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CONSUMPTION:

ITS NATURE, CAUSES, PREVENTION, AND CURE.

BY

DR. SICARD DE PLAUZOLES.

Translated from the French by

BERTRAM H. HALL.

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PUBLISHERS' NOTE.

No apology is required for the issue of this manual—the placing of which, in an English form, upon the bookselling market, will probably prove a boon to hundreds of thousands of sufferers.

It may be stated at the outset that the original is an invaluable little volume from the pen of one of the most eminent of French medical men and scientists, who has made Consumption his profound study. It has been translated and issued in a cheap form, in the belief that it will thus find a large market in this country, where consumption is as terribly rife almost as it is in France.

There is no more deadly disease in England than consumption, or tuberculosis as it is termed by the medical profession. One person in every fourteen dies of the disease in England, and although the scourge is more virulent

in France, where 150,000 die annually of the disease, yet the mortality from the same cause in England—some 60,000 per annum—is a sufficiently good reason for giving the widest possible publicity to the invaluable contents of this little volume.

There are few families wherein the ravages of this dire disease have not been felt, and, what is worse, left their mark; also, it is to be feared that to this alarming fact may be coupled the mournful corollary that the impression left upon the minds of almost every one outside the medical profession is that consumption is a disease which baffles the skill of the physician—in short, is an incurable malady. Happily this is not, probably, the case.

Eighteen hundred years or so ago Aretæus of Cappadocia (*circa* A.D. 100) drew attention to consumption. He distinguished the symptoms of the dread disease, and drew a word-portrait of a consumptive as faithful as anything that could be issued from a Harley Street consulting-room to-day. Yet until the very close of the nineteenth century practically nothing was done to combat the ravages of perhaps the worst scourge on the face of the

earth. Millions, mostly young people unhappily, have gone down to their graves, while medical skill and research have, until recently, stood still so far as concerns this consuming disease—one that literally eats away everything, save soul and bones. Who has not been an eye-witness to such a picture as the one drawn by Sales-Girons? "This deceitful disease," he says, "ever lends a charm to its victim, gives roses to the cheek, a sweet expression to the pale face, an angelic gentleness to the glance, a melodious tone to the voice; the father transmits it to his family like his fortune and his virtues; it does not wait for the birth of its victims to set on them its fatal seal; it hastens the spring but to bring on the autumn, and develops before due season but to crush before due time; it sows hope in the morning in a family, but it will fill it with grief before night.'

Hippocrates, the "Father of Medicine," the greatest physician of ancient times, as long ago as 2,300 years laid down the law that "a consumptive is the offspring of a consumptive." Yet it was not until 1882 that Koch, the eminent German bacteriologist, made the discovery

of an organism which is present in all cases of consumption proper, the destruction of which organism, or bacillus, appears to furnish the clue to a new era in the treatment and possible cure of phthisic patients.

This pulmonary consumption, however, is an insidious monster, whose secret work is at first unnoticeable, but which soon assumes the offensive. The public at large, the laity as distinct from medical men, cannot become too familiar with the varied ways through which the bacillus of tuberculosis may enter the system—the most ready one being, unhappily, through the respiratory passages.

A plain, unvarnished story, then, of consumption (or phthisis), what it is, how it is acquired, how to grapple with it, particularly in its initial stages, must be of the greatest value in every home and to every person in that home. Such the present little manual undoubtedly is; and that it will prove of immense value in all English-speaking countries is beyond doubt.

It is to Sir Hugh Beevor, Bart., M.D., that we are indebted for the use of the four maps and other data in the final chapter dealing

especially with this dire disease as it affects our own country.

Actually reliable figures for the present time are difficult to arrive at until a fresh census is taken, but the diagram and statement extracted from a valuable paper entitled "Some Pioneers in the Prevention of Phthisis," which Sir Hugh Beevor contributed to *Tuberculosis*[1] (see Chapter XV.), well illustrate the condition of consumption in England, as far as London is concerned, at the census of 1897.

We desire to express our acknowledgements to Messrs. Allen & Hanbury, Messrs. Boulton & Paul, the Proprietors of *The Lancet*, and Dr. C. Guthrie Stein for the loan of several of the blocks illustrating this manual.

FREDK. J. CROWEST.

EDITORIAL OFFICES,
FELLING-ON-TYNE,
October, 1903.

[1] January No., 1901.

INTRODUCTION.

A TERRIBLE disease, which strikes its innumerable victims everywhere, and seems to increase with the progress of civilisation; a hereditary disease, which is transmitted by parents to their family more surely than their fortune, and sets its fatal seal on the child from birth; a contagious disease, from which neither youth nor wealth is a safeguard—tuberculosis is one of the most formidable scourges of humanity.

The annual tale of its victims is fearful; a quarter of the human race perish from it.

Pulmonary consumption kills 10,000 persons every year at Paris; 180,000 succumb to it annually in Germany; and it is practically the same with all civilised countries, so that the mortality from pulmonary tuberculosis may be reckoned at 1,000,000 victims per year for Europe alone. The terrible eloquence of these figures needs no comment.

But the ravages of tuberculosis do not end there: tubercular meningitis and peritonitis sweep away children in thousands. Not content with killing, the pitiless disease deforms

and maims its victims. It attacks and eats away the bones: Pott's disease undermines the vertebral column, causing it to give way, while hip-joint disease and white swellings dislocate and destroy the joints; and if the sufferer escapes death, it is only as a miserable cripple.

It will be readily understood that there is no more urgent problem for the physician than that of the treatment and cure of this cruel disease.

For a long time the efforts of the profession remained fruitless, because they did not know even the nature of the disease they had to combat. But we know to-day what tuberculosis is, and though we do not yet possess a specific remedy for it, we know how the tuberculous may overcome the disease and recover, and we know what means have to be employed to secure recovery. We know more. We know how the development of the disease may be prevented, and by what means a healthy man may be safeguarded from its attacks. Every one should have this knowledge, for the struggle against tuberculosis cannot be the work of a few: to be effective, it requires the enlightened aid of all.

To meet an enemy successfully, we must know him well; must know who he is, where he is, where and with what weapons he may make his attack, who are his allies, and what

are his tactics. We can then prepare our defence, and when the time comes, repel the invasion. Our object, then, is to study the nature and causes of tuberculosis, and how it is propagated and developed, and to deduce therefrom the means of preventing it or of arresting its progress.

We trust we may interest our readers, and convince them that tuberculosis can be and must be combated by each in his own sphere, that war must be waged unceasingly against the scourge, and that victory, though yet distant, can only thus be attained. We shall then be conscious that we have done useful work.

DR. SICARD DE PLAUZOLES.

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NATURE OF CONSUMPTION.

CHAPTER I.

HISTORICAL REVIEW—NATURE OF TUBERCULOSIS —ZYMOTIC DISEASES AND MICROBES.

TUBERCULOSIS, in its most frequent form, that of pulmonary consumption, has been observed from the earliest antiquity. But the ancients did not open dead bodies, and they have only left us descriptions of symptoms. The word phthisis (from $\phi\theta\acute{\iota}\omega$, to waste away) was applied by them to any wasting malady connected with an affection of the lung, accompanied by expectoration and fever, and ending in death.

Hippocrates was well acquainted with the

principal signs of pulmonary consumption, cough, purulent expectoration, hæmoptysis, hectic fever, sweats, digestive troubles, loss of flesh, drumstick fingers, and incurved nails, also with its progressive and deadly course; and if the causes and nature of the disease were unknown to him, the Father of Medicine had nevertheless observed and noted the part played by heredity in its development.

Aretæus of Cappadocia (100 A.D.) has drawn an accurate portrait of the consumptive, which is one of the finest pages in ancient medicine. "Phthisis," he says, "is caused by ulceration of the lung. Following on a persistent cough or a hæmoptysis, it is accompanied by constant fever, which, usually more marked at night, may be, as it were, masked, being concealed during the day and appearing intermittent; yet it shows itself by malaise, weakness, and loss of flesh. The pulse is feeble and easily diminished, the sleep is disturbed, the skin loses its colour; the appearance of the sputa is extremely variable: they may be livid, blackish, white, yellow, greenish, or flecked with white and green, large or rounded, viscous, glutinous or watery, fetid or odourless.

"To the foregoing symptoms are added oppression, weakness of the lungs, anxiety, impatience, loss of appetite; the feet are cold in the morning, and burning in the even-

ing; then sweats supervene, which are more troublesome than the heat, and extend to the chest.

