## CHAPTER VIII

# AIR AND VENTILATION

THESE are closely related to housing and indoor occupations. Air is not a chemical compound, but a mixture of gases. Air has the same composition all over the world.

It is when we come to deal with vitiated atmospheres that the most marked variations are encountered.

| *Constituents of Air.* | *Volume per cent.* |
|---|---|
| Oxygen | 20·93 |
| $CO_2$ | 0·03 |
| Nitrogen | 79·04 |
| Argon | 0·94 |

Ozone is also present, but is much more evident near mountains and over the sea. Other constituents found in the air are ammonia, coal tar and sooty particles, pollen, debris, aqueous vapour. Such chemical substances as mineral acids may be encountered, especially near industrial centres.

To secure the maximum efficiency for work, play, or rest, an abundant supply of pure air is an absolute necessity.

To appreciate the ill-effects of impure air, it is only necessary to refer to the physical condition of those working in badly ventilated interiors.

In overcrowded class-rooms or badly ventilated institutions it will be generally found that there is a high incidence of sore throats, catarrhal affections of the respiratory tract, pneumonia, bronchitis, and pleurisy.

It must be kept in mind that digestion and metabolism are improved when the individual is surrounded by abundant and constant supplies of pure air. The reverse conditions hold good, since those who work in badly ventilated places suffer from anaemia, listlessness, and want of appetite.

The air that is inspired differs greatly from that which is expired.

Expired air is warmer and more moist than inspired air. It is also increased in volume. It contains fewer particles in the form of dust or bacteria. In fact, under ordinary conditions of quiet breathing the air that is expired contains no bacteria.

| | *O.* | *N.* | $CO_2$ (*volume per cent.*) |
|---|---|---|---|
| Inspired air . . | 20·93 | 79·04 | 0·03 |
| Expired air . . | 16 | 79 | 5·0 |

*Oxygen.*—Slightly over one-fifth part of the atmosphere consists of oxygen. The air of towns invariably contains less than that of mid-ocean atmospheres. But even if the amount of oxygen in the air drops to 15 per cent. or rises to 50 per cent. the vital functions are not affected. Should the amount of oxygen fall to 11 or 12 per cent. the air becomes dangerous. When the oxygen falls to 7·2 per cent. death results. In submarines the signal to replenish oxygen is given when the amount falls to 16 per cent. A candle will cease to burn when only 16 per cent. exists in the atmosphere. An acetylene flame is extinguished when the oxygen content of air falls to 2 per cent. At the other extreme, when there is an excess of oxygen present, the irritation may excite Pneumonia.

The amount of oxygen absorbed will altogether depend on the work being performed. Oxygen is conveyed to the different parts of the body by the oxy-haemoglobin of the blood, the red blood corpuscles being saturated with oxygen. Contradictory as it may seen, the amount of oxygen found in halls crowded with human beings rarely falls below 20 per cent. In the course of 24 hours an average person inhales 36 lb. of air, which is equal to 7 lb. of oxygen. The daily amount of oxygen absorbed is about 2 lb.

*Nitrogen* is merely a diluent. It is of greater value to plants than it is to human life. *Argon*, which was mentioned as a constituent of the air, was discovered in 1894, but so far as known it has no hygienic value.

*Ozone* is formed by electrical discharges and by the friction of large masses of water with the air. These facts account for the presence of ozone near hills and over the sea. Ozone is never found in the air of occupied rooms and rarely in town atmospheres. In large amounts ozone may prove fatal, and even in small quantities it acts as an irritant. Ozone has been used to sterilise water and to disinfect surgical dressings. It is now and again used to revivify the air of occupied places.

*Ammonia.*—The ammonia found in the atmosphere usually comes from the decomposition of organic matter. Less is found in the air after rain, because the gas is absorbed by the water in its downward course. Ammonia is actually an indication of the sewage contained in the air. Put in another way, the ammonia present in the air indicates the amount of living or dead organic matter in the atmosphere.

*Mineral Acids.*—The chief interest attached to their existence in the air is the evil effects they exert on the stonework of buildings. These acids owe their origin to the presence of the products of combustion in the air.

*Carbon Dioxide Gas.*—This is usually present to the extent of 0·03 per cent. in the atmosphere. Another way of expressing its presence is by stating that it exists in the ratio of 3 parts per 10,000 of the atmosphere. The main sources of carbon dioxide in the air are the products of fermentation, combustion, oxidation of organic matters, respiration, and the chemical action taking place in the soil itself. There is more carbon dioxide present near the ground than 10 feet above the surface of the earth. Air collected at high altitudes contains as much carbon dioxide as that at sea-level.

The exhaled breath contains 5 per cent. of carbonic acid gas.

It is agreed that an alteration in the balance of the carbon dioxide in the air would not only change the climate of the globe but would cause the death of human beings. Though the normal amount of this gas is 3 parts per 10,000, the quantities in picture-houses and crowded interiors may rise to 40 or even 50 parts per 10,000. The real significance of carbon dioxide in an atmosphere depends on its source. In an aerated water factory, for instance, the amount may rise to 20 parts per 10,000 without in any way affecting the health of the individual. But where the air is stagnant, and the source of the gas is from human beings, animals, or fermentation, a different condition of affairs holds good. It is then that we begin to consider the evils of polluted and motionless air. Carbon dioxide does not accumulate to any great extent in the actual atmosphere, because it is absorbed by vegetation and water.

On an average a man discharges 0·6 cubic feet of $CO_2$ per hour and a woman 0·4. During the periods of rest a man produces 1 cubic foot of $CO_2$ per hour. A gas jet produces 3 cubic feet of $CO_2$ per hour and gives off 6 cubic feet in the same period. A man vitiates the atmosphere of a room much less than does an open gas jet. $CO_2$ acts as an index of atmospheric vitiation. The gas is not irritating, nor is it poisonous. Large volumes may be inhaled or taken in beverages without causing any noticeable ill-effects. When $CO_2$ is present to the extent of 5 per cent., panting develops ; when 8 per cent. is reached, breathing is distressed. A man will become unconscious when 30 per cent. exists in the atmosphere. Animals die when the percentage reaches 35 to 45 per cent.

A man enclosed in a box filled with saturated air, and with only a small hole let into the box to admit fresh air, will soon be overcome, but he can be quickly revived if a fan inside the box is set in motion.

A man drawing his air supply from the box will not suffer any inconvenience, because he stands outside the box and is surrounded by air in constant motion.

The foregoing experiment proves how an individual working or living in an enclosed place, the atmosphere of which is moist and more or less motionless, can be injuriously affected.

Research conducted in connection with industrial fatigue has indicated that the energy, the output, and the health of the indoor worker are to a great extent dependent on his environment. Moist-laden atmosphere retards evaporation from the skin ; respiration is hampered and the blood is not properly purified. The activity of the heart is hindered and, as a consequence, the brain and the other parts of the body are not supplied with their normal quantity or quality of blood.

For these reasons, well-ventilated factories and workshops, with fans in operation in certain industries, shorter spells of work, greater facilities for recreation, better food, together with Welfare Schemes and medical supervision, are now conspicuous features in many modern establishments.

In factories and workshops the aim is to secure no more than 10 parts of $CO_2$ per 10,000 parts of air at the breathing level of the workers.

$CO_2$ is no longer looked upon as a waste product, but as an important constituent of the body. It helps to regulate the heart's action, balances the tone of the blood-vessels, and stimulates the respiratory centre in the brain.

A worker is much less efficient in a warm and moist atmosphere than in one where the air is dry and cool. It has been found that work is not satisfactorily carried out when the temperature is above 65° F. (see under Industrial Diseases).

Stoves, more especially if their exhaust gases are not properly carried away by an adequate chimney flue, may cause serious vitiation of internal atmospheres by carbon dioxide and the still more dangerous carbon monoxide gas. Water gas, now rarely used in this country, gives off nearly 50 per cent. of carbon monoxide. Water gas is manufactured by passing jets of steam over incandescent coke. Water gas was used to improve the lighting properties of ordinary gas. The chief danger of water gas consisted in its odourlessness, consequently its presence could not be detected by the senses.

Effluvia from offensive trades, and from the manufacture of chlorine and other chemicals, also add to the vitiation of atmospheres.

Government Inspectors maintain supervision over chemical works under the Alkali Regulation Acts, while in the case of offensive trades the public health officials are responsible for the enforcement of bye-laws which control the conduct of businesses giving off effluvia.

The ventilation of many houses, schools, public buildings, places of entertainment, and of churches is often far from satisfactory. Deficient ventilation is commonly encountered, excessive ventilation being the exception. Draughts are felt when the speed of air currents exceeds 4 feet per second. It is much more difficult to ventilate a small room than a big one. The accepted rule is to change the air of an apartment thrice every hour. A small space is quickly filled and emptied, whereas the larger interior can be much more slowly dealt with; consequently, draughts in the small apartment will be much more liable to occur.

The secret of successful ventilation is to keep the air in slow but constant motion, to avoid humidity of the atmosphere, and to maintain an equable temperature.

Ventilation as generally practised may be *natural* or *artificial*.

In the case of natural ventilation, windows, doors, chimneys, perforated bricks, Tobin's Tubes, Arnot's Mica Flap-valves, McKinnell's Ventilators, Galton's Ventilators, etc., provide the leading examples. The most simple form of natural ventilation is provided by the partially lowered top sash of a window on the one hand, or the raised lower sash on the other. In the latter case a wooden board fills the gap left by the raised lower sash, leaving an opening between the upper and lower sashes at their junctions for the admission of fresh air into, or the escape of foul air from, the apartment. This constitutes Hinckes-Bird Window Ventilator (Fig. 4). If either of these simple expedients were generally used in the occupied rooms of dwelling-houses, greater benefit to health would result.

The modern type of house is provided with such small rooms that the lowering of the top window sash invariably provokes complaints of draughts. The Hincke's Birds system offers a good and safe alternative. It must not be forgotten that a fire burning in a room will aid considerably in ventilation; because a considerable volume of warmed air is sucked upwards from an occupied apartment (see also under Heating by Open Fires).

Foul air in occupied rooms, after being heated, expands

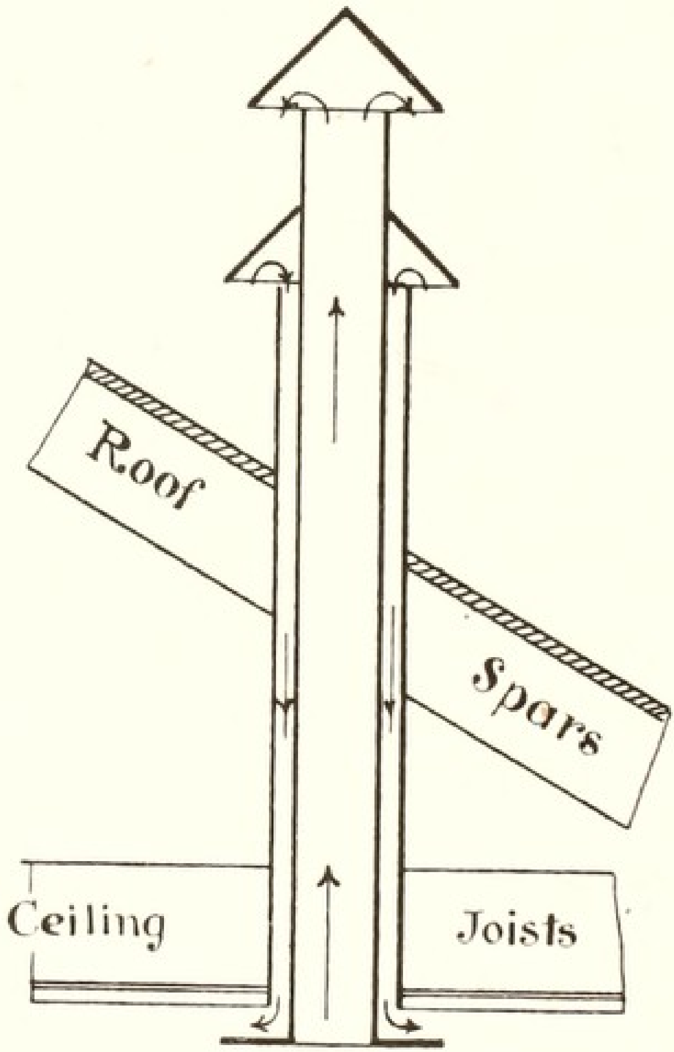


FIG. 3.—MCKINNELL'S VENTILATOR, WHICH MAY BE PLACED ALONG THE RIDGE OF THE ROOF OF A BUILDING.

The arrows show the direction of incoming (heavy) fresh air, and outgoing (warmed) air.

and rises. This foul air may collect near the ceiling if exit openings are not provided by McKinnell's Ventilators (Fig. 3), or lowered window sashes, or by mica flap-valves. To obviate the noise sometimes made by the rattling of mica valves, silk may be substituted. These valves may be let into the wall near the ceiling, but a better method is to fit the valve over the line of the chimney flue, so that the foul air may be sucked into a space surrounding the chimney. This space is heated by the warm air in the flue and so encourages the aspiration of air from the apartment it is desired to ventilate.

Tobin's Tubes are sometimes of value when rooms are placed in the heart of a building, where windows on external walls are not possible (Fig. 5).

Building Regulations preclude such a construction for habitable rooms, so that Tobin's Tubes will be rarely utilised for dwelling-houses.

Perforated bricks built into the wall will be more applicable for ventilating stables and places where animals are kept (Fig. 6). In hospital wards the Galton type of stove serves the double purpose of providing heat and ventilation. The value of the open fireplace as an aid to ventilation, and with a bright fire burning in it, will be discussed under Heating.

Slight ventilation of houses is carried on through bricks or sandstone, which are more porous than granite.

**Mechanical Ventilation.**—This implies the introduction of motive power as opposed to the natural agency of the diffusion of gases.

In natural ventilation, foul air, after being warmed, rises to find an escape. In mechanical ventilation that rule is often broken.

The mechanical systems are the (1) *Plenum*, (2) *Vacuum*, and (3) *Balance Methods*.

In the *Plenum* or *Key's System* (see Fig. 7) air is forced into an apartment at a point above the heads of the inmates, and foul air is extracted or pushed out at or near the floor level. It is the force of the air pumped in that

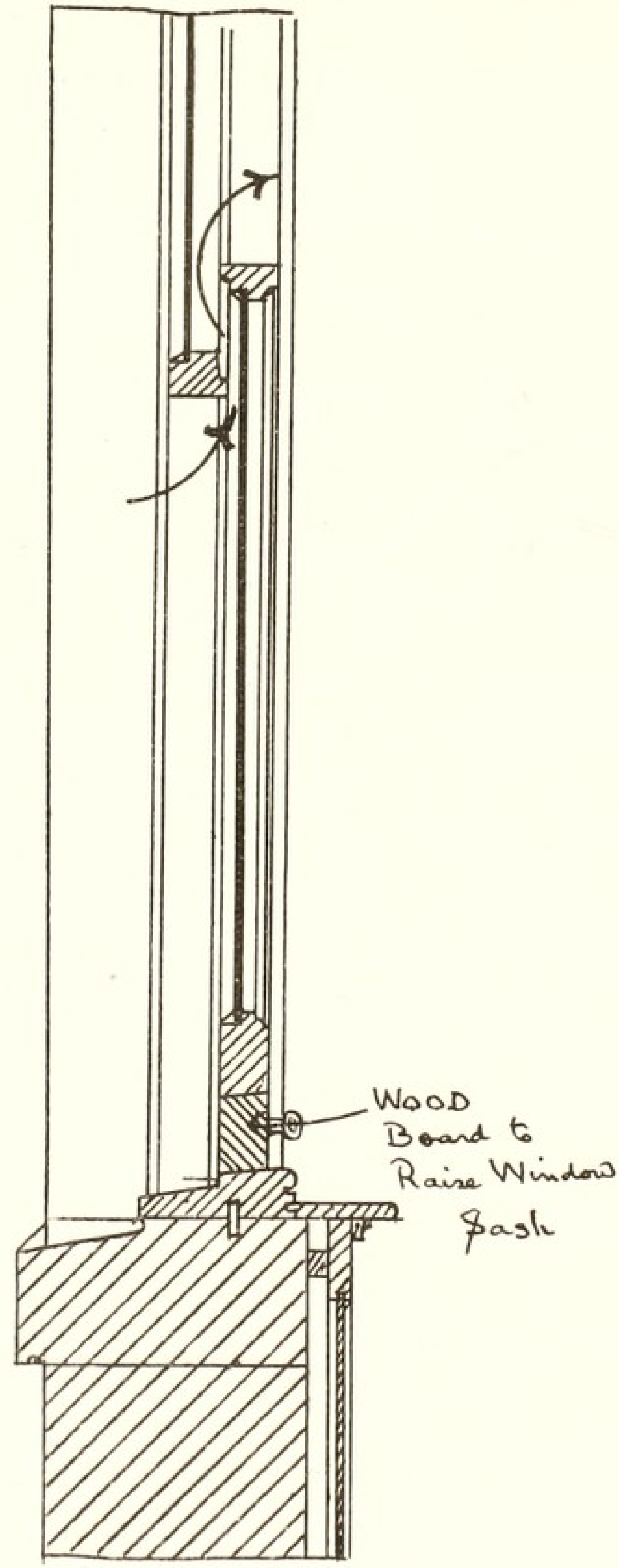


FIG. 4.—HINCKES-BIRD WINDOW VENTILATOR.

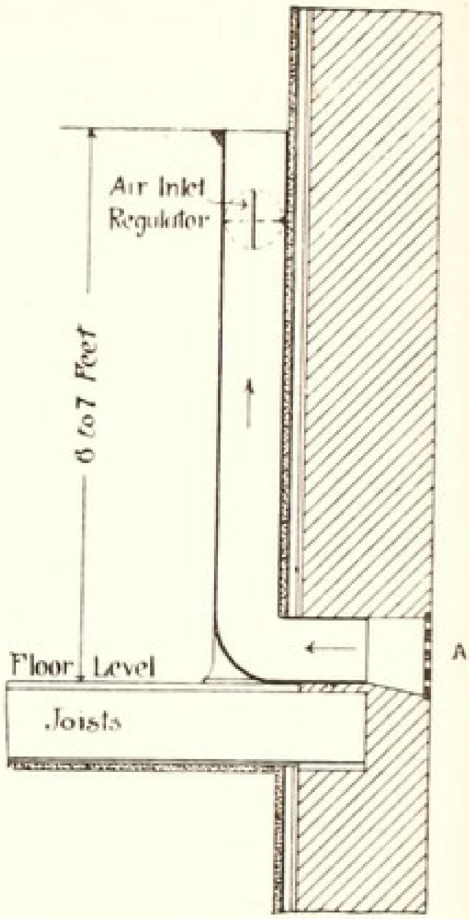


FIG. 5.—TOBIN'S TUBE.
Fresh air enters at A.

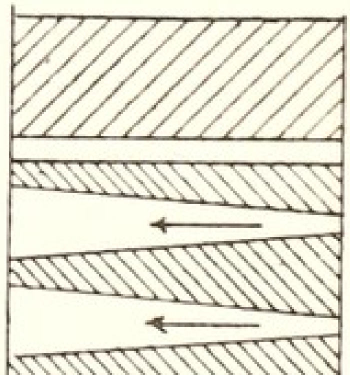

FIG. 6. — PERFORATED BRICKS.

The arrows show the direction of incoming air.

compels the used air to find a way out. As the outlets are usually near the floor level, they offer the only avenue of escape. Only in exceptional circumstances should the Plenum or Vacuum Systems, or the compromise between the two, known as the Balance System, be advised. This may happen when a school, or factory, or other institu-

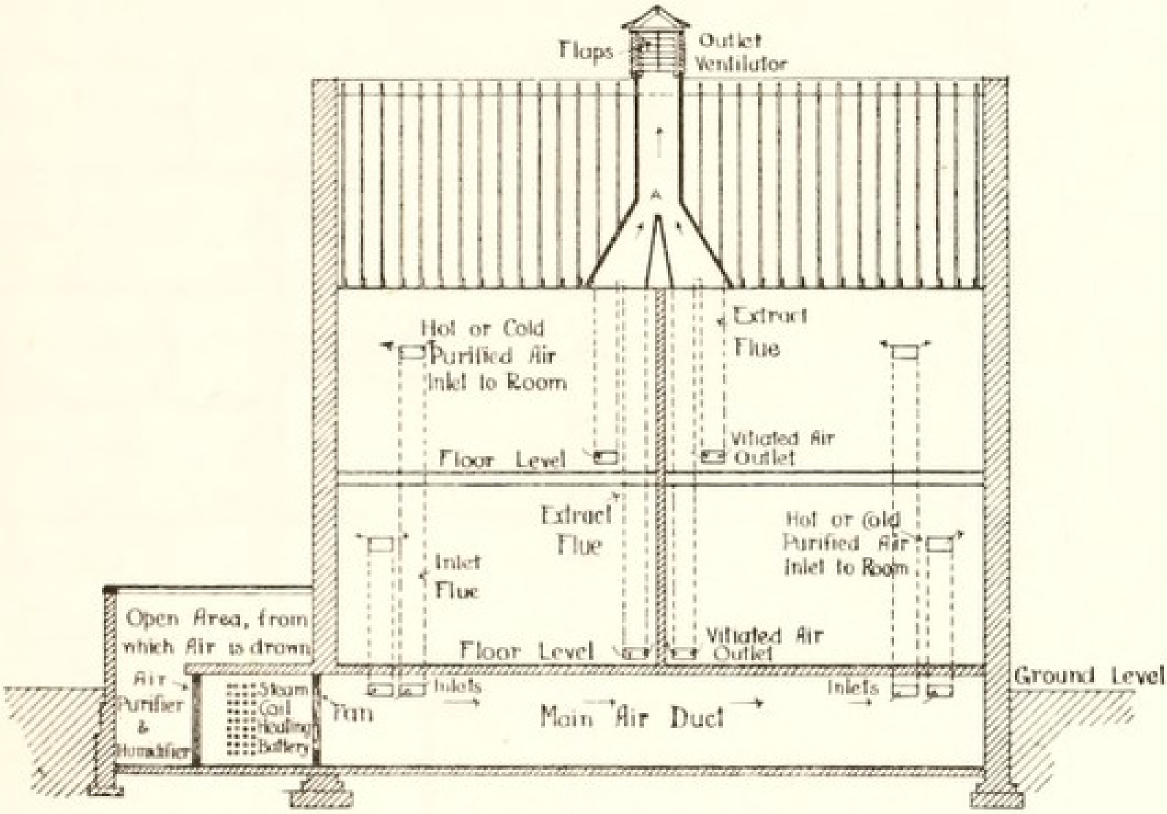


FIG. 7.—PLENUM SYSTEM.

The fan draws fresh air through the air purifier, and in winter over steam pipes (the heating battery).

tion is erected near the centre of a city, in a locality where natural ventilation will be difficult to operate with satisfaction.

In the *Vacuum System* the air is sucked out of a building by fans.

In the *Balance System* there is a combination of the Plenum and Vacuum Methods.

The disadvantages of mechanical systems are : (1) their initial expense ; (2) their cost of maintenance, supervision, and operation ; (3) their liability to break down ; (4) windows and doors must be tightly closed if mechanical ventilation is to be successful ; (5) this is a bad object-lesson for scholars, who ought to be impressed with the value of open windows in their own homes ; (6) the

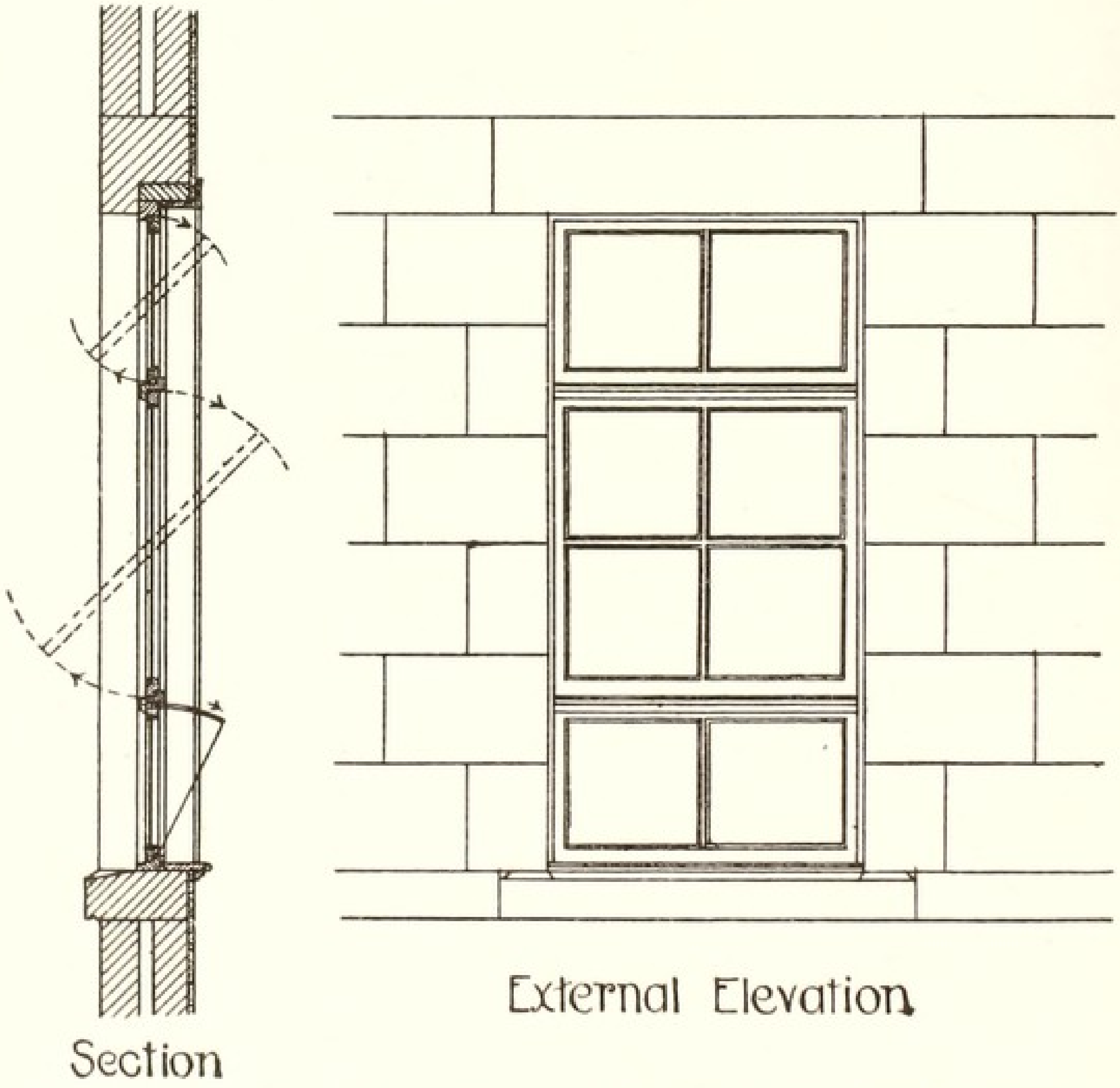


Fig. 8.—Natural Ventilation by Simple Window Device, made to open in Three Different Sections.

monotony of the quality of the air in mechanically ventilated interiors is a decided weakness ; (7) the air is too dry, and this causes a drying of the mucous membranes of the throat ; lack of humidity in the air being a common fault in mechanical systems.

In the *Plenum System* mechanically operated fans draw the external air through filters of fabric such as jute, which may be kept moist in summer. In winter, on the other hand, the incoming current of air may be passed over coils of pipes through which steam circulates (Fig. 7).

The ventilation of schools and factories is always of vital importance. In schools a great deal depends on the teachers. If the teacher says he or she dislikes cold, the ventilation of the class-room will rarely be satisfactory. The reverse will hold good if the teacher is a fresh-air enthusiast. School medical officers should make it one of their first duties to lay down definite instructions regarding the ventilation of class-rooms (see under School Construction).

It will be a waste of time to give lectures on hygiene to teachers and scholars if the precepts are not put into practice by teacher and taught (Fig. 8).

## CHAPTER IX

# ATMOSPHERIC POLLUTION

THE advice often given to seek rest and a complete change of air is usually prompted by the knowledge that such change will be to some part of the world where the air is pure, free from dust and cloud, and also where the ultra-violet rays of the sun can exert their beneficial influences. It is usually the smoke pall which hangs over our populous centres that prevents the sun from doing its good work. And it is unfortunately true that this screen of smoke hangs over the most densely populated parts of our cities. It has been computed that this smoke barrier keeps 40 per cent. of sunshine from glowing with its full effects on many industrial communities. Thus, defective sunshine, coupled with overcrowding, density of houses, narrow streets, and faulty environment, all play their parts in causing ill-health. Every year when the fogs and the hazes of winter recur, the vital statistics of many districts appear at their worst. Fog is specially inimical to those who suffer from pulmonary affections. Fog is moisture in the atmosphere in which particles of soot become enmeshed to form dense and almost impenetrable screens. Even the healthy adult finds it difficult to breathe with comfort when fog is prevalent. The discomforts suffered by sufferers from Asthma, Bronchitis, and Pulmonary Tuberculosis become exaggerated, and a continuance of fog invariably sends up the death-rate from pulmonary and heart diseases. The existence of the smoke screen and fog cannot be entirely ascribed to the emission of smoke from factory chimneys, though they do play a big part in causing atmospheric pollution. This is evidenced by the sudden improvement in overhead atmospheric conditions when, during holiday periods and on Sundays, the factories are not in full operation. Much has been done within recent years to persuade owners of factories to reduce the emission of smoke from furnaces. Special smoke inspectors are now detailed to make photographic observations on offending chimneys. A series of consecutive photographs, taken over five or ten-minute periods, offer good and unanswerable evidence regarding undue smoke emission. A certain period is always allowed for stoking, during which some black smoke may be permissible. But with the introduction of smoke-consuming devices and with good stoking, it has been found possible to reduce the emission of smoke from factory chimneys to negligible proportions. By reducing the quantities of black smoke from coal-burning furnaces, appreciable savings in consumption can be recorded, because the smoke allowed to escape is combustible material. A great deal depends on the personal factor. If firemen and stokers are zealous and careful, the amount of smoke allowed to escape from a furnace will be much less than in those cases where the furnaces are given little more than passing attention. In point of fact, the need for introducing expensive smoke-consuming devices may not occur if furnaces are carefully tended by good stoking coupled with the correct admixture of air through the furnace doors.

The chief atmospheric pollution offender is the domestic coal fire, and not until a non-smokeless fuel is in general use need we expect any dramatic change or reduction of smoke. Such fuels are now on sale, but their price is as yet too high to compete successfully with ordinary coal. Gas and electricity used for cooking and heating are increasingly playing their parts in improving atmospheric conditions. But gas passes into the air chemicals that are injurious to plant and animal life. The advice frequently offered to burn all household waste, such as vegetable debris, is of questionable value, because the slow combustion of vegetable leaves, potato-peelings, fish bones, etc., leads to the emission of dense and often evil-smelling smoke.

Much yet has to be achieved before the conditions of the atmosphere over populous places can be materially improved. And, as has been suggested, the introduction of a smokeless fuel at a reasonable price offers one of the best hopes for rendering the domestic fire more or less innocuous.

In the midlands of England, 539 tons of soot were deposited on one square mile of an industrial centre in the course of a year. Whereas in the outlying suburbs of the same city, and during the same period, 25·7 tons fell on a similarly measured area. It has been calculated that in London alone 400 tons weight of soot are deposited each day. This means that London is being deprived of the benefit of a sixth of its available sunshine and bright light during the summer months.

Air pollution is caused by dust, effluvia, and soot, together with partially consumed hydrocarbons, tar, and volatile matters. Sulphur is also discharged into the air in appreciable amounts from the sulphides contained in coal consumed in fireplaces and furnaces. The sulphur makes its appearance in the atmosphere in the form of sulphur dioxide, to become converted into sulphurous acid. When rain washes this chemical down on plants and buildings, it exerts a destructive effect on them.

## CHAPTER X

# HEATING AND LIGHTING

For the warming of houses open fires are mostly favoured in this country. In America and on the Continent, where the winters are longer and more severe, stoves and central-heating devices are preferred.

Heat may be diffused throughout an apartment, large or small, by radiation, convection, and conduction. The open fire, to be presently described, heats mainly by radiation. This means that only the surfaces played on by the heat radiated from the fire are warmed. Convection is the method depended on for heating interiors by stoves, steam, or hot-water pipes. The principle at work is the following: the air of a room, coming into contact with the heated surfaces of stoves, etc., becomes warmed and immediately rises towards the ceiling. The warmed atmosphere is replaced by one layer of cooler air after another until the whole air has its temperature raised. Conduction means that a cold object on coming into contact with a warmer one borrows heat from the warmed part. A hot-water bottle warms cold feet in that manner.