"The voice becomes hoarse, the neck bends forward, and is slender and without flexibility, almost stiff; the fingers are thin, and swell out at the joints, showing the shape of the bones; the flesh at their extremities is clubbed, and the nails incurved. The nose is sharp and thin; the prominences of the cheeks exaggerated and highly coloured; the eyes hollow, clear, and bright; the face pale and fleshless, or sometimes suffused and livid. The lips are stretched across the teeth as in laughter, and the whole appearance of the sufferer resembles that of a corpse.

"The other parts of the body have undergone the same change; the flesh has disappeared; the muscles of the arms are no longer visible; the breasts are atrophied, and only represented by the nipple; the ribs can be counted, and their points of termination and of articulation with the vertebræ and breast-bone remarked; the intercostal spaces are depressed, showing the form of the bones. The epigastric region is hollow, and seems to have moved upwards. The abdomen and sides hold close to the back; the fleshless joints become prominent; the vertebral column, instead of showing a channel, shows in relief at the back, through

the atrophy of the muscles on each side; the shoulder-blades lift up the skin, and resemble the wings of birds. If the bowels get out of order, hope is at an end."

For centuries nothing could be added to the description of Hippocrates and Aretæus.

From the time of the Renaissance, anatomists began to dissect dead bodies in order to study the structure of the organs, and doctors for the first time began to open bodies to discover the seat and causes of disease; but it was not until the seventeenth century that it was ascertained that phthisis is the result of a particular lesion of the lung. François de la Boë (Sylvius) first described the tubercles, a kind of small tumour, which arise in the lung, and by their purulent disintegration form vomicæ, and recognised the analogy between these and the glandular lesions of scrofulous persons. The English doctor Morton, in 1689, stated phthisis to be an actual specific disease; he maintained that pulmonary phthisis, whatever its form, is always characterised at some period of its evolution by the presence of tubercles in the lung; hence the name of tuberculosis, given later to the disease. Portal, in 1792, found that these tubercles disintegrate and leave cavities in the lung. The German, Vetter, in 1803, compared the matter resulting from the degeneration of the tubercles to cheese;

whence the name of caseous matter, often applied to the tubercular matter.

But it was reserved for the genius of Laënnec (1781-1826) to give an exact anatomical description of the lesions of pulmonary consumption, of such precision that later labours have added to it but taken nothing away, and, by his immortal discovery of auscultation, to enable the doctor to examine the depths of the lung of a living man, and determine its lesions with as much exactitude as though the affected organ were on the dissecting table.

"The progress of pathological anatomy," says Laënnec, "has proved to demonstration that pulmonary consumption is due to the development in the lung of a particular kind of accidental product, to which modern anatomists have specifically applied the term *tubercle*, formerly given to any kind of unnatural tumour or protuberance.

"Tubercular matter may appear in the lungs and other organs under two principal forms, as isolated bodies (tubercles and miliary granulations) and as infiltrations; each form presents several varieties, depending chiefly on their different degrees of development.

"Whatever the form in which the tubercular matter develops, it presents at first the appearance of grey semi-transparent matter, which gradually becomes yellow, opaque, and very

compact. It afterwards softens, gradually becoming almost as liquid as pus, and when expelled through the bronchial tubes leaves spaces, which we call tubercular cavities, or excavations.

"Tubercle is the most usual form assumed by tubercular matter in the lungs. In appearance the tubercles resemble small grains, grey and semi-transparent, sometimes even almost diaphanous and colourless, in consistency a little softer than cartilage; their size varies from that of a millet seed to that of a hemp seed; their shape, apparently oval, is seen to be less regular when examined by a magnifying glass; sometimes they even appear somewhat angular; they adhere firmly to the tissue of the lung, and cannot be detached without tearing it.

"The grains increase in size by absorption, and thus unite in groups. Before this union takes place, a small, opaque, yellowish-white spot forms in the centre of each tubercle, and spreading to the circumference, involves the whole of the tubercle as it increases.

"After a time the invasion of the yellow matter becomes complete, and the whole group forms one homogeneous whitish yellow mass, in texture rather less solid and moister than cartilage; it is then called crude yellow tubercle, or simply crude tubercle.

"When there are but very few tubercles, say only a hundred, or less, in each lung, the single tubercles sometimes attain the size of a cherry stone, a hazel nut, or even an almond. It is very rarely they exceed this latter size; larger masses of crude tubercle in a lung are usually the result of the aggregation of several tubercles or of tubercular infiltration.

"Miliary granulations are about the size of a millet seed, and exactly round or oval in shape; they also differ from the ordinary tubercles by their uniform size and their colourlessness and transparency. They are usually scattered in enormous quantities about the whole or a large portion of a lung often otherwise perfectly healthy, but are not united in groups. Sometimes, however, from their number at certain points and their close juxtaposition, they form solid masses or nuclei. On cutting into these masses each granulation can be distinguished, isolated, and separated from the others by tissue which is perfectly sound, or slightly infiltrated by serous matter.

"A careful examination of these granulations will show that they change into opaque yellow tubercles. There is no other difference between them than that between a green and a ripe fruit. Miliary granulations are, moreover, hardly ever found except in lungs containing

at the same time other larger tubercles sufficiently advanced to leave no doubt as to their nature.

"Sometimes tubercular masses of considerable size are formed by infiltration, without the previous formation of miliary tubercles. The lung tissue thus filled up is dense, moist, quite impermeable to air, and of a more or less dark grey colour, and when cut in slices the pieces removed are almost as firm as cartilage, and present a smooth polished surface of homogeneous texture, in which no trace of the areolæ of the lung can be seen. As these indurations reach the stage of crude tubercle a number of small, opaque, yellow spots are seen to form, which multiply and increase, and at length invade the whole of the indurated portion, and transform it into crude tubercular infiltration.

"In whatever way the crude tubercles are formed, sooner or later, after a period apparently of very variable duration, they at length soften and liquefy. This disintegration begins towards the centre of each mass, where the tubercular matter becomes daily softer and moister and cheesy, or at least oily to the touch, like soft cheese, then viscous and fluid like pus. The disintegration gradually reaches the circumference and at length becomes complete. When the tubercular matter is com-

pletely disintegrated, it makes its way to one of the nearest bronchial tubes."

"By his immortal labours on pulmonary consumption," says Professor Dieulafoy, "Laënnec bequeathed to the medical world so deep a study of this disease, was so correct in describing its lesions and its forms, and in proclaiming their unity, and discovered and described so marvellously the signs revealed by auscultation, that we can only bow before the imperishable work of this man of genius." But the nature of tuberculosis remained unknown; Laënnec believed it to be a growth foreign to the system, having a life of its own; Broussait maintained that it was a product of inflammation; discussion became heated, when in 1865 Villemin demonstrated that tuberculosis can be transmitted by inoculation from man to animals. He showed, by unexceptionable experiments, that if small portions of tubercular matter, or of expectoration from a consumptive, are introduced under the skin of an animal, a rabbit for instance, on killing the animal a few weeks later granulations or tubercular masses will be found in its lungs and other organs. At the point of inoculation there appears a small tumour, which may be re-absorbed, but more frequently breaks down and becomes purulent, opens outside, and forms a tubercular ulceration; the animal becomes thin; the lymphatic

glands corresponding to the tubercle of inoculation swell and become caseous, and if the disease is left to take its course, the animal wastes away and dies in from six weeks to three months.

Villemin's method was as follows: on the ear of a rabbit, or under the hind or fore leg of a dog, on a small surface previously shaved, he made a sub-cutaneous wound, so small and shallow as not to yield the smallest drop of blood, and then introduced a bit of tubercular matter the size of a pin's head into the wound in such a way that it could not escape, or injected expectoration from consumptives, diluted in distilled water, under the skin. On examination after death most of the animals thus inoculated showed the characteristic lesions of tuberculosis.

Villemin's experiments were repeated with variations by scientists in all countries. In Germany, Cohnheim had the ingenious idea of inoculating tubercular matter into the anterior chamber of an animal's eye by means of a fine needle. Thanks to the transparency of the cornea, he was able to observe the development of the local lesions day by day, and, like Villemin, found that the disease became generalised in the animal under experiment. In France, Chauveau (1868) induced tuberculosis in animals of the bovine species by causing

them to eat tubercular matter mixed with their food, and showed that a very small quantity of matter introduced into the digestive passages sufficed to make the animal ill. Parrot obtained the same results by causing guinea-pigs to swallow expectoration from consumptives, and Viseur by feeding cats on tuberculous lights. Finally, Tappeiner (1880) made animals tuberculous by causing them to breathe air containing tuberculous expectoration in the form of dust. He diluted expectoration, from a consumptive in the stage of excavation, in distilled water, and projected the liquid by means of a spray syringe into a sort of cage, open on one side only, in which was a dog; and the animal had to breathe air thus contaminated each day. Twelve dogs treated in this way for different lengths of time were all found after death to have their lungs full of tubercle. These experiments afforded startling proof of the virulent nature of tuberculosis: it remained to discover its active principle.

The term zymotic diseases is applied to those induced by the introduction into the system of pathogenic agents called viruses, which modern investigation has shown to consist of microscopic living organisms analogous to ferments, known as bacteria. Before the labours of Pasteur, these viruses were but suspected to be living. Since the ninth century, when Rhazes com-

pared small-pox to the fermentation of grape must, which works when it turns into wine, various scientists of an ingenious turn of mind have thought that virus acted on the system in the same way as ferments; but the nature of ferments was unknown. Pasteur threw light on the subject; he showed first (1857) that fermentation is a correlative of life, being the work of microscopic living organisms, and from that time it has been supposed that the disease, like the fermentation to which it had so often been compared, is dependent on a living agent.

In 1850 Bayer and Davaine had discovered thread-like bodies, like rods or sticks, in the blood of animals suffering from anthrax; in 1877 Pasteur definitely established the specific pathogenic influence of these minute organisms by cultivating them and reproducing the disease by inoculation. The labours of Pasteur, and the methods he had employed in studying ferments and anthrax, served as a guide and model for others; thanks to the impulse given by him, discoveries multiplied, and in 1882 Robert Koch of Berlin discovered, isolated, and cultivated the microbe of tuberculosis.

Microbes, or bacteria, are microscopic vegetables of a low order, very widely disseminated in the air, in the soil, in water, and on the surface and in the natural cavities of the bodies

of man and animals. Bacteria present the most varied forms, which may be referred to three principal types, micrococci, bacilli, and spirobacteria, comparable respectively to a billiard ball, a pencil, and a corkscrew. The

FIG. 1.—TUBERCLE BACILLI AND SOME EPITHELIAL CELLS IN SPUTUM. × 1000. VACUOLES APPEAR IN SOME OF THE BACILLI.

micrococci are small round or oval cells, sometimes solitary, sometimes connected by twos or more in chains or bunches; the bacilli (from *bacillus,* stick) have the form of more or less elongated cylinders, straight or hooked; the

spirobacteria are curved filmaments, rolled up in a spiral, or twisted like a screw.

Bacteria propagate with extreme rapidity in surroundings favourable to their nutrition and development. They take the elements of their nutriment from the medium in which they live; not being able to assimilate directly the alimentary substances round about them, they secrete soluble ferments or diastases which alter their nature. By means of these they change starch into maltose and glucose, invert cane sugar and milk sugar, transform albuminoids into peptones, liquefy gelatine, make cellulose soluble, etc. Most of these diastases are powerful poisons to animal cells, and these fermentations produce various toxic agents, such as many alkaloids and ptomaines, which are the active causes of poisoning produced by the consumption of food which has begun to putrify (preserved meats, game, fish, etc.). But besides these alkaloid diastases, bacteria are also able to elaborate poisons of their own, the toxalbumens, which are described by the general term of bacillar toxins.

Certain bacteria, the saprophytes, only exist in dead organic matter, the putrefaction of which is caused by them; others, the pathogenic bacteria, live as parasites in living tissues, and are the cause of zymotic infectious diseases, the symptoms and lesions of which

are determined by the toxic substances they secrete. Thus the bacillus of tetanus, localised in a wound, secretes a toxin which permeates the whole system, and has a convulsive action on the nerve centres analogous to that of strychnine. In diphtheria, the microbe does not penetrate the system, but remains on the surface of the mucous membrane, on the tonsils, for instance; there it produces its toxins, which by their diffusion cause organic lesions, poisoning, and paralysis. The bacillus of yellow fever, which enters the blood, produces a specific poison which causes lesions of the liver and kidneys, and occasions hæmorrhage and vomiting.

It may be affirmed that a microbe is the cause of any definite disease when it is constantly met with in those attacked, and when the symptoms and lesions of the disease can be reproduced experimentally by inoculation of cultures of it, or by injection of its toxic products. Koch demonstrated in this way the specificness of the bacillus bearing his name, which he discovered to be constantly present in the tubercles and expectoration of consumptives, which he isolated and cultivated in suitable media (culture broths), and which, inoculated into animals, unfailingly reproduced tuberculosis.

CHAPTER II.

KOCH'S BACILLUS — FORMATION AND EVOLUTION OF TUBERCULAR LESIONS.

TAKE up on a needle the most purulent portion of the expectoration of a consumptive; put it on a thin glass plate, previously washed with nitric acid and then with alcohol to make it perfectly clean and transparent; on this plate put another, so as to crush the matter to be examined between the two and spread it out as much as possible. Separate the plates by sliding one over the other, and dry them by passing rapidly two or three times through the flame of a spirit-lamp. Lay the plates in a bath of carbol fuchsin for ten minutes; wash them, first in distilled water, then in a solution of dilute nitric acid (one part nitric acid to two parts water), and then in alcohol; then put them in a solution of methyl blue in alcohol and water for three or four minutes. Again wash in distilled water to clear of superfluous colouring matter, and allow to dry. Now put this preparation under a powerful

microscope. Among the ordinary elements found in all expectoration, epithelial cells from the bronchi and the mouth, which are coloured blue, you will perceive small rod-like bodies coloured red, in shape and appearance like small sticks (whence their name of bacilli), very slender, from 80 to 150, or even 300 millionths of an inch long, and 12 millionths of an inch across, of uniform diameter, straight or sometimes considerably curved, solitary, grouped in twos end to end at right angles, or sometimes collected in bunches. These are Koch's bacilli. They are always found wherever tubercular matter exists.

Koch's bacillus possesses the property of resisting the bleaching action of nitric acid when coloured by an aniline dye, and can thus be distinguished in the tissues, humours, and expectoration, and differentiated from the cellular elements and other microbes, which, after bleaching, can be dyed another colour. The bacillus is found in tubercular granulations of every size and age, in the tubercular infiltrations which attack the lungs, lymphatic glands, and joints and bony tissue (white swellings, Pott's disease), in the discharge from tubercular abscesses, in the urine of persons with tuberculosis of the urinary passages, and in the loose evacuations of sufferers from intestinal tuberculosis and tuber-

cular enteritis; and it is especially found in the expectoration of consumptives.

Koch's experiments have shown that if this bacillus is cultivated and inoculated into various animals, tuberculosis is produced even more surely than by inoculating with portions of tubercular matter, as Villemin did. Injection of fluid containing bacilli into the veins brings on an acute, rapid, and generalised form of tuberculosis.

Koch's bacillus produces soluble toxic substances, which it leaves in the culture broth; among these, experimenters have succeeded in isolating a toxin causing dilatation of the blood-vessels, a toxin causing convulsions, and a toxin causing necrosis, which, as we shall see, play a considerable part in the genesis of the lesions and symptoms of tuberculosis.

The experiments of Villemin, Chauveau, and Tappeiner have shown that the bacillus of tuberculosis may enter the system through an injury to the skin, through the digestive passages, or through the respiratory passages. It is conveyed to the internal tissues of the body by the blood-vessels or the lymphatic vessels. When the tubercular virus enters the blood-vessels, a generalised form of tuberculosis quickly results. Propagation by means of the lymphatics is slower, but it is most frequent.

Later on, when dealing with the contagious-

ness of tuberculosis, we will come back to the various means of entry open to it, and the obstacles it meets with. Let us now suppose the bacilli to be established in the tissues, and see how they produce the lesions indicated by Laënnec. The bacilli multiply at first without causing any noticeable lesions; but soon they assume the offensive. They penetrate the fixed cells of the tissues, and by their presence give rise to a nutritive and formative irritation in the cells in which they are lodged, whether cells of the connective tissue, endothelial cells of the blood-vessels, or epithelial cells of the lungs, which results in the multiplication of these cells. Then begins the struggle between the destroyers and the system. Through the walls of the blood-vessels there rush forward, against the enemy who has crept in, battalions of living, moving cells, the white corpuscles or leucocytes. These are the only cells in our tissues which have movements of their own. They are composed of mucous matter, which they elongate like a tentacle in the direction they want to go. To advance, they fix the end of this tentacle and pull themselves up. When there is a bacillus within their reach they seize it in their tentacles, drag it in, envelop it in their substance, and dissolve it; they have therefore been given the name of *phagocytes*, or microbe-eaters. To employ Duclaux's comparison, the

phagocytes are the police of the organism; always moving about with unceasing vigilance, they are constantly going their rounds in search of bacteria malefactors. The flying columns of moving phagocytes are reinforced by fixed phagocytes, which at various points in the body seize the microbes that pass within their reach; among these are the cells found adhering closely to the walls of the blood-vessels, and those in the pulp of the spleen and the marrow of the bones. Besides the mobile police force which is constantly patrolling our system to apprehend any worker of mischief, there are therefore police pickets whose duty it is to arrest malefactors as they pass. But some of the bacilli have succeeded in evading the police and established themselves, and are multiplying; the leucocytes hasten up and besiege the point occupied, and the struggle with the invaders begins. The leucocytes secrete fluids which diminish the vitality of the bacilli, and dissolve them, and they also produce calcareous matter, with which they try to surround and envelop the bacilli, so as to wall them up. The latter are not only defended by their armour-like integument, which protects them against the secretions of the phagocytes; they also possess formidable weapons; they secrete toxins or violent poisons, which repulse or kill the phagocytes. If the leucocytes are strong and

active, and the bacilli few and not very virulent, the latter are absorbed and dissolved by the former; the invaders are annihilated, and victory remains with the organism. On the other hand, if the bacilli are numerous and virulent, the disease is triumphant; the leucocytes are conquered and killed by the poisons of the bacilli, and caseous necrosis appears.