**Open Fires.**—These heat mainly by radiation, though in a minor degree convection currents may be set up from the parts (brickwork and hearths) heated by the fire. From the standpoint of heat production and coal economy, open fires are wasteful, because five-eighths of their heat escapes up the chimney. The warmed air so lost is replaced by currents of colder air coming through windows and doors and any other crevices. These may and do excite sufficient draught which causes discomfort, the feet frequently suffering. Open fires are not well suited for warming large buildings. At any time they are extravagant and add considerably to air pollution, especially when coal is used. Smokeless fuel is still too costly for general use. On the other hand, open fires are cheerful and, because there is a flue to encourage ventilation, there is little impurity from the results of combustion. Chimney flues considerably aid in ventilation by drawing foul air out of rooms. The disadvantage of creating floor-level currents of incoming air has been mentioned. From the standpoint of extravagance, it is the case that a fire consumes on an average about 8 lb. of coal every hour. Since every pound weight of coal requires 300 cubic feet of air to complete its combustion, 2400 cubic feet of air must be hourly admitted to keep the coal in a state of activity. It has been computed that between 20,000 to 40,000 cubic feet of air daily pass up the chimney flue of an active fire. With that knowledge before him, the architect or house designer should be advised to place doors in such positions that they do not encourage currents of incoming air to flow in direct lines to a fireplace. Too often this precaution is neglected or overlooked. When it is known that between 60 to 90 per cent. of the heat from a fireplace is lost up the ordinary chimney, it is not surprising that various attempts have been made to devise economical grates. The well or sunk fire is one. Being low set, it derives its fresh-air supply from the sides of the fireplace or from underneath it. As a further improvement, it is now usual to introduce as much fireproof brick material into the construction of modern fireplaces as possible. This enables the fireplace surroundings to retain heat for longer periods than when stone or iron is wholly employed. Reference to Fig. 9 will indicate the outstanding features of a heat-saving fireplace. The fire is sunk, fresh air enters its sides, the back of the brickwork forms an elbow to project forward. This, with the brickwork,

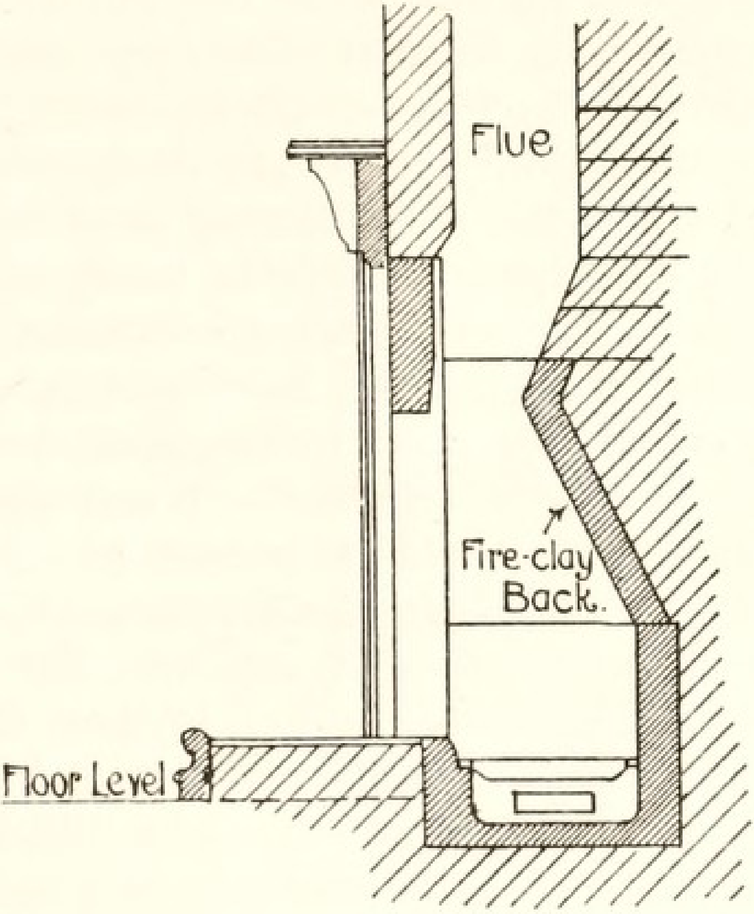


FIG. 9.—LOW-SET FIRE AND ECONOMISER WITH SIDE OPENING.

conserves and throws out more heat. The neck of the flue is narrowed to reduce the loss of heat, and, finally, the fireplace is deep, that is, it recedes under the projecting elbow. The openings at the sides of the fire-grate enter a small chamber. These openings can be reduced to admit sufficient air to the chamber to keep the coals burning brightly. This device is called an "economiser," for reasons that are obvious, since the more widely the sides are opened the more quickly and actively will the fuel burn, and *vice versa* when the openings are closed.

Modern types of stoves, such as Galton's, are frequently used for heating hospital wards and large interiors. In their case the use of an upright chimney flue may be dispensed with, because the intakes of fresh air are carried through gratings in the side walls, beneath floors, to enter below the fireplaces. Outlet flues are also conveyed under the floors and up through the side walls. These and other stoves of a similar type are designed to provide radiated and convected heat, because their fireplaces are surrounded by glazed tiles which, on being warmed, help to set up convection currents. Conduction also plays a part in the production of heat from these stoves. Iron stoves are always open to suspicion, because they are liable to become overheated. When that happens they split up the carbon dioxide content of the atmosphere of a room to release carbon monoxide. Also, if the apartment is overcrowded, organic effluvia may be singed to cause disagreeable odours. Because they may be overheated, iron stoves are liable to make the atmosphere of an apartment very dry. To atone for this lowering of humidity, dishes filled with water may be placed near the stove to lend more moisture to the atmosphere. Anthracite stoves are valuable, because they give a consistent heat and consume an almost smokeless fuel. They are practically dustless and demand little attention. But the greatest care must be taken to secure tight junctions for the pipe which connects with the outlet flue. Poisonous fumes are given off by anthracite, and those who sit for prolonged periods in places where anthracite stoves have been badly fitted often suffer from headache and anaemia. Gas fires, like anthracite stoves, must possess perfectly fitting and gas-tight outlet flues. Even when a gas fire burns constantly in a room, it is, in spite of its position in a fireplace provided with an adequate flue, liable to produce disagreeable effects. The most modern types of gas fires must always be selected for providing heat. Their advantage over electric fires is that they do induce currents of air to be drawn into the fire to be sucked up the heated chimney. Electric fires, like gas fires, are specially convenient when heating is quickly required, and for temporary purposes. They may be instantly set in operation and as quickly put out of action. Electric fires, like gas fires, if constantly kept burning, are apt to dry the atmosphere. But electric radiators excel gas fires in that they cannot emit any gases or effluvia. As has been said, it is mainly in America and on the Continent that central-heating systems are preferred to open fires. Broadly speaking, two systems are employed, the one operating on the low-pressure (thermo-syphon) principle, the other being the high-pressure installation. Both depend on the establishment of convection currents to achieve their purpose. The decided objection to central heating is that the warmed atmosphere has too little relative humidity in it. It becomes dry and monotonous. One may become accustomed to its uniformity, but those who are expected to speak for long periods in such dry atmospheric conditions frequently suffer from persistent cough, which is evidence of the extraction of moisture from the delicate mucous membranes of the upper air-passages. When central heating is badly con trolled, this excessive warming may be exaggerated to such an extent as to reduce the mental and other physical energies of the individual subjected to the somewhat debilitating heat. The temptation to overheat interiors is always strong when the external temperatures are very low, as happens during winter.

When central heating is combined with mechanical ventilation the foregoing faults are apt to be intensified, because the success of mechanical ventilation depends on closed windows and tightly fitting doors. These are bad object-lessons, especially for school children. The

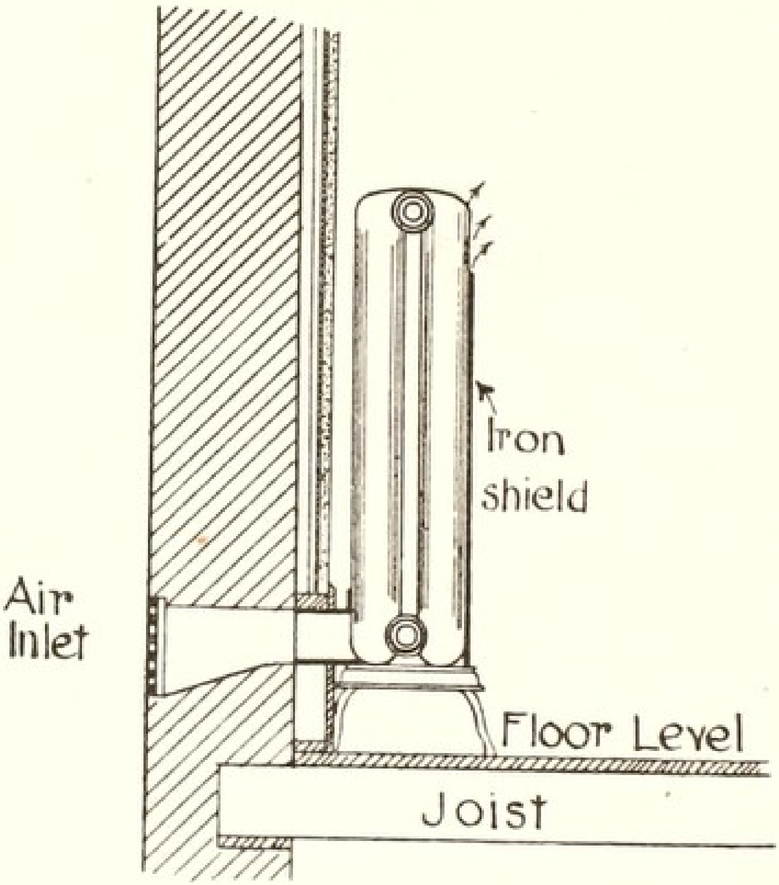


FIG. 10.—RADIATOR.

Through the radiator steam or heated water circulates. Fresh air entering through a perforated grating impinges against the radiator to warm the incoming air. Convection currents, created by contact with the radiator, also heat the air of the room.

most comfortable temperatures for rooms are between 56° F. to 60° F. If hot-water pipes or other devices, such as radiators, are supplemented by open fires in class-rooms, better results, from a health-giving point of view, will be assured (see Fig. 10).

*Electric Elements for warming Interiors.*—A recent adaptation consists in enclosing electric elements in metal tubes which run along the floor levels. The incandescent elements heat the tubes and impart a pleasant warmth to the atmosphere. This device is useful where the heat is required at a moment's notice, since it can be turned on and off by moving a switch. If wisely employed it is not costly. For providing domestic hot-water supplies, the open fire with its dust-provoking and difficult-to-clean flues is being replaced by gas and electricity. In both of these systems a thermostatic attachment regulates the amount of gas and electricity required. When, for instance, the water in a copper tank becomes very hot, the thermostat cuts down the gas jet or reduces the electric supply. Whereas the cooling of the water puts the thermostat into reverse action to release the supply of gas and electricity. The advantages of these new systems are that their employment avoids the emission of smoke and gets rid of dusty flues. Greater and more constant supplies of hot water for all domestic purposes can be promised by these new methods.

## CHAPTER XI

# DRAINAGE

In rural districts especially, where no water-carriage system has been provided, recourse must be had to privies or dry earth closets. Both are perfectly satisfactory if

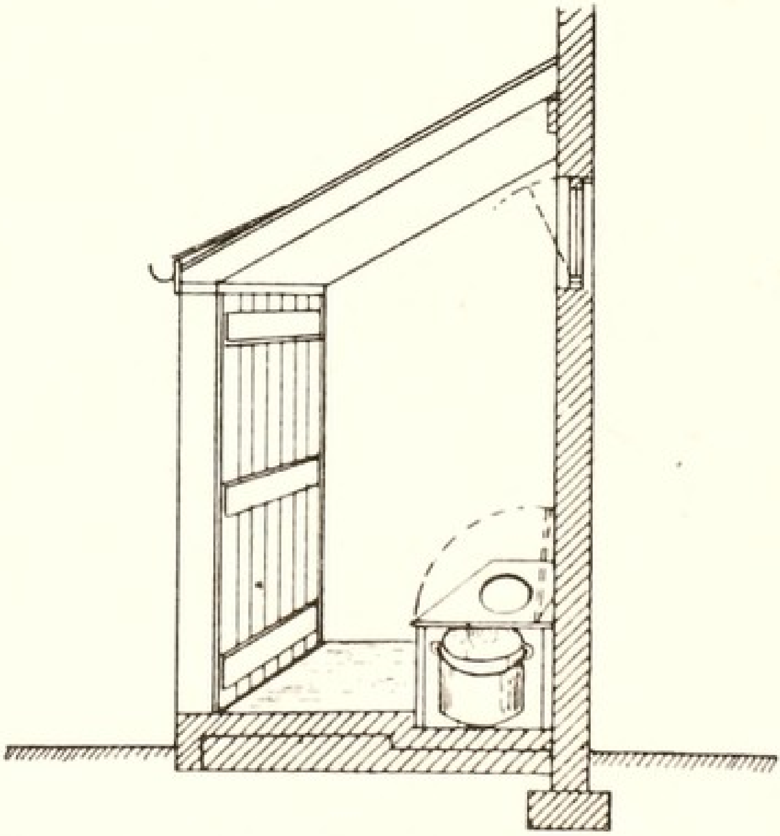

Fig. 11. — A well-constructed Privy, lighted, ventilated, and covered in, with Cement Floor.

well constructed, periodically emptied, carefully looked after, and kept in a good state of repair (Fig. 11).

Privy-middens, which may yet be encountered in some districts, are most undesirable. They encourage the pollution of the soil, the breeding of flies, the creation of effluvia, and in dry weather the diffusion of dust. Where privy-middens still prevail, Enteric Fever usually recurs, and may even be endemic. Short of providing a complete sewage system, cesspools may be installed. These will only be possible where a water supply has been

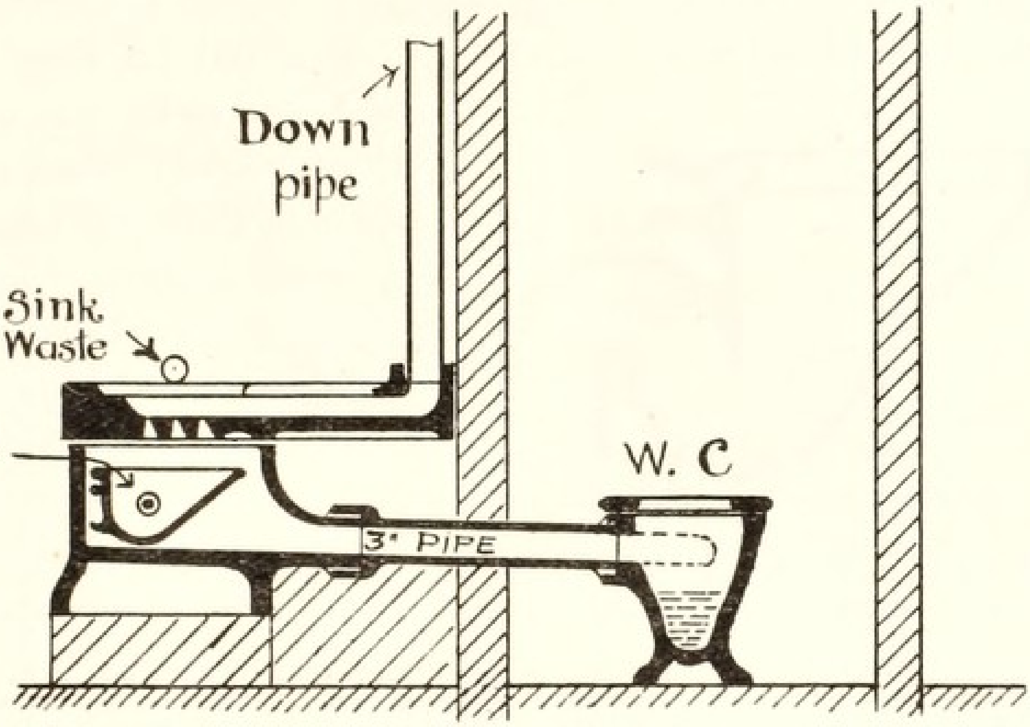


FIG. 12.—SLOP WATER-CLOSET.

When the tipper fills it decants to empty its contents, which flush out the W.C., situated in a separate compartment.

led into houses to flush the water-closets. But the cesspool must be forty feet away from the house, and, in addition to keeping it at a safe distance from wells or water supplies, it must be a brick compartment, the walls and floors of which are rendered impervious with cement, to make the cesspool water-tight.

Often the difficulty will be to secure a piece of vacant ground over which the liquid from the cesspool may flow to complete a satisfactory scheme for disposing of the household sewage. Experience will show, as it has done in the past, that in properly constructed covered-in cesspools the solid portion of the sewage will gradually become liquefied by the putrefactive process excited by anaerobic micro-organisms.

In some parts of the midlands of England, where the water supply is scarce, the slop water-closet principle has been introduced (see Fig. 12). As the name suggests, the household slop waters are diverted to flow into the water-closets to wash out their faecal contents from time to time. There is little to commend such a system, apart from its water-saving value.

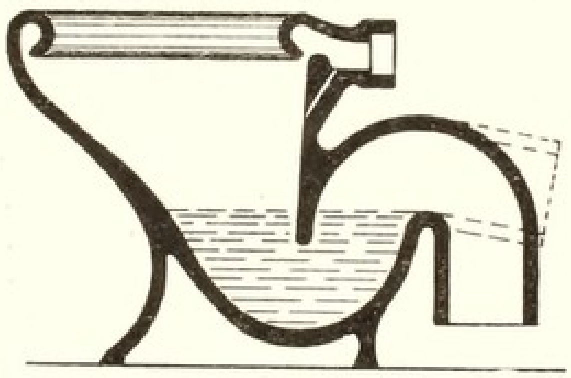

Fig. 13.—Short Hopper Closet with Water Seal.

In the ordinary water-carriage system, water is led to small cisterns (*Waste Water Preventing Cisterns*), each of which contains about three gallons of water. When a syphon is set in operation by pulling the chain attached to the cistern its contents are completely emptied to flush the closet, which should be of the *Short Hopper* and *Wash-down* variety (see Figs. 13 and 14). This type of closet offers a reasonably wide area of water to receive dejecta, with few exposed surfaces to become soiled.

The short hopper should have a *Water Seal* at least two inches deep. The joint between the water-closet outgo and the soil pipe must be carefully made, because defects at this point may allow effluvia to enter the water-closet apartment (Fig. 14).

The *soil pipe*, into which the dejecta pass, runs up and down the external wall, and is never less than four inches in diameter. It extends upwards above the eaves of the house, where its open end is protected by a wire netting to prevent birds building their nests in the mouth of what is known as the *ventilating end of the soil pipe* (see Fig. 15). This opening must be at least nine feet distant from the window of any room. Following the soil pipe downwards, it disappears under the surface of the ground at the base of the wall to become the house drain. This in turn continues

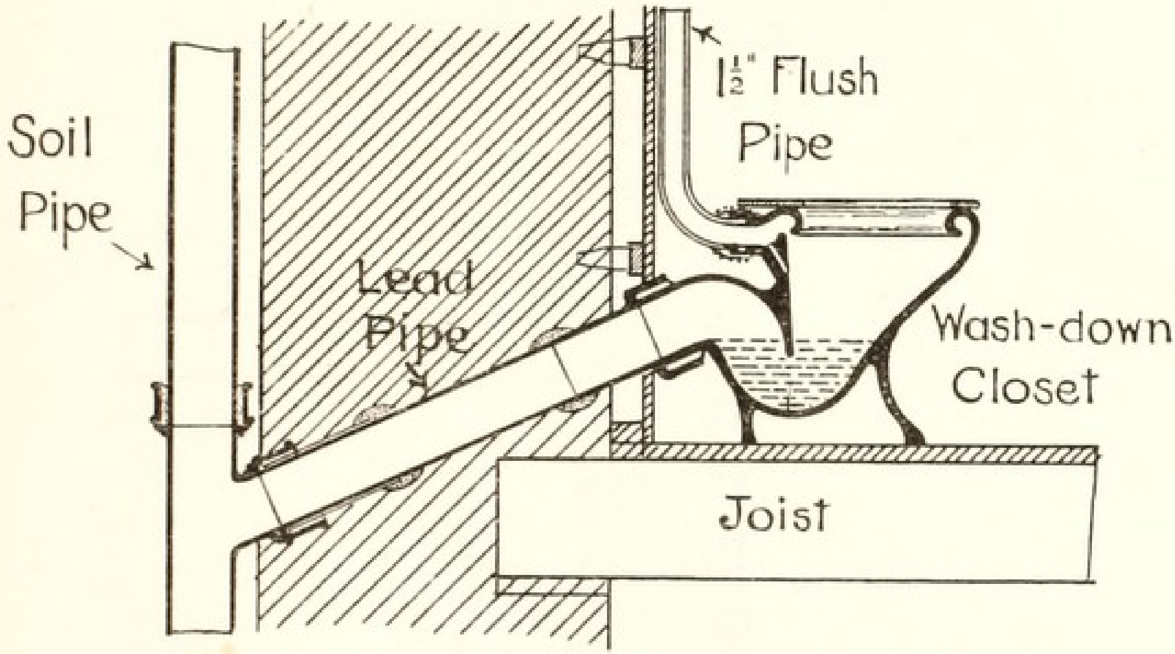


Fig. 14.—Showing the Flush Pipe from the Cistern which washes out the Pedestal Closet and its Contents. The Out-go Lead Pipe joining the Soil Pipe to the Pedestal Closet is also shown.

its passage under the ground to join the sewer or cesspool, if no sewers are available.

It will be recalled that when a Local Authority constructs a sewer and brings it within one hundred feet of a house being served by a cesspool, the owner of the house may be required by the Local Authority to discard the cesspool and to connect the drainage of his house with the sewer.

All waste matters passing down the house drain enter what is known as the *Main Intercepting Trap*, which is

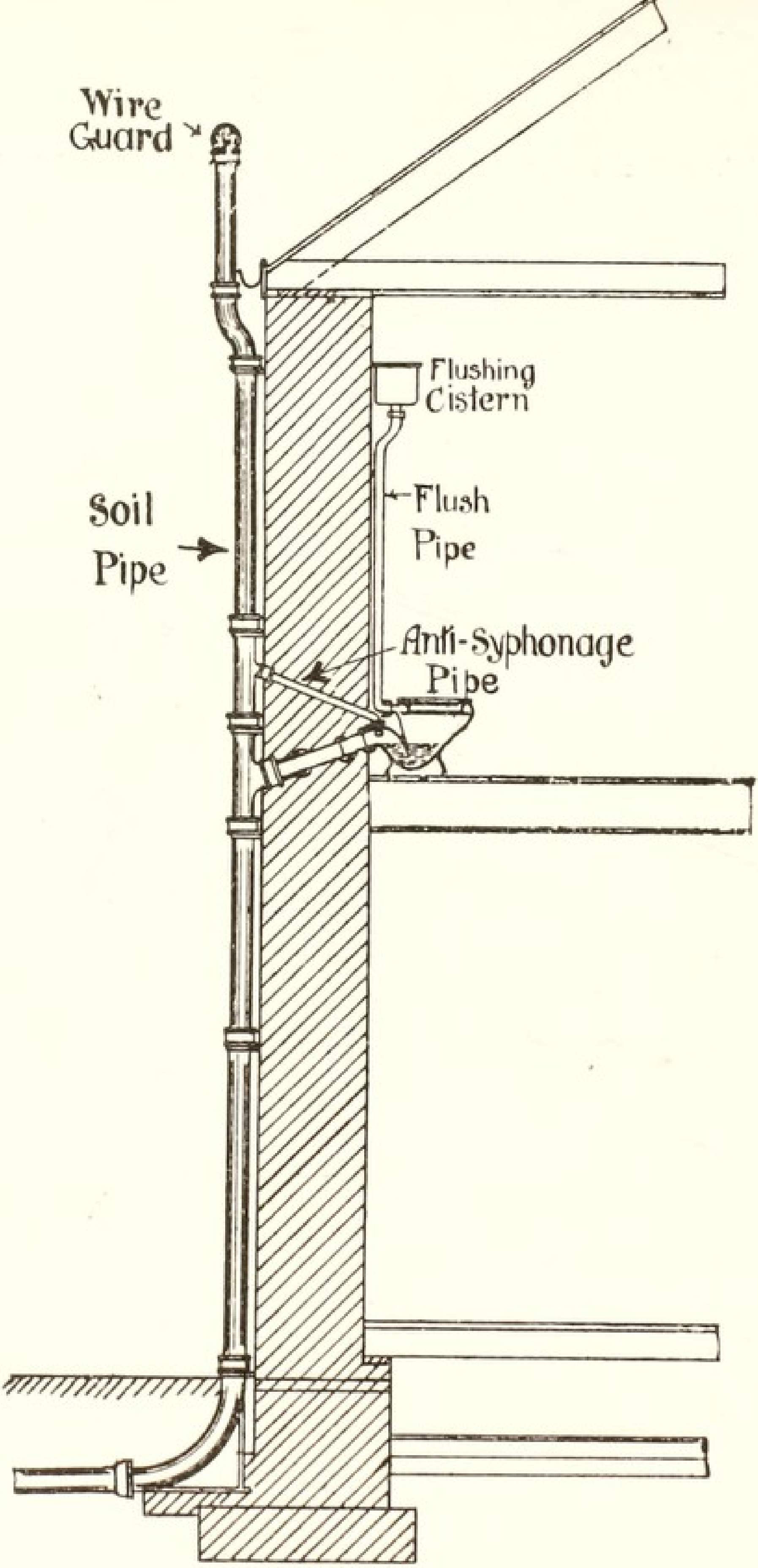


FIG. 15. — SHOWING POSITION OF FLUSHING CISTERN, FLUSH PIPE, SOIL AND ANTI-SYPHONAGE PIPE. IN THIS CASE THE ANTI-SYPHONAGE PIPE ENTERS THE SOIL PIPE.

It is only when several water-closets are situated above one another that a separate pipe is provided to receive the branch anti-syphonage pipes.

situated close to the sewer (Figs. 16 and 17). This trap, as the name indicates, is intended to intercept effluvia coming from the sewer and to prevent them from travelling along the drain to enter the house. But before these

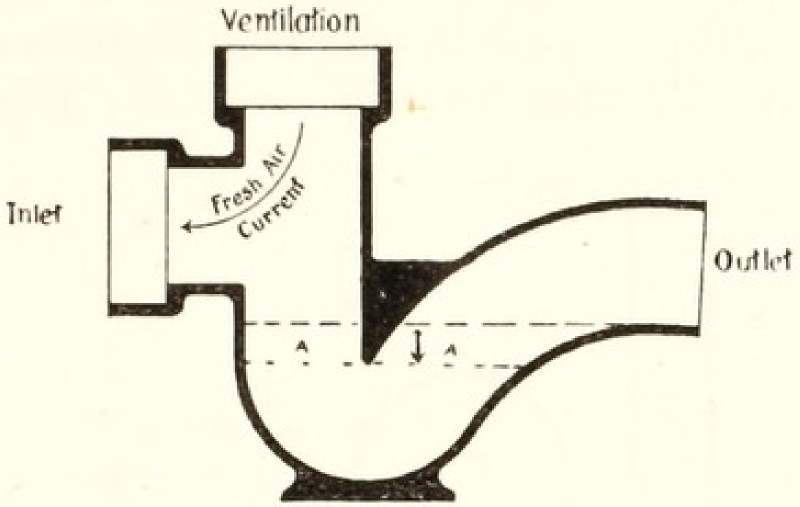


FIG. 16.—BUCHAN (INTERCEPTING) TRAP, SHOWING WATER SEAL A-A AND ITS EXTENT IN DEPTH.

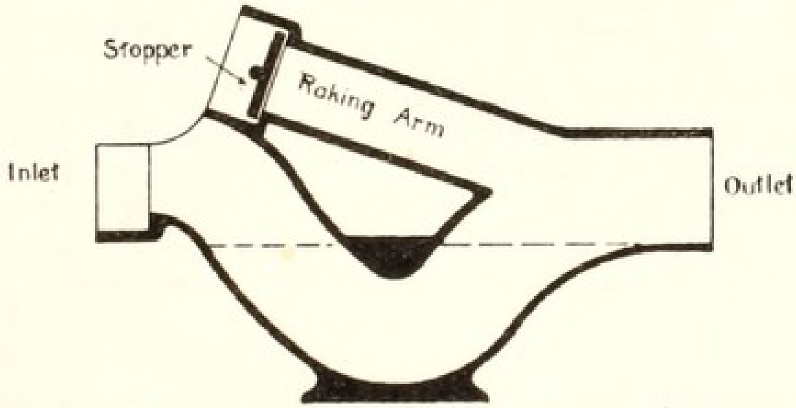


FIG. 17.—A BUCHAN TYPE OF INTERCEPTING TRAP WITH RAKING ARM FOR REMOVING OBSTRUCTIONS IN THE DRAIN BEYOND THE TRAP. THE DOTTED LINE INDICATES THE TOP LEVEL OF THE WATER SEAL.

effluvia can find their way into a house they must penetrate the water seals in the water-closet, bath, wash-hand basin, and sink traps. As a further safeguard, effluvia are encouraged to follow their natural upward course to escape at the open end of the soil pipe.

It is doubtful whether so many traps (see Figs. 22 and 23) as are usually introduced are necessary, especially when adequate safeguards at the various closets, sinks, etc., are provided. The danger of sewer air has been exaggerated. The air in sewers of good construction and well ventilated in no way differs, except in temperature, from the external atmosphere. Neither Enteric Fever nor Diphtheria are

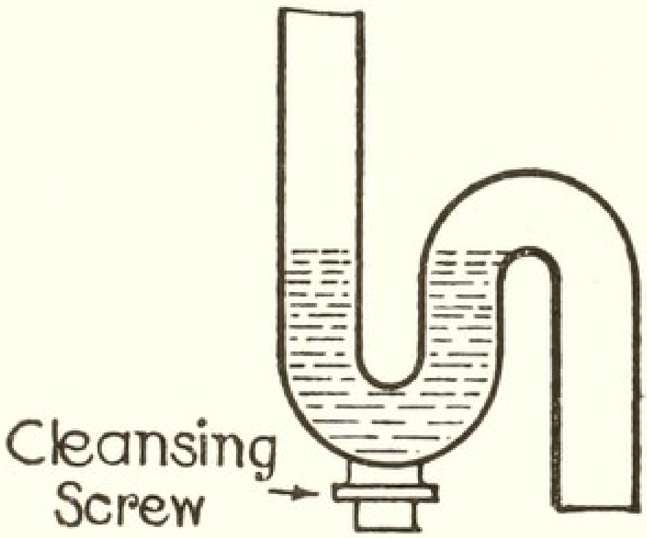


FIG. 18.—LEAD TRAP SOMETIMES USED UNDER WASH-HAND BASINS AND BATHS. THE SHADED PORTION INDICATES THE LIQUID ALWAYS FOUND IN THE TRAP WHEN IT IS IN USE IN A HOUSE.

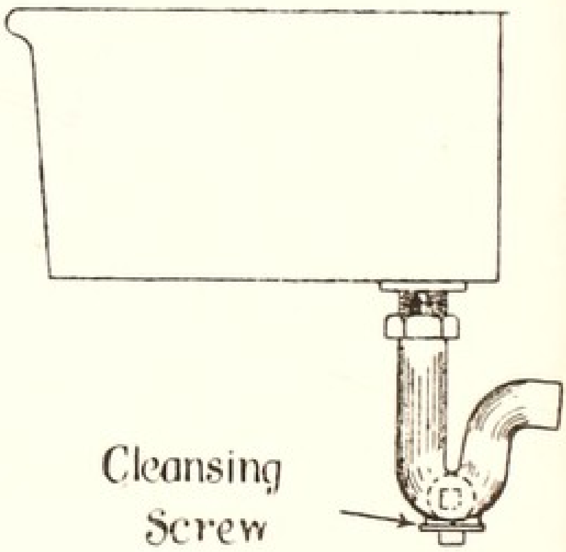


FIG. 19.—LEAD TRAP UNDER SINK. THE CLEANSING SCREW IS PROVIDED TO PERMIT THE REMOVAL OF GREASE OR FOREIGN MATTER.

spread by smells from drains. But the constant exposure to objectionable effluvia may lower the vitality of an individual to such an extent as to render him more liable to attack by illness of any kind.

It is difficult to persuade the layman that little or no relationship between sewer or drain effluvia and infectious diseases exists. Consequently, when the householder insists that there must be something wrong with the drains of his house, the practitioner will be well advised to request the Public Health Department to test the system.

This may be done by means of the *Smoke Test* or the *Water* or *Hydraulic Test.* The former is that invariably employed. The latter is only applied when new as well as iron drainage systems are being subjected to a very searching examination. Old drains may not be fit to withstand the pressure exerted by the hydraulic test.

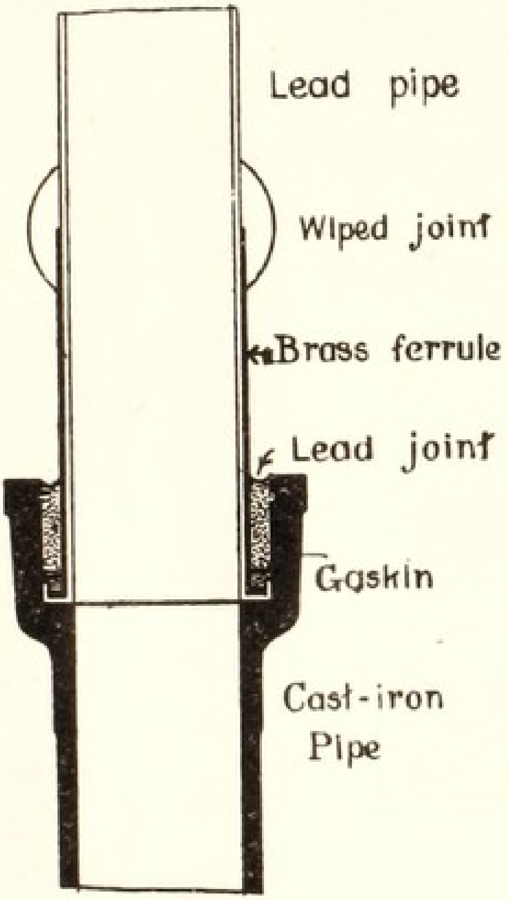


FIG. 20.
Showing how connection is made between lead and iron pipe.