The first effect of the development of bacilli in a tissue is the multiplication of the fixed connective-tissue or epithelial cells, and the formation of small nodular foci, at which the bacilli occupy the cells themselves or the spaces between them. These elementary foci or tubercular follicles, full of bacilli, consist of a central giant cell with a number of nuclei, which is formed by the coalescence of conquered leucocytes, whose tentacles seem to project into the substance of the follicle, and surrounded by a ring of rather large (epitheloid) cells, and then quite on the outside by small round embryonic (lymphoid) cells. By their agglomeration, the tubercular follicles form granulations and miliary tubercles, which may form in turn by their union large tubercles the size of a nut or even an egg, such as are found in the lungs, the brain, and other organs. All these tubercular products undergo caseous degeneration from centre to circumference, under the influence of the necrosing toxins secreted by the

microbe, and while the lesions are spreading from the outside, degeneration is taking place at the centre. The central portion of the follicle, the giant cell, then the epitheloid cells, are gradually infiltrated by oily granulations, and become vitreous and homogeneous; they adhere and unite; their nuclei disappear, and they are transformed into a transparent, vitreous mass, with markings which give it the appearance of an irregular mosaic. The degeneration spreads to the ring of embryonic cells; then the transparent mass, which constitutes Laënnec's grey granulation of miliary tubercle, becomes opaque; all trace of structure disappears, and cells and nuclei are finally annihilated and replaced by an extremely friable amorphous or granulated substance; vitreous degeneration has been succeeded by caseous degeneration. The grey granulation, which first appeared as a small, shining, homogeneous body, almost as hard as cartilage, then shows in the centre an opaque yellow spot, which gradually increases in size until the whole mass becomes yellow and opaque; it can then be crushed with the finger like cheese, and constitutes yellow tubercle or crude tubercle. The tubercular matter, at first grey and hard, then yellow and friable, gets softer and softer, and becomes a sort of puriform, thick, yellowish paste, which seeks discharge outside. Sometimes, instead of forming

clusters of granulations, the tubercular follicles spread out in a sheet and infiltrate the tissues, which thicken and assume an appearance similar to that of bacon. These tubercular infiltrations, which play a considerable part in pulmonary consumption and in tubercular disease of the bones and joints (white swellings), follow the same course as the tubercular granulations; they pass to the caseous state, disintegrate, and become greyish and yellowish in colour; and when the caseous transformation is complete no cellular element is recognisable. The nodular and infiltrated forms of tuberculosis often occur together in various proportions in the same tissue. According to the organ attacked by the tubercular lesions, and their nodular or infiltrated character, the disease assumes extremely varied forms; we shall pass in review the most important of these—tuberculosis of the lung or pulmonary consumption, tubercular meningitis, intestinal tuberculosis, tubercular peritonitis, and tuberculosis of the bones and joints, including white swellings, hip-joint disease, and Pott's disease.

CHAPTER III.

PULMONARY CONSUMPTION.

PULMONARY consumption is the most frequent form of tuberculosis, and that which claims most victims.

Koch's bacillus may reach the lung by two different ways: through the blood, or by inhalation. Where the bacillus is conveyed by the blood, the result is a rapid and general invasion of tubercle, a real infection, in the old sense of the word, which implies the idea of a complete impregnation of the whole system by some infinitely subtle and penetrating deleterious matter. Miliary granulations develop in immense numbers throughout the whole extent of the lungs and in the other organs, and the tubercular toxins, secreted in great abundance, rapidly bring on death, before the tubercular lesions have had time to evolve towards caseation and disintegration. This acute form of tuberculosis (called in France *granulie*) shows itself under very diverse aspects; sometimes it is characterised by rapid asphyxia, sometimes it simulates the course of

typhoid fever, sometimes it is accompanied by brain troubles and meningitic symptoms. It is almost always quite intractable and fatal.

Trousseau draws a graphic picture of acute tuberculosis. He says: "A young woman—for it is mostly women, and young women, whom I have seen attacked by this disease—a young woman, hitherto very well, gets out of health without any perceptible cause, and without any definite ailment; her digestion is out of order, she loses her appetite; her strength falls off, and a more or less pronounced feverishness bears witness to the presence of a disturbing element in the system. This condition of malaise and languor lasts a fortnight or three weeks, sometimes a month. The sufferer nevertheless continues to attend to her duties, though she complains of unusual weakness and lessened capacity for any work requiring some amount of mental application. At the same time she has night sweats and a slight dry cough.

"When these symptoms have only been present a few days they are attributed to a cold or a slight attack of bronchitis, and there seems really to be nothing worthy of serious attention. But the cold continues and the fever persists. The days go by and things get worse instead of better; the fever increases, the patient loses her sleep, the cough becomes

more and more troublesome, and is accompanied by expectoration, at first mucous, but soon becoming muco-purulent. The breathing is laboured, short, and quick, and the dyspnœa becomes such that the patient is obliged to maintain the sitting position. The symptoms continue to increase, the strength gradually fails, the face acquires an anxious look, the natural colour gives place to a livid hue, and in five, six, seven, or eight weeks after the first symptoms the patient dies in a state of emaciation analogous to that which occurs in severe cases of fever, but in no way comparable to that which accompanies ordinary consumption. In the typhoid form of acute tuberculosis the general condition is so similar as readily to be mistaken for typhoid fever; the onset of the disease is more sudden, and its course more rapid, and the end comes by asphyxia or coma."

When the bacilli reach the lung by the respiratory passages in large numbers they cause a wholesale infection, which produces extensive tubercular infiltration. This destroys large areas of lung tissue, and rapidly kills by asphyxia and poisoning before purulent softening of the caseous mass can take place. This form is called *scrofulous pneumonia.* If the bacilli are but few they settle at the apex of the lung; granulations form there and

follow their evolution, while the tubercular lesions spread in turn to the middle and lower portions of the lung. This is the most common form of pulmonary consumption; its advance is as a rule slow and chronic, but sometimes it runs its course in an extremely short time (three to six months), and goes through all its stages post-haste; it is then called *galloping consumption*. Recovery is exceptional in acute tuberculosis, scrofulous pneumonia, and galloping consumption; but this is not the case with ordinary chronic pulmonary consumption. We shall see that those attacked by this form of tuberculosis may and often do recover, and we shall study in what ways such recovery may be brought about. From this point of view the study of chronic pulmonary consumption is especially interesting.

In the chronic forms of ordinary pulmonary consumption Koch's bacillus is most frequently brought in from outside by the air inspired. The bacilli stop at the bifurcations of the smallest ramifications of the bronchi in the lung, and for preference at the apex, in the part situated underneath the collar-bones. Now, in the upper portion of the lungs respiration is imperfect, and the air does not pass freely, or rather, whilst inspiration is strong and atmospheric dust easily gets in, expiration is too feeble to expel it, and dust

and microbes accumulate in the bronchi, which are consequently often irritated and inflamed. These conditions favour the establishment and development of the bacilli and diminish vital resistance locally. Thus pulmonary tuberculosis usually begins with the apex of the lung and spreads gradually downward to the rest of the organ.

Post-mortem examination of a phthisical lung shows at the apex cavities produced by the first tubercles, which have disintegrated and opened into the bronchi; lower down, in the central portion, we find caseous tubercles, and finally, in the lower portion there appear incipient grey granulations. The tubercular nodules developed in the lung at length form by their union caseous masses of considerable extent, say about the size of an orange, which look like pieces of Roquefort cheese. These caseous masses disintegrate, as we have seen, and the resultant matter enters the bronchi, whose walls have been destroyed, and is discharged by expectoration, leaving in its place a hole, which we call a *cavity*. The cavities, of which, as a rule, there are many, are more numerous the smaller they are; the tissue of the lung is eaten away and mined in all directions with these irregular holes, which communicate one with another, and whose sides exude pus or purulent matter of greater or less

consistency. The smallest are the size of a pea or a nut, but by the union of several cavities they may reach a considerable size and become as large as an egg, an orange, or the fist, while sometimes we find enormous cavities resulting from the destruction of half or two-thirds of the lung. As these lesions spread they meet with the arteries of the lung and injure their walls, causing them to break in the cavities. This results in hæmorrhages, which are sometimes so copious as to be at once fatal, the blood coming in streams from the patient's open mouth, and death ensuing in a few minutes.

The course of ordinary pulmonary consumption may be divided into three stages, corresponding to the successive stages of the anatomical lesions: (1) an initial stage, or stage of germination and agglomeration of the tubercles; (2) a stage of maturity, or stage of disintegration of the tubercles; (3) a final stage, or stage of excavation, *phthisis desperata* of the ancients. The beginning is generally so obscure and silent that it is hardly possible to ascertain the exact date of it.

"Chronic pulmonary consumption," says Dr. Hanot, "usually appears on the scene quietly and unannounced, in apparently perfect health. It is often necessary to scrutinise the

system with a practised and suspicious eye in order to detect it as it slowly advances or creeps in under the guise of another disease."

However insidious may be the beginning of the disease, as soon as the tubercular granulations form at the apex of the lung, the irritation of the bronchi manifests itself by the cough. This short, dry cough requires no effort; it comes on in the daytime at greater or less intervals, and at night after retiring, during the first sleep; it ceases towards the middle of the night and begins again in the morning about five o'clock, whence the name of *quinte*, formerly given to it by French doctors, the meaning of which has extended to any cough which comes on in repeated and troublesome fits. Very often the cough comes on after meals, when it occasions vomiting of food. At this stage the patient expectorates but little; he only brings up a few sputa consisting of frothy saliva and mucus, but bacteriological examination of the expectorated matter may now at any time reveal the presence of Koch's specific bacillus. The discovery of this bacillus is a sure sign of tuberculosis. If, on the other hand, repeated investigations give uniformly negative results, it may be asserted without fear of error that there is no tuberculosis. Bacteriological examination is especially valuable in the initial stage of con-

sumption, when the nature of the trouble is still in doubt, not only for the diagnosis, but also for the prognosis, for the inference to be drawn as to the patient's future prospects; the seriousness of the case, in fact, is proportionate to the number of bacilli found in the expectoration.

One of the most important signs of pulmonary consumption, the one which is best known, and which frightens the sufferer most, is *hæmoptysis* or spitting of blood. Spitting of blood, coming on in the midst of apparently perfect health, is often the first symptom to reveal the existence of the disease, but more frequently it follows on some effort, fatigue, or emotion, in persons who have already had a slight dry cough for some time. Sometimes the patient only brings up a little expectoration tinged with blood; sometimes during violent coughing fits he throws up a quantity of bright red, frothy blood, having, as Trousseau puts it, "the appearance of blood beaten up with air, or of the froth produced in a vessel when bleeding an animal." Sometimes "the patient begins to cough, when a warm fluid comes up in his throat, and the blood gushes out in such quantity that the consumptive has not air enough to spit it out, one would rather say he vomits it" (Dieulafoy). However, hæmoptyses at the beginning are rarely copious enough to cause death; they result from the rupture of

small blood-vessels injured and made more fragile by the tubercular lesions, which break under the influence of the congestion of the lungs and the increased pressure of the blood caused by the tubercular toxins. They are neither so copious nor so serious as those later hæmoptyses of consumption, which supervene at the stage of excavation and are often rapidly fatal.

While the tubercular granulations are forming and growing, the bacilli secrete their toxins in great abundance, and the action of these on the system is revealed by various symptoms. First there is loss of appetite, anæmia, and rapid loss of flesh. "From the commencement," says Grisolle, "emaciation may be extreme, comparable to that produced by cancer of the stomach; this should always arouse the doctor's suspicions." There will also be failure of the limbs, pains in the nape of the neck (already known to Aretæus), painful sensations in the muscles of the chest, actual intercostal neuralgia, supra-orbital neuralgia, and sciatica. The mind is affected, and the patient suffers from hypochondria and melancholy. Daily attacks of fever come on in the evening, and end in the night in profuse sweats, especially marked on the chest. "Where the sweat is, there is the disease," is Hippocrates' remark.

The chest of the consumptive is badly shaped, and narrow; the ribs, collar-bones, and shoulder-blades project; and the arms are thin. The persistence of fleshiness and the preservation of the muscles at first are, however, relatively frequent. Thus often one sees porters at the corn-market, who, though acknowledged consumptives, nevertheless remain quite athletic, and continue to follow their arduous calling.

The toxins also cause a special disturbance of the nutrition of the extremities, which induces a particular deformity of the fingers and nails, increasing as the disease progresses. The extremities of the fingers widen out through the enlargement of the phalanges, the nails curve inwards towards the palm, and the fingers assume the shape of a drum-stick. This deformity of the fingers in consumptives is known by the name of Hippocratic fingers, and, as we have seen, it did not escape the notice of the Father of Medicine, nor has Aretæus forgotten it in the description he has given us.

Besides these symptoms, which are obvious to the sufferer and his friends, there are others of extreme importance that only the doctor can discover; these are the signs furnished by auscultation, explained by Laënnec. Auscultation will reveal affections of the thoracic organs even when no functional disturbance is present;

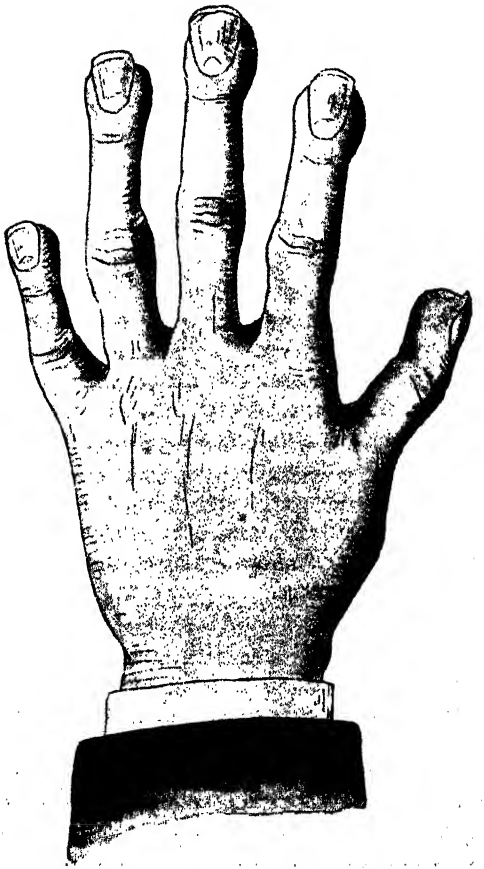

FIG. 2.—HAND OF A CONSUMPTIVE.

it demonstrates the existence of the disease, and detects lesions which without it would entirely escape our notice; it enables a diagnosis to be made with marvellous promptness, and almost mathematical certainty and exactitude.

From the commencement of pulmonary tuberculosis, a practised ear, applied to the upper part of the thorax, can recognise characteristic modifications of the respiratory sounds, which can be distinguished even before the appearance of the cough, and before it is possible to detect the bacilli of tuberculosis in the sputa. The importance of this early diagnosis will be readily understood when it is remembered that the better attention the disease receives from the first, the greater are the chances of recovery; intervention will be the more efficacious the prompter it is. An early diagnosis is the best guarantee of safety.

The duration of the first stage of consumption varies very much; it is generally very short, and at the end of a month or two the stage of disintegration begins. But at this first stage especially the course of pulmonary tuberculosis may be arrested, either spontaneously or under well-planned hygienic treatment. The cough then ceases, the expectoration diminishes and then ceases entirely, the fever and sweats disappear, the appetite and flesh return. It is a

cure, sometimes absolute, but too often deceptive and temporary.

The disease resumes its course: the tubercles disintegrate, and the cough is accompanied by copious expectoration. The latter becomes muco-purulent, greenish, opaque, streaked with yellow, "flecked with white and green" (Aretæus); it contains whitish bits of caseous matter comparable to grains of cooked rice. With the muco-purulent masses are mingled more or less perfectly isolated portions of puriform matter; these portions of muco-purulent and puriform matter float in a fetid serous fluid, and assume a rounded form which has led to their comparison with coins; hence their name of *nummular sputa*.