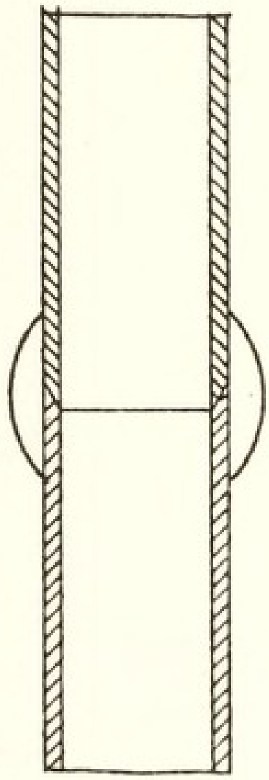

FIG. 21.—WIPED JOINT BETWEEN TWO LEAD PIPES.

When purchasing or taking over a house the tenant is advised to have a test of the drainage system made. In some towns the City Engineer's Department carries out all drainage-testing. In Edinburgh all new house drainage systems are tested and certified by the City Architect's Department. Where infectious diseases have occurred in houses, or when complaints have been lodged regarding effluvia, or blocked drains, officials attached to the Sanitary

Inspector's staff conduct the tests. Should defects be discovered, the author of the nuisance (the owner) is called upon to abate the nuisance.

Drains should be securely jointed. They should also

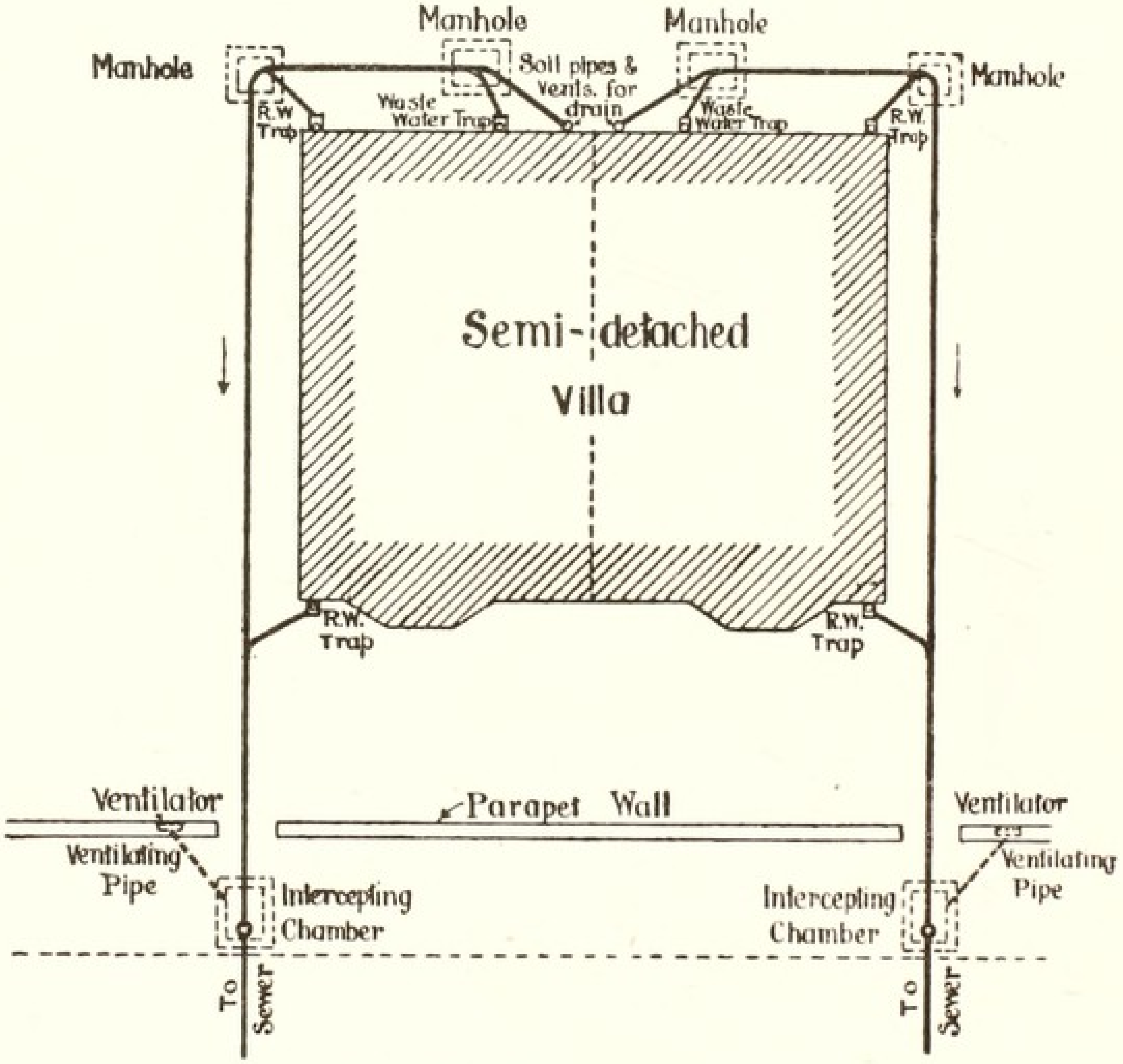


FIG. 22.—DRAINAGE PLAN.

Shows position of various traps, inspection manholes at changes of direction and of main intercepting traps situated in Intercepting Chambers close to sewer.

have a graduated fall to encourage the flow of drainage in them. Stoneware drains are jointed with Portland cement; iron pipes with caulked lead (Fig. 20). Drains should run in straight lines, but when they change their direction, or where several drainage pipes join one another, there should be inspection eyes, or inspection bends, or inspec-

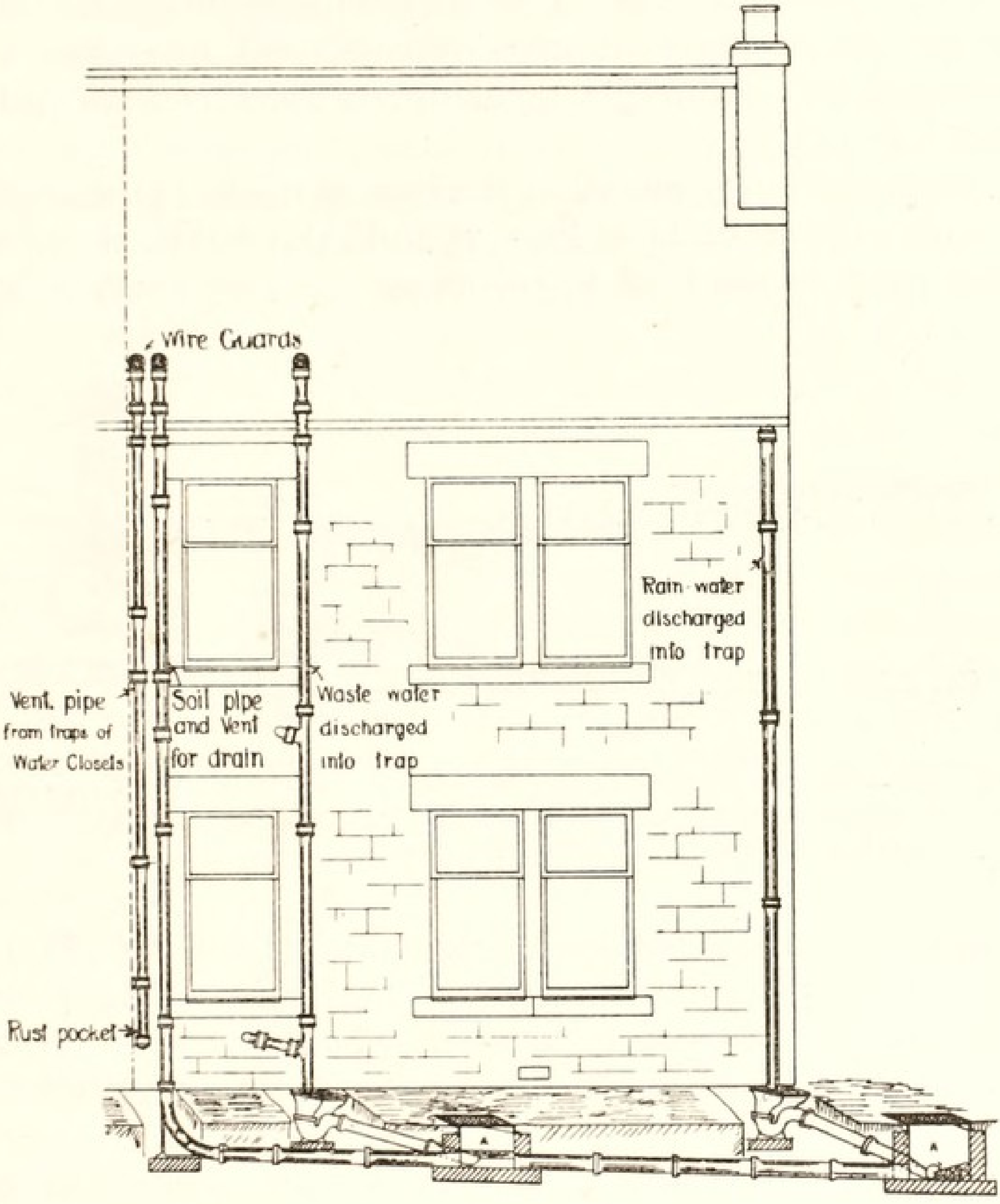


Fig. 23.

The various pipes usually observed on the outer walls of houses are shown. Notice must be taken of the absence of a trap at the foot of the soil pipe. Traps are provided in the case of the bath or wash-hand basin, or sink pipes, as well as the rain-water pipe. Observe the Inspection Chambers (A-A) where several pipes join one another, and where the flow in them may be examined by lifting the cover of the Inspection Chamber.

tion chambers at each change of direction or junction (see Figs. 22 and 23).

Inspection chambers merely afford facilities for the inspection of pipes at given points, and must not be confused with intercepting chambers, which contain traps (see Fig. 24).

Traps are never placed at the base of the soil pipe where it enters the ground (see Figs. 15 and 23). A trap placed at that point would tend to encourage blockages with solids

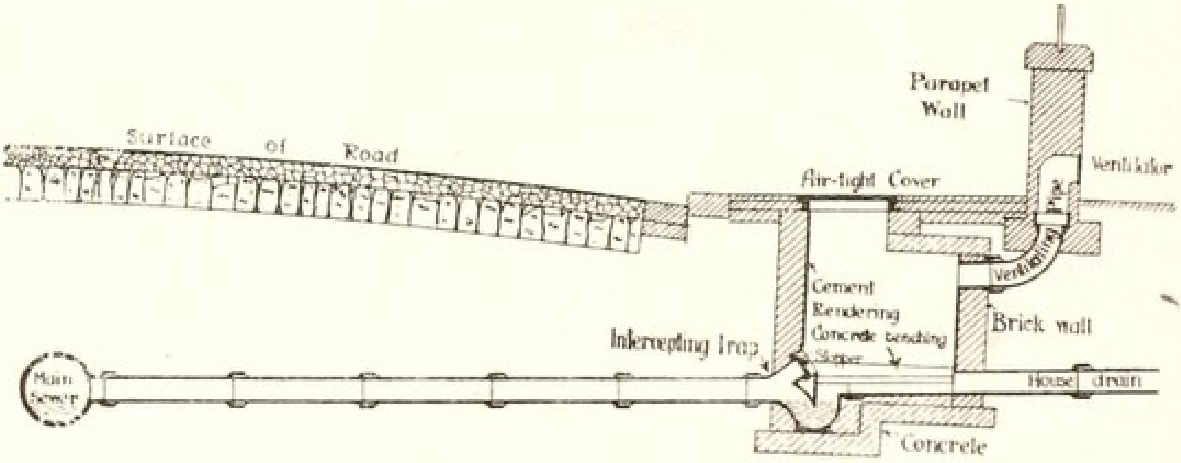


Fig. 24.—Shows Arrangement of Main Intercepting Chamber, its Ventilation by Grating at Parapet Wall. Also the Position of the Sewer in the Street.

and would impede the desired rapid flow of dejecta. Traps are always placed at the foot of the pipes taking away wash-hand basin and bath water. These traps are fitted with iron gratings, which encourage the escape of effluvia into the open air.

Traps are also placed at the base of the wall of the house to receive rain, bath, and wash-hand basin and sink waters.

The pipes seen passing down the external wall of a house are (1) the soil pipe, which is continued upwards as the ventilating pipe ; (2) anti-syphonage pipes, which have for their object the prevention of unsealing or unsyphoning of the water seals in traps, may also be seen. Only when a series of water-closets is superimposed in a building, and when a sudden flush of several closets takes place, is a partial vacuum likely to be created in the outgo pipes of a water-closet. Arising out of that vacuum the seal may be partially sucked out of a trap, but the risks are small. It is to defeat the possibility of sucking the water out of traps that anti-syphonage pipes are provided. (3) Another pipe observed is that carrying the rain from the rones which collect the water falling on the roof. (4) Yet another pipe that will be noticed is that which carries off the wastes from sinks, wash-hand basins, and baths (see Fig. 23).

**Collection and Disposal of Household Refuse.**—Household refuse consists of floor-sweepings, waste paper, kitchen debris, etc. This rubbish is placed in metal bins, which are regularly emptied into motor freighters or carts. These convey the refuse to be disposed of in a manner about to be described. The bins should be provided with covers and so constructed as to be easily emptied and cleansed. Many communities now insist on covered receptacles.

*Ash-pits* are still used for collecting household refuse, but their employment is confined to those districts where the Local Authorities cannot provide a full staff of scavengers to cope with frequent emptying of ash-bins. When ash-pits are used they should be roofed over to keep out moisture. To prevent pollution of the adjacent soil the floor and walls of the ash-pit should be rendered impervious.

*Ash-pits* should be restricted to a three days' capacity. If they are too large they encourage the accumulation of excessive amounts of rubbish for unduly long periods.

*Disposal of Household Refuse.*—It is not always wise to advocate the burning of all household refuse on the kitchen fire. Kitchen garbage, consisting of cabbage leaves, potato-peelings, bones and fish offal, smoulder slowly, and in doing so emit smoke and objectionable odours. This only encourages atmospheric pollution, which health authorities are anxious to avoid.

*Tips* are used to dispose of the household refuse in many places. The practice is not one that commends itself, because it encourages rats, plagues of flies, and effluvia. It is becoming increasingly difficult to secure suitable sites for refuse dumping. The only argument that can be reasonably advanced in favour of this method of emptying refuse over land is its cheapness. It has been found that 2/- per ton covers the cost of collecting and tipping household refuse. When a destructor is employed to destroy the refuse by fire the cost may be increased to 10/- per ton.

When household refuse is properly screened and spread out evenly day by day, and when, in addition, each day's spread is top-dressed with a layer of earth six inches or more deep, no nuisance should arise. Old quarries, ravines, and waste lands are now and again used as tips.

*Incineration.*—The most sanitary method to adopt is to burn all household refuse in a specially devised apparatus known as a refuse destructor. In this the refuse is heated to very high temperatures to ensure its complete destruction and reduction to hard ashes, known as clinker. This clinker may be used for making blocks for building houses, for providing bottoming for new roads, and for filling filter beds for purifying sewage. Sometimes the heat generated by burning refuse at a destructor is employed to raise steam to provide motive power.

## CHAPTER XII

# WATER SUPPLY AND ITS PURIFICATION

A WHOLESOME water supply must be free from contamination or from risk of such. The Romans and Greeks fully appreciated the importance of abundant supplies of pure water. A great viaduct led water into ancient Rome from the uplands and provided the inhabitants of the city with 300 gallons of water per head of the population per day. In this country 60 gallons is considered a very liberal quantity to allow each citizen. In some American cities water is freely supplied, Pittsburg receiving 250 gallons per head, Philadelphia 227, and Washington 218.

**Source of Water.**—Originally our water supplies come from the ocean. From the sea the heat of the sun induces evaporation, which condenses in the higher strata of the atmosphere to form vapour clouds. This watery vapour may fall on the earth as rain, snow, or hail. When rain descends, some evaporates, another part inclinates, and the remainder percolates. Evaporation causes a further condensation of vapour to form clouds; inclination supplies surface streams, and percolated water feeds wells, springs, and underground collections.

Water supplies are derived from: (1) rainfall (directly), as in the case of Gibraltar, Aden, and other places in tropical regions; (2) rivers; (3) lakes, natural or artificial; (4) springs; and (5) wells, which may be shallow or deep.

*Rivers* as a source of water supply are not beyond reproach, because they are subject to pollution by sewage.

If a river has a very long course and its water is considerably agitated and oxygenated by waterfalls and turbulent gorges, the dangers of pollution may be minimised, but they are never absent. No sanitarian would recommend a river as a source of water supply for a community, be it large or small. If such a supply is the only possibility, the water must be carefully passed through sand filters, gravitation or mechanical, and subsequently subjected to chlorination.

Only if these precautions are adopted will it be possible to place a safety barrier between the river and the citizen. In this country the Thames supplies London ; but the water is carefully filtered and chlorinated before it is passed on to the consumer. Towns deriving their supplies from unfiltered rivers have paid the penalty by suffering from outbreaks of Cholera and Typhoid Fever.

*Lakes* may be natural or artificial, and offer valuable sources of water supply. Glasgow depends on Loch Katrine and other lochs for its water supplies. Manchester, Liverpool, and Dundee are other large industrial centres that are dependent on lakes. Great care is taken to safeguard the " feeders " which supply lakes with water. For that reason the natural collections of water (lakes) selected are situated as far as possible from inhabited areas, and every effort is exerted to prevent the contamination of streams (" feeders ") emptying into the lakes. In order to safeguard such streams against pollution, large sums of money are spent in acquiring wide stretches of land surrounding the " catchment " area. Once they control this " catchment " area, Sanitary Authorities are better able to remove or prevent possible sources of pollution. If lakes are extensive, and if the rate of flow of water from inlet to outlet is slow, self-purification is greatly encouraged, since exposure to the air, gradual sedimentation, and oxygenation play very important parts in purifying water. Nor must it be forgotten that the specific micro-organisms of Enteric Fever and Cholera will quickly die when they reach pure water; whereas water contaminated with sewage is a favourable breeding-ground for the bacteria of Cholera or Typhoid Fever. It will be found on visiting a lake selected for supplying a community with water that the land in the immediate vicinity is usually occupied by belts of trees. These protect the earth surface from the heat of the sun and so retard evaporation. When the lake is considered to be perfectly defended against pollution, sand filtration or other treatment of the water, after it leaves the lake, need not be put into operation. But safety to the consumer should always be taken into consideration by the intervention of sand filtration. Unless the lake is suspect, the adoption of chlorination need not be seriously considered.

*Artificial Lakes.*—The name explains itself. It means the damming of a stream or streams in a valley so as to create artificially a lake or huge dam. Edinburgh secures its water supplies from several artificially developed lakes, one of them being nearly sixty miles distant from the city. Having selected a suitable "catchment area," where the average rainfall calculated over a series of years is uniformly high, the outlet extremity of a valley through which a stream had been running is built up with a huge embankment, the core or centre of which is packed tightly with clay. The clay prevents the leakage of the water collected in the artificially formed lake. Because the water is kept back to form such a lake, the collection is often called an "impounded water." The condition generally laid on Sanitary Authorities is that they must not completely arrest the flow of the water of streams coming to supply any artificially developed lake. In other words, "compensation water" must be permitted to pass down the streams, which may, previous to the creation of the artificial lake, have provided motive power at farms, factories, and so on. Litigation now and again arises over the undue reduction of "compensation water" by a Water Authority. It must be repeated that the water of natural or artificial lakes always tends to purify itself by sedimentation, and exposure to the air. With that knowledge before them, engineers design artificial lakes in such a manner as to make them long, narrow, deep, and devoid of shallow parts round their edges. If a lake, whether natural or artificial, is long, better opportunity and greater time are given for the sedimentation of the waters entering the lake. It has been demonstrated that the bacterial content of the water coming into the lake is much higher than that emerging at the outlet extremity, because gradual precipitation had taken place. Depth is encouraged in the construction of artificial lakes, to slow down the rate of flow of water from entrance to exit. The slower the flow the greater time is given for precipitation or, as it is generally termed, sedimentation. When the edges of a lake do not dip suddenly down into deep water, wavelets disturb the shallows and agitate the water to make it dirty.

*Springs* may be discounted as sources of water supply for more than a limited number of houses. *Surface Springs* often go dry in summer, and, being near the surface, are subject to pollution. *Deep Springs*, on the other hand, generally offer constant supplies of water. Because they are deep, the water which supplies them has often considerable distances to travel through the soil. In its course the water absorbs carbonic acid from the ground air always found in the interstices of the earth. Highly charged with carbonic acid, the water exerts a solvent action on the carbonates of calcium, potassium, sodium, and magnesium. It is also capable of decomposing silicates. The chief characteristics of deep spring water are its clearness and coolness. It is usually sparkling and palatable, owing to the gases and other minerals it has absorbed. Very deep springs and wells may produce water that is comparatively warm. And in lime basins, such as are found in the London area, deep spring waters are very hard.

*Shallow Wells* are invariably viewed with suspicion. Their proximity to the surface of the ground, and their closeness to dwellings or farmyards, exposes them to the ever-present risk of pollution. Should a shallow well be the only possible source of water supply, it must be situated at a higher level than possible sources of pollution. If that is not feasible, the inner walls of the well should be " steined " (lined) with bricks, behind which clay should be tightly packed to prevent surface leakage into the well. Also, the mouth of the well should be protected by a circular coping of cement sloping away and down from the mouth of the well to prevent the entrance of surface water or spillings. As an additional precaution, stones, gravel, and sand may be put into the bottom of the well so that water entering from the bottom, made necessary by the brick and clay barriers, must pass through the stones, gravel, and sand to ensure upward filtration.

The definition of a shallow well is one that rests on the top of the first impermeable stratum. But the term " shallow " must not be taken too literally, since forty feet or even more may have to be traversed before the first impermeable stratum is reached. *Deep Wells* are safer sources of water supply. A deep well indicates water that rests between the first and second impermeable strata (see Fig. 25).

An *Artesian Well* follows the definition of the deep well, with this difference, that the water of the artesian well, when tapped, rises to the surface, because the tapped liquid had been held between impermeable strata rising up to higher levels than the point at which the water had been reached by boring. The artesian well derives its name from one that was tapped in the province of Artois in France. Such wells are now and again 2000 feet deep. Their water is usually hard and pure, but not

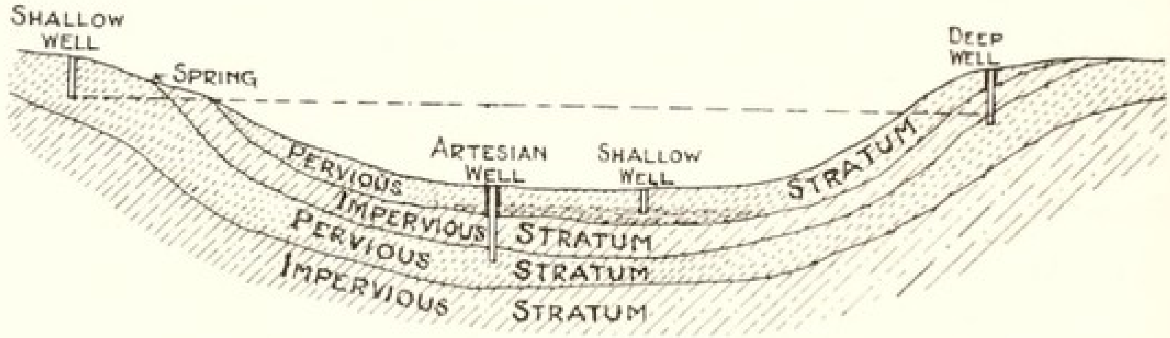


FIG. 25.—ILLUSTRATES THE VARIOUS TYPES OF WELLS.

well aerated. Breweries often select this type of water for making beer.

*Distilled Sea Water* is now used in the tropics when other supplies are unavailable. Aden has such a supply when its rain-water tanks run dry. Unless it be artificially aerated, distilled water has an insipid taste owing to its lack of oxygen.

*Abyssinian Tube Wells.* These, as the name suggests, were first used during a military campaign in that arid country. A pointed hollow steel tube with perforations at its point is pushed down into the soil which is being explored for water. One section after another is joined up and pushed forward until water is ascertained to exist. It is purely an emergency device intended for extremities.

*Amount of Water required.*—It would be correct to affirm that no hard-and-fast rule can be laid down, because the citizen should not be tied to a given quantity. Times have changed, and with the introduction of new housing schemes, the more general employment of baths, wash-houses, together with the introduction of motor traffic, the needs for abundant water supplies are more clamant than ever. In fact, the new conditions of living are exerting heavy demands on existing water supplies. Every new house now has its bath, water-closet, wash-tub, and sink. Thirty years ago one water-closet often served several working-class houses, and baths were undreamt-of luxuries. It has been customary to state that each citizen in a community should daily receive between 35 and 40 gallons of water. This is a bare allowance when one realises that a plunge-bath requires between 25 to 40 gallons of water each time it is used. The water-closet cistern empties at least 3 gallons every time the basin is to be flushed. Then there is cooking and drinking water to be taken into account. Fire-extinguishing has its demands; street-cleansing, car-washing, public baths, public wash-houses, and trades must also be considered. Taking those facts into consideration, it would be safe to say that at least 60 gallons of water per day should be allowed for every citizen. In addition, one has to reckon with cows and horses, each of which requires between 10 to 15 gallons per day.

Added to the foregoing actual requirements, every Water Authority has to anticipate wastage caused by carelessness on the part of the house consumer or through defective pipes and fittings.

**Methods of Supplying Individual Houses.**—These may be classified under three headings: Constant; Intermittent; as well as a combination of them.

In the *Constant System* the service pipe comes directly from the water main in the street to the house taps. In the second or *Intermittent System* the service pipe empties into a cistern placed under the roof, and from the cistern the water taps are fed. This cistern is usually constructed to contain a two days' reasonable supply for a household, if due care be taken to avoid waste or too free use of the water. A cistern is interposed because the supply from the water main, usually running down and under the street, may be cut off from time to time, especially during periods of prolonged drought. When each house is provided with a reserve of water, contained in a cistern, the occasional or intermittent cutting off of the water supply enables Water Authorities to save water or to effect necessary extensions or repairs. It is because the supply is arrested at intervals that the name "intermittent" is applied to the principle, as opposed to the "constant method," where no cistern is used. In some towns there is a combined use of cistern and direct supply. In Edinburgh, for instance, each house is allowed to have one tap which draws its water directly from the water main. Other taps supplying baths, wash-hand basins, sinks and so on, are fed from a cistern. Sudden stoppage of the water supply, occasioned by shortage or accidents, is faced with equanimity, because the cistern can be drawn upon to supply the household needs.

The objection to the *Intermittent System* is more theoretical than real, since it has been urged that the emptying of the water mains may create a partial vacuum in them. Under such circumstances, impurities may be drawn into the emptied pipes through fissures or defective joints. The possibility exists, but it is difficult to believe that pipes of defective construction will be allowed to pass undetected nowadays. *Deacon's Water Meter* is an apparatus used by engineers to measure the flow and to detect leaks in any system. It is the constant care of engineers responsible to a Water Authority to maintain all water mains in good condition, since leakages lead to serious waste.

*Rain-water.*—Gibraltar offers an outstanding example of a community which depends on rain-water for its supplies. Some of its rocky slopes are faced with concreted cement, and any rain falling on these is led to underground reservoirs from which the town is supplied. Aden now and again derives its supplies from several enormous craters, which have their inner surfaces protected by cement to prevent leakage through the igneous rocky formations from which the open reservoirs have been developed. But the rainfall at Aden is so spasmodic that distilled sea-water is resorted to when the fresh-water tanks become depleted. In and near urban areas, rain-water cannot be advised for drinking or for general use, because, in its passage through the atmosphere, rain washes down pollen, soot, sulphuric and sulphurous acids, tarry particles, and other debris. In rural districts, however, rain-water is more potable, because it absorbs oxygen and nitrogen from comparatively clean atmospheres. An apparatus known as *Robert's Rain-Water Separator* has been introduced to collect rain-water for domestic use. Rain falling on a roof is diverted to the machine, which automatically rejects the earliest portions of water. When the first and presumably unclean washings reach the separator it casts them aside by a canting device. Subsequent rain falling on the roof is passed into a special storage tank from which household supplies may be drawn. When rain-water is stored in tanks, in tropical regions especially, a tightly fitting lid should be provided to prevent the access of mosquitoes ;

collections of water being favoured by the insects as breeding-places.

*Testing Suspected Wells.*—A well or other water supply may be under suspicion, yet its actual source of pollution may not be easily guessed. To establish a clue to pollution, common salt solution, naphthol, fluorescine dissolved in alcohol and diluted with a 5 per cent. solution of ammonia, the salts of lithium, the bacilli of prodigiosus, or yeast itself, may be poured over or into the suspected source or sources of pollution in turn. Should any of these substances eventually gain access to the water supply being tested, an indication is given regarding the seat of mischief.

*Cisterns.*—Reference to cisterns demands an explanation, since in each house there are usually three. The main cistern already referred to being one, a second supplies water to feed the boiler which provides hot water, while the third cistern is that which contains water for flushing out water-closets. Cisterns for storing a domestic water supply should be constructed of galvanised iron, or slate. Wooden cisterns and those lined with lead should not be introduced into houses. Wood decays, and lead may be acted on by certain types of waters, to which reference will be presently made. Cisterns should always be covered to prevent the access of dust, debris, cockroaches, beetles, rats, and mice. Water Authorities usually issue instructions to householders to have cisterns periodically run dry and carefully cleansed. It is surprising how much sediment and foreign matter accumulates in cisterns after long use.

*Water Impurities.*—These may be organic or inorganic. Among the inorganic impurities the principal ones are derived from any minerals with which the water comes into contact. Chalk and limestone formations impart hardness to water. Hardness may be derived from contact with salts of magnesium, chlorides, nitrates, silicates, alumina, and iron. Metalliferous formations may give up lead, zinc, arsenic, copper, and manganese to water. Fluorine, bromine, and iodine may also be extracted from a soil through which water has passed. Peaty (acid) water takes up lead from lead-lined cisterns or lead pipes (see Plumbo-solvent Action).

*Organic Impurities.*—These must always be viewed with suspicion, because they imply that pollution by sewage has taken place. Such impurities may be dissolved or suspended in the water. Sewage is one of the most serious impurities, because it may carry pathogenic organisms with it. For that reason rivers, streams, and wells demand careful supervision and adequate protection before their supplies can be confidently passed on to the consumer.

*Hardness of Water.*—Hardness in water is due to the presence of soluble alkaline salts, those of calcium and magnesium predominating. The main drawback of hard water is that it wastes soap and often injuriously affects the skin. It is not very suitable for cooking, and it wastes coal because more heat is required to penetrate the coatings of salts which are deposited inside kettles and factory boilers. Hardness may be of two varieties: temporary and hard.

*Temporary Hardness* is so called because it can be dispelled by boiling. The carbonates of calcium and magnesium, which are the main causes of temporary hardness, are held in solution as bicarbonates by the carbon dioxide dissolved in the water. When such water is boiled, the carbon dioxide is driven off to precipitate the soluble bicarbonates in the form of insoluble carbonates.

*Permanent Hardness* is caused by the sulphates and chlorides of calcium and magnesium. Being stable, these salts cannot be dispelled by boiling.

*Testing Hardness.*—A standard soap solution is used for this purpose. The stock soap solution consists of 100 grm. of dry white Castile soap in a litre of 80 per cent. alcohol, the solution being standardised against one of standardised chloride. The test is employed by adding the soap solution drop by drop, taking care to constantly shake the water for the earliest detection of lather formation. The additions of soap solution and the agitation are continued until a lather covers the entire surface of the water and remains continuous for five minutes. From the amount of soap solution added, the quantity of calcium carbonate equivalent to each cubic centimetre of the soap solution is indicated by reference to a specially compiled table.

Hardness is expressed in degrees. For instance, each degree corresponds to one grain of carbonate, or its equivalent of other lime or magnesium salts in a gallon of water. Water showing 4 degrees of hardness is considered to be a soft one. A hard water is one that reveals over 12 degrees of hardness.

Hard water usually comes from limestone formations. But if the water passing through limestone contains little carbon dioxide it will have little power to dissolve out lime. The source of carbonic acid in the soil comes from the decomposition of organic matter. Accordingly, if water passes over a catchment area which is comparatively sterile it may not absorb much carbonic acid. London waters are generally hard.

*Softening Water.*—On a very small scale this may be accomplished by adding bicarbonate of soda to water. On a large scale the *Clark* and *Porter-Clark* methods have been employed. In the *Clark* process slaked lime or milk of lime are used. The process which takes place in the treated water is a reaction between the calcium hydroxide and the carbon dioxide, calcium carbonate being formed. This is insoluble. At the same time the calcium carbonate which had been held in solution by the carbon dioxide in the water is precipitated. When sulphates are the cause of permanent hardness, sodium carbonate is used for softening purposes. When the appropriate chemical is added, the water is diverted into open tanks, where precipitation is allowed to take place before the water is passed on to the consumer. As that process was comparatively slow, the more rapid *Porter-Clark* system came into more general use. In this case the water, with the chemical added, is passed through coarse filtering material to arrest the precipitate instead of encouraging it to sediment in the tanks.

For domestic use a *Zeolite-Permutit* process has been devised. Zeolites possess the power of exchanging their soda bases for other bases when the two are brought into contact. Zeolites exist in the soil in a natural state. Permutit is a synthetic exchange-silicate made by fusing felspar, kaolin, pearl ash, and soda together. The outcome is a glass which is crushed and its soluble silicates removed. When hard water is treated by passing it through permutit, the calcium and magnesium are removed from the water, being substituted or exchanged for the zeolite of the sodium. The permutit process is useful for houses, hotels, institutions, and factories. For factory boilers especially the avoidance of " furring " or deposit of lime and other salts is important.

*Plumbo-solvent Action of Water.*—Waters derived from peaty areas usually contain free vegetable acids, the most prominent being humic, ulmic, crenic, and hypocrenic. These act readily on lead pipes and cisterns lined with that metal. Waters containing organic matter, chlorides, or those that are highly oxygenated, also dissolve lead when brought into contact with it. When an excessive amount of carbonic acid is found in water, plumbo-solvency may be exerted. When a moorland (peaty) water shows an acidity reaching ·5 parts per 100,000, it is dangerous, and its lead-dissolving power increases with every rise of ·5 of acidity.

As a rule, a protective layer of carbonate of lead is deposited inside lead pipes, but if chlorides are present in the water the carbonate of lead is dissolved to expose another fresh surface of metal. Because rain and upland surface waters are highly oxygenated they exert a solvent action on lead. The result is the formation of an oxide of lead which may exist as a suspension, or it may be dissolved if the water be acid. It is for that reason (acidity in water) that sulphates or excess of carbon dioxide exert plumbo-solvency. Though alkaline waters do not have a solvent action on lead, deep well waters containing free as well as combined carbonic acid, though alkaline, may be plumbo-solvent. Plumbo-solvency must be distinguished from *Plumbo-erosive* action. When plumbo-erosion takes place, an oxycarbonate of lead is deposited on the metal surface, but it does not offer a protective coating, because it is of a powdery character, and in that state is carried along into the water in a state of suspension. Waters capable of plumbo-solvency can also be plumbo-erosive. Hard waters, those containing silicates and those containing ordinary amounts of carbonic acid, are least likely to be plumbo-solvent. Plumbo-solvency is encouraged by lead pipes and cisterns that are new, and by the length of time of contact with lead surfaces, the temperature of the water, the pressure of the water, the junction of lead with other metals, the intermittent passage of water through lead pipes, and the quality of the lead used. Zinc pipes may also be sources of danger owing to the lead they contain.

Drinking water containing more than $\frac{1}{20}$ grain of lead per gallon is considered unsuitable. But it must be remembered that smaller amounts may be dangerous to some people with an idiosyncrasy. Generally speaking, any water containing lead should be condemned.

*The Prevention of Plumbo-solvency*.—This may be partially effected by filtration through sand, spongy iron, and charcoal. But to deal successfully with moorland (peaty) waters their acidity must be reduced below ·5 per 100,000 or by rendering the water completely alkaline. Alkalinity is brought about by placing blocks of limestone or magnesium limestone in the collecting reservoirs. Alternatively, lime and chalk in the proportion of 80 to 90 grains to the gallon may be mixed with the water in specially provided tanks. As a preventive only 3 grains per gallon of carbonate of lime are used at Bradford. Carbonate of soda may be employed towards the same end.

The symptoms of lead-poisoning have been dealt with under Industrial Diseases. The insidiousness of lead-poisoning conveyed by water is a characteristic. Also, while many consumers may escape, those who possess an idiosyncrasy will be most liable to attack. Instances of lead-poisoning by water are more numerous than is commonly supposed. It is, as has been indicated, the insidiousness of the poisoning that is apt to be puzzling when perhaps mysterious illness manifests itself among a population, especially one served by moorland water supplies.

*Diseases spread by Water*.—The most commonly spread diseases are Enteric Fever, Cholera, and Dysentery.

*Ankylostomum duodenale* is found among miners who may drink water in mines, the water having been infected by the dejecta of those suffering from the disease. *Taenia solium, Echinococcus, Ascaris lumbricoides, Filaria perstans, Oxyuris vermicularis,* and *Bilharzia haematobia* may also be passed on to human beings by water. Among non-specific diseases, lead-poisoning is outstanding. The deficiency of iodine in water has been blamed as a probable cause of Goitre, but that fact has not been fully established.

*Sand Filtration,* when properly supervised, is the best method yet devised to purify water, and purification from the consumer's point of view means preventing the passage of disease-producing micro-organisms through the filter. A sand filter is an open-air pond having its sides built of brickwork which is rendered impervious. The bottom of the pond is similarly treated, but on its floor collecting channels are provided so that the purified water may pass into them to reach a draw-off compartment (outlet well) separate from the filtering area. The filtered water enters the outlet well at its most dependent part and rises to escape downwards by a pipe which leads the purified water to large covered-in reservoirs capable of holding two or three days' supply for a community. Some water engineers prefer the side walls of sand filters to show a slope. It is argued that perpendicular sides may permit unfiltered water to escape between the sand in the filter and its brickwork. Most sand filters measure one acre or an acre and a half in extent, and for large communities there may be as many as two or three dozen such filters. This multiplicity enables filtration to be slow and continuous, because one or more filters may be out of action while the sand in them is being washed, or while necessary repairs are taking place. Generally speaking, each sand filter is filled with successive layers of broken stones, coarse gravel, finer gravel, and on the top of these a layer of sand. The sand is the most important layer, but special qualities of it must be used, flinty or coarse sand, collected from Glen Sannox in the island of Arran, being much sought after. Sand from sandpits and from the seashore is not suitable, because it is too close in texture and would not permit a sufficiently

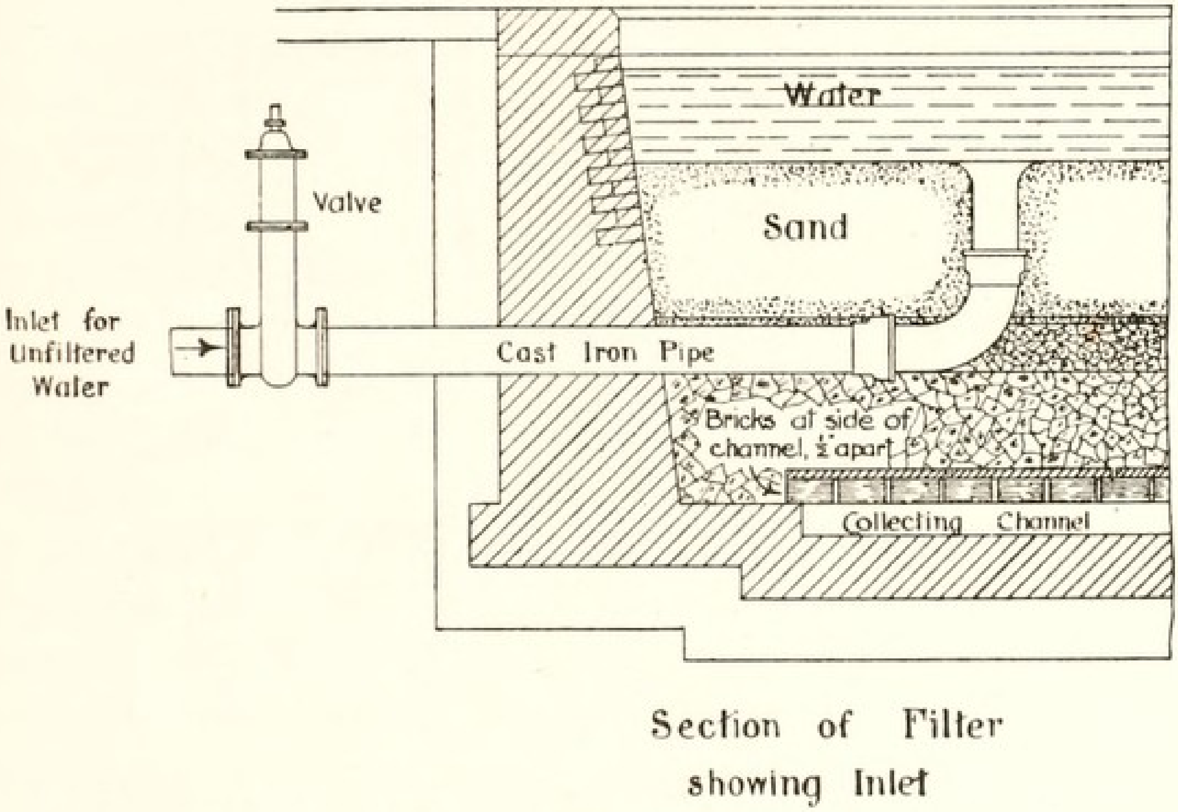


Fig. 26.—Section of Sand Filter showing Different Layers of Sand, Gravel, Coarse Stones, etc.

steady flow to pass through it. A flinty sand is more easily washed and more readily aerated. The depth of the sand layer varies between 2 feet 6 inches to 3 feet. That thickness has been decided on because it allows a steady and not too rapid flow of filtered water to descend through the gravel and stone layers before it reaches the collecting channels on the floor of the filter bed. (Sand filtration should be studied by visitations to sand filters.) (See Figs. 26 and 27.)

*Purification* is effected by the formation of a gelatinous layer of algae in the uppermost part of the sand. Sometimes the name zooglæar layer has been applied to it, because it is composed of a fine washwork of diatoms and algæ. Another and appropriate name given to this artificially created sieve is the " vital " layer, because its formation and action are vital needs for water purification.

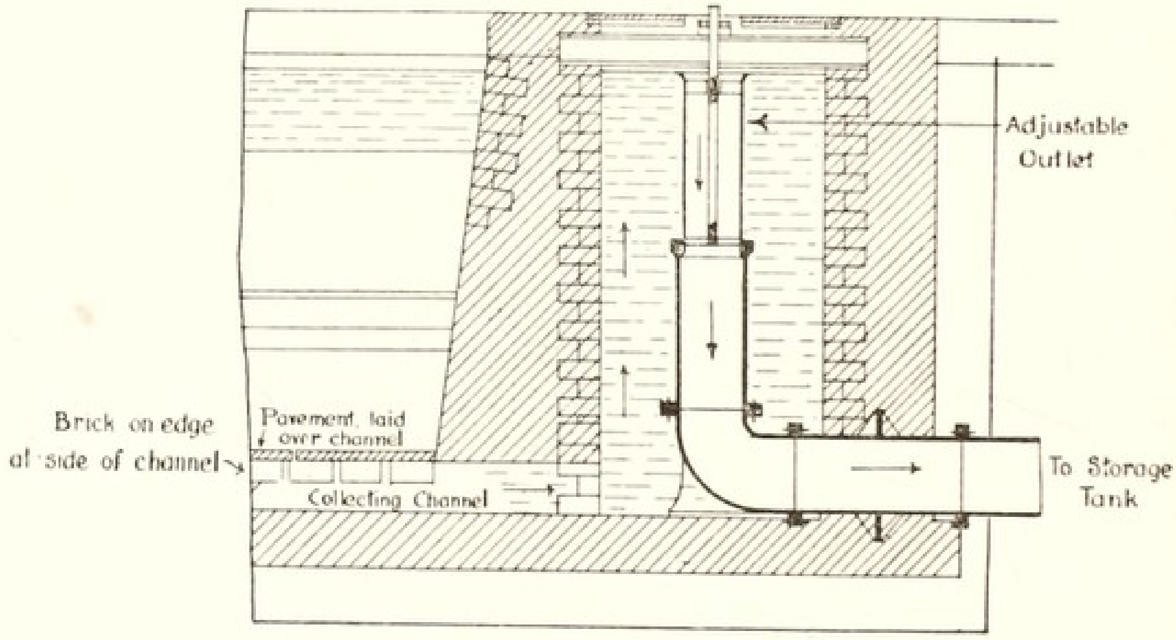


FIG. 27.—SHOWING HOW PURIFIED WATER LEAVES THE SAND FILTER.

This " vital " layer seldom extends farther than an inch into the sand, but it is so efficient that over 95 per cent. of the micro-organisms in the water are caught in the meshes of the zooglæ. Even if a small percentage of the Coli group passes through the sand along with the filtered water, the survival of the organisms is of brief duration, since, as has been pointed out, Typhoid bacilli do not live for any length of time in pure water. A sand filter, chiefly through the agency of its " vital " layer, acts in a dual capacity. It mechanically arrests foreign matter, including bacilli.

It also acts biologically, because the non-pathogenic micro-organisms prey on others that are trying to pass through. The action is analogous to the nitrifying process which takes place in the purification of sewage. Oxidation is encouraged to assist the purification in the subsequent gravel and stone layers.

*Sand-washing.*—In the course of time, it may be six weeks, the " vital " layer becomes so dense that it slows the passage of water through its meshes. When that occurs, the water in the filter is run out and the surface of the filter bed completely exposed. Then the opportunity arrives to scrape off the " vital " (zooglæar) layer to wash it in tanks through which water is passed upwards, through perforated openings in the floor of the washing tanks. Having washed the algae and debris out of the entire " vital " layer, by stirring and constant agitation, the cleaned sand is again spread over the denuded surface of the filter. A sand filter is not considered to be fit to function properly until an adequate zooglæar layer has been developed. The standard laid down for well-filtered water is that it must not contain more than 100 micro-organisms in 1 c.c. of water. The consumer rarely receives such water, because additions to the bacterial content are effected during the passage of the water through mains, service pipes to houses, cisterns, and taps. The rate of filtration through sand is usually fixed at 4 inches per hour, which implies that over 4,000,000 gallons daily pass through an acre of sand. The depth of water standing constantly over the sand to maintain such a rate of flow is usually between 3 and 4 feet. But in a slow sand-filtration scheme, with an ample supply of filters, between 2,500,000 to 3,000,000 gallons per acre per day is considered to be adequate and safe. With a rate of 2,500,000 gallons, the rate of percolation is about 2 inches per hour.

It may be taken as a general guide that rates of 4 inches and over per hour may be viewed with confidence if the filtered water is to be subsequently treated by chemicals. But slow filtration is to be preferred where no secondary treatment is to be employed.

Now that sand filtration and chlorination have been applied to water supplies, the incidence of water-borne diseases has almost disappeared in this country.

One of the most convincing examples regarding the value of sand filtration was furnished by the Cholera outbreak at Hamburg in the year 1892. Hamburg has two districts attached to it, Wandsbeck and Altona. Wandsbeck emptied its sewage into the Elbe above Hamburg, and Hamburg drew its water supply directly from the river. Altona was farther down the stream, into which the combined sewage of Wandsbeck and Hamburg had been emptied. Wandsbeck being farthest up the river escaped comparatively lightly, because it derived most of its water from lakes and springs. Hamburg had over 8000 Cholera deaths. Altona, which drew its water from the Elbe, grossly polluted by sewage from Wandsbeck and Hamburg, escaped because all its water had been carefully sand-filtered. Hamburg suffered because no purification of the Elbe water had been practised.

*Mechanical Filters.*—A more rapid system, and a labour-saving one, has been introduced to purify water by the application of mechanical methods. Semicircular steel cylinders, a series of which constitutes a "battery," receive water from a settling reservoir, the height of which above the level of the steel (filtering) cylinders provides the necessary pressure to drive the water through the battery. Sand is the filtering material used to a depth of 4 feet or thereby. And to imitate or provide a substitute for the zooglæar layer, a grain of sulphate of alumina is added to each gallon of water entering the mechanical filter. This chemical, as has been suggested, offers a reliable barrier against the passage of micro-organisms. Just as in the case of open-air gravitation sand filters, there comes a time when the topmost layer in the mechanical filter becomes clogged. It must be removed and the sand washed. This is done by reversing the flow of water through the cylinder. At the same time an internally fitted rotating stirrer is set in motion. This churns the entire contents of the steel cylinder to completely wash out all arrested impurities from the sand. In this type of filter mechanical purification is depended on; whereas, in the ordinary sand filter, biological processes are also at work. The rate of water filtration in mechanical plants is equivalent to 125,000,000 gallons or even more per acre per day. The percentage of purification is as good as that of slow sand filtration, between 95 to 99 per cent. of the bacteria being removed.

Some authorities advocate the covering over of sand filters. This prolongs the activity of the filtering material and prevents the formation of algae round the edges of the brickwork. By keeping the filter longer in operation less labour is demanded for repeated sand-washing and general supervision. Covered sand filters are favoured on the Continent.

*Storage of Water.*—As soon as water has been filtered it is passed on to extensive covered-in underground tanks of great depth. These may hold as much as a two- or even three-day supply for a population. The tank is designedly covered over to exclude light and thereby to prevent the growth of algae, since daylight encourages their development. The cover also avoids contamination from dust and other foreign matter. Water stored in such covered tanks has good keeping qualities.

*Chemical Purification.*—The employment of permanganate of potash and alum cannot be looked upon as any more than precipitants and clarifying agents. But such a chemical as chlorine and its hypochlorites come under a different category. Even when permanganate is used in large quantities its disinfecting effect is transitory.

*Ozone* has been applied to the purification of water. It is too costly for domestic use, but ozonising plants have been in practical operation in Europe and America. Generally speaking, the system is complicated and demands highly skilled control. Ozonisation is best adapted to water contaminated by sewage. Turbid waters are not suitably dealt with by the process, because they are not clarified. The ozone is produced by electrical discharges in air, which after being highly charged is brought into contact with the water. The ozonizer is constructed of two conducting metallic surfaces separated by glass or mica in such a way that a current of air is required to pass between the two conducting surfaces. A very small amount of ozone—between 1 to 3 milligrams per litre—is required to purify water.

*Chlorination.*—For waters drawn from rivers, sand filtration should always be followed by chlorination. This dual treatment places a barrier of safety between the consumer and the water supplied to him. Chlorine is an antiseptic, and when added to water, in the form of bleaching powder, known as chlorinated lime, the germicidal action is brought about by the formation of nascent oxygen, by the liberated chlorine and the chloramins which are formed from any organic matter existing in the water. The formula of chloramin is $NH_2Cl$, and it is formed when hypochlorites come into contact with ammonia, which substance has its origin from organic matter in the water.

The strength of a good bleaching powder for use in water purification is generally stated as containing 35 per cent. of available chlorine, this being equal to 7·9 per cent. of available oxygen. For using chlorine on a small scale, $\frac{1}{2}$ lb. of bleaching powder should be dissolved in a gallon of water. This contains about 6 per cent. by weight of bleaching powder, representing nearly 2 per cent. of available chlorine. After treatment by this 2 per cent. chlorine, the water must be allowed to settle for at least eight hours before it is consumed. Chlorination on a big scale must be carefully supervised, since overdoses will affect the taste of the water. In practice, the amount used in water purification is from 5 to 12 lb. of bleaching powder to 1,000,000 gallons of water. The more highly polluted the water with organic matter the more bleaching powder is necessary, because more chlorine is required to oxidise the organic matter before the chemical can exert its germicidal influence.

For campers, tourists, and others who may have to rely on casual water supplies, a suitable solution of chlorine may be prepared by mixing a teaspoonful of bleaching powder with a pint (20 ounces) of water. This provides a stock solution which may be employed thus: add 1 teaspoonful to 10 gallons of water; or 9 drops to 1 quart. But preferably allow the treated water to stand for half an hour before using it. For the convenience of travellers, tablets of hypochlorites are now sold for water disinfection. But they must be freshly prepared to be reliable.

*Gaseous Chlorine* is now coming into more general use. The action of the gas on water is just the same as that of the bleaching powder solution. Gas possesses the advantage over bleaching powder in that its purity and strength can be depended on, and its dosage much more accurately gauged. It is no more costly than bleaching powder. But the distributing apparatus is somewhat expensive. The strength employed is stated in parts of chlorine per million parts by weight of water. A gallon of water weighs 10 lb. Therefore 10 lb. of chlorine to 1,000,000 gallons of water are equivalent to 1 part of chlorine per million parts of water.

The amounts used to treat water successfully are ·2 to ·75 parts per million. A word of warning is necessary with regard to chlorination as a defensive measure. Like every other process, the personal factor must always be taken into consideration. In other words, if those in charge of a chlorination plant are careless or perfunctory with the application of the process, complaints or serious consequences (spread of water-borne diseases, for instance) may result.

*Water Analysis.*—To take a reliable sample for submission to the analyst the following procedure should be adopted. Narrow-necked, glass-stoppered, sterilised bottles should be requisitioned, and their external surfaces carefully washed before they are dipped under the surface of water to be sampled. The stopper is left in the mouth of the bottle. After the bottle has been submerged the glass stopper is removed and the bottle almost filled. Then the stopper is firmly fixed in position by string. When a sample is taken from a tap the water should be allowed to run for some moments. Mention of the word "analyst" calls for a word of warning. A chemical analysis alone must not be relied on for offering an offhand opinion regarding the quality or fitness of water for human consumption. A bacteriological examination is also necessary. If, however, the chemical analysis reveals a water possessing the bad features undernoted, there need be no hesitation about condemnation of the water. The sample must be carefully labelled to denote the date, place, and the type of water sampled, and by whom.

SAMPLES OF WATER

| *Good Water* | | *Bad Water* |
|---|---|---|
| Clear | | Turbid |
| No colour | | Brown or yellow |
| No smell | | Present |
| Palatable | | Unpleasant |
| No suspended matter | | Marked |
| No sediment | | Present |
| Neutral reaction | | Acid or alkaline (marked) |
| Dissolved solids under 10 (parts per 100,000) | | Above 50 |
| Hardness—permanent | 2° | 4°–6° |
| Total hardness . . | 6° | 12°–20° |
| Chlorides . . | 1·5 | 5–10 |
| Free ammonia . . | ·002 | ·01 |
| Albuminoid ammonia | ·005 | ·015 |
| Nitrites . . . | Nil | Present |
| Nitrates nil or less than | ·05 | Present |
| Micro-organisms, non-pathogenic : | | |
| Filtered . under 100 per c.c. | | Over 100 per c.c. |
| Unfiltered . 500 per c.c. | | Over 500 per c.c. |
| Few coli, proteus, and no bacilli of *Enteritidis Sporogenes* | | Many coli, etc. |
| No pathogenic organisms | | Present |

In addition to the foregoing, the presence or absence of lead must be stated.

*Significance of the Foregoing Analysis.*—Free ammonia, which signifies ammonia given off by boiling, is not of such material significance as albuminoid ammonia, which affords an indication of organic pollution which in turn may be of vegetable or animal origin. Vegetable sources may be objectionable because an unpleasant taste is often imparted to the water. Nitrites are always to be looked upon with grave suspicion because they point to comparatively recent pollution with organic matter. While one does not desire to note the presence of nitrates, their existence in less than ·05 parts per 100,000 need not cause alarm. Also, nitrates prove that the oxidation of organic matter is nearly complete. Nitrites, on the other hand, point to active growth of micro-organisms. Chlorides in water in amounts varying between 5 to 10 parts per 100,000 may suggest pollution by urine. But the presence of chlorides alone must be studied in relation to the analyses of other waters in the neighbourhood, since earth formations may be concerned in contributing chlorides. Obviously the presence of micro-organisms of the pathogenic or related groups should be viewed with suspicion.

## CHAPTER XIII

# SEWAGE DISPOSAL

In the case of privies and dry-earth closets, the contents of pails or buckets should be regularly emptied into trenches, which must be immediately covered over to prevent effluvia or collections of flies. Also, care must be taken that these trenches do not imperil any water supply.

As has been indicated, a well-designed dry-earth closet, kept well supplied with riddled loam, or ashes, or a mixture of both, will provide a perfectly sanitary method for dealing with human excreta. Care should be taken to place the compartment containing the dry-earth closet, or privy, in a suitable position surrounded by trees or bushes and concealed from public view. Reference has already been made to the cesspool method of disposal of household sewage and domestic waste waters.

Where the sea is near at hand, and especially when a fairly strong tide ebbs and flows, the sewage of a community may be diverted into the sea below the level of the lowest water mark. While this crude method does not commend itself, it is surprising how slight the pollution by sewage appears to be along the foreshores, even in the vicinity of sewer pipe outlets. A powerful tidal current quickly washes away the solid debris. While that may be true, danger to the individual does exist, because shell fish of various kinds, gathered from the shores in the vicinity of places that discharge their sewage into the sea, have, when consumed, caused outbreaks of Typhoid Fever. It was not until the public were warned by notices that such danger existed that recurring Typhoid Fever outbreaks were prevented at Leith a good many years ago. Infection was more than once traced to the consumption of mussels, made into a sauce which was eaten with fried fish. (See Shell Fish Regulations.)

Though the Rivers Pollution Prevention Acts lay down very definite requirements regarding the pollution of streams, these statutes have been ignored by many county councils, and neither Ministry nor Department of Health in England or Scotland has compelled negligent Local Authorities to do their duty. Beautiful countrysides with delightful valleys and ravines, lined by luxuriant vegetation, have been converted into ugly and unsavoury places by the passage through them of streams that are very little removed from being open sewers.

**Sewage Purification.**—The simplest methods are land-treatment systems, but it is becoming every day more and more difficult to secure areas of ground of sufficient extent to carry out such methods, especially in the vicinity of big centres of population. In county districts a land system of sewage purification may be conveniently used in combination with one or other of the biological systems. No sewage purification scheme is automatic, and unless close and constant supervision is maintained, unsatisfactory results are likely to result.

**The Land-Treatment Methods are:** (1) *Intermittent Downward Filtration*; (2) *Broad Irrigation*.

In the former case the land selected should be loamy and arranged like a ploughed field in ridges and furrows. Six feet below the surface of the ground open-jointed field drains are arranged, either in parallel rows, six or more feet apart, or on the herring-bone principle. These drains empty their contents of more or less purified sewage either on to a second area of similarly furrowed and under-drained land or into a passing stream. The dual process is to be preferred, because better results will be assured. The land selected is divided into sections. The sewage is directed to flow into section (1) until a depth of six inches of sewage stands in the furrows. The sewage is then diverted to sections (2), (3), and (4). When (4) has been reached it will be found that the sewage passed on to section (1) has disappeared, because it has percolated through the six-foot depth of soil to find its way into the open-jointed drains. Purification, as will have been gathered, is effected by intermittently using the different sections of the land. Micro-organisms in the soil start the process of purification by converting the ammonia of the sewage into nitrites and nitrates. That process is called *nitrification.*

In the case of *Broad Irrigation,* on the other hand, while field drains may also be laid six feet below the surface of the ground, the land selected is planted with vegetation, which may be grass or vegetables, such as mangel-wurzel or turnips. And in place of being arranged in ridges and furrows, the ground is sloped, so as to encourage the flow of the sewage in a thin film over the surface of the slope.

A graphic illustration may be offered by picturing a railway embankment provided with a wooden trough, running from end to end of the top of the embankment. This trough would convey sewage, and when the sewage overflowed the edges of the trough the overflow would pass down over the slope of either side of the embankment. It is in the course of its journey over the incline that the sewage is purified by the nitrification process which is specially active at the roots of any vegetation growing on the slope.

When it is realised that these methods of land treatment require one acre for 250 and 500 persons respectively, it will be understood how difficult or impossible it is to set aside sufficiently wide tracts of unoccupied land for sewage purification near populous places.

**Biological Processes.**—Strictly speaking, intermittent downward filtration and broad irrigation are biological processes, but engineers and chemists have from time to time introduced systems designed to purify sewage more expeditiously. Thus there have been introduced the Scott-Moncrieff System, Cameron's Septic Tank, Dibden's Contact Beds, and Stoddart's System. Combinations and modifications of these different methods have been used with varying success. The latest to claim attention has been the Activated Sludge Process. Each can be made to function in a highly satisfactory manner if intelligent and regular supervision is given to it. None will produce good effluents if the scheme is neglected. The standard for a good effluent is one that does not putrefy on keeping. It is a standard that is extremely difficult to attain and maintain under existing conditions.

In every scheme yet devised, purification depends on the action of anaerobes and aerobes. Anaerobic action takes place in covered or uncovered tanks into which the crude sewage is received. Thence the liquefied sewage is led to aerating troughs or filter beds filled with clinker. In this, the second part of the purification process, aerobes play their part.

Reference has already been made to the mistaken idea that "fever" can be spread by effluvia from drains or sewers. It need only be repeated that effluvia do not harbour pathogenic organisms. All that can be urged against "bad smells," coming from drains or sewers or accumulations of putrefying matters, is that their long-continued inhalation may lower the vitality or resisting powers of the individual to render him or her more vulnerable to attack by disease, not necessarily infectious. Reference to that feature has been made when dealing with land-treatment methods at Edinburgh.

## GENERAL CONSIDERATIONS

**Land-Treatment Methods.**—These are now gradually passing into the category of what might be termed historical interest, because the required extent of land is seldom available, especially in the vicinity of largely populated districts. For isolated communities, however, purification of sewage by passing it over land has still a place. Also, it may be utilised in connection with asylums and other isolated institutions where the surroundings are free from habitations. While that caution is offered, it cannot be said that infectious or other disease has been traced to land-treatment schemes of sewage purification. Odours, especially during the warmer months of the year, may come from a sewage farm, but these will probably be present because the purification process has been left to follow out its own course. All sewage purification schemes, no matter how much may be claimed for them, must be carefully supervised. The city of Edinburgh for many years depended on land treatment for the purification of its sewage. No untoward results came to light, despite the comparative proximity of the sewage-soaked meadowland to a rapidly growing part of the city. It is rather suggestive, however, that ever since the land-treatment scheme was stopped, the diversion of the crude and untreated sewage of the city into the adjacent sea has provoked many and oft-repeated complaints regarding the fouling of the foreshores and the defiling of the sea-water in which bathing used to be enjoyed. Such complaints clearly suggest that settling tanks should be provided to receive the raw sewage and that the subsequent effluent from these tanks should be carried out to deep water, where the tides will take possession of any objectionable waste matters.

*The Activated Sludge Process*, which is the last to be introduced, has a distinct merit in that, unlike many other schemes of purification, the resulting sludge (muddy sewage residue) may be converted into manurial value. No other process has been able to produce sludge that could be so usefully employed. Exception to that statement might be offered in the case of the dried sludge resulting from chemically treated sewage, since dried chemically treated sludge has been used in connection with fruit-growing. Before a description of the above process is given it must be kept in mind that in every sewage purification it is highly desirable to run the raw untreated sewage into what are known as detritus tanks. In these much insoluble refuse, such as street mud and debris, is arrested. Other parts of the sewage, liquid and solid, pass from the detritus tank or tanks into the first section of the sewage purification scheme. It may be a septic tank, closed or open, in which place anaerobic action is encouraged to develop. The thick, black, unsightly froth which is formed as the result of putrefactive processes excited in the sewage acts as a cover to the raw sewage, and so shuts out light and air to enable the anaerobes to exercise their function of liquefaction. Since this layer of froth has been found to exercise the desired influence in keeping out light and air from the anaerobes, the need for a costly covering of concrete work no longer exists. The septic tank originally introduced by Cameron of Exeter was provided with a sealed and substantial cover. As has been indicated, the call for such construction has almost disappeared. From the septic tank the liquefied sewage is syphoned over to aerating troughs which, as their name suggests, initiate aerobic action by encouraging a free admixture with oxygen. Finally, the oxygenated sewage is led to filters filled with vitreous clinker, where further purification is encouraged by nitrification, the organic ammonia being split up into nitrites and subsequently into nitrates. Having passed through these stages (if systematically supervised) the effluent from the clinker-filled filters issues as clear as many stream waters, and, being highly oxygenated, is comparatively innocuous. To render the effluent still more perfect, it should, if land is available, be treated by intermittent downward filtration or broad irrigation. Little fault would be found with an effluent so thoroughly treated, and any stream could be confidently used for the reception of so pure a result of what might be termed scientific methods.

In the *Activated Sludge Process* there is no septic tank; but a detritus tank is provided, as in other purification processes. Its place is taken by what is called an aeration and disintegration tank. Aeration and the breaking-up of the solid particles of sewage (disintegration) are effected in two ways. The one is to forcibly blow air through the sewage from pipes running along the floor of the disintegration tank. These pipes are provided with small apertures through which air is forced upwards to agitate and oxygenate the sewage. Another method employed is to use paddle-wheels or agitators, which will probably be more thorough in their work, because their action will be more vigorous. The next stage is the nitrifying one. The liquefied sewage passes from the disintegration tank along tortuous channels before it reaches its destination.

The tortuous construction of the channels delays the flow of the sewage, and in doing so encourages the precipitation of sludge to promote nitrification. The resulting clear effluent may next be passed over land or over clinker beds, but the nitrified sludge is kept back to be collected in specially provided tanks. The difficulty presented is the ultimate disposal of this great mass of sludge. Also, before the sludge can be usefully employed as a manure, it must be dried—dehydrated. The percentage of water contained in the raw sludge is so high that the drying becomes a tedious and costly process. If the drying costs can be reduced, and if the time taken to effect desiccation can be shortened, the commercial value of dried activated sludge will be enhanced, because it can be sold at reasonable prices.