The expectoration of consumptives contains a considerable quantity of chloride of sodium and phosphates. The enormous loss of mineral matters thus caused shows the great amount of nutriment lost by the system, and explains the state of emaciation and wasting into which consumptives fall.

During this second stage the general condition becomes more and more affected; emaciation makes rapid progress, the strength fails, loss of appetite is complete, and the digestion bad; diarrhœa appears, betraying the spread of tubercle to the intestines and the formation of tubercular ulcerations on their

mucous membrane. The complexion becomes pale and livid, and the skin dry and brown; the prominences of the cheeks alone retain an intensely red colour, accentuated during the attacks of fever, which come on daily towards evening and end in the middle of the night in profuse sweats. These profuse sweats, which are the effect of the general poisoning of the system by the tubercular toxins, are one of the most constant and troublesome phenomena of the stage of disintegration. They come on at any effort, but are especially frequent at night; whence their name of night sweats; they are no longer confined to the chest, but extend to the whole body, and contribute very much to weaken the patient. The coughing fits become so severe that sleep becomes almost entirely impossible, and insomnia is added to all the other causes of exhaustion.

The tubercular lesions continue their destructive evolution, and the stage of excavation succeeds that of disintegration. The existence of cavities at the apex of the lung is then revealed by auscultation, by means of so-called cavernous rumblings and blowing or rattling noises (*râles*), produced by the entrance of air into the cavities in the lung, empty or partially filled with fluid secretions. Where the cavities are the voice assumes a cavernous quality to the auscultator, while the cough is resonant,

and strikes the ear with a peculiar hollow sound, which has earned it the name of cavernous cough. On percussion of the chest with the finger over the empty cavities it gives a drum-like sound; the lung sounds hollow.

FIG. 3.—BACILLI IN TUBERCLE OF HUMAN LUNG, SHOWING (*a*) GIANT CELL AND (*b*) PERIPHERAL ARRANGEMENT OF BACILLI INSIDE IT.

Tubercular lesions in the lung can also be detected by means of the Röntgen rays. Professor Bouchard "has been able, thanks to this means of examination, to diagnose pulmonary tuberculosis even in the initial stages, to trace

its course, and to discover the existence of cavities."

At this stage, again, an arrest of the progress of the disease is possible. As we shall see by-and-by, repair and cicatrisation of the cavities may take place, complete recovery sometimes being the result. Unfortunately, such cases are rare, and most frequently the symptoms of the second stage increase, and the condition becomes more serious from day to day. The cough becomes more and more violent and troublesome. "The fever rises higher and higher. Wasting sets in with its marked characteristics, and the general condition becomes pitiable. Emaciation makes terrible progress, the nose becomes sharp and the cheeks hollow, the cheek-bones project, the orbits lose their fat and appear too large for the eyes, the whole muscular system becomes atrophied, and the patient becomes mere skin and bone. The profuse sweats are incessant. The appetite is entirely lost; the mouth is dry, and the thirst intense; vomiting may come on, either spontaneously, or after coughing. Intractable diarrhœa sets in, sometimes sanguineous" (Dr. Marfan). "If the bowels get out of order," says Aretæus, "hope is at an end." The sufferer breathes with extreme difficulty. Through the progressive spread of the tubercular lesions, the area of the surface where

exchange can still be effected between the blood and the air is continually reduced; the system does not get air enough; the patient is stifled; respiration is accelerated, the lips gradually become blue, and cyanosis appears, indicating the progress of asphyxia. The wasting stage continues its course, with remissions and exacerbations; at times, the cough is less violent, the expectoration less copious, the fever less pronounced, and the appetite seems to return; but these remissions are of short duration; all the signs of consumption speedily reappear; after a number of remissions and exacerbations of this kind weakness becomes extreme, and the patient succumbs to the general decay of the system.

"It is a remarkable fact that while the body becomes weakened, and death approaches, the patient usually retains full possession of his faculties; often he is full of hope, and dwells on plans for the future.

"It sometimes happens that consumptives get up and go out even on the eve of death, and death overtakes them unexpectedly.

"The sufferings of the unfortunate consumptive may be shortened in this final stage by various complications, especially by hæmoptyses due to rupture of the blood-vessels in the cavities. A hæmoptysis may be rapidly fatal; the patient throws up a stream of blood and

succumbs almost at once; in other cases the hæmorrhage stops for a time, and recurs in repeated attacks, and the fatal termination only supervenes after several days. A fatal hæmoptysis may occur without apparent cause, or after a cough or a fit of coughing; it is characterised by its suddenness, its copiousness, and its intractability to all treatment" (Marfan).

The duration of chronic pulmonary consumption is extremely variable; there are as many kinds of consumption as there are consumptives, and as many durations of consumption as there are kinds. The average duration of the disease is from one to three years.

CHAPTER IV.

TUBERCULOSIS OF THE LARYNX AND OF THE ALIMENTARY CANAL—TUBERCULAR PERITONITIS—TUBERCULAR MENINGITIS.

In the course of pulmonary consumption all the organs may be attacked as the tubercular lesions spread; extremely numerous and varied complications may ensue, which modify the character and progress of the disease and add to the patient's sufferings.

We cannot here review all the complications of pulmonary consumption, nor all the forms of tuberculosis; we will confine ourselves to tuberculosis of the larynx, of the alimentary canal, and tubercular peritonitis and meningitis.

Lesions of the digestive system are the most frequent during pulmonary consumption. "Of all the organs," says Andral, "the alimentary canal is undoubtedly that which, after the lungs, presents the most common and most important lesions in consumptives."

The spread of the disease to the digestive organs is effected in the simplest manner by

swallowing sputa containing tubercular matter from the lungs.

Gastric troubles are very common in consumptives, and are most important, as in the treatment of the disease success partly depends on the proper action of the digestive system; so that, as Professor Peter says, the stomach of a consumptive must be attended to with "pious care."

Intestinal tuberculosis usually supervenes during pulmonary consumption; it is the result of auto-infection, the bacillus penetrating into the digestive passages with the sputa swallowed. But the bacillus often comes from without also, being conveyed by food, *e.g.* milk from tuberculous cows, and in that case the intestinal tuberculosis may be primary, *i.e.* the first manifestation of the infection of the system.

Intestinal tuberculosis is characterised by copious and persistent diarrhœa, accompanied by abdominal pain, fetid, black, or sometimes tinged with blood, and complicated by hæmorrhages. The tubercular ulceration of the intestine may cause perforation, resulting in fatal acute peritonitis. But Koch's bacilli often get into the abdomen or the peritoneum without any perforation of the intestine, and there give rise to chronic tubercular peritonitis. This form of tuberculosis especially attacks children between six and twelve years old, and young

people, especially young soldiers. Misery, fatigue, and poor food favour its appearance.

Tubercular meningitis frequently supervenes in pulmonary consumption in the adult, and may cause death at any stage of the disease. It is characterised by raving delirium and violent convulsions, sometimes paralysis; it rapidly ends in coma and death.

In children tubercular meningitis is usually primary. It attacks especially children of tuberculous, neurotic, or intemperate parents.

CHAPTER V.

LOCAL TUBERCULAR AFFECTIONS—HIP-JOINT DISEASE—POTT'S DISEASE.

THE tubercle bacillus often gives rise to lesions which remain localised in a circumscribed area of the body, *e.g.* a bone or joint.

Of these local manifestations of tuberculosis, some appear in subjects already suspected to have pulmonary tuberculosis; others seem to be independent of any general infection of the system. They may appear, go through their stages where they are, and cause anchylosis, without becoming general or spreading to the lungs or other organs, and they may even heal up. But too often the disease spreads, the bacilli are disseminated through the system, and reach the lungs or the meninges of the brain, and these local tubercular affections become the starting-point of slow pulmonary consumption, or an outbreak of an acute form of tuberculosis, such as *granulie* or meningitis.

Among these local tubercular affections we may mention as the commonest and best known

those which attack the bones and joints, white swellings, hip-joint disease, and Pott's disease of the vertebræ; but it must be borne in mind that any part of the body may be the seat of their development.