*Chemical Treatment.*—This system is of special value to large communities where huge volumes of sewage must be treated satisfactorily and rapidly. Glasgow offers a good example for the study of a chemically treated sewage scheme. The sewage from the city sewers is first arrested in large underground detritus tanks. From these the soluble parts are pumped up to precipitation or settling tanks of great length and depth. But, prior to its being passed into these precipitation ponds, studied quantities of chemicals—chiefly lime or alumina—are added to the sewage. When the chemically treated sewage reaches the tanks, slow and steady precipitation, encouraged by the chemicals, takes place. This is revealed when a precipitation tank is run dry, since a thick deposit of sludge is left behind on the floor of the tank. This is subsequently pumped up to a separate part of the works, where the sludge is compressed into hard blocks and subsequently dried. The liquid sewage, after it has passed through the chemical precipitation, is filtered and exposed to further purification before it is allowed to flow into the Clyde, on the banks of which two vast sewage purification schemes are constantly in operation.

## CHAPTER XIV

# CLIMATE

THE climate of a country is influenced by (1) temperature; (2) barometric pressure; (3) moisture; (4) electrical disturbances; (5) distance from the sea; (6) ocean currents; (7) elevation of the hills; and (8) the general character of the soil.

**Temperature and Sunshine.**—Excessive heat may induce heat apoplexy, a condition sometimes encountered in tropical countries and among stokers on board steamers operating in tropical regions. The cerebro-spinal system is specially involved. Nausea, giddiness, eye congestion, contracted pupils, and coma are usual manifestations. Recovery may be followed by Chorea, Epilepsy, and mental derangement. High temperatures in combination with sunshine are not conducive to muscular or mental activity. The influence of sunshine on health may be direct or indirect. In therapeutic and in what might be termed reasonable amounts, sunshine is valuable, not only because it increases growth, but it promotes physical activities. An excessive dose of natural sunshine may cause that condition known as Insolation—which is a mild form of Sunstroke. Children playing about in the open with their heads and necks unprotected from the sun are not infrequently affected by this condition, which is revealed by headache, giddiness, general prostration, pallor, with perhaps sickness and actual vomiting. In tropical countries especially, the more severe form of Insolation is called Sunstroke. In this case the circulatory system is involved. Feeble pulse and even death from syncope have been associated with Sunstroke. Sun helmets, with suitable protections for the base of the skull (the medullary region), are invariably worn in the tropics to guard against Sunstroke. Milder effects of sunshine are revealed by cutaneous eruptions, followed by blistering of the skin. Languor and severe headaches may be additional manifestations of prolonged and ill-advised sun-bathing. Because the results of sunshine are not immediately seen, the unthinking sun-bather exposes his whole body to the full glare of the light. Some hours afterwards he usually discovers that he has overdone the exposure. Languor invariably succeeds such indiscretion. If benefit is to be expected from sun-bathing, whether it be by artificial or natural sunlight, successive sections of the naked body should be exposed, and only for comparatively short periods at a stretch. When the skin becomes tanned (evidence of the release of pigment from the superficial blood-vessels) longer exposures may be indulged in, because the pigmentation protects the deeper layers from the powerful ultra-violet rays. When sunshine is therapeutically employed, it aims at increasing the lymphocytes and reducing the number of polymorpho-nuclear leucocytes. The importance of this change is that lymphocytes are considered to be one of the best defences against Tuberculosis. In Switzerland and other health resorts where sunshine is freely employed to cure or improve those suffering from Tuberculosis, the patients, even in the dead of winter, wear scant clothing, and freely expose their bodies to the ultra-violet rays, which are not interfered with by clouds, dust, or smoke. Also, the absence of these obstacles allows the comforting heat rays to play on the bodies of those who sit or walk about among the snows.

Insufficiency of sunshine, as opposed to excess, is evidenced by the lack of vitality among those who live in sun-starved countries. Development of growth is hindered, and mental dullness is a feature. Where there is little sunshine the growth of the lower forms of life is encouraged. But when the sun does shine the development of bacteria is arrested.

**Instruments used.**—In different countries various reading scales are employed: Fahrenheit and less frequently Centigrade in this country, and Réaumur in some parts of the Continent. The boiling-point in Fahrenheit is 212°, Centigrade 100°, and Réaumur 80°. Spirit and mercurial thermometers are used, the former acting more slowly than the latter, because their bulbs are larger and spirit possesses a greater thermal capacity than mercury. For that reason spirit thermometers are valuable in cold regions. The maximum thermometer registers the greatest heat, while the minimum indicates the greatest degree of cold. They are generally self-registering, like clinical thermometers. SIX'S thermometer, which is a U-shaped tube closed at both ends, contains mercury and alcohol, and registers maximum and minimum temperatures. The SOLAR RADIATION THERMOMETER measures the amount of heat in the atmosphere. This instrument is exposed to the sun, and placed above the level of the ground. By observing the maximum registered, the maximum indicated by a thermometer placed in the shade is also read. The latter reading, when subtracted from the former, gives the maximum solar radiation of the day. Both are self-registering, so that the observation is reliable. For finding the degree of cooling from the ground by radiation, STEVENSON'S SCREEN is employed. This is a box with louvered sides and covered over by a sloping roof to protect a contained self-registering thermometer from the sun. The nearer the screen and thermometer are placed to the ground the higher will be the temperature recorded. The mean temperature of each day is recorded by taking hourly readings. If only three readings are taken, they should be noted at 6 a.m., 2 p.m., and 9 p.m. The hottest hour of each day is between 2 and 3 p.m. The mean temperature of a month is ascertained by dividing the sum of daily mean temperatures by the number of days in the month. The mean temperature of a special locality is ascertained by adding the mean temperature of several months and dividing that by the number of months included in the period of observation.

Modifications of temperature are influenced by land, water, forests, and deserts. Elevation above sea-level also exerts a considerable effect.

**Atmospheric Pressure.**—Human beings are able to accommodate themselves to pressures varying between 8 to 72 inches of mercury, which is equal to 36 lb. to the square inch. It is when the pressure is excessive, as is found in CAISSON DISEASE, that untoward manifestations develop. To enable divers and workers to operate at great depths, as happens when foundations for bridges are being examined or made, a steel cylinder (caisson) is used. Under such conditions work has to be carried on at abnormal atmospheric pressures. Slow pulse, headache, torpor, deafness, and singing in the ears may result. But it is mainly when release from the caisson takes place that the chief danger arises. Consequently as soon as the operative emerges from a diving-bell or caisson he must enter a decompression chamber, in which the pressure is slowly reduced to establish an equilibrium of pressure for him before he comes to the surface. Sudden emergence is accompanied by considerable risk, since it may be followed by bleeding from nose, ears, and stomach. There is epigastric pain and neuralgia. In extreme cases paralysis may ensue.

**Diminished Atmospheric Pressure.**—In direct contrast, a condition known as Mountain Sickness may be induced when altitudes of over 6000 feet are reached. The pulse quickens, breathing is shallow, and perspiration is free. As one climbs higher the weight of oxygen in each cubic foot of air is lowered. Hence there comes the effort to breathe more quickly to take in more oxygen. At such heights the climber begins to feel that his legs are too heavy for him. Unless supplies of oxygen are carried, as in the case of the Mount Everest and balloon expeditions, the climber suffers from epistaxis and bleeding from the ears. Generally speaking, at altitudes between 3000 and 6000 feet the effect on the climber is exhilarating.

**The Barometer** is used to record atmospheric pressure. The principle on which the instrument works is that every surface exposed to the atmosphere is capable of sustaining a normal pressure equal, on an average, to the weight of a column of mercury 30 inches in height. The pressure of the atmosphere at sea-level is 14·7 lb. to the square inch.

FORTIN'S is the barometer most frequently employed. The **Aneroid** barometer measures the weight of the atmosphere by its pressure on a vacuum chamber, the movements of the sides of the chamber being communicated by springs to an indicator which may be arranged to leave a record on a graduated paper wound round a slowly revolving drum.

Barometric readings offer reliable indications of weather changes. When the barometer falls the outlook is often unfavourable. Steady pressures of 30 inches in this country usually portend good weather. A sudden fall suggests stormy weather accompanied by wind or rain or both. Sudden changes in temperature and pressure often excite colds and catarrhs. Excessive cold may cause frost-bite, and the most intensive cold may be followed by anaesthesia of the whole body with resulting coma and death from syncope.

**Moisture and Rainfall.**—When the relative humidity of the atmosphere is 75 per cent. the conditions for living are generally good. This means that the atmosphere contains three-fourths of the moisture which it is capable of absorbing at the prevailing temperature. When, however, the relative humidity is excessive, the interference with evaporation from the skin and lungs prevents the excretion of effete products. An accumulation of these in the system does harm. Various instruments, notably the wet- and dry-bulb thermometer, have been employed for measuring relative humidity. The wet- and dry-bulb thermometer has now been replaced by the kata thermometer, especially in factories and other places where indoor work is carried on. The kata thermometer has been devised to measure the cooling power of the air. It does so by indicating in mille-calories the heat lost per second by one square centimetre of surface at the body temperature. The loss is ascertained by dividing the factor on the stem of the thermometer by the number of seconds taken by the spirit in the thermometer to fall from 100° F. to 95° F.

**Rainfall.**—When moist-laden air is quickly cooled below its dew-point moisture is deposited in the form of rain, snow, or sleet. (The dew-point is the temperature at which the moisture in the air, called the absolute humidity of the air, would suffice to saturate it.) Moist-laden clouds blown from the sea become suddenly chilled when they come into contact with cold mountain ranges. This explains the heavy rainfall on the west coast of Scotland, in Wales and Cumberland. In those districts the rainfall may reach 75 inches per annum, whereas the average for the rest of the United Kingdom is between 30 and 40 inches.

The effect of continued rainfall is its depressant action. Because it prevents people from moving about freely in the open air, it also interferes with exercise and promotes overcrowding. This, when accompanied by inadequate ventilation, is detrimental to health. In wet countries pulmonary affections and rheumatism are common. Rainy climates, with their moist-laden atmospheres, retard adequate evaporation from the skin. The advantages of heavy rainfalls are that they provide abundant water supplies, and wash down impurities in the air.

Rainfall is calculated by a rain gauge, which consists of a circular funnel having a diameter of 5 to 8 inches. The funnel opens at its lower end into a receiver, which collects the rain entering the funnel mouth. Rainfall is measured every day at 9 a.m.

**Wind.**—The effects of winds on the individual depend on their velocity and the amount of moisture they contain. Dry winds which are uncomfortable are the *Bise* of the Riviera and the *Bara* of Trieste, both of which blow from the Alps. The *mistral* of the Riviera is also well known. The east winds of Edinburgh, especially in spring, are inimical to those suffering from chest affections. Those winds cross the German Ocean after passing over the Russian plains and the Norwegian glaciers. The *Sirocco* is a south-east wind which rises in the Sahara, crosses the Mediterranean, and reaches the Riviera in a moist condition. The *Monsoons* of India occur in summer and in winter, the one being hot and moist while the winter type is cold and dry.

Another division of climates has reference to their geographical distribution. Thus there are ocean, continental, insular, mountain, and littoral climates.

**Ocean Climates** are found associated with large tracts of sea. Their chief characteristics are purity of air, which is moist and charged with ozone. They are windy, with moderate variations of temperature. There is little shade, with consequent strong reflection of the sun.

For various conditions induced by worry or overwork, a change of scene and air often prove beneficial. Under such circumstances ocean climates are indicated, because they are bracing and fairly equable. Many debilities, with the exception of Pulmonary Tuberculosis, Asthma, and Catarrh, are improved by residence at ocean climates.

**Continental Climates** are associated with areas of land devoid of lakes and far from the sea. Germany offers a good example. The peculiarity of continental climates is that they show extremes of heat and cold.

**Insular Climates.**—Because they are near the sea these climates are more equable than the former. The United Kingdom possesses such a climate.

**Mountain Climates.**—These are understood to refer to heights of 3000 feet above sea-level. They are characterised by much sunshine, dryness, and coolness associated with free air movement. Ozone is present, and dust and smoke absent. The day and night temperatures show marked variations. Should the mountains be near the sea the tendency to heavy rainfall and snow will exist.

**Littoral Climates,** sometimes called maritime climates, show equable temperatures with moisture predominating. The weather also shows quick changes.

## CHAPTER XV

# FOOD AND DIETETICS

SUFFICIENT attention in the medical curriculum is not being given to the study of dietetics. The doctor who is anxious to become a successful practitioner will be amply rewarded if he devotes some time to the close study of foods in relation to health and sickness. As much success in treatment will depend on the dieting of patients as in prescribing drugs. The majority of people eat too much and too often. Also, many consume foods that are injurious to their health. When the practising doctor understands dietetics he will quickly build up a large practice for himself, because, as has been suggested, the majority of people require guidance and advice on what to eat and what to avoid. Cooking has become such a fine art that many foods are eaten only because they are temptingly served and highly seasoned. The consumer is enticed to eat when he would have been well advised to give his already overburdened stomach a rest. When alcoholic beverages are added to the various mixtures of fish, meat, sweets, and cheese that are frequently consumed, the imagination can be left to picture the tumult created in the stomach.

As long as people continue to overeat, so long will medical men require to prescribe sedative stomachic powders, potions, and pills.

The simpler the fare the better will the health of the individual be. There is much to be said in favour of a vegetarian dietary, if for no other reason that it restricts the consumer to a limited variety of foods of a simple kind.

The following list of the principal articles used will guide the student in assessing the respective values of different foodstuffs.

| | Proteins. | Fats. | Carb. Hyds. | Salts. |
|---|---|---|---|---|
| Raw Meat | 20·5 | 8·5 | — | 1·5 |
| Hen's Eggs | 13·5 | 11·5 | — | 1·0 |
| Cow's Milk | 4·0 | 3·5 | 4·5 | 0·7 |
| Butter | 1·5 | 83·5 | 1·0 | 1·5 |
| Cheese | 28·0 | 23·0 | 1·0 | 7·0 |
| Bread | 8·0 | 0·5 | 50·0 | 1·5 |
| Potatoes | 2·0 | 0·1 | 21·0 | 1·0 |
| Oatmeal | 12·6 | 5·5 | 63·0 | 3·0 |

The pulses, which include peas, beans, lentils, and their allies, are very valuable foods, and, because they contain large quantities of protein, have been called " The Poor Man's Beef."

The chief protein found in pulses is legumin. Since pulses contain sulphur they are liable to excite flatulence. Beans contain most sulphur and lentils least. Because they are not rich in fats the pulses combine well with fatty foods, *e.g.* bacon and beans, pork and pease pudding. Pulses should be cooked in olive oil or served with butter. Because they contain greater quantities of purin than most foods, the pulses cause an undue excretion of uric acid. For that reason those who suffer from the gouty diathesis are usually forbidden to eat pulses. But that apart, the pulses should figure much more frequently than they do as supplements to the dietaries of most people, especially those who can least afford to pay for meat and fish in quantities considered sufficient to satisfy the appetite.

COMPOSITION OF PULSES

| | Water. | Proteins. | Carb. Hyds. | Fat. | Cellu-lose. | Matters Mineral. |
|---|---|---|---|---|---|---|
| Green Peas . | 78·1 | 4·0 | 16·0 | 0·5 | 0·5 | 0·9 |
| Dried Peas . | 13·1 | 21·0 | 55·4 | 1·8 | 6·0 | 2·6 |
| Pea Floor . | 10·21 | 27·98 | 56·93 | 1·97 | 0·42 | 2·49 |
| Lentils . . | 11·7 | 23·2 | 58·4 | 2·0 | 2·0 | 2·7 |
| Butter Beans . | 10·5 | 20·6 | 62·6 | 2·0 | — | 4·3 |
| Haricot Beans . | 11·7 | 23·0 | 55·8 | 2·3 | 4·0 | 3·2 |
| ,, (Dried) | 10·0 | 13·81 | 52·91 | 0·98 | 2·46 | 2·38 |

The theoretical amount of heat produced by the changes of the various foods in the body are stated in terms of calories. As has been explained, a calorie is the amount of heat required to raise 1 kilo (1 litre) of water 1° C. or 1 lb. of water to a temperature of 4° F.

**Vitamins or Accessory Food Factors.**—The term vitamin is a misnomer, since these substances have nothing to do with ammonia. It is now agreed that a better definition to apply to vitamins is that of *Accessory Food Factors*, the presence of which, singly or in combination, is essential to growth and metabolism.

So far, six of these *Accessory Food Factors* have been discussed, but in no case has their composition been discovered or announced.

**Food Accessory A** is found in cod-liver oil, milk, butter, egg yolk, spinach, peas, and lettuce. Cows kept in byres and not allowed to pasture in sunshine yield milk deficient in A. Vegetable oils such as are found in certain brands of margarine are also deficient in A. Because it is a protective it is necessary for nutritional growth. Xerophthalmia may arise when A is absent from the diet. This Food Accessory is called Fat Soluble A, because it is closely related to Fat.

**Food Accessory $B_1$** is found in yeast, and in most natural foods. It is the anti-neuritic factor. As it is found in the germ and husk of the grain, the milling process removes $B^1$. Beri-beri is believed to be caused by eating polished rice.

**Food Accessory $B_2$** is believed to be the anti-pellagra factor. It also occurs in many foods, such as ox liver, yeast, and egg albumen. Not so abundant in milk and maize.

**Food Accessory C.**—Prevents Scurvy. Chiefly found in fresh vegetables and fruits, especially in tomatoes and oranges. In milk ; may be reduced in pasteurised milk. Lemon and orange juice must now be given to members of ships' crews after they have been continuously at sea for 14 days. Ordinary lime juice does not contain C.

**Food Accessory D.**—Found in cod-liver oil. It is the anti-rachitic factor sometimes called Fat Soluble D.

**Food Accessory E.**—Found in the oil of the wheat germ. Also found in olive oil, cotton seed, and peanut oil. Sometimes called the " reproductive vitamin."

**General Considerations.**—Having studied the legal enactments bearing on food supplies, the student will realise that the interests of the citizen are well safeguarded in so far as the preparation and sale of foods are concerned. Foods and drugs are methodically sampled and analysed, and, as has been indicated, any citizen may, on paying a fee of 10/6, demand an analysis of any food or drug suspected by him to be adulterated, or which is not, in his opinion, of the nature, substance, or quality of the article requested. Shops and stalls, as well as food hawkers' barrows, may be examined by authorised sampling officers. Animals, alive or dead, exposed for sale or intended for sale as human food, are critically watched for the detection of any unsoundness in them, by qualified veterinary officials. It has been because a persistent campaign of milk sampling was carried on that adulteration either by the addition of water or the abstraction of fat is now rarely encountered. The more uniform inspection of meat at the place of slaughter has practically put an end to the sale of tuberculous and unsound flesh. At every seaport imported food is systematically examined, suspected or unwholesome consignments being seized and destroyed. Improved methods in the collection, preparation, and storage of food have resulted in the abolition of the use of chemical preservatives. Exceptions are made at certain periods of each summer, when minute amounts of boric acid may be added to preserve sausages and minced meat. Chemicals must no longer be added to milk and cream, because care and cleanliness at the dairy farm are looked for to maintain them in a fresh state for a reasonable length of time. How far we have to travel before perfection in that direction is reached has already been discussed. All milk vendors must now be registered. This has put the smaller trader out of commission. It was well that that happened, because shopkeepers carrying on businesses of greengrocers, fruit merchants, and other perishable goods often sold small quantities of milk which was subject to contamination by dust, effluvia, and careless storage.

**Food Constituents.**—There are (1) proteids or nitrogenous substances, which are subdivided into albuminates, albuminoids, and extractives ; (2) fats or hydrocarbons ; (3) carbohydrates ; (4) organic acids ; (5) mineral salts.

*Albuminates* are found in animal and vegetable foods, and include albumin, casein, globulin, fibrin, fibrinogen, myosin, syntonin, glutin, and legumin. Without these life cannot be maintained, so that they may be described as essential foods. Digestion converts them into albumoses and peptones. Their chief function is to nourish the nitrogenous fluids and tissues of the body. They also supply material for growth and repair. They provide the oxidisable matters required for the upkeep and repair of energy and heat. In addition they are valuable in stimulating the flow of gastric secretions, and so aid digestion. But in his future work as a practitioner, especially in connection with the treatment of digestive ailments, proteids will require to be withheld or sparingly prescribed. For instance, eggs and milk are looked upon as what are known as light diets, yet they may be contra-indicated in dyspepsias of various kinds. Too much milk given in gastro-duodenal affections provokes acidity, which must be kept down in the treatment of these conditions. Bilious subjects are made more bilious when too many eggs are eaten.

*Albuminoids*—also found in the animal and vegetable kingdoms—comprise chondrine, gelatine, keratin, mucin, nuclein, ossein, spongin, and elastin. They contain more sulphur than albuminates. But albuminoids contain 2 per cent. more nitrogen than albuminates. While albuminoids also assist in growth and repair, the part they play in that respect is much less than that of albuminates.

*Extractives.*—These owe their origin to the metabolism of other forms of proteids. They exist in animal and vegetable kingdoms and are found in the juice of meat. Typical extractives are keratin, keratinim, karnin, xanthin, and aspirigin. They are not foods, but they stimulate the flow of gastric juices. Beef tea, for instance, is an extractive, and mainly acts as a stimulant. Soups made from bones alone are not real foods, but when macaroni, rice, barley, peas, lentils, and other substances are added, soups become nourishing and sustaining.

*Carbohydrates.*—These are more abundant in the vegetable than in the animal kingdom. Typical examples are cane sugar, dextrine, glycogen, galactose, grape sugar, lactose, maltose, pectose, and starch.

Immediately on entering the mouth they are acted on by the ptyaline in the saliva, to be converted into grape sugar and, in the case of starch, into dextrin. Another change occurs in the intestines, where the pancreatic ferment and intestinal juices complete the transformation of starch into sugar. After the sugar has been absorbed it is conveyed to the liver to be stored up in the form of glycogen. In the use of carbohydrates the dietetician always exercises care and judgment.

*Organic Acids* are chiefly found in fresh fruits and vegetables, but only in small proportions in meat and milk. Examples are acetic, citric, lactic, malic, oxalic, and tartaric acids. Being carbonates, they assist in keeping the blood in an alkaline condition and prevent the urine from being over-acid. By reason of their oxidisation they help in a minor degree to maintain heat and energy.

*Mineral Salts.*—The salts of sodium are more commonly encountered in the animal foods, while those of potassium are more evident in the vegetable world. The chief salts are chloride of sodium, phosphates of lime, potash and magnesia, also sulphates and iron. The hydrochloric acid of the gastric juice owes its origin to the chlorides. The function of the mineral salts is stimulation of the appetite and the intestinal secretions. Potash salts nourish the muscles and red blood corpuscles. Soda salts supply intracellular fluids. The salts of lime, potash, and magnesia are not, as is generally believed, good bone-builders, because they are excreted from the body in an unchanged condition. Iron salts supply the red blood corpuscles with haemoglobin.

*Phosphorus* is found in animal and vegetable foods, but chiefly in the animal kingdom. The varieties of phosphorus encountered are glycero-phosphoric acid, lecithin, nuclein, phospho-carnic acid, and phosphates. Phosphorus is a true bone-former and acts through the agency of its organic compounds. The young especially benefit from the absorption of phosphorus. Fish are generally believed to contain more phosphorus than meat. It is a fallacy, and fish can lay no special claim to being brain-builders.

**Heat (Calorie) Value of Food.**—Too much has been written and said in support of calories and their importance. It has become a habit to assess the value of food from a calorie standpoint. There is no secret or special dietetic value in calories. They merely indicate units of heat. The standard of the calorie was established to show the amount of heat produced by the complete oxidisation of the various constituents that have been described. (The food calorie is not to be confused with the word Calorie, which is the ordinary heat unit referred to, for example, by gas manufacturers.)

In assessing the value of food, the following must be taken into consideration :—

(1) The readiness of its assimilation

(2) Its complete combustion.

All these data have been furnished by experimental feeding. Selected individuals have been allowed to go to work, while their food and excreta were carefully measured and analysed. The unit of measurement of energy production is the calorie, which is the amount of heat required to raise 1 kilogramme of water from 15° C. to 16° C. This is equivalent to 3100 foot pounds, or the heat required to raise the temperature of 1 lb. of water to 4° F. Fuel value means the total number of calories derived from a gramme or pound of any given substance, if it is completely used within the body. The following figures afford a simple guide for making calculations of food values: 4·1 calories are derived from a gramme of proteid or carbohydrate; 9·3 calories are got from a gramme of fat.

If, therefore, an individual at work, or at rest, requires a stated number of calories, it will be comparatively simple to state how much proteid, carbohydrate or fat he should receive every day.

1 lb. of protein yields 1860 calories.

1 lb. of carbohydrate yields 1860 calories.

1 lb. of fat yields 4200 calories.

A man doing a moderate amount of muscular work requires :—

| | Weight in Grammes. | Average Ration. | Amount required in Ozs. | Energy Value in Calories. |
|---|---|---|---|---|
| Protein . . | 100 | 158 | 3·75 | 400 |
| Carbohydrate . | 500 | 514 | 18·00 | 2000 |
| Fat . . | 100 | 200 | 3·75 | 900 |

The value of a diet will depend to a great extent on the skill and care of the cook, since good food material may either be destroyed by bad cooking, or it may be presented in an unpalatable or unappetising form.

The following is a simple illustration of the amount of some common article it requires to produce 100 calories: 1 small lamb chop; 1 large egg; 1 small dish (about 3 ounces) of baked beans; 1 large potato, if boiled; 1 ordinary thick slice of bread ($1\frac{1}{2}$ ounces); 1 plateful (6 ounces) of oatmeal; 1 ounce of sponge cake; 1 ounce of sugar; 4 big prunes; 1 large (10 ounce) orange; $\frac{1}{2}$ ounce of butter; $\frac{1}{4}$ glass of cream; 5 ounces (1 small glass) of milk. The above do not contain the quantity of mineral matter required. Calcium is found in milk, as well as in eggs, vegetables, and fruits. Phosphorus is also present in milk, in eggs, nuts, peas, and beans. Iron is found in beef, eggs, beans, peas, green vegetables (especially spinach), and in the outer coats of grain foods. White flour and cereals lacking their seed coats are poorest in minerals. Meat, eggs, and cereals have an acid ash; vegetables, milk, and the majority of fruits an alkaline one. The bases represented by vegetables and fruits should predominate in our dietaries.

## How Food may injure Health.

Non-edible mushrooms, some varieties of fish, as well as alkaloids found in some plants, cause poisoning. Trichina and tapeworms are usually found in meat which may convey parasitic diseases to the consumer. The need for eating well-cooked meat is obvious. Raw or partially cooked flesh foods must always be suspect. Watercress among vegetable foods has been known to spread Typhoid Fever.

**General Remarks.**—Though meat possesses a high food value, it is not an ideal form of sustenance, because it contains a large amount of proteid, with a lack of carbohydrates. And, on account of its high proteid content, rheumatic and gouty subjects and many dyspeptics react to a meat diet. Sufferers from Asthma may also be affected. A change-over to purely vegetarianism in such cases not infrequently produces marked benefit. Excessive proteid dietary may cause hyperchloridia or recurring acidity with torpidity of the liver. Skin irritations and Diarrhoea also result from excessive consumption of nitrogenous foods, especially by individuals who seem to possess an intolerance for animal proteids. Such fat meats as pork and mutton are indigestible, because the fat they contain may mechanically protect the fibre of the flesh from the action of the digestive juices. The flesh of mature animals has a better flavour than that of the young, because the flesh of the older animals contains more extractives. The meat of young animals is more watery. While meat may be objected to as a staple article of food, it holds the advantage over other nutritive substances in that little of it goes to waste, 90 per cent. of it being absorbed. Other foods that are fully absorbed and very nourishing are herring, salmon, and eels. But again, fish containing so much fat are not suitable for every individual. Mackerel, for instance, often produce severe forms of urticaria. Shell fish are also inimical to some individuals. Idiosyncrasy in such cases plays a very important part in the choice of shell and other fish as foods. Cod is not easily digested. Plaice, sole, whiting, and flounders are very watery, but, being easily digested, are looked upon as specially suitable for invalids. Fowls are overrated as foods, but, being easily digested, are frequently prescribed. Chicken and meat jellies are stimulants because they are extractives. Hospital authorities might easily reduce their bills if other foods were substituted for chickens. Poultry, especially if the animals have been boiled, are illusory forms of nutriment. Yet it is standard diet in the vast majority of infirmaries. Probably the white sauce, usually made with flour and butter, is of much more value as a food than chicken made dry and tasteless by boiling. Tripe, well boiled, and served with white sauce, is much more nourishing than chicken, plaice, and sole. The whiting is a delusion as a source of nutriment. It contains a large percentage of water, but it is cheap. Eggs are deficient in carbohydrates. Their advantage is that they are easily absorbed when lightly cooked, but, as has been said, their high proteid content may preclude their consumption by some individuals. Milk is a good food, but its value must not be exaggerated by the effort to help the farming industry. It may be harmful to those who suffer from acidosis and allied affections. As an accessory to other foods it can be recommended. Skimmed milk is neglected as an article of diet, especially by those who cannot afford to pay the prices demanded for whole milk. Skimmed milk should be advised for the making of milk puddings and for addition to soups. It may be profitably used as a drink, because its proteid content is intact. And any fat deficiency can be made good by butter spread on bread. The cheapest grades of margarine do not contain butter fat. The better and higher-priced grades must contain 10 per cent. of butter fat. They are therefore useful adjuncts to the poor man's dietary. Cheese is another excellent food, but it may be contra-indicated, for it frequently produces acidity with fermentative changes. It is difficult to support the habit of eating cheese after a dinner of several courses, when the digestive machine is straining to do its work. Cheese and biscuits and fruit constitute an excellent midday meal if well masticated and eaten slowly. Reference to milk would not be complete without making allusion to an excellent alternative to raw milk in the form of Horlick's Malted Milk. In cold weather especially the comforting heat of the warmed preparation is preferred to cold milk by many school children throughout the country. It is not constipating like raw milk, and it is equally nourishing and more stimulating. And, above all, it is free from the risks of tuberculous infection.

*Vegetables* also contain proteids, but they are not so easily absorbed as those derived from animals. The heat value is as great as the animal proteids. Oatmeal is an excellent food, especially when combined with milk.

Here again, however, oatmeal may on account of its high fat, carbohydrate, and proteid content cause gastric and skin disturbances. Barley meal contains less fat and often can be digested when oatmeal cannot be tolerated.

White bread by itself is not an ideal type of food, but when butter, fat, milk or cheese are consumed with it its nutritive value is greatly increased. Wholemeal bread by itself is superior to white bread. All the pulses are nutritious, when they can be tolerated. That feature of intolerance has been emphasised because a careful study of dietetics will be found of immense value when the practitioner is brought face to face with digestive disturbances and the abnormal conditions often associated with them. Some pulses contain more sulphur than others, consequently flatulent distension and abdominal discomfort are often complained of after beans and peas have been eaten.

Vegetarianism offers a strong appeal to many, because it does not overload the digestion with undue amounts of proteids or fats. The sugar and fats contained in vegetables suffice to maintain vigour and good health. A very important asset of vegetarianism is that it is much less liable to excite putrefactive changes in the gastro-intestinal tract. In support of that, vegetarians rarely suffer from appendicitis. Greater quantities of vegetables must be consumed than meat, if the necessary amounts of nitrogenous materials are to be provided to produce sufficient output of energy. While the cellulose of vegetables is not easily digested, the "roughage" or vegetable waste is valuable in exciting intestinal peristalsis. This, therefore, suggests an anti-constipation dietary consisting mainly of vegetable substances. Nuts of various kinds, especially Brazil nuts, are nutritious, but nut foods contain a large amount of indigestible cellulose. Fruits are not real foods. Their nutritional value, though slight, depends on their carbohydrate content, in the form of grape sugar, pectin, and cane sugar. The mineral matters contained, especially in fresh fruit and vegetables, consist of potash in combination with vegetable acids and are described as anti-scorbutics. The more ripe the fruit the less vegetable acid will it contain. On the other hand, there is a greater amount of sugar in ripe fruit. Potatoes are anti-scorbutic, but they contain a great quantity of starch, with small proportions of proteids and fat. Potatoes constitute the chief means of subsistence of many Highland and Irish peasants. But they usually add milk, dripping, butter, herring, or sour (butter) milk to the potatoes. Instinct has obviously taught these poor people to add proteids to the starchy food. " Tatties and dip " was, in the early part of this century, a staple article of diet in many parts of rural Scotland. As the name suggests, the members of a household dipped boiled potatoes into a plate containing melted ham fat or dripping and made a good repast at a sitting. Turnips and carrots possess little food value. They contain little proteid and consist mainly of water. Pectose is the carbohydrate found in turnips, while carrots contain much sugar. Even the foregoing brief summary will suggest that the consideration of dietetics offers much scope for study. A well-balanced diet is of outstanding importance for the maintenance of good health. It should always contain due proportions of proteid, fat, carbohydrates, and hydrocarbons. Mineral salts and accessory food factors, commonly known as vitamins, are supplied by fresh fruits, vegetables including salads.

One of the most graphic illustrations of the value of well-balanced rations, coupled with strictly regulated hours for sleep and exercise, was provided by the Great War. Thousands of young men who joined the colours were recruited from the poorest districts of our cities. Many of them had been improperly fed, badly housed, and rarely looked like possible types to create soldiers. Yet, in the course of six months intensive training, coupled with well-balanced diet and good sanitary environment in barracks, tents, or billets, they developed in the vast percentage of cases into straight-backed, healthy-looking fellows. It is not how much is eaten that matters. It is the well-chosen (balanced) diet that counts.

Experiment and experience have proved that the standard daily diet of a man performing moderate work should contain 120 grms. of proteid, 440 of carbohydrate, and 85 of fat. When the question is asked how much beef, bread, and butter are required to supply the foregoing quantities, the answer is provided by the following formula:

Let X = amount in grms. of beef required.
,, Y = ,, ,, bread ,,
,, Z = ,, ,, butter ,,

$$\text{Then } \frac{20X}{100} \times \frac{8Y}{100} \times \frac{1Z}{100} = 120.$$

The numerators indicate the percentage proportions of proteids, bread, and butter individually. For example, proteids form 20 per cent. of the beef, 8 per cent. of white bread, and 1 per cent. of butter.

**Slaughter-houses.**—These are of two types—*Private* and *Public*.

As the name suggests, the former are owned by the butcher, and the killing-shed (slaughter-house) may be close to the shop where the meat is exposed for sale.

Every well-regulated community should own and maintain its public slaughter-house. This may not be always possible in rural areas, where villages and townships are widely scattered. Under such circumstances it will be necessary to countenance private slaughter-houses. The outstanding advantage of the public (municipally owned and controlled) establishment is that the killing of animals is forbidden in any other place. This, as may be readily understood, ensures systematic inspection of all animals before, during, and after slaughter. Where private slaughter-houses prevail, their supervision is always difficult, and nuisances from mismanagement or from noises frequently arise in connection with such establishments.

Without entering more fully into the discussion of this subject, it may be said that the risk of inferior or unsound food reaching the retail shop from the well-conducted slaughter-houses of the present day is extremely small, since meat inspection in and out of slaughter-houses is now being strictly and systematically maintained.

Foods are examined at seaports by qualified officials, and, as has already been indicated, samples of foods and drugs are regularly taken by inspectors attached to every Public Health Department.

As may be readily understood, it is very difficult to maintain a close supervision of meat killed in private slaughter-houses, especially if there are many of these places scattered over a wide area. An inspector cannot be ubiquitous. Also, private slaughter-houses, being frequently of crude construction, are not easily kept clean. Accumulations of manure and of offal may also provoke nuisance, especially during the warmer months of the year.

Recent regulations governing private slaughter-houses require that the killing of animals must be carried out at specified times. This should enable inspectors to examine animals during slaughter.

**Food Preservation.**—Cold, heat, drying, salting, smoking, and chemical agents are used for the preservation of foods. Though none of these methods is an ideal one to employ, each possesses a certain value of its own for travellers, for tropical or warm climates, and for military campaigns. It must be accepted that where fresh foods are available those that are preserved should be accorded a second place in the selection of a dietary. It is well to point out, however, that chemically treated foods should not be countenanced. With the exception of mince and sausages, to which small amounts of boric acid are permissibly added during some of the warmest months of each summer, chemicals are now prohibited.

*Cold.*—The application of cold as a temporary expedient is an excellent method for preserving milk, fish, meat, butter, and vegetables in a fresh state. If the employment of cold chambers in dwelling-houses were as prevalent in this country as it is in America, greater amounts of fresh vegetables and fruit would probably be consumed. Lettuce, for instance, maintains its crispness and freshness for a considerable period if it is kept in an ice chest or cold chamber. On modern ships going to and from India and the tropics, salads and salmon and other perishable foods kept in cold storage are served throughout the voyages. The importance of keeping milk fresh in summer, especially for those who depend on that food for their chief article of diet, cannot be overstated. Confidence in cold as a method for indefinitely preserving food is apt to be misplaced, because freezing does not completely kill micro-organisms. Many observers have recovered the *Bacillus typhosus* from melted ice. It has also been demonstrated that organisms capable of causing putrefactive changes actually multiply in milk kept for long periods at low temperatures. Whilst freezing does not ensure complete sterilisation, it will, in the majority of cases, reduce the numbers of harmful bacteria which may be present in any food. But even if it falls short of perfection as a preservative, the application of cold holds the decided advantage over other methods in that it maintains the flavour, freshness, and nutritive qualities of food.

*Heat.*—Cooking preserves food, but the preservation is of a temporary character. It is when complete sterilisation is effected that preservation by heat becomes real. That knowledge has been applied to the canning or bottling of meat, fish, fruit, and vegetables of various kinds. Meat-canning is now an extensive industry and, as has been said, foods so treated have proved of great value when other fresh substances were unobtainable. Great care is now employed in the selection and preparation of canned foods. Prior to being canned, the food is partially cooked. Then the tins with their contents are subjected to boiling temperatures for one or two hours. In each tin a small opening is left. As soon as the process is at an end the aperture is closed with a drop of solder. At the expiry of twenty-four hours a second process of heating is applied. And again a hole made in the tin is sealed with solder. The temperature used during the second heating varies between 225° F. to 250° F. After the tins are sealed they are allowed to cool. This cooling creates a partial vacuum in the receptacles, because all their contained air and steam have been forced out by the heat. As soon as a vacuum is established the ends of the tins fall in to become concave. If the food has been imperfectly sterilised, gases are formed by the surviving micro-organisms. These putrefactive changes by the evolution of gases bulge the ends of the tins to make the tops and bottoms convex. Bulging ends, known as "blown tins," are rejected, because their contents are presumed to be unfit for human food. Outbreaks of food poisoning have been traced to the consumption of foods taken from "blown tins." The unfortunate feature, from the consumer's point of view, is that the contents of such tins do not always reveal their faults to the sense of taste. Often, however, the food is acrid and its jelly may be watery. Popular belief holds that canned foods completely lose their nutritive qualities. But that is not wholly true. Most foods have an acid reaction, and some of the most important vitamins survive heat. It has been established that "Fat Soluble A" is uninjured after milk has been dried or condensed. Horlick's milk converted into powder by the vacuum process still retains most of its anti-scorbutic Vitamin C. "Water Soluble B" is also left intact in canned foods. Preserved (tinned) tomatoes retain their Vitamin C content. But in most canned foods Vitamin C is injured or destroyed.

The majority of canned foods contain minute quantities of stannous salts, but they do not play any important part in metallic poisoning associated with food consumption. Copper was usually added to maintain the green colour of peas and other preserved vegetables. The addition of copper is now forbidden.

*Drying and Salting* are commonly practised for the preservation of fish, ham, macaroni, and spaghetti. The two latter consist of wheat-flour paste which is dried in the sun. Bacon is usually steeped in a special brine consisting mainly of salt with the addition of potassium nitrate, which latter preserves the red colour of the flesh. After their steeping, the hams are exposed to the smoke of burning oak bark. This dries and imparts the brown colour to the bacon. Kippered herrings are also exposed to the fumes and smoke of burning oak bark. Fish of the ling and cod varieties are split open, rubbed with salt, and exposed to the sun. Cottars in the Highlands of

Scotland preserve salmon, sea trout, and other fish by drying them for winter use when food supplies are scarce.

In Africa and among American Indians, strips of meat rubbed with flour are exposed to the sun and dried for use during long journeys. When drying is depended on for the preservation of such bulky articles as hams and thick sausages, it is not reliable, because the drying may not reach the deepest parts of the foods.

*Chemicals.*—Preservatives are forbidden in most articles of food, and none must be added to milk or cream. Preservatives must always be looked upon with suspicion, because they may cloak other imperfections of foods.

## CHAPTER XVI

# MILK SUPPLY

MUCH remains to be done to educate public opinion on the question of pure milk supplies, and the general practitioner can play a very important part in any campaign which urges clean milk drawn from healthy cows. Too much lip-service has been accorded to milk as a food. It is a good food, but it must be freed from suspicion before its universal consumption can be advised. Milk guards against deficiency diseases when it is consumed in conjunction with other animal or vegetable foods. Even when it is the sole article of diet for children, it is advisable to supplement it with vegetables and fruit juices, because too many cows in this country are denied fresh air and sunshine. They are kept all the year round in dark, dirty, and unwholesome cowsheds. Cows pastured in the open provide milk rich in Vitamin D, which is the antirachitic factor. It may be deficient or absent from the milk of stall-fed animals.

While milk is of high dietetic value, it has to be admitted that it is responsible for the causation of more illness than any other food. There are several reasons for that. In the first place, between 35 to 40 per cent. of the dairy cows in this country suffer from Tuberculosis, and their milk is sold to the public. Secondly, no food encourages more active growth and proliferation of micro-organisms than milk, as evidenced by the rapid spread of Scarlet Fever and Enteric Fever when a milk supply is infected. Thirdly, its keeping qualities are poor, because too much of it is collected and stored in a most unsatisfactory way. A spirit merchant is immediately fined if he sells whisky adulterated with an excess of water. A grocer is penalised if he gives a customer margarine in place of butter, and, should a mixture of coffee with chicory be sold to anyone who asks for pure coffee, a fine follows. But unclean milk may be dispensed without let or hindrance. The standard composition of milk is our only guide to its quality. In a progressive country like ours it is a confession of legislative ineptitude that so much unwholesome milk should be sold to the public. The efforts made to provide better milk supplies have been half-measures, as has been indicated by the introduction of various grades of milk. Marketing schemes have actually induced many new producers to enter the competitive field, but these new-comers have only increased surplus or what have been aptly termed " unwanted " supplies. The obvious remedy would have been to insist that all accessions to the milk trade would undertake to sell only tubercle-free milk from carefully tested animals. Taking the foregoing facts into consideration, the practitioner is strongly advised to encourage the consumption of tubercle-free milk and to set his face against the use of any other. In a laudable effort to assist the dairying industry of this country, Milk Marketing Boards have been established. These Boards in England and Scotland, by means of advertisements, have been tempted to overvalue the nutritive qualities of milk. Milk schemes for school children have been pushed with the double purpose of getting rid of surplus milk and of improving the health of the scholars. The fact that Grade A (T.T.) and pasteurised milk have been recommended goes to show that ordinary milk is not considered safe. Even

Grade A milk coming from untested cows must be pasteurised before it is distributed among the school population. But another interesting point is brought into prominence because the scheme for dispensing "school milk" is founded on a valuable experiment conducted among 10,000 scholars in Scotland and Northern Ireland some years ago by the Rowatt Research Institute of Aberdeen. During that experiment, which was spread over a period of months, groups of children of different ages were tested on whole milk, separated milk, and biscuits possessing the calorie values (heat-raising) of separated milk. Where certified milk was available, it was used. In the other cases pasteurised milk was given. At the end of the test it was found that those who had received certified and pasteurised milk showed an increase in height and weight and their general health was improved. It was claimed that the intelligence of the milk recipients had been raised. There was a slightly greater improvement among the groups that had received certified milk, but the increase in height and weight after pasteurised milk had been consumed were also appreciable. A very important and interesting feature was demonstrated when the biscuit-rationed group was changed over to separated or what is known as skimmed milk. The change was made because those supplied with biscuits did not show any marked improvement. When separated milk (skimmed of its fat) was substituted, improvement took place and the recipients increased in height and weight. This is a very important feature, because it supports the views advanced by those who have repeatedly urged the greater use of skimmed milk not only as a drink by itself but also as a valuable and much-neglected article of diet of reasonable price. It contains all the proteins found in milk, but is deficient in fat. The popular idea prevails that skimmed milk is of poor nutritive value. It is a mistake to permit that belief to continue, because skimmed milk should be more freely used for making soups and puddings for growing children. Having appreciated the importance of the foregoing experiments, it must be kept in mind that children between the ages of 6 to 7 each received two-thirds of a pint of milk per day, whilst those between 9 and 10 and 13 to 14 were given a full pint. That totally differs from the school scheme, which prescribes one-third of a pint of milk for each scholar—a little over 7 ounces—which amount fills a 6-ounce medicine bottle to overflowing. One must not be misled by the enthusiasm of those who have persuaded themselves that 7 ounces of milk given each day will produce outstanding results. In the near future, legislation may be expected to demand the universal production and sale of only one grade of milk, which will be free from taint or suspicion of every kind.

It is important to know the difference between human and cow's milk. By virtue of the Sale of Foods and Drugs Acts, the Board of Agriculture is empowered to make regulations governing the standard composition of milk, butter, margarine, and milk-blended butter (see page 31). But the milk standard is not to be confused with the chemical composition of milk.

| (Percentage compositions). | Human Milk. | Cow's Milk. |
|---|---|---|
| Water | 87–88 | 87–88 |
| Protein | 1–2 | 3–4 |
| Fat | 3–4 | 3½–4½ |
| Sugar | 6–7 | 4–5 |
| Mineral matter | 0·1–0·2 | 0·7 |
| | Reaction—Alkaline | Reaction—Acid. |

The excess of protein in cow's milk, its greater amount of fat and reduced amount of sugar, together with the acid reaction, are to be noted when comparing the two. Cream is generally added to cow's milk when infants are bottle-fed. And water or barley water may be employed to dilute cow's milk and to reduce the concentration of the proteid to approximate the amount found in human milk. Citrate of soda may be used to make the casein (part of the proteid) more flocculent and therefore more easily digested. Lime water may be added to counteract the acidity of cow's milk. But the tendency of lime water to induce constipation must be kept in mind. Finally, sugar of milk or glucose should be added to cow's milk when required for infant-feeding. The advice to parents must always be to use tuberculin-tested milk; failing which, cow's milk should be carefully pasteurised. This may be carried out at home or only labelled pasteurised milk should be used. This is emphasised, because too much of the milk that has undergone some kind of heating process is believed by the consumer to have been scientifically pasteurised. The inferior keeping qualities of imperfectly pasteurised milk usually betray it during the warmer months of summer and autumn, either by altered taste or when it causes gastro-intestinal disturbances.

The average yield of a cow is between 2 and 3 gallons per day. But exceptions to that rule occur among individual animals. Ayrshire cows are excellent donors of milk, but they are prone to develop Tuberculosis when constantly confined to cowsheds. Friesians are also splendid milkers. Alderney and Guernsey cows yield milk that is generally rich in fat. The cross-bred cow is favoured by many dairymen because it is more resistant to Tuberculosis and gives a steady yield of milk.

The "colostrum" milk of newly calved cows should not be used for infant-feeding for a fortnight at least after the animal has calved. Such milk invariably excites gastro-intestinal errors. The first draws from a cow's udder are known as "fore milk." This is not only very watery and deficient in fat, but it also contains the greatest number of micro-organisms which gain access to the teats and milk ducts when the animal lies down. The last dregs of milk drawn from the udder are called the "strippings." These are richer in fat, and it is always the last draws that must be taken when milk is being sampled for the discovery of tubercle or pyaemic bacilli. Abscesses of a tuberculous or other character are more likely to be stripped of pus by the final emptying of the udder with the fingers of the milker. It is when the teats and udder are the seats of Tuberculosis that the greatest danger to the milk consumer arises.

**The Proteins** in milk are casein, lactalbumin, and lacto-globulin. *Casein* exists in milk in combination with calcium phosphate in the form of caseinogen. It is not coagulated by heat, but is precipitated by acids. But the addition of lime water or dilute alkalis will redissolve the clot.

*Lactalbumin* is coagulated by heat, but is not affected by acids. It is more abundant in colostrum than in normal milk, and, unlike casein, which contains phosphorus, lactalbumin holds sulphur.

*Lacto-globulin* is found in small amounts in normal milk, but it is abundant in colostrum.

*Fat.*—The chief importance of this constituent is that on its amount the quality of milk is gauged. From the nutritional standpoint, milk fat, on account of its "Fat Soluble A," is of the greatest value because it is a potent anti-rachitic factor. When fat is absent or deficient in food, xerophthalmia may manifest itself. It is fortunate that the application of heat to milk fat does not affect its "Fat Soluble A."

*Milk Sugar or Lactose.*—Milk sugar is only found in milk. When milk is overheated by prolonged cooking, as in sterilisation, it is burnt and caramelised.

**Vitamins in Milk.**—Milk contains the following vitamins: "Fat Soluble A," "Water Soluble B," and a small amount of anti-scorbutic "Water Soluble C." Only the last is injured by heating and drying, though milk manufactured by the vacuum process is believed to retain its "Water Soluble C" unharmed or only slightly affected. It is a safe rule to follow, when infants are fed on cow's milk, to add fresh fruit juices to the dietary, because the anti-scorbutic element even in the best of cow's milk is small in amount. The various ferments and enzymes contained in milk need not be discussed in these pages. It is well to know, however, that the ordinary heat necessary to kill bacteria does not affect the enzymes, but prolonged high temperatures required to kill spore-bearing organisms will do so. This tends to prove that sterilisation of milk does affect its vital principle. Pasteurisation does not do so.

**Diseases spread by Milk.**—These are Tuberculosis, Enteric Fever, Cholera, Paratyphoid Fever, Scarlet Fever (which see), Diphtheria, Septic Sore Throat, Malta Fever, Foot and Mouth Disease. Food infections by means of *Bacillus enteritidis* and others of the Gaertner group, causing Infantile Diarrhoea. Dysentery is rarely traced to milk.

**Pasteurised Milk.**—While it is generally admitted that milk should reach the consumer in a fresh and pure state, necessity has compelled the employment of the pasteurisation process. Enough has been said to indicate that, without such a safety measure as pasteurisation, vast quantities of unsafe milk would be distributed for sale. Too much has been made of the alleged destruction of the anti-scorbutic " Water Soluble C " in milk by pasteurisation. As has been pointed out, this anti-scorbutic factor exists only in small amounts in the best of fresh milk. There was no trace of Scurvy found among the thousands of school children who received a daily ration of pasteurised milk during the experiment to which full reference has been made. No leading authorities in America have made references to Scurvy caused by the almost universal consumption of pasteurised milk in that country. It is established that no epidemic has been traced to the consumption of scientifically pasteurised milk. That cannot be urged in support of ordinary commercial milk. The strongest argument against the pasteurisation of milk is that it may and does cloak the imperfections of milk that should not be consumed in its raw state. The plea that pasteurised milk may be a cemetery of dead micro-organisms is not unfounded. Overheating in pasteurisation will kill the lactic acid bacilli.

What is aimed at in pasteurisation is the production of milk that may be safely drunk by the consumer. This involves the killing of any pathogenic bacteria that may be in the milk. And those mainly aimed at are the specific micro-organisms of Tuberculosis, Scarlet and Enteric Fever, and Diphtheria. Summed up in a few words, the pasteurisation of milk requires it to be heated to a temperature between 145° to 150° F., and keeping it at that heat for half an hour. To be completely successful the heated milk must be immediately " chilled " or cooled to a temperature of 55° F. in England and 59° F. in Scotland. Probably the difference in the climate of the two countries calls for such temperatures of chilled pasteurised milk.

Such other viruses as those of Dysentery and Malta Fever and Cholera are also destroyed by pasteurisation.

But spore-bearing micro-organisms are not killed by the temperatures advised for pasteurisation.

An inherent weakness of pasteurisation is that its manufacture depends on the personal factor. Machines and other apparatus may be mechanically perfect, but they must be operated by intelligent individuals. If they are not carefully worked, the presence of tubercle bacilli may, as now and again happens, be detected in milk that has been subjected to an imperfect process.

There are two methods employed for pasteurising milk. The one is the "Flash," the other the "Holder" process.

The "Flash" process is an attempted improvement on Pasteur's method. The term "flash" explains itself. It means the subjection of milk to a temperature of 178° F. for a few seconds and immediately chilling it. Because it is unreliable and unscientific it may be dismissed without further remark.

Pasteurisation has passed through several phases, but the introduction of the "Holder" process appears to be the most satisfactory one, if it is well and carefully conducted. The "Holder" process implies that the milk under treatment is held in contact with the desired temperature for the stipulated twenty minutes. This is effected by passing the milk through different compartments of a specially jacketed container heated by steam, the temperature being observed by thermometric readings recorded on a revolving cylinder. At the expiry of twenty minutes the warm milk is passed over chillers having corrugated surfaces. Brine or other cooling liquid circulates through the chillers, and when the milk comes into contact with the ribbed exterior of the chilling apparatus the desired temperatures of 55° F. and 59° F. are attained. The chilled milk is then bottled and sealed. Loopholes for contamination are still left in commercially pasteurised milk, but it is safer to drink it than impure milk coming from diseased cows or unclean premises. The householder should be advised to pasteurise milk in bottles in his own home. Domestic pasteurisers are now available and can be easily operated by a person of average intelligence.

**Sterilisation.**—When applied to milk, sterilisation alters the character of the liquid. Reference to the destruction of the enzymes and the clotting of lactalbumin has already been made. For tropical countries and for long-distance travellers, sterilised milk has a value because it will keep for long periods if it has been carefully sterilised, but its repeated heatings and the high temperatures required render the taste of the milk objectionable. For infant-feeding it must always be supplemented by anti-scorbutic fruit juices.

## CHAPTER XVII

# THE KEEPING OF COWS FOR MILK PRODUCTION

In many districts where dairy cows are kept, the regulations laid down for the construction of cowsheds, as well as for their lighting, ventilation, drainage and cleanliness, are flouted or ignored. That being so, much of what is subsequently said about the milk problem of this country will be more easily understood and appreciated.

The Dairies, Cowsheds, and Milkshops Regulations only offer recommendations regarding the construction, cleanliness, lighting, ventilation, and drainage of the dwelling-places of cows. And, though the keeping of dairy stock in towns is being gradually discouraged, cow-houses in rural districts are often extremely unsatisfactory. A much more vigorous insistence of hygienic requirements will be necessary before unclean milk from unclean cows, looked after and milked by careless workers, ceases to be distributed. These faults are never found among progressive farmers, who have realised that the best way to secure good results is to follow the rules of cleanliness, and to give cows every possible advantage that may be gained from good lighting and free movements of air in the sheds, which in England are generally called shippons, whilst in Scotland they are known as byres. It is unnecessary to enter into elaborate details. It will suffice, therefore, if an outline is given of what should constitute a hygienic cowshed, together with what should be done to produce clean milk. Elaborate design and construction are no longer demanded. Many progressive dairymen systematically produce large quantities of certified (the highest grade) milk with a bacterial count of 1000 micro-organisms per c.c. The significance of such a low count may be realised when it is remembered that under the Milk (Special Designations) Orders the bacterial content permissible is 30,000 micro-organisms per c.c. To the student the point of outstanding importance is that the cowsheds in which the animals are housed and milked are often very simple buildings, devoid of costly fittings, but provided with good lighting, ample facilities for ventilation, as well as internal surfaces that can be maintained at all times in a clean condition. Even with an elaborate place to house cows, the personal factor comes into play. The milkers wear clean overalls and head coverings. Before the cows are milked, each animal has its flanks (previously shaved, or with the hair cut short), teats, and udder and tail freely lathered with soap and water. The lather is wiped away with clean cloths wrung out of clean water. The milker next washes his hands with soap and water. Then he proceeds to draw the milk into a special milk pail into which steam at boiling temperature had been previously projected. The pail has a narrow mouth so designed to reduce to a minimum the amount of dust or debris that might enter with the milk. The milk is then removed from the cowshed to be passed over a chilling apparatus (see Pasteurisation) before bottling and stamping finally takes place. It should be mentioned that certified and Grade A (T.T.) producing herds are invariably pastured and kept out in the open air when the climatic conditions permit. When they sleep in their cowsheds they come to beds of clean straw.

Now contrast the foregoing methods with the usual routine followed at too many farms. The cows are kept in dark, stuffy, ill-lit, and inadequately ventilated premises. Their bedding is not methodically changed, with the result that the teats, udders, flanks, and tails of the animals are often hanging with adhering manure and filth. When the unprotected milker, with unwashed hands, draws milk into the pail, much debris finds its way into the receptacle. The pails and dishes used for storing or transporting the milk may have been washed with oft-used cloths and warm (not steam) water, so that further contamination with extraneous matters is invited.

The pictures have not been overdrawn, and in his journeyings throughout the country the student will repeatedly see many slipshod methods being followed. It is not surprising that Tuberculosis among dairy cows continues to prevail, for it must not be overlooked that the disease is spread, especially in such unhygienic cowsheds, by the faeces as well as by coughing and expectoration of the animals. The lesson to be learned is that taught by asepsis. By avoiding dirt one may be confident of good results.

**Cubic Space.**—The cubic space allowed for each cow is 800 feet. Where cows are supposed to spend most of their lives in the open air in rural areas the allowance may be reduced to 600 cubic feet. This is a paradox, because the uneducated dairyman often does all he can to keep his cows indoors in the mistaken belief that as long as they are warm they will yield greater quantities of milk. Also, in some areas where official supervision is lacking in initiative, the sanitary conditions demand even more than 800 cubic feet of air space.

**Ventilation** is left entirely to the whims of the dairyman. Regulations suggest 40 square inches for inlets and outlets for each animal. But, in winter especially, smaller openings than these are stuffed with straw to avoid the cold and to keep the animals in heated atmospheres. The progressive dairyman tries to maintain the temperature of his cowshed, summer and winter, between 59° F. to 60° F.

**Lighting** is of very great importance, and the recommendation, rarely followed, is to provide 3 square feet of window space for each stalled cow. Windows along the side walls are advantageous, because they may be shut or opened according to prevailing winds, especially in winter. Roof lights, because they are fixed, do not facilitate the ventilation of an interior. If roof lights are used they must face the north to avoid the hot rays of the summer sunshine.

**Drainage.**—No drains or traps are allowed within cowsheds. The manure channel is open, and must be of adequate depth and width, the depth varying with the slope of the channel towards the outlet. Through this outlet, which is an opening in the end wall of the cowshed, urine and other semi-liquid matters pass into a small cesspool from which the liquid overflows and passes into a properly constructed drain. The solids left behind in the cesspit are cleaned out from time to time. The width of the manure channel varies between 18 to 24 inches. It is required by the regulations aforementioned that the manure channel must be cleaned out at least twice each day.

**The Stalls and Floors.**—The floors of all cowsheds and the animal stances should be laid with concrete and their surfaces grooved. This construction provides impervious and easily cleaned surfaces, while the grooving offers the cows a better foothold. The stall divisions may be constructed of iron or concrete rendered smooth with cement.

Ironwork has many advantages, since, quite apart from lending its parts to ready cleansing, it permits a freer circulation of air about the animals, more especially their heads. Woodwork for stalls is objectionable, because it is perishable and harbours dirt and mucus. It cannot be easily kept clean.

**Walls.**—It is not necessary to have tiled interiors, but for a height of 9 feet from the level of the floor of the cow-shed the wall surfaces should be rendered as smooth as possible with cement. This may or may not be periodically lime-washed. Not only does lime-washing enhance the fresh appearance of an interior, but its periodical application ensures cleanliness.

**Tuberculin-tested Herds.**—While this matter mainly concerns veterinary officers, it will not be amiss if the routine is briefly described. Many institutions throughout the country are now maintaining tubercle-free herds for their patients or are insisting on getting unimpeachable supplies from contractors. To develop a tubercle-free herd of 60, 80, or 100 cows is not such a simple scheme as one might be inclined to believe. Three years passed before the herd of 80 animals provided for the Edinburgh Isolation Hospital was declared to be free from tuberculous taint, and that is a common experience. There are two ways in which a scheme may be brought to perfection. The first and most usual plan consists in freeing an existing herd of Tuberculosis by a gradual elimination of affected animals. This is carried out by the systematic application of the tuberculin test. All cows that react to the test are separated from the animals that are ascertained free from the disease. The method is slow, because it requires a very careful system of segregation. New and carefully tested animals must then be purchased to replace those that have reacted. When at last all the affected cows have been eliminated, the plan usually followed is to purchase a tubercle-free bull from a reliable source and to rear fresh stock from the accumulated herd of tubercle-free cows. As has been indicated, it occupied three years to clear and replace the affected cows at the farm which had been supplying the Edinburgh Fever Hospital with milk. The mere fact that milk from affected cows had been for many years the chief source of supply to many susceptible subjects conveys a very good lesson.

The other method for building up a tubercle-free herd of dairy cows is begin *de novo* and purchase only guaranteed animals. Big prices must be paid for these, but the method may prove cheaper and less arduous in the long run.

The normal temperature of a cow is 102° F. Under the old system of using the tuberculin test it was hypodermically employed. If an animal was suffering from Tuberculosis it usually responded (reacted) to the test, and at the expiry of several hours the temperature of infected cows rose to 105° F. or 106° F. Subsequent readings, continued beyond 18 hours, manifested equally high temperatures. The reactors were at once separated from the non-reacting animals. Professor Bang of Copenhagen was the first to recommend the eradication of Tuberculosis among dairy stock by the foregoing method of testing cows and rejecting reactors. It would be a costly, and one might even say disastrous, scheme to employ among the herds of this country. The subsequent slaughter and necessary replacements would be colossal, since, as has been indicated, it would entail the destruction of approximately 40 cows out of every 100 in many herds.

**The Double Intradermic Test** is now being employed in preference to the subcutaneous one. The following is the procedure usually followed by veterinary officers. The site chosen for the application of the test is the middle part of the side of the animal's neck. It is customary to clip the hair closely a day or two before the test is applied. This, besides being an aseptic precaution, avoids any confusion that might arise between wounds made by the clippers and the needle. A fold of skin is measured (by calipers) at the site of the intended injection and the measurement recorded. The normal measurement in cows is between 5 to 8 mm. An ordinary dental syringe is used to inject 0·2 c.c., about 2 drops, into the deeper layers of the skin. If the injection has been properly made, a small pea-like nodule can be felt by the fingers. At the expiry of 48 hours the skin is again measured by calipers at the site of the injection. At the same time a second injection of the same amount as the original is made at the site of the first injection. At the end of 72 hours, measurement of any swelling is again made and its character carefully noted. In place of the concentrated O.T. (Old Tuberculin) that was commonly employed, the use of a synthetic tuberculin is now preferred, because it avoids the injection of foreign proteins. The newer preparation reduces the number of doubtful readings. An increase of measurement from 6 to 7 mm. to 12, 14 or more, suggests reaction (positive test). But the expert relies more on the character of the swelling than on its extent.

In non-reacting animals the swelling is firm, circumscribed, and is only slightly painful. It may not give rise to pain when palpated. In the reacting animal the swelling is diffuse, fluffy, oedematous, and invariably painful. If the reaction is apparent at the 48th hour, a second injection is unnecessary. In the hands of the inexperienced the interpretation of the significance of a swelling that does not increase beyond 12 to 14 mm. may cause doubt. On the other hand, no one need have any difficulty about interpretating the huge swellings which may be so extensive as to be beyond the range of ordinary calipers.

## ICE CREAM

Outbreaks of Enteric Fever and Epidemic Diarrhoea have been traced to the consumption of ice cream. The term Ice Cream, as sold in this country, is frequently a misnomer, since much of it contains no cream at all. This specially applies to the corn-flour custards and synthetic powders which are mixed with milk and put through freezing machines, to be sold at low rates. Their agreeable flavour is their only attraction, because their food value is negligible. The sale of such a confection should be regulated by the fixing of a definite standard, as well as by correct nomenclatures for Cream Ice, as opposed to Iced Custard. In this country 1 gallon of ice cream (so-called) is consumed per head of the population every year. In America the quantity is 3 gallons per head. But in America many of the States define ice cream and also demand that it shall contain a minimum amount of 8 per cent. of butter fat (cream). Strict supervision over the rank-and-file of ice-cream vendors has greatly reduced the opportunities for spreading disease either through the agency of carelessly conducted operations or from insanitary premises. But far too much cheap stuff is being sold in this country under the guise of ice cream. To those who prefer to consume it, iced custard may still be countenanced, provided it is given its correct name. But, as a food of dietetic value and a pleasing confection, cream ice should be specified as a preparation guaranteed to contain a minimum of 8 per cent. of butter fat.

**Food Poisoning** may be caused by eating decomposing food. This used to be called Ptomaine poisoning, but the term is no longer used.

When micro-organisms of the Salmonella, Aertrycke, and Gaertner groups begin to act deleteriously on foodstuffs, notably meat, pies (often after they have been reheated), sausages, and so on, the poisoning is of a bacterial type, the manifestations of poisoning being produced soon after the food has been ingested.

**Botulism,** on the other hand, is an outstanding example of poisoning by a toxin developed by the *Bacillus botulinus.* Botulism is a preventable condition. If food is thoroughly and completely cooked, the heat kills the *Botulinus* bacilli. Without the bacillus there can be no toxin developed.

*Incubation.*—This period varies between a few to 24 hours. Since the bacillus is a spore-bearer, the temperatures required to kill it must be high and prolonged. The presence of *B. botulinus* is not confined to one kind of food. It is because a bottled or tinned food may not have been heated to a sufficient degree that surviving bacilli may be presented with an opportunity to develop in the food. That will be more likely to occur if the food chanced to be a favourable medium for the proliferation of the micro-organisms. In the well-known outbreak of Botulism at Loch Maree in 1922, sandwiches made from wild duck paste taken from glass containers were the cause of the fatalities that occurred.

*Bacillus botulinus* is probably frequently swallowed without producing toxic manifestations. The bacilli have been recovered from olives, animal manure, hay, and the soil. It is interesting to know that acid-containing fruits are antagonistic to the bacilli and the toxin.