The term *white swelling,* or tubercular osteo-arthritis, is applied to chronic inflammation of a joint caused by Koch's bacillus. Any joint may be the seat of a white swelling. Every articulation consists in essence of two bony surfaces covered by a smooth layer of cartilage, sliding one over the other under the action of the muscles, and kept in contact by ligaments. All the constituent elements of the joint may be attacked and destroyed by tubercular lesions. The bony surfaces of the joint are deprived of their covering, softened, worn away, and deformed, and the ligaments broken; and the disjoined bony extremities may separate. Not only is the use of the joint lost,—for even when the disease is cured it is only very rarely that the cure is complete and the use of the joint perfectly regained,—but deformities of the limb and stiffening of the joint in bad positions also result, which may render the sufferer quite a cripple and create what is often an irreparable infirmity. A dull pain, at first intermittent, comes on after fatigue or excessive exercise; then the pain becomes permanent and continuous; movement is difficult and painful; the

joint swells and tumefies; the skin is hot, white, and shining. In consequence of the destruction of the ligaments of the joint, the limb bends, doubles up, or twists in an abnormal manner, then becomes fixed and anchylosed in a bad position. This is a comparatively favourable termination. The tubercular lesions may suppurate and form abscesses; the skin puffs up, reddens, and ulcerates; the pus runs out through fistulæ; and the bony surfaces and the ligaments of the joints are completely destroyed. General symptoms supervene which may carry off the patient.

Tubercular arthritis of the hip is known as coxalgia (from *coxa*, hip, and ἄλγος, pain), or *hip-joint disease;* Professor Lannelongue calls it coxo-tuberculosis.

Hip-joint disease is an infantile complaint; it attacks especially children from five to twelve years old.

The onset of hip-joint disease is slow and insidious; its presence is not revealed by any particular sign at first; it seems to come on by fits and starts. The slight functional troubles which arouse suspicion appear for a short time, then disappear. The parents, uneasy at the first manifestation of the trouble, quickly reassure themselves, thinking it is growing pains or an unimportant temporary derangement. But the disease reappears, establishing itself

as it were little by little, and at length attracts serious attention. The little sufferer first experiences difficulty in walking, and a certain degree of stiffness at the hip; he easily tires, drags the limb, and cannot go far without having to rest. Little children refuse to walk, and demand to be carried. This difficulty and stiffness are accentuated at the end of the day; on the contrary, in the morning, after the night's rest, they have disappeared; fatigue brings them on.

These troubles appear thus with variations for a few days, then they cease to be noticed. These alternations are frequent, and may extend over weeks and months. Moreover, the gait is not so abnormal as to make it easy to recognise the disease at first sight. The movements of the limbs appear to be effected normally; but on careful observation it is seen that when the child walks it rests an unequal time on each leg; the weight of the body does not bear equally on each foot; the foot on the sound side treads more strongly, and that on the diseased side is put down more lightly. As a result, on a resonant floor the gait gives alternately two different sounds; this is readily perceived by listening to the patient walking, without looking at him. Horse-dealers recognise a very slight degree of lameness in horses in this way. A little later on the limping

becomes evident; the length of the time of support on the diseased limb becomes less and less; the child walks with a mowing motion, without bending the thigh, by making the diseased limb describe a circular arc, the sound limb serving as a pivot. In the standing position also the child bears all the weight of his body on the sound side. The result is a bad attitude and abnormal curvature of the vertebral column, at first temporary, readily disappearing with rest, then persistent, and later on permanent.

Pain will already have been noticed; sometimes it is a sensation of severe aching in the region of the hip, sometimes severe acute pains, which children compare to needle pricks, or jumping pains. Walking and the fatigue of the day cause or increase it; rest soothes it. The pain appears in various places; sometimes it first shows itself in the knee, the calf, the ankle, or even the great toe; the cause of this distant pain cannot be satisfactorily assigned. The diseased limb becomes thin and atrophied. This atrophy is an early sign, and may be the first symptom of the disease; it is practically never absent.

The disease may not progress further, recovery taking place before the joint is permanently deformed, especially if proper treatment has been applied, *i.e.* absolute rest in bed and

complete immobilisation of the diseased joint. But if the young patient, not having much pain, continues to walk, the disease becomes worse and takes its course. Sometimes, indeed, in spite of every care, its progress cannot be arrested, and continues whatever may be done. The first symptoms persist and increase; the pains become more acute, the patient being awakened at night by their onset; the lameness increases to an extreme degree, and walking at length becomes quite impossible. The diseased limb assumes a characteristic bad position, the thigh being bent over the pelvis.

If a cure is effected now, it can only be by anchylosis of the joint, *i.e.* by union of the bones and complete immobilisation of the joint; the limb will retain its bad position, and the child will be sadly crippled and very ungracefully deformed, only being able to walk by inclining the pelvis towards the diseased side to counteract the shortening caused by the curvature of the thigh, and at the same time giving an abnormal twist to the spine. The surgeon's efforts are therefore directed to the immobilisation of the limb in a good position, to secure anchylosis of the diseased joint under the best possible conditions for walking, but it is often very difficult to avoid curvature of the thigh, which may be still more accentuated after the cure. In any case, a noticeable

shortening of the limb must be expected, sometimes an inch or two, and sometimes the cure is effected under much more unfavourable conditions, the diseased thigh crossing the thigh of the sound side.

If the tubercular lesions pursue their destructive evolution, serious deformities may result in other ways. Normally, the rounded upper end of the thigh-bone, or head of the femur, rests in a cavity of the pelvis (hip-bone), also spherical, the cotyloid cavity. The head of the femur turns in its corresponding cavity in all directions, but cannot come out of it. The tubercular lesions alter the form and reduce the size of the head of the femur, and also wear away the cotyloid cavity, which enlarges; the head of the femur thus becoming too small for its enlarged cavity, is no longer held in position, and is liable to come out and become dislocated. When the muscles of the thigh contract, the head of the femur slips, comes out of the cotyloid cavity, and goes back above it. This dislocation results in a great variety of bad attitudes, and a very marked shortening of the limb, which causes great difficulty in walking, even when anchylosis in a good position is afterwards secured. In a large number of cases hip-joint disease is complicated by the formation of abscesses and fistulæ, and by copious suppuration, causing death from exhaustion.

Finally, it is unfortunately only too common for other tubercular manifestations, in the lung or the meninges, to supervene on hip-joint disease, the unfortunate sufferer then being carried off by pulmonary consumption or tubercular meningitis.

Like hip-joint disease, vertebral tuberculosis especially attacks young people; it is common in infancy, between two and ten years of age, rather less so in adolescence, and occurs also with some frequency in adults. The name of *Pott's disease* is given to vertebral tuberculosis. The English surgeon, to whom posterity has rendered this homage, Percival Pott, did not, however, either discover or completely describe vertebral disease, but he traced with a master hand (1779) the concomitant nervous troubles ordinarily observed.

The reader will know that each vertebra consists of two portions: in front, a flattened cylindrical piece, the body of the vertebra; behind, bony laminæ forming a ring. The vertebral bodies, by their superposition, form the vertebral column or spine which bears the whole weight of the head, trunk, and upper limbs; the superposed rings constitute the vertebral canal and enclose the spinal cord. The seat of the tubercular lesions in Pott's disease is in the anterior portions of the vertebræ, or vertebral bodies, and the area of destruction

may extend to several vertebræ. When the lesions are deep and extensive the solidity of the skeleton is endangered; the destruction of one or more vertebral bodies causes a break in the continuity of the vertebral column, which gives way under the weight of the upper portion of the body. The posterior portions of the vertebræ remaining intact, the spine bends forward, forming an angle at the back which causes the formation of a more or less angular and pronounced hunch or curvature, which is the most characteristic sign of the disease.

Angular curvature usually comes on slowly and gradually; occasionally it is rapid or even sudden. Its sudden appearance is exceptional. A patient feels a sudden crack in the back or the loins when making some effort, or in carrying or lifting a weight, and sinks forward; sometimes paralysis of the lower limbs shows itself at the same time. A child with a latent lesion, as yet unsuspected, has a trifling fall, and an angular curvature suddenly forms as the result.

While angular curvature is developing, patients are conscious of lack of solidity of the spine, and assume an attitude and take certain precautions which Boyer has described in the following classic passage:—"The deformity increases; the upper portion of the trunk is thrown more and more forward, and

the patient's mode of lying down, standing, and walking is peculiar and characteristic. He lies down on his sides; when standing, the legs are slightly bent, whilst the neck is held very stiff, and the face turned up so that the nape of the neck rests on the shoulders, and the latter seem higher and the neck shorter. In walking, the lower limbs move along lines close together, so that the body is not thrown from side to side so much; movement is effected slowly and cautiously; the trunk is *not* balanced by the alternate motion of the arms, which remain parallel with the body. Later on, when the deformity is more considerable, the patient rests his hands on the upper part of the thighs, so that the arms form a support for the upper part of the body and hold it up in front. Patients avoid bending the body forward; to pick anything up from the ground, they spread out their legs, bend the legs and thighs, hold up the upper part of the trunk by leaning one hand on the front of the corresponding thigh, and pick the object up with the other, to one side or between their knees, but never in front."