*Taking Samples.*—In all cases of suspected food poisoning the following procedure is advised. Samples of the suspected food should be collected. Vomited matter should also be secured. Faeces should be recovered. All or any of the foregoing samples should be placed in glass-stoppered bottles and dispatched to the appropriate Public Health Department. Each bottle should bear a label with the name, address, date, and nature of the sample. The sender's name should also be affixed. Any additional information relative to the case may also be forwarded in a covering communication.

If no samples could be recovered, specimens of blood taken, as in the Widal test, should be submitted. But agglutination must not be expected in the earliest stages of suspected food poisoning, because some days elapse before the agglutinins develop in the blood. It should be remembered that it is possible to discover "carriers" in cases of food poisoning; so that the agglutination test becomes a valuable aid in investigating suspected cases.

## CHAPTER XVIII

# SCHOOL BUILDINGS AND MEDICAL INSPECTION OF CHILDREN

ARCHITECTS design school buildings, but the advice of medical men will be accepted when it is intended to plan new schools which will embody not only educational but also health-giving facilities.

The modern type of building is breaking new ground, since it aims at offering the best orientation for the provision of sunlight and fresh air. The architect's attention is no longer solely focused on class-rooms, for he is frequently expected to incorporate swimming-baths, playgrounds, workrooms, gymnasia, and other useful adjuncts in his design.

The modernly planned school building is now finding its rightful place, because new and extensive housing developments are removing artisan populations from densely populated areas to the outskirts of our cities. Schools have suffered for many years from congested surroundings and unfortunate environment. Playgrounds and recreational facilities scarcely existed. Motor traffic, ever on the increase, has necessitated the presence of policemen to control and guide the movements of school children when they desire to cross busy thoroughfares after school hours, because school buildings had been erected on what have now become dangerous and unsuitable positions. Because their sites were limited in extent, schools were required to be several stories high.

The modern school, erected in a new area with adequate space round about it, is now spread out to left and to right, which arrangement enables the south and south-westerly sun to reach every class-room. The windows of the class-rooms are large and often designed to open to their fullest extent, and, in place of inside stairways, balconies give access to class-rooms. The suggested raising of the school age to 15 will probably necessitate the erection of larger schools, because additional class-rooms will be demanded. The tendency to overcrowd class-rooms has been influenced by lack of accommodation. If every class numbered 30 pupils, each could be granted a reasonably good amount of floor and cubic space. It should be noted that floor space, from the scholar's point of view, is of greater moment than cubic space. A slight defect in the allotment of cubic space may be overcome by free ventilation, which, as has already been explained, means a steady and constant movement of air. But a limited floor space cannot be overcome save by materially reducing the numbers of those attending each class.

Many Education Authorities now provide extensive parks which are set aside for the playing of football, cricket, hockey, lawn tennis, and other outdoor pastimes. Wednesday half-holidays are not uncommon, and, with the Saturday break, playing-fields are being fully utilised. Dancing, deportment, and gymnastics, now indulged in by girl pupils, are already revealing their benefits by the straight backs and well-poised bodies of rising womanhood.

Education would take care of itself perfectly well if it were left more under the guidance of competent teachers. It is the domination of Education Departments that threatens to turn boys and girls into automatic lesson-learners. If education were simplified, young and growing brains would not be unduly taxed in the effort too often exerted to pick up smatterings of subjects that will never be of much value in the after-lifetime of the vast majority of the rising generation. The mistake has been made to place the clever boys and girls as the object-lessons for the many who have not been so fortunately gifted. That reads like a digression, but the remarks are justified on the ground that medical opinion should raise a protest against a system of education which does in many cases indirectly damage or prejudice the health of the scholar. Keeping these facts in mind, the suggestion is offered that every new school designed to educate boys and girls should be provided with a hall where films, photographs, models, and other illustrations may be exhibited to implant practical knowledge on such a subject, for instance, as geography. Interesting talks on ship-building, steamships, trades, railway developments, air travel, agriculture, industry and so on, would be interlarded. If physiology is to be taught to senior pupils, no better means for conveying memorable information could be offered than by moving pictures. A healthy mind in a healthy body could be quickly developed if our educational system was completely revised, because the work of the pupil would be considerably lightened. And the advantage of such a scheme of teaching would be that the pupil would not feel that he was being forced to learn. The mental photographs developed in young brains would create indelible impressions.

**The Class-room.**—If 30 pupils in each class are to be the maximum, the rooms should be arranged in correct relationship to one another. The plan usually followed was to visualise the site and then to fit the various class-rooms within the allotted space. Nowadays, as has been indicated, the primary considerations must be good ventilation, full lighting, and ample floor space. The minimum floor space should be 15 square feet for each scholar. But if expense is not made a primary consideration, as it often has to be, 20 square feet would afford liberal moving space for teacher and taught. If this condition of affairs became general, we should assuredly hear and see less of the unfortunate effects of "droplet" infection. Scarlet Fever, Diphtheria, and, in infant departments, Measles, Whooping Cough, and Chickenpox and Mumps would be afforded less opportunity to spread. The closer children are crowded together in badly ventilated class-rooms the greater is the risk of spreading infection either by "droplet" infection or by personal contact.

*Colours of Walls.*—Light green and grey absorb least light. The ceilings will reflect most light if they are white or cream-coloured. Oil-paint that is glossy should be replaced by matt-surfaced water-paint which can be washed down and quickly renewed.

*Cubic Space.*—No differentiation should be made between infant and juvenile classes as regards the provision of air space. Consequently, each scholar should be allowed between 200 and 220 cubic feet of such space. It will be recalled that in each dwelling-house an adult must be provided with 400 cubic feet of air space, and that two children under 10 are reckoned as one adult. In estimating space no greater height of ceiling than 13 feet should be included in the cubic measurement.

*Lighting.*—The accepted rule is to afford between one-sixth to one-quarter of glass (window) to the floor area. When one-quarter is allotted in new schools erected on sites that are not overlooked or overshadowed by neighbouring buildings, the exhilarating effect on scholars is bound to be appreciable. Light should fall over the pupil's left shoulder. This will avoid the casting of shadows when reading or writing. Frontal lighting is always to be avoided. Because the richest light enters from the upper part of a window, the sashes should extend from $3\frac{1}{2}$ feet above the floor level to within a few inches of the ceiling.

*Ventilation.*—Too much emphasis cannot be laid on adequate ventilation of class-rooms. It is as necessary as it is in factories and workrooms if concentration is to be sustained by the scholars. This is a subject in which every school medical officer should take a keen interest.

The incidence of colds and catarrhal affections will be reduced if the scholars are "hardened" by being taught to feel the benefits of constant movements of air. The diluting effect of fresh air will also tend to lessen the dangers of "droplet" infection. In a stagnant, warm, and necessarily moist atmosphere (due to exhalations from the lungs and perspiration from the bodies) the opportunities for spreading infection are intensified. Where windows cannot be fully opened a modified scheme may be introduced (see Fig. 8). Another good method is the Hinckes-Bird Window Ventilator (which see). In both systems the ventilation can be maintained during the coldest seasons of each year. In summer, window sashes may be widely opened, but the disturbing sounds of vehicular traffic must be kept in mind.

In the outlying districts of our cities the question of introducing artificial ventilation should not be seriously entertained. Not only does natural (window) ventilation excel all others, but artificial systems convey faulty lessons to the pupils. The maintenance of the relative humidity of artificially ventilated interiors is always a difficulty. The pumped-in air is usually dry. It is monotonous in its sameness, and, when central heating accompanies artificial ventilation, teachers and scholars frequently complain about weariness and lack of alertness whilst at work in the class-room. The pupil who sees windows and doors constantly shut (because artificial ventilation must have tightly sealed windows if it is to function properly) is not being taught to appreciate the full value of fresh air and good ventilation.

*Heating.*—Modern opinion is inclined to discard stoves, steam coils, or pipes through which hot water passes. It is now urged that air entering a class-room should be heated by passing it *over* steam or hot-water pipes. Warm air is pushed into the class-room through openings 7 feet above the floor level. Each opening should have a cross suction equal to 20 square inches for each pupil. Outlets are placed on the same (inner wall preferably) wall, but only a little above the floor level. The incoming, warmed air should be moistened to preserve its humidity. The amount of air admitted should be at the rate of 30 cubic feet every minute for each scholar. This is equivalent to 1800 cubic feet per hour. The temperature of each class-room, in winter especially, should never be below 60° F. and never above 68° F. Teachers should be expected to take hourly readings from thermometers hung on the walls about the level of the heads of the pupils.

A convincing example of the value of natural ventilation by open windows was demonstrated at a school attended in Leith by children drawn from the poorest section of the community. Because sickness-rates and irregular attendance had been conspicuous the headmaster was persuaded to try open windows. During the succeeding year the improved health and better attendances shown exceeded expectations. A great deal must always depend on the teacher if ventilation is to produce good results. Fortunately, the majority of teachers are keen disciples of the fresh-air doctrine.

*Desks.*—Much depends on the correct posture of school children during class hours. It has been found that badly fashioned seats and wrongly disposed desks tended to cause stooping and, in some cases, spinal curvature. Also, a pupil uncomfortable in his seat cannot concentrate on his work, and eye-strain becomes a habit. Because different children have different rates of growth at various ages, their seats and desks must be adjustable. The seats should be concave, so as to allow the ischial tuberosities to fit comfortably into the depressions. The back-rest should suffice to support the small of the back. It should not be higher, and it must not support the shoulder-blades, because slouching will be encouraged. When the pupil is comfortably seated, his thighs should be level when his feet are resting on the floor. In that position the lower leg and thigh will be at right angles to one another. The distance between the seat and the desk at which the pupil sits should enable him to write without stooping. He should feel the back of his seat supporting him. The desk must not press against the abdomen. This means that the scholar will be able to rise with comparative ease. In order to achieve these ends, the space from the edge of the desk to the back of the seat should measure between $10\frac{1}{2}$ to $14\frac{1}{2}$ inches.

*The Desk.*—Continental authorities now favour a slope of 15° for the desk and not 30°. Experience has shown that this 15° inclination encourages the best posture when writing. Desks and seats should be carefully adjusted not only twice yearly but also for each new-comer to a class-room.

**Water Closets.**—The trough closet is now being discarded, wash-down closets being preferred. But, in place of providing an individual flushing cistern for each pedestal, an automatic syphon is introduced which frequently and systematically flushes all the closets at the same time. When chains are introduced to enable the scholars to operate the flush, mischievous hands too often break the mechanism to put the closets out of action. The one unfortunate feature of the automatic flush is that children are liable to leave well alone in their homes, and so the flushing is forgotten or omitted. The pedestal closets will require to be of different heights to convenience infants as well as older pupils. For males, urinals are necessary, one urinal being required for every 15 boys. All materials used in the construction of lavatories, etc., should be of strong, impervious material, such as slates or glazed stoneware. Iron should not be used. It rusts, and in course of time gives off objectionable effluvia. And, unlike slate or glazed stoneware, it is not easily kept fresh and clean. Disinfectants are a delusion and can never take the place of scrupulous care and cleanliness. Disinfectants do not cloak dirt.

**Cloakrooms, Pegs, and Lockers.**—Corridors should never be used for hanging coats or hats. Special cloakrooms of ample size should be set aside for the purpose. Pegs should be at least 12 inches apart, and accommodation should be provided for holding shoes or books. The cloakroom must be heated so that damp coats or outer garments may be dried. Scholars should never be allowed to sit in class-rooms with sodden boots or damp foot coverings.

**Wash-hand Basins.**—In a separate apartment wash-hand basins should be provided in series, and in place of towels paper of an absorbent character should be used to dry hands or faces. Each paper towel is cast aside after it has been used. Towels soon become filthy and, if a plentiful supply of them is provided, the laundry bill will prove much heavier than the cost of paper towels. Cloth towels may readily spread infection. As an alternative hot air currents may be introduced to dry hands after they have been washed.

**Exercise.**—Recreation facilities are now well adjusted, but at the end of each hour it is good practice to lead the scholars out to the playground to indulge in some form of physical exercise. It not only relieves the monotony of class-work, but it stimulates the activity of the circulation through the lungs and the rest of the body.

**Food.**—Education Authorities now provide rational meals for many of their school children. Such meals are of special value to pupils whose home conditions are unsatisfactory. The food consisting, as it invariably does, of well-balanced ingredients exerts a good influence on the child's well-being. An ill-nourished child cannot be expected to learn its lessons well. Enough has already been said regarding the provision of milk in schools to indicate that too much weight must not be attached to the nutritional value of 7 ounces of milk given each school day. That scheme has been obviously designed to provide an outlet for surplus milk and to help the farming industry. If each child had been invited to drink two-thirds or a whole pint of milk each day, greater benefits would have resulted. During the colder months of the year especially we have noted the value of a warm drink of Horlick's Malted Milk given to school children. Many pupils find that raw milk does not agree with them, just as adults show intolerance to milk.

**Open-air Schools.**—The definition applied to such schools has been aptly provided in America, where they describe such institutions as " Preventoria." No elaborate description of these schools need be offered. As their name suggests, all children on what might be termed the " delicate " border-line may, with considerable benefit to their present and future well-being, be given their teaching in class-rooms freely exposed to the open air. The selection of a site which is exposed to the south or south-west and sheltered from north or north-easterly winds must always be an important factor. What applies to ordinary schools in the direction of sanitary and cloak-room accommodation will also apply to open-air schools, but cubic space need not be so important a consideration, because each pupil will be literally bathed in fresh air. Posture must be jealously watched, and specially selected meals ought to be a primary consideration.

Because pre-tubercular children will preponderate, and because tuberculous subjects are frequently precocious, highly strung and quick to learn, they should not be overtaxed with lessons, nor should their teaching periods be so long as they are for normal children.

**Medical Inspection of School Children.**—Just as too much was expected from the compulsory notification of infectious diseases in the direction of preventing the spread of infection among school children, so has there been some disappointment with the outcome of medical inspection. The early detection of such abnormalities as defective vision, faulty hearing, bad teeth, nose and throat disabilities, deformities, and so on, has already been beneficial to the school population. But it is laborious work and demands painstaking effort to detect early cardiac and pulmonary defects. Much yet remains to be done to make the examination of children, before they reach the school-age period, trustworthy and valuable. If the pre-school period were thoroughly dealt with, the school medical officer would be in a much better position to detect abnormalities and to winnow out the weak from the strong. With a card-index system based on pre-school examination, the boy and girl on reaching the school-age period would be assigned to his or her proper category of education. Defects in the circulatory and pulmonary systems and early evidences of rheumatism should be diagnosed at very early stages of a child's life-history. It is almost too late to wait until the scholar displays marked evidence of cardiac or pulmonary disorders. Eugenics are based on the sound principle of anticipating ill-health by being ready to anticipate its attack. Medical inspection *en masse* is apt to be hurried and therefore scamped. Orthopometric measurements are valuable for statistical purposes, but the detection of conditions that may cause future impairment of health and wage-earning capacity are more important.

Most teachers now possess a useful knowledge of psychology, and experience quickly indicates to them which pupils are in need of medical attention. The medical inspector must therefore work hand in hand with the person who is seeing his scholars regularly. Discharging ears and nostrils, skin eruptions, thick enunciation, and backwardness will often be first noticed by the teacher, who will pass on the information to the medical officer responsible for the examination of the boys and girls. And, to render the co-operation between the doctor and the teacher more thorough, lectures to the staff should be given regarding the early manifestations of common ailments, including inherited Syphilis. It is somewhat disappointing to learn that under 50 per cent. of the scholars who are advised to accept free dental treatment at the hands of specialists appointed by an Education Authority fail to take advantage of that service. But, despite weaknesses in medical inspection schemes, much valuable preventive work has been done in connection with the treatment of adenoids, enlarged tonsils, ringworm, and other skin diseases. Eye defects are corrected, deformities receive suitable treatment, and special classes and schools are set aside for dealing with mentally weak children.

The following table affords an idea of the most commonly encountered defects among school children in a populous centre.

| | Incidence per 1000 |
|---|---|
| Malnutrition | 9·5 |
| Defects of Vision | 54·7 |
| Squint | 9·1 |
| Other Eye Diseases | 9·5 |
| Hearing | 5·4 |
| Otitis Media | 6·3 |
| Enlarged Tonsils and Adenoids | 53·3 |
| Other Throat and Nose Defects | 6·2 |
| Organic Heart Diseases | 2·2 |
| Pulmonary T.B.—Definite | 1·6 |
| Pulmonary T.B.—Suspected | 1·6 |
| Non-Pulmonary T.B. | 7·1 |
| Nervous Diseases | 1·8 |

**Keeping the School Clean.**—The cleanliness of floors, desks, seats, wall-surfaces, cloakrooms, and sanitary conveniences must be conducted on a routine and trustworthy basis. Disinfectants are expensive if they are to be employed in sufficient strength to act as germicides. Only after infectious diseases invade a school may it be necessary to resort to liquid disinfection by means of a suitable spraying apparatus. This method in competent hands ensures the even application and distribution of a disinfectant of known strength. Gaseous disinfection is too superficial to be trustworthy. Scrubbing and disinfection should always be followed by free through ventilation by means of open windows and doors.

## CHAPTER XIX

# MATERNAL MORTALITY

In no branch of preventive medicine is it more necessary to maintain systematised and sustained interest and activity than in the direction of making effort to reduce maternal mortality. The figures for England and Wales stand at 4 deaths per 1000 births, and in Scotland the figure approximates 6 deaths per 1000 births. Since a goodly proportion may be reckoned to include preventable deaths, the steps suggested to reduce these figures may be summarised.

(1) **Notification of Pregnancy.**—It has been advocated that impending births should be made known. With such a scheme in operation a firm supervisory control might be expected to follow, especially among that section of the population which calls for it. Such a scheme is in operation in Huddersfield, which justifiably claims to show the lowest infantile mortality figures in the country. Under this method of notification, which is voluntary, the consent of the pregnant woman must be secured, and a fee of 2/6 is paid to the doctor or nurse who makes the notification. In 1934 nearly 77 per cent. of the pregnancies were notified in Huddersfield. In 1918, when the scheme was introduced, the percentage was only 11.

(2) **Ante-natal Care.**—Much has been said and written regarding the establishment of these valuable adjuncts to a maternity and child welfare scheme, but the actual work done has not been commensurate with the importance

of the subject. There are various ways in which ante-natal work may be conducted. It is certain, however, that skilled men and women should be mainly responsible. The Huddersfield principle deserves consideration, because it meets the desires of those mothers who are averse to presenting themselves at public clinics. This difficulty is met by affording expectant mothers the opportunity to be visited in their own homes. But it is stipulated that the mother shall pay at least one visit to the municipal ante-natal clinic. An ideal system should aim at monthly visitation either at the clinic or at the private residence of the expectant mother. The Central Midwives Board regulations require the maternity nurse to keep in touch with the expectant mother for some weeks before her confinement. A competent nurse, no matter how skilled, will always seek the advice of a medical man in every case when abnormality is suspected or detected. It is in this direction that prevention will play its most important part. The need to keep the private medical attendant informed of abnormal conditions is essential to the success of any municipal scheme. The early detection of Albuminuria, Placenta Praevia, abnormal presentations, pelvic deformities, and specific infections at the ante-natal clinic must necessarily help to promote the objects of prevention.

(3) When the confinement is to take place, provision may be made for the delivery in one or other of the hospitals available. In connection with ante-natal care the financial circumstances of the pregnant woman may suggest or even compel the provision of suitable food, including milk.

(4) Post-natal examination may be found necessary in cases threatened with post-confinement disabilities.

A striking testimony in support of the efficient way in which their work is carried out is afforded by the low maternal mortality figures found when skilled nurses carry out the confinements of pregnant women. Strict attention to asepsis, the abstention from the application of forceps, and the policy of waiting for, in place of expediting, the births all play a conspicuous part in preventing sepsis and other untoward manifestations. Much of the success among highly trained nursing organisations must be ascribed to their studied ante-natal care of the mother. In addition to the foregoing procedures, some Sanitary Authorities have wisely appointed home-helps and daily assistants, whose duties are to look after the domestic affairs of the house when the mother is unfit or unable to do so.

## CHAPTER XX

### INFANTILE MORTALITY

Is defined as the deaths of all infants under one year per 1000 births. The problem is closely related to maternal mortality. Perhaps too much importance has been attached to the value of official efforts and expenditure in attacking infantile mortality. The most fruitful results produced by nurses and other municipal activities have been reached by education. The mere visitation of infants at their homes and the taking of records has little weight in prevention compared with the housing conditions, together with the feeding and intimate care of the infant. If the house is overcrowded, if the wages are poor or inadequate, and if, coupled with intemperate habits, the mother is ignorant and irresponsible, the health of the newly-born infant will be jeopardised. Infantile mortality figures are without exception highest among the worst-housed and most ignorant sections of our populations. The most direct way of solving the infantile problem may be inferred from an appreciation of the foregoing facts. With the demolition of slums and the provision of better housing conditions, better opportunities will be offered for fortifying the infant against ill-health. With the advantages now placed in the hands of Sanitary Authorities, the visitation of every home in which a birth has taken place must inevitably produce good results when mothers in their new houses will be better able to put into practice the advice given to them by the visiting nurses as to cleanliness, the proper storage and preparation of necessary foods, since the nursing woman must be supplied with nutritious food. In that connection the teaching of simple cooking to working-class women should be a part of the work of every child welfare department.

In Edinburgh such a scheme was carried out at various centres throughout the city, and it was encouraged by the increasing attendances of many women belonging to the artisan classes. The majority of those who attended the demonstrations were astonished to discover that the meals cooked were much more economical and more appetising than the orthodox dietaries of the average working man's regular fare.

Death levies a heavier toll among artificially than breast-fed infants. During the siege of Paris, in the Franco-German War of 1870, the slaughter of milk-producing animals compelled mothers to rely on breast-feeding, with the result that infantile mortality figures, especially from gastro-intestinal manifestations, showed a sudden and satisfactory decline. Premature births and deaths are still common and, as such, come under the preventable category. Overlaying is preventable, because it is not infrequently associated with intemperance. Among illegitimate births the mortality is higher than in the legitimate class. Marasmus is a preventable condition. Most deaths occur among first-born infants, especially among mothers married at early ages and careless or lacking in knowledge. Infantile mortality is higher among those mothers who go to work too soon after the birth of their children. The Factory and Workshops Act forbids mothers to return to work until a month after delivery. Syphilis plays its part in adding to infantile mortality. In a lesser degree, Measles and Whooping Cough are contributory causes. Even a cursory review of the chief causes of infantile mortality figures will convince the student that the majority of the deaths can be prevented. Thus there is a wide field offered for effecting further reduction in the figures that have been attained. Fifty years ago cities revealing such high infantile mortality statistics as over 150 deaths per 1000 births can now show such figures as 70 per 1000 births. In industrial and densely populated centres it is obviously more difficult to produce uniformly good results. In districts where the housing conditions and hygienic amenities and intelligence are of higher standards, infantile mortality is low. Visits and attendances at child welfare clinics and treatment centres, and their valuable adjunct in the form of homes for weakly babies, will teach the student far more than a written description of these institutions and the valuable work performed by them.

One must never lose sight of the fact that voluntary organisations supported and organised by ladies deeply interested in the child welfare movement are doing and have done much to dovetail with and assist the municipal efforts directed at the same end.

**Birth Control.**—This subject has been approached from two points of view. There is the religious one, which affirms that no attempt should be made to reduce the number of children a woman is capable of bearing, and that self-denial should be practised if the woman's health is to be prejudiced by pregnancies. The other side argues that a woman should be advised to refrain from child-rearing when the medical man thinks it will be dangerous for her to have any more children. One is inclined to doubt the efficacy of the self-denial system, for it simply means that a man will go elsewhere to gratify his natural desire. Medical opinion generally supports the establishment of clinics working in connection with the prevention of maternal mortality, at which married women will be correctly advised regarding the practice of birth control. Scientifically practised and guided by skilled, qualified men and women, birth control must not, as is too often the case, be confounded with the employment of various contraceptive devices. On the other hand, one would prefer to know that certain contraceptives were more commonly used by other than married persons, because their employment would reduce illegitimacy and prevent the spread of venereal diseases.

Birth control is indicated when a mother suffers from pelvic deformities, syphilis, mental deficiency, making it well-nigh impossible to rear healthy infants, chronic ill-health, caused perhaps by malignant or renal mischief, and previous Caesarean sections. Many women have had cause to be grateful to those who offered them sound and accurate advice on birth control.

The social aspect of birth control is one that should never be overlooked when the problem is being discussed. A small wage will not adequately maintain a big family, and the house may prove too small for a rapidly increasing household. The limitation of children according to the individual's ability to pay rent, food, and clothing is not a matter that should be ignored, because family exchequer problems do possess a bearing on the subject of birth control, especially among the needy sections of our populations. Experience, however, is all the other way, since limitation of children is more common among the rich than it is among the poor. In both cases selfishness plays its part. On the one hand, the mother does not want to be hampered in her social life ; and on the other, the faculty of self-restraint is not put into practice.

There is, however, the further and more far-reaching consideration of undue increase of population. This country is not self-supporting. It does not grow enough food to supply its present population. Nor can it offer enough work to enable every adult to earn a living wage. To advocate large families and a big increase in the population, so far as this country is concerned at least, is a doubtful step. The Great War proved how an efficient blockade might bring us to the verge of starvation.

Studied birth control, especially that directed at weaklings, appears to be a logical procedure.

**Eugenics.**—GALTON'S definition of Eugenics was "The study of the agencies under social control that may improve the racial qualities of future generations, either physically or mentally."

The pursuit of Eugenics actually means the intensive development and practice of every available preventive agency at our disposal. The aim must be to rear such a virile and disease-resisting population that it may become fit to look after itself; clearly suggesting that, in addition to giving our citizens good houses, good food, good purchasing power, good environment, and the best methods and means for preventing disease, they may become sufficiently educated to guide their own destinies through their future life-histories. Put in a few words, the public health conscience must be aroused in each individual to such a high degree that he will look after his own health, without any dragooning or persuasion. The student will appreciate how far we have to go before that happy state may be reached. Even when one glances back at the Middle Ages, when the weak went down like ninepins, we are compelled to admit that appreciable strides have been made towards reaching the first rungs of the Eugenic ladder. The virility of the civilised races is improving. People are living longer. Men and women of the present generation are now doing good physical and mental work at what were once looked upon as advanced ages.

Theorists busy themselves with the advocacy of short cuts to the attainment of the perfect Eugenic state. Theory alone will not bring us nearer the goal, though theory may be right in giving us directions. Germany has, practically speaking, seized the right end of the stick when it made up its mind to introduce the system of sterilisation of those who are the hidden enemies of any State so long as they are permitted to propagate weaklings, imbeciles, and mental defectives. Our own country provides a serious object-lesson when we see all round us elaborate and costly institutions being provided for the segregation, treatment, and education of thousands who become burdens on a State and community. The sterilisation of those who should not be allowed to propagate more of their species is only one part of a big problem. There are other social sores to be healed if the Eugenic state is to make more rapid advances. Their cure must begin with the early detection of the human factors most likely to promote physical abnormalities. Having done so, they must be classified and recorded so that the best-known methods may be applied to each individual case. By that means a high wall of protection will surround them. Education will always stand out as one of the most potent forces for coping with the problem of Eugenics.

The Great War showed how difficult it was to secure recruits fulfilling an A1 standard of physical fitness. Quite apart from the bad feeding, faulty housing, and careless habits of those who were marked down as belonging to C3 categories, one cannot get away from the conviction that much more drastic and less perfunctory systems of medical inspection of school children are demanded. Young men of C3 category might have their numbers greatly reduced if faulty eyes, teeth, lungs, hearts, and other abnormalities were detected at the proper time. Also, a more critical and intimate search of family histories would materially assist in tracing back physical defects which are not infrequently legacies of inherited disease.

Eugenics is a wide problem, full of suggestive interest. Enough has been said to indicate its importance to any country anxious to promote and apply the study of what has been aptly defined as " the science of being well born."

## CHAPTER XXI

# INDUSTRIAL CONDITIONS

Departmental committees and others have given much attention to the conditions under which work is carried on in different occupations. As a result, great advances have been made in improving the lot of the workers in and out of factories and workshops.

Manufacturers now vie with one another in not a few instances in providing canteens, rest-rooms, as well as indoor and outdoor recreational facilities, because they have come to recognise that the comforts of their workers are likely to lead to better health, more contentment, and greater output. Should the occasion present itself to the student, he should seize the opportunity to visit and inspect any large and well-equipped modern industrial concern. He will be surprised and gratified to observe how much is being done nowadays to make the environment of those in employment as agreeable and bright as possible. Medical men and women are attached to large works. Preventive work is practically applied, since such conditions as gastric derangement, anaemia, rheumatism, faulty teeth and vision, and other ailments are diagnosed early and properly treated to prevent the workers from losing their efficiency. Over £2,000,000 a year are paid in sick benefit to those who are laid aside by rheumatic manifestations. This means a great loss of wage-earning, and with it a drop in production. Bearing these facts in mind, the need for preserving the health of those engaged at work becomes obviously necessary. One of the outstanding improvements introduced for promoting a higher standard of hygiene has been the recognition of the fundamental principle of good ventilation, which entails the constant movement of air in the workplace. In a word, it means that rational ventilation has become a standard necessity. The hours for work are now regulated. So are the periods set aside for taking meals and for recreation. It has been demonstrated after prolonged investigations in different trades that long hours, monotony of work, faulty ventilation, causing stagnation of atmosphere and lack of skin activity, led to poor output, faulty workmanship and ill-health, as well as accidents.

The introduction of the Kata thermometer now enables the observer to measure the cooling power of the air of confined places, the Kata thermometer having now superseded the wet- and dry-bulb thermometer.

**The Kata Thermometer.**—This is an alcoholic thermometer used for testing the cooling power of the air. The bulb of the thermometer is cylindrical and measures 4 cm. in length. At the other or top end of the instrument there is a smaller bulb. There are two graduations on the Kata thermometer: one, 100° F., being above the normal temperature of the body; and the other below it, being 95° F. The time occupied by the alcohol in the stem in falling from 100° F. (the upper mark on the stem) to 95° F., the lower mark also shown on the stem, is that which has to be noted when observations are being made. This fall indicates the heat loss of the Kata thermometer in mille-calories. When divided by its total area in square centimetres the unit heat loss is arrived at. This is a constant for each instrument, known as its "factor." This is also marked on the stem, and is indicated by the letter *f*. To operate the instrument it is placed in water heated to 80° C. (176° F.) until the alcohol enters the upper and smaller bulb. The instrument is then removed from the water, wiped dry, and exposed in the place where the test is to be made. The time occupied in seconds for the fall of the alcohol from the upper (100° F.) mark to the lower (95° F.) is then noted. The calculation is made by dividing $f$ by $t$. If, say, $t=80$ and $f=456$, $\frac{f}{t}$=a little over 5, therefore the rate of heat loss in millecalories per square centimetre is 5 seconds.

The dry Kata thermometer gives the measure of cooling by convection and radiation. A high reading of the instrument indicates great cooling power, and a low one the opposite.

By covering the large bulb with thin muslin, the instrument may be used as a wet Kata thermometer. The instrument is wiped dry, except the muslin, and is read in the same way as the dry instrument. The wet Kata thermometer readings indicate the cooling influences of convection, radiation, and evaporation. The cooling effect is arrived at by subtracting the wet- from the dry-bulb readings per second. At the ordinary temperature and humidity of the atmosphere the wet Kata thermometer cools three times more quickly than the dry one. It is when one encounters dry and hot atmospheric conditions on the one hand and moisture on the other that the value of this instrument comes into play.

As has been indicated, the comfort of the worker, and his efficiency, will greatly depend on the rate of activity of his skin, especially in the direction of controlling regulated evaporation from it to ensure its activity.

## CHAPTER XXII

# OCCUPATIONAL DISEASES AND OFFENSIVE TRADES

THOSE that are notifiable to the Chief Inspector of Factories, Home Office, London, by any medical man who encounters them have already been indicated. Occupational diseases have a wide range of character. For instance, there are those caused by gases, vapours, and excessive heat. Atmospheric pressure (Caisson Disease) is another. Then come diseases caused by metallic poisons, dust, and fumes. Inorganic and organic dusts, together with warm atmospheres, also play a big part in the causation of diseases associated with some industries. Nor must it be forgotten that fatigue induced by constant strain constitutes another occupational disease. The interesting feature of that classification consists in realising that each condition in each occupation must be treated on its merits in so far as preventing disablement or disease is concerned. There is no one method for dealing with them.

**Lead Poisoning.**—Lead is a cumulative poison, excreted by the skin, liver, and kidneys. When it appears in the urine, albumin is usually associated with it, which fact suggests that lead can only pass through a damaged or diseased kidney. Susceptibility plays a big part in lead poisoning (see also under Plumbo-solvency of Water Supplies), young people being more susceptible than aged persons, and adolescents suffer more than others. Alcoholic excess hastens the risk of lead poisoning. In most cases the lead reaches the individual in the form of dust or fumes. Dust is swallowed. The metal may also be conveyed to the mouth by the fingers or by pipe-smoking. Even cosmetics containing lead have been known to cause lead poisoning. The salts that are most poisonous are the basic carbonate and red oxide. Litharge and red lead follow. Lead palsy is not usually associated with acute poisoning. It is a characteristic sign in chronic Plumbism. Lead poisoning was encountered in potteries and in works where sanitary ware was made, because the glaze used contained lead. Leadless glazes are now demanded. Short of using a leadless glaze, the lead is mixed in such a way as to change the character of the soluble red or white lead to an insoluble desilicate.

Among painters the wrist extensors were affected. Typesetters were similarly attacked, along with the manifestations of constipation, blue line along the gums, and digestive disturbances. When files were produced by hammering the steel against cushions of lead, the interosseous muscles of the hand became involved. Lead smelters suffered from the involvement of the muscles of their shoulders and upper arms. Abortion and fatal deaths used to be associated with female labour in lead works. Generally, the following signs and symptoms are associated with Plumbism: pallor, drawn face, loss of appetite, blue line along the gums, sweetish taste in the mouth, constipation, loss of energy, and disturbed sleep.

*Prevention.*—This is directed against fumes and dust generated in any branches of the lead industry with free ventilation by the provision of fans for aspirating dust and fumes; the wearing of respirators. After work is over, and before taking food, the hands and finger-nails must be carefully scrubbed. All food must be consumed in a compartment separated from workrooms. Clothes and overalls worn at work must be kept in special apartments set aside for the purpose. Because the gastric juice dissolves any lead that may be swallowed, it has been suggested that some bland oil or milk consumed at intervals may help to counteract the acidity in the stomach and so reduce the liability of lead absorption.

**Phosphorus.**—This substance is encountered in the form of white or yellow and red or amorphous preparations. The former is poisonous, the latter is only harmful in a minor degree. For commercial purposes phosphorus enters into the composition of rat poisons and matches. The ordinary safety matches are made of chlorate or chromate of potash. When this substance is rubbed against the side of a match-box covered with antimony sulphide and red phosphorus it bursts into flame. The other poisonous or strike-anywhere match is made with a mixture of white or yellow phosphorus and chlorate of potash. The paste used to make these poisonous matches formerly contained as much as 5 per cent. of white phosphorus. After the match paste is mixed in open vessels the match heads are dipped in the semi-liquid mass. It was the fumes given off from the molten phosphorus that gradually affected those engaged in match-dipping. There is a third variety of match known as the strike-anywhere, but made with non-poisonous sesqui-sulphide of phosphorus, and now almost in general use. One to three grains of yellow phosphorus will cause death. In this country the use of yellow phosphorus for making matches is now forbidden. There was a time when " Phossy Jaw " (necrosis of the bones) was commonly encountered among operatives. But with the introduction of new methods and preparations, coupled with the precautions adopted while handling phosphorus, the painful malady has almost disappeared.

**Arsenic** is found in nearly all the sulphide ores of metals. It is evolved in iron, lead, zinc, and copper-smelting. Lead arseniate and aceto-arseniate of copper are used to kill insects. White arsenic enters into the composition of sheep dip. It is also used for the preservation of furs, feathers, and hides. Wall-papers now rarely contain arsenic (Scheele's green), and when they do the percentage is very small. Among workers, arsenical poisoning causes anaemia, gastro-intestinal disturbances, loss of energy, with accompanying neuritis and skin irritation. Workers among Paris green suffer from eczema of their eyelids, with ulcers round the nostrils and lips. The scrotum is sometimes attacked by ulceration. Glass-cutters are among the tradesmen who may be attacked. In the year 1900, in Lancashire and Staffordshire, over 6000 persons were attacked by arsenical poisoning caused by beer which had been contaminated by glucose and invert sugar. The origin of the arsenic had been the sulphuric acid used to hydrolyse starch to convert it into glucose and invert sugar. A more serious form of poisoning is caused by arseniuretted hydrogen gas evolved in connection with some industrial processes. When sulphuric acid and most of the metals are brought into contact with one another, hydrogen arsenide is evolved, and the inhalation of this gas may cause death. In the galvanising process, when hydrochloric acid is used to treat zinc, arsenic is developed. When copper is recovered by electrolysis, and also when metals are dipped in acid (pickling) for plating them, the process is accompanied by an evolution of arsenic.

*Prevention* is practised by preventing dust, so far as possible, with a strict control over any fumes. There must, as in the case of lead, be strict care of the hands, nails, and personal apparel. Meals must also be consumed in a place separate from the workrooms.

**Mercury.**—This poison is readily absorbed by the skin, respiratory and digestive tracts. Dentists who worked amalgam in the palms of their hands prior to stopping teeth were attacked by symptoms of mercurial poisoning. In the manufacture of scientific instruments, such as barometers and thermometers, ill-effects among those engaged have been common. In making felt hats and in the dressing of furs, poisoning has resulted from the employment of nitrate of mercury. When an amalgam of silver or gold is heated prior to gilding, mercury is emitted. The manifestations of mercurial poisoning are loosening of the teeth, spongy gums, foetid breath, anaemia, muscular tremors of the tongue, with swollen submaxillary glands. The bowels are also attacked by tenesmus. Diarrhoea often supervenes.

*Prevention.*—Good ventilation, wearing rubber gloves, clean skin, hands, and nails, changes of overalls, and care with meals are prime necessities.

**Bisulphide of Carbon.**—This substance, which has an obnoxious odour, is used by vulcanisers and others engaged in rubber works. It is also used by shoemakers for affixing soles to boots and shoes. Bisulphide of carbon is absorbed by the inhalation of its fumes. It also enters the system through the skin.

Poisoning manifests itself in the form of headache, vertigo, sleeplessness, and cramp. Epileptiform convulsions have been known to occur. There are two stages of attack, the one being that of excitation, the other assuming the form of collapse. Among female workers abortion may take place.

*Prevention.*—Good ventilation, ample cubic space, and suction fans for getting rid of vapours. With the introduction of new and improved processes, danger from the employment of carbon bisulphide is being greatly reduced.

**Pneumoconiosis** is a dust disease encountered among stone-masons, coal-miners, steel-grinders, potters, workers among Portland cement, tin miners, quarrymen, wool-workers, and also among those engaged in cotton, flax, and shoddy mills. Other classes of operatives occasionally involved are tobacco and sandpaper workers.

*Prevention.*—Control of dust, wearing of respirators, and, in the case of indoor work, free ventilation.

**Anthrax** (Splenic Fever; Charbon).—This disease is more peculiar to cloven-footed animals than to man. Humans are attacked through their skin, when malignant pustule results. On the other hand, the inhalation of spore-bearing dust may cause Wool-sorters' Disease, which is a dangerous type of Pneumonia. A gastro-intestinal form of infection is occasionally encountered. Malignant pustule is most liable to attack butchers and those who handle skins and hairs of infected animals. Dock labourers carrying hides on their shoulders may be attacked by malignant pustule on their necks. Skin infection usually takes place through abrasions or through hair follicles. The arms and hands are the most common sites of attack. Shaving-brushes have been known to cause malignant pustule. The common stable fly is believed to be capable of spreading the infection of Anthrax from one animal to another. Wool-sorters' Disease is caused by the inhalation of the dust developed when wool is being teased out and sorted. The disease, as has been said, is a severe type of Pneumonia, which often has a fatal end. The gastro-intestinal form of Anthrax, which is not common, is caused by the consumption of infected flesh that has only been partially cooked. As is well recognised, the resistance of Anthrax spores is so high that the ordinary temperatures used in cooking do not suffice to kill them.

*Prevention.*—Wearing rubber gloves, washing of hands, nails, and arms after handling suspected carcasses. Adhesive plaster or other protection over skin abrasions, pimples, etc. In the case of Wool-sorters' Disease, the operatives work at benches with fans sucking dust downwards, away from their mouths and nostrils. The wearing of respirators, free ventilation, good cubic space, and cleanliness. Meals taken in dining-places separate from workrooms. Hairs to be used for shaving-brushes or mattress-filling may be disinfected by the application of prolonged pressure steam. Wools and hides must be treated by chemical agents, because steam damages hides and wool fibres. Should shaving-brushes be suspect, they should be steeped for several hours in a 10 per cent. solution of formalin, and to be most effective the temperature of the solution should be not less than 100° F.

**Caisson Disease** has been referred to elsewhere.

**Offensive Trades.**—With slight variations in England, Wales, and Scotland, the Public Health Acts give lists of trades which are recognised to be offensive. At the same time the Public Health Acts lay down the principle that such trades can be conducted without prejudice to the health of others if the " best practicable means are adopted " to prevent the occurrence of any nuisance. A nuisance in public health means that health may be prejudiced. It is not necessary to prove that people actually did suffer illness from any particular nuisance. A prolonged continuation of effluvia or smoke emission in close proximity to human habitations may so prejudice the health of the inmates as to excite conditions that might encourage ill-health. So, in order to reduce the chance of nuisance from any of the offensive trades quoted in the various Acts, Sanitary Authorities are expected to draw up bye-laws which insist on the construction of suitable premises for carrying on any offensive trade. Before a new offensive trade may be started, the site and construction of the proposed buildings must be approved by the Sanitary Authority. Having received consent to conduct his trade, the owner of the premises must obey the bye-laws, which require the premises to be well drained and well lighted. Also, every practicable means must be taken to prevent the escape of effluvia from the premises. Impervious floors and smooth surfaces on inside walls make washing and cleanliness possible. Debris and used materials must also be stored in covered galvanised receptacles.

The trades specified are: slaughterers of animals, knackers, blood-boilers, bone-boilers, blood-driers, tallow-melters, soap-boilers, tripe-boilers, gut- and tripe-cleaners, leather-dressers, fellmongers, tanners, manure manufacturers. While fried-fish shops are not in the foregoing list, they may be added when a Sanitary Authority considers they can only be adequately controlled by bringing them under the bye-laws which deal with other offensive trades. But, within the past few years, improved methods and better fish-frying ranges have been introduced to reduce effluvium emission to a minimum.

If a trader fails to observe the bye-laws, his licence may be revoked. No trader is allowed to extend his premises without permission, and when he flits from one set of premises to another he must seek a fresh licence.

# CHAPTER XXIII

## BURIAL

THE provision applicable to graves is that the grave spaces for the burial of persons above 12 years of age shall be at least 9 feet by 4 feet, and for the burial of children under 12, 6 feet by 3 feet, or, if preferred, $4\frac{1}{2}$ feet by 4 feet. Also, no coffin shall be buried in any unwalled grave within 4 feet of the ordinary level of the ground, unless it contains the body of a child under 12, when it shall be not less than 3 feet, and a layer of earth 1 foot deep must separate superimposed coffins. It is well to know, however, that the foregoing conditions contradict what might appropriately be called hygienic burial. During the Franco-German War of 1870, many French soldiers were hurriedly buried in shallow graves. French officers who had lost their lives were similarly interred, but they were laid in their graves enveloped in the military cloaks they had been wearing. After the war was over, the authorities, in order to allay the fears of the population regarding the alleged dangerous proximity of the dead to the surface of the ground, proceeded to deepen the graves of the killed. Exhumation of the bodies showed that the corpses of the rank-and-file had little more than skeletons left, whereas the protecting mantles of the officers had prevented disintegration, because the micro-organisms had been unable to hasten the process of dissolution. From that practical experience the inference to be drawn is that the deeper a body is buried the longer will it be preserved, whereas when it is near the surface the active bacteria get to work and prey on the soft parts, leaving only bones behind. The enclosing of the dead in tightly sealed coffins only delays the putrefactive changes.

**Cremation.**—This practice is growing, but for sentimental reasons it has not progressed to the extent that the sanitarian would desire. Crematoria are now established in a great many important centres of population. It is surprising to observe that so many medical men still continue to be buried in the ground, despite their knowledge of the advantages of cremation. Probably sentimental objections are raised by the relations of the deceased against cremation. There can be no loophole of escape for the concealment of crime, because it is compulsory to produce two independent medical certificates to the cremation authorities before destruction by fire will be undertaken. The student will be taught in his class of forensic medicine more fully about that aspect of the question.

Burial grounds that have been in use for many years are provocative of nuisance. Rats invade the burial places, and the senses are often offended when bones are dug up and exposed to public view. No one can urge that a cemetery with tombstones as grim reminders is a pleasing place to look at or visit. The modern crematorium has now a chapel attached to it. In that place a reverent burial service may be held under all climatic conditions. The same cannot be said in favour of the earth-burial service when it takes place in the dead of winter or when piercingly cold winds play about bare-headed mourners. Cemeteries occupy comparatively large tracts of ground, a scarce commodity nowadays in the neighbourhood of rapidly extending cities. A crematorium hidden from view by a protecting screen of trees, and having its adjacent ground ornately laid out with plants and shrubbery, is rather attractive to the visitor. There are no graves to stir the imagination of the most sensitive or faint-hearted, and the quick disintegration of the body is complete. The hygienic disposal of the dead is an important branch of preventive medicine, and the practitioner is advised to follow it to its logical end by urging the principle when called upon to do so.

## CHAPTER XXIV

# VITAL STATISTICS

VITAL statistics deal with populations, ages, and sexes of the people, as well as the distribution of the sexes in the population. They also take births, marriages, deaths, and diseases into consideration. When the population is enumerated, occupations are recorded, so that the death-rates and expectation of life in different industries may be ascertained. It is not possible to secure a reliable estimate of sickness-rates. To gain particulars regarding the foregoing factors it is necessary to take a census. This is carried out in the United Kingdom every ten years, the enumeration being made on a Sunday at the end of the first quarter of the year in question. On that day every one resident in the United Kingdom must, on a form supplied, give his or her name, age in years, sex, occupation, birthplace, relation to the head of the house, married or not, widowhood, number of rooms in house, employer or employed, with particulars regarding National Health Insurance. The first census in this country was taken in 1801, and it has been repeated every ten years since that time. It would be more reliable and accurate if the census were taken every five years, as is done in some other countries. But, chiefly on the ground of the cost involved, the quinquennial census has not been adopted in the United Kingdom. Even with a more frequently taken census certain inaccuracies are apt to creep into the enumeration. Incorrect statement of ages is one, and occupations may be wrongly described. Most women prefer to state their ages as being between 20 and 25. This has been verified by the greater number of those stated to be between 20 and 25 as compared with those given in the previous census as being between the ages of 10 to 15. Among the poorer classes lack of education, and in some cases a desire to secure old-age pensions and other communal relief, prompts the statement of ages to be greater than they actually are.

There are three methods available for taking a census. The one used by the Registrar-General in this country is by means of logarithms. The student who desires to pursue that study is referred to books devoting their pages to the subject. It may be said, however, that it rarely tallies with the estimate (usually more accurate) made by Local Authorities through the Assessor's Department, since that department keeps an accurate and yearly record of every occupied house, with the number of its occupants. The second and most accurate method is the one just mentioned. It entails a census of the occupied houses with the total number of people living in them. A rough-and-ready way of expressing that population is to allow 4·5 inmates to every house. But recent changes in the provision of new types of houses might disturb that method. The third method is to take the birth-rate as a guide :—

$$\text{Thus—}\frac{\text{Number of births in the year} \times 1000}{\text{Birth-rate per 1000 since last census taken}} = \text{Population.}$$

The increase of a population may be "natural" or "actual." The "natural" increase means the excess of births over deaths, while the "actual" increase depends on the balance between births and immigration, and deaths and emigration. For instance, the census in 1931 showed a decline in the "natural" increase. This was not due to a higher death-rate, but to lowered birth-rate. The "actual" increase also revealed a decline mainly due to an increase of emigration over immigration as well as an inequality between births and deaths. In cities the "actual increase" is greater than the "natural increase," because the drift from the country to towns is constantly going on, the desire to find more lucrative work and the disinclination of the younger sections of the population to remain in country districts being promoting causes of this movement from rural areas.

**Calculating the Birth-rate.**—It will be remembered that all births, including still-births, must now be notified to the Medical Officer of Health within 36 hours of the occurrence of the birth. But other information, namely registration, is available for statistical purposes. It is more reliable, because all births are not notified (due mainly to carelessness), whereas all births must be registered with the Registrar of Births, Deaths, and Marriages. Registration of births in Scotland must be made within 21 days, but in England 42 days may elapse before registration need be made. From the registrar of each district the Medical Officer of Health receives the weekly return of births and deaths, and from these returns the birth-rate is calculated. The birth-rate may be reckoned by the week, month, or annually as the needs demand. Prior to the introduction of the Notification of Births Act, no accurate record of still-births was possible. Now that still-births must be notified, that defect for statistical purposes has been remedied. Still-births must be notified by the person whose duty it would have been to state that the child had been born alive. The registrar insists on receiving a certificate from the doctor or midwife to the effect that a still-birth had taken place. Failing such certificate it is necessary for the parent or person responsible to make a declaration (signed) that neither doctor nor midwife was in attendance at the birth ; on the other hand, it must be stated that neither one nor the other could be obtained and that the child had not been born alive. A still-born child cannot be buried without a certificate from the registrar, granted to the person who gave information regarding the birth ; failing that, the registrar may give a certificate to those in charge of the burial-ground. The birth-rate is given as the total births per 1000 of the whole population of the district or the county as a whole.

$$\text{Thus—}\frac{\text{Number of Births} \times 1000}{\text{Population}} = \frac{\text{Birth-rate}}{\text{per annum.}}$$

The birth-rate has been gradually falling in this country. In 1875 it was 36·3. It has now dropped to nearly 18 per 1000 of the population. In Ireland, Hungary, and in Germany the birth-rate is still high. In France it is low. The birth-rate is influenced by the numbers of persons at marriageable ages. In time of war it is lower than during peace, especially when accompanied by prosperity. It is highest amongst the poorer classes. A more scientific method for calculating birth-rates would be to give the number of babies born per 1000 married women of marriageable ages.

**Illegitimate Births** should be calculated from the number of births per 1000 unmarried women and widows between the ages of 15 and 45.

The fertility-rate implies the average number of children born in each family. It is stated to be 4·5 children per family.

The decline of the birth-rate in a country like ours is a blessing in disguise, because the food supplies grown would not suffice to maintain an ever-increasing population in life. Also, as has been experienced within recent years, there is not enough work to absorb those of employable ages. Emigration to the colonies would be a partial solution of a high birth-rate were the conditions favourable for accepting emigrants. But the colonies also have their unemployment problems to solve.

The balance between births and deaths need not be a disturbing factor, on economic grounds at any rate. (See also Birth Control.) The chief point of interest to the student of preventive medicine is the safeguarding of the health of those who are actually born. (See under Eugenics.)

**Death-rates.**—Deaths must be registered within 5 days. The drop in the average death-rate of this and other civilised countries has been marked. This is partly accounted for by the tendency for the birth-rate to fall to balance the death-rate. Also the health defences, especially for the young, are greater than they used to be. And last, but by no means least, people are living beyond the ages at which many deaths used to occur. Cities that showed death-rates of 21 per 1000 among their inhabitants forty years ago can now boast of rates below 16 per 1000.

In rural areas the death-rate may be as low as 11 per 1000. The death-rate of such a disease as Tuberculosis does now and again reveal a higher incidence in rural than it does in urban areas, and females suffer more than males. Faulty housing conditions, indoor work, and tuberculous milk probably exert their evil influences in these directions. *Death-rates* estimated for weekly or for other short periods do not provide statistical evidence of real value regarding the healthiness or otherwise of a district. Violent and fatal visitations of Influenza, Measles, or Whooping Cough may cause such a sudden rise in the number of deaths that the average deaths for the year becomes suddenly increased. A weekly or monthly return under such circumstances, especially if it be abnormally high, must only be read to imply what happened during such epidemic periods. But should epidemic diseases, carrying with them high death returns, recur more frequently in one community than in another, a more serious view would be taken of their recurrence.

Overcrowding, poverty, or other social factors would then come under critical review. The figures for calculating weekly death-rates are supplied to the Public Health Department by the Registrar of Births, Marriages, and Deaths, because it is with him that all three events must be registered. A simple way of calculating a weekly death-rate is the following.

If a town had 30 deaths in a week, and its population was 60,000, the weekly death-rate would be :—

$$30 \times \frac{365 \text{ (days in the year)}}{7 \text{ (days in the week)}} \div \frac{60{,}000}{1000} = \begin{matrix}26{\cdot}07 \text{ deaths} \\ \text{per } 1000.\end{matrix}$$

The general or crude death-rate is defined as the number of deaths which occur every year from all causes per 1000 of the mean population living at all ages. If the death-rate in a district numbered 1288, and the estimated population was 82,660, the death-rate per 1000 would be found in the following manner :—

$$\frac{1287 \times 1000}{82{,}660} = 15{\cdot}5.$$

**Specific Death-rates.**—These give the death-rates of specified or special groups of a population. To calculate these death-rates the population must be divided into age, sex, racial, social, and occupational sections. Thus, if we take a specific age-group for the calculation of its death-rate, it is given as the number of deaths per annum per 1000 of the mean annual number of the population in that group. This calculation is of real value to the statistician, because it enables him to provide the death-rates of different ages, sexes, occupations, and nationalities. Among what might be termed a polyglot population, discrepancies may be found to exist in the death-rates of whites and natives of other countries. Such facts would prompt an investigation into the social habits of those groups in which the death-rates were pronouncedly high as compared with others. In reckoning occupational death-rates in special industries it should be observed that those engaged may belong to different age and sex groups.

**Case Mortality.**—Among specific death-rates the following are outstanding. Cancer ranks high, with a specific death-rate of 1·3 per 1000. The rate, unlike most others, has shown a tendency to increase. This is probably due to better diagnosis and more correct death certification of the disease. Tumours formerly set down as the causes of death are now more accurately stated as malignant tumours. Also, it has to be kept in mind that people are living longer and are reaching stages when Cancer is more likely to make itself apparent. This will obviously yield more " Cancer deaths " than formerly.

All forms of Tuberculosis come next. The decline in Pulmonary Tuberculosis to 0·57 proves that prevention is doing its steady work.

Pneumonia and Bronchitis and Diphtheria are also prominent, with their respective death-rates of 0·96, 0·94, and 0·12. When these rates are scrutinised by the statistician, he is better able to point to the contributory causes, and when these are revealed to the preventive officer, he can direct his attention to the cure of the causes.

Another way in which special or specific death-rates may be expressed is by referring to the case mortality of the special disease, or to the sex, or age, or occupation. Case mortality is expressed in percentages and is defined as the number of deaths per 100 cases of the special disease under consideration.

**Occupational Mortality.**—Statistics have demonstrated that most deaths from occupational diseases occur between the ages of 25 to 65. Occupational mortality is stated as the number of deaths per 1000 males living between the foregoing ages and following the same occupations.

A more accurate statistical method is to gauge the comparative mortality figure for each occupation. This is ascertained by finding the number of males between the ages of 25 to 65 in the whole population amongst whom 1000 deaths would occur each year, and discovering how many deaths would take place every year among the same number of men of similar ages, at work in the same occupation. This elicits such facts as the following. The comparative mortality figures for clergymen and agricultural labourers are low, while at the other end of the scale one finds that comparative mortality figures for publicans and general labourers are high. Given in figures, the comparative mortality figure for clergymen is 524, that for general labourers is 2235. The comparative mortality figure for doctors is 952. Among the occupations inimical to longevity those calling for sedentary habits are least favourable.

**Expectation of Life.**—This is taken to imply the probable number of years any person in a particular population may live, according to the rate of mortality prevailing in that area. But consideration must be given to the ages of individuals at the time of fixing the expectation. The following method has been offered to enable one to assess the expectation of life. Use the fixed number 96 between the age periods 20 to 45. Deduct the age of the person at the moment from 96. Half the remainder yields the expectancy. For those over 45, in place of 96 the fixed figure 90 is used. The expectation of life of women is three years longer than among men. But during the child-bearing period it is less. The expectation of life figure is a good index to the health of a community.

**Age and Sex Distribution.**—These are ascertained from the census returns. In assessing rates of mortality or other vital statistics, the age and sex distribution must always be taken into consideration. A health resort and another town may have equal populations, but the death-rate in one may be much higher than in the other. This may be accounted for by the greater number of young persons (domestics) employed in one of the districts. The town having a higher death-rate may also provide work for those following unhealthy or hazardous occupations. The one town may be chiefly composed of well-to-do classes, the other may accommodate a big population of artisans, whose social habits are not ideal. Also, the well-to-do town will probably engage many healthy young adults as servants, chauffeurs, gardeners, and so on.

**Recorded Death-rate.**—This takes institutional and other imported deaths into consideration. Glasgow, Edinburgh, Aberdeen, and Dundee provide large hospitals, nursing homes, and other institutions where the sick are treated. Many patients come from outside districts, so that when one of these imported patients succumbs, his death is notified to his place of residence. Thus, a Perth patient dying in Edinburgh has his death recorded against Perth. The converse applies to Edinburgh patients dying in Perth or elsewhere. If that system were not systematically carried out, the death-rates of Glasgow and Edinburgh especially, because they treat so many sick persons, would be artificially and wrongly increased.

**Density of Population.**—Death-rates and sickness-rates are deleteriously influenced by over-density of population. And when such is found to exist it is not merely the density of houses, but the overcrowding of them, that are material in causing higher death-rates from Tuberculosis, pulmonary affections (often associated with Measles and Whooping Cough), and gastro-intestinal disturbances among bottle-fed infants. The density of population is ascertained by dividing the number of persons living on so many acres by the number of these acres.

**Standardised Death-rate.**—This is somewhat difficult to define in simple language. It is the death-rate which would have taken place in the standard population if the rates in each one of its age groups had been the same in each of the corresponding age groups of the population. The population of this country is divided into sexes in five-yearly age periods—thus, 0 to 5, 5 to 10, 10 to 15, and so on. This system enables the Registrar-General to standardise the population according to age and sex groups. A death-rate may be influenced by the excess of births over deaths (natural increase of population). If, however, the births do not exceed the deaths, a balance may be struck. Under such circumstances the two will approach equality. Generally speaking, a consistently high birth-rate will show a lower crude death-rate, because there will be an increasing addition to the young adult population. A high birth-rate may under certain circumstances—such as poverty and bad housing conditions—show a high infantile mortality figure. Statistics have shown that there has been a general fall in the crude death-rate. The death-rates among the younger sections of the population have decreased, but among those over 50 years of age it has increased. In other words, conditions have improved for the young, and people are now living to more advanced ages. This latter fact has somewhat disturbed actuarial estimates. For instance, superannuation and pension schemes cost much more than they were estimated to do, because the recipients are not dying so soon as actuaries had expected. This has been specially noticeable in the teaching profession, whose retired officials have greatly accumulated within recent years.

The term *Mean Age at Death* is known as the average age at death. It is actually the sum of all the ages at death divided by the number of deaths.

The *Mean Duration of Life* is ascertained by adding the age to the expectation of life.

**Infantile Mortality** (see also Maternal Mortality).—This is defined as the number of deaths of all infants in one year from all causes. The preventive side of infantile mortality has already been discussed, but it may be repeated that over 70 per cent. of these deaths are caused by prematurity, gastro-intestinal affections, congenital debility, and Marasmus. The remaining 30 per cent. of the deaths are accounted for by Tuberculosis, Syphilis, injuries at birth (overlaying), and convulsions. In industrial towns where the mothers go out to work, and in districts where bad housing, careless habits, overcrowding, and want of education are prevalent, the infantile mortality rate is higher than in better-favoured districts. In the slums of a city there may be an infantile mortality figure of 120 deaths per 1000 births, whereas in the residential parts of the same city the rate may be below 50.

*Maternal Mortality* has already been discussed.

**Life Tables** have been compiled from time to time by different authorities. They are of special value to life insurance societies and to the lover of statistics. A life table indicates the duration of life or mean after-life time of individuals born at the same time. For that reason a life table has been called a barometer of life. If a group of individuals is taken, a life table will show the number who will remain alive in each succeeding year as long as they live. It will also reveal the number who died yearly and during each preceding year. To compile a life table the census enumeration must be searched so that the age and sex incidence of a population may be accurately ascertained. From these figures the compiler will discover the numbers and proportion alive at each age group. The deaths reveal the numbers dying at the expiry of each year. Armed with such a mass of reliable data, steps are taken to make up a life table.

Comparative mortality figures have already demonstrated how the duration of life affects different trades and occupations. Life tables are now perfect methods for measuring life.

# APPENDIX

*The Milk* (*Special Designations*) *Order*, 1936.—This revokes the Milk (Special Designations) Order, 1923, and the Milk (Special Designations) Order, 1934, but does not yet apply to Scotland.

Under the 1936 Order the following grades of milk are specified: (1) Tuberculin Tested; (2) Accredited; (3) Pasteurised; (4) Certified (Pasteurised).

*Tuberculin Tested Milk.*—Every animal of the herd must be tested at an interval of not less than two and not more than six months after the last preceding test of such animal, or, in the case of an animal born and bred in the herd, after it attains the age of six months. No animal shall be added to the herd unless it has passed a tuberculin test within fourteen days before it is so added. If an animal has been added from an already attested herd, the same condition applies regarding a test. Unless an animal has been added from an attested herd it shall be isolated for a period of two months from the date of its addition, and at the expiry of that isolation period this animal must be re-tested. No animal shall be injected with tuberculin other than that used for the test. No animal is to be inoculated or vaccinated against tuberculosis, nor with live *Brucella abortus*. Reacting animals must be removed from the herd. Every animal in the herd shall be submitted to an examination at intervals of not more than six months. Certificates of all examinations must be sent to the licensing (Local) Authority within seven days after the dates of such examinations. Animals suffering from any disease likely to affect the milk injuriously must be removed from the herd, and a record of such animals must be kept, with the reasons for their isolation, removal, or manner of their disposal.

Where containers other than bottles are used, every container shall be closed with a tightly fitting cover and shall be suitably sealed and labelled. Containers are not to be of less than two gallons capacity; bottles which come under the definition containers must not exceed one quart capacity. Caps on bottles must bear the address of the bottling establishment and the words "Tuberculin Tested Milk." Caps may also bear (*a*) day of production, with or without the word "morning" or "evening"; (*b*) name of dealer by whom the milk was bottled; (*c*) "Produced from cows which have passed the tuberculin test"; and (*d*) if the milk has been bottled at the place of production, the words "Farm bottled." No other words are to be on the cap without the consent of the licensing authority. If there is no cap on which the wording can be placed, it shall be placed within a surrounding line in a prominent position elsewhere on the container. The same wording relating to the cap may be used. Where containers other than bottles are used, every container shall be closed with a tightly fitting cover and shall be suitably sealed and labelled.

The foregoing conditions apply only to producers; whilst the following apply to dealers (whether producers or not):—

No heat is to be applied to "Tuberculin Tested Milk." Until 31st December 1936 milk samples being taken any time before delivery to the consumer must not contain more than 200,000 bacteria per millilitre. On and after 1st January 1937 any sample of milk to which the special designation is used, and any sample of milk from the herd in respect of which a licence authorising the use of the special designation is in force (whether the designation is used in relation to that milk or not), if the sample is taken before the sample has been placed in bottles or other containers for delivery to the consumer, and either while it is in possession of the producer or before the containers in which it is consigned to another dealer are opened by that dealer, shall satisfy a methylene blue reduction test carried out in such manner as the Minister of Health may direct. Before the test is begun, samples shall be kept at atmospheric temperature until 6 p.m. on the day of production if it is morning milk. If it is afternoon milk, until 10 a.m. of the next day. Any other sample may be kept at atmospheric temperature for a period not exceeding 2 hours. If the test is not then immediately begun, the milk shall be cooled and kept at temperature from 32° to 40° F. for a further period not exceeding 18 hours, and the test shall be begun at the end of that period.

A sample taken at any date between 1st May to 31st October shall be considered satisfactory if it fails to decolorise the methylene blue in $4\frac{1}{2}$ hours, and a sample taken between 1st November and 30th April shall be regarded as satisfactory if it fails to decolorise the methylene blue in $5\frac{1}{2}$ hours.

*Accredited Milk* (Producers' Conditions).—Cows to be examined once in every three months, and Veterinary Inspector's Certificate to be sent to licensing authority within 7 days of such examinations. Same conditions apply to cows in herd as in the case of "Tuberculin Tested" category, already detailed. All milk cows in herd to be marked for identification and a complete register of the cows kept. No cow previously tested and a proved reactor to be knowingly added to the herd. Milk of this designation to be conveyed in unventilated steel containers, and to bear the address of the dairy, the day of production (morning or evening being added), and the words "Accredited Milk."

The following conditions apply to dealers (whether producers or not) by whom the milk is delivered to consumers: The milk in relation to which the special designation is used [unless it is delivered to the consumer in the containers in which it is received] shall be delivered either in bottles or in other suitable containers of not less than two gallons capacity. "Bottle" includes any container of a capacity not exceeding one quart and of a type approved by the licensing authority. Bottles to be tightly closed and securely fastened with a cap overlapping the lip of the bottle or by other approved device. The cap must bear the address of the bottling establishment and the words "Accredited Milk." It may bear the other markings indicated under "Tuberculin Tested" Milk. Where containers other than bottles are used, every container shall be closed with a tightly fitting cover and shall be suitably sealed and labelled.

The following conditions apply to all dealers (whether producers or not): The milk must not at any stage be heated, or heated in any way to injure its qualities. Until 31st December 1936 the milk sampled any time before delivery to the consumer must not contain more than 200,000 bacteria per millilitre. On and after 1st January 1937 any sample, taken before the milk has been placed in bottles or other containers for delivery to the consumer, shall satisfy a methylene blue reduction test. The same conditions apply with regard to the keeping of samples as have already been detailed.

*Pasteurised Milk.*—The same conditions apply as in the case of Pasteurised Milk in the former Order, and the bacterial count is fixed (before delivery to the consumer) at not more than 100,000 bacteria per millilitre.

*Certified (Pasteurised) Milk.*—This gives power to pasteurise "Tuberculin Tested" Milk. The count is to be 30,000 bacteria per millilitre.

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