Sometimes vertebral disease, latent, or barely suggested by vague pains, shows itself primarily, before any deformity, by paralysis of the limbs, but usually angular curvature precedes paralysis. Paralysis may come on

suddenly, but usually its beginnings are slow. Before ceasing to be able to walk, the patient is languid and indifferent; he does not care to move, and very quickly tires; he is seen to stumble and trip, though no obstacle is in his way. When he moves quickly or incautiously, his legs cross involuntarily, often throwing him down; if he tries to stand upright without support, his legs bend under him. At length, in a short time after the appearance of these symptoms, he entirely loses the power to walk (P. Pott). Large abscesses form where the tubercular focus is. These purulent formations may remain concealed in the thorax or abdomen, while sometimes they open into some visceral cavity, into the bronchi, stomach, intestine, or bladder. Usually the abscess moves away and opens externally, sometimes at a considerable distance from its place of origin. The course of the disease is very slow, and may extend over several years.

The cure of Pott's disease is a matter of everyday occurrence, but an angular curvature, once established, must, as a rule, be regarded as a permanent deformity (Lannelongue). By well-directed treatment it can sometimes be reduced or even got rid of. Dr. Chipault, of Paris, and Dr. Calot, of Berck-sur-Mer, have been very successful in correcting such curvatures, but

in the great majority of cases patients, when cured, remain hunchbacked and crippled. Many patients waste away and die exhausted by the copious suppuration, others are carried off by general tuberculosis, pulmonary consumption, acute tuberculosis, or tubercular meningitis.

As we have just seen, sufferers from local tubercular disease often succumb to pulmonary consumption or some other manifestation of general tuberculosis.

A German surgeon, Billroth, has estimated that in a period of sixteen years about sixteen per cent. of the patients treated for white swelling in his practice died of tuberculosis. The proportion is much higher for hip-joint disease, and higher still for Pott's disease.

The generalisation of the tubercular disease is the result of the penetration of Koch's bacillus from a local focus of tuberculosis into the blood and its transmission into the organs by the veins or lymphatic vessels.

Generalised tuberculosis may break out all at once during a local tuberculosis, and often follows on an operation, such as the removal of a tuberculous gland, the scraping of a tubercular focus or a bone, or an operation for white swelling. The bacillus then gets into the blood-vessels laid open by the incision, and the symptoms of acute tuberculosis or tubercular meningitis suddenly appear.

CAUSES OF CONSUMPTION.

CHAPTER VI.

THE CAUSES OF TUBERCULOSIS:—I. HEREDITY—INFLUENCE OF SURROUNDINGS—TRADES—DISEASES.

We know the cause of tuberculosis, Koch's bacillus; we have seen what its action is on the system, what lesions it produces, and what are the commonest leading forms assumed by the tubercular infection. We now enter on the most interesting part of the story of tuberculosis, the study of the conditions under which the disease develops and spreads.

In order that any microbe may cause disease, it is not enough for it to enter the system, it must be able to develop there, and the general condition must be favourable to its development; in short, there must be a predisposition which puts the individual in a receptive state.

Among the predisposing causes of tuberculosis, which prepare a suitable soil for the development of Koch's bacillus, the first rank must be given to heredity on the one hand, and environment on the other. The idea of heredity in consumption goes back as far as Hippocrates, who says, "A consumptive is the offspring of a consumptive." It has since been a common belief that the children of consumptives are especially liable to die of the same disease as their parents. As Professor Strauss writes: "If there is a thoroughly established idea in medicine, it is that of the heredity of tuberculosis." The influence of heredity is undeniable; statistics show that the great majority of children born of consumptive parents die of tuberculosis.

Hereditary influence proceeds more often from the mother than the father, and the predisposition is greater if the father and mother are both tuberculous; hereditary influence from the grandparents is much less powerful, but the predisposition increases with the number of generations affected.

Heredity may exert its influence in two different ways—tuberculous parents may only transmit to a child a hereditary predisposition to the disease; or they may transmit the germ of the disease itself, *i.e.* Koch's bacillus, in other words, the child of consumptive parents

may be born tuberculous. In the former case there is said to be *heredity of soil*, in the latter, *heredity of seed*, according to the neat expressions of Professor Landouzy.

Heredity of seed—*i.e.*, direct transmission of specific bacillus from parent to child actually before birth—is possible, but rare, indeed exceptional.

Sometimes manifest tubercular lesions have been found in the organs of children of tuberculous mothers who died a few hours after birth; direct heredity from the mother therefore certainly does occur; but it by no means necessarily follows. As to transmission of the tubercle bacillus from the father to the fœtus, this is very problematical. Still, certain cases observed appear to afford evidence of it, among others the following, which we borrow from Professor Landouzy.

A commissioned officer died in 1888, after two winters at Algiers, of tubercular inflammation of the liver, the final manifestation of a tubercular affection which began in 1878 when apparently in good health, with a chest cold ensuing from a chill, and followed a few months later by the appearance of the first symptoms of pulmonary consumption. In 1879 there was spitting of blood; in the following years laryngeal symptoms and hæmoptysis; in 1887 and 1888 hectic or constant fever, with

sweats, gradual loss of flesh, and death. Married in 1876 to a splendid young girl of twenty-one, who bore him five children. The first, a boy, born in December 1876, and reared at Nantes, was developing normally, when at eight months old, during an epidemic of infantile cholera, he was seized with diarrhœa and succumbed in three days in convulsions. The second child, a girl, born at seven months in 1878, died in convulsions within twenty-four hours. The third, a boy, born in March 1881, and reared like the first and under the same conditions, at five months old was seized with all the symptoms of ordinary tubercular meningitis, to which he succumbed in a few weeks. A fourth child, a girl, born in 1882, was attacked at three months old with tubercular meningitis, to which she succumbed in three weeks. The fifth child, a boy, born in 1883, and reared at the breast, under excellent conditions, out in the country and right away from the father, died at five months old of a tubercular affection of the ear. Dr. Landouzy adds: "Taking into consideration the whole history of the father's case, recollecting the date of the first appearance of his disease, noting the fact that the mother was never in other than good health for fifteen years, notwithstanding five pregnancies in seven years, the bad mental and physical conditions in which she was placed by

anxiety about the health of her husband and grief at losing her five children one after the other in the same way and at the same age, and her widowhood, it will be conceded that here tuberculosis may well have been inherited directly from the father, and that if the children died of tubercular disease in their first year the reason was that they were born infected by a tuberculous father."

The following observation by Dr. Fieux, of Bordeaux, is still more conclusive: A very healthy woman had six pregnancies in five years, all ending in abortion. A seventh reached its natural term, but the child died of tubercular meningitis a fortnight afterwards. An eighth pregnancy resulted in a miscarriage. Almost at the same time the woman's husband died of tuberculosis. Two years afterwards the woman became pregnant for the ninth time, but now by a strong healthy man who already had two perfectly healthy children, a boy and a girl of fourteen and sixteen years old respectively. This time a healthy, well-developed child was born.

The frequency of tuberculosis in very young children has been adduced in favour of direct hereditary transmission; but in many cases contagion has been mistaken for hereditary transmission. A child of tuberculous parents, with hereditary predisposition to the disease, is

very often infected by its diseased parents, and becomes tuberculous itself, but is not born tuberculous. We shall see in a later chapter how contagion takes place.

If direct hereditary transmission is rare, indirect heredity, or heredity of soil, *i.e.* the transmission of a hereditary predisposition to tuberculosis, is extremely frequent. This alone is admitted by some authors. "Persons are not born with tuberculosis, but liable to tuberculosis," says Professor Peter. "What parents transmit to their children," says Professor Bouchard, "is potential, not actual tuberculosis."

What is hereditary is not the bacillus, but susceptibility to receive it and permit it to germinate. This susceptibility resides in a diminution of the vitality and resisting power of the system, which is the effect in the child of the bad condition of the parents. Heredity prepares the soil, but the seed is brought by contagion.

Persons predisposed to pulmonary consumption, candidates for tuberculosis as Professor Landouzy calls them, present peculiar physical qualities: their constitution generally shows a set of characteristics from which the development of the disease may be foreseen. The ancients endeavoured to describe this peculiar constitution of those marked out for tuber-

culosis. Aretæus, who has given us so exact and striking a portrait of the consumptive, thus describes the children who are destined to become the prey of the disease. "They are slender, delicate, thin as boards; they have wing-like shoulder-blades, a prominent throat, a white skin, and a narrow chest." Such children grow quickly; the rapidity of their growth is characteristic; but their development, though rapid during infancy, is often arrested midway in adolescence, and they then retain an ill-developed appearance, while their muscles are small, and their great joints seem out of proportion to the size of their limbs. Thus persons doomed to consumption are often ill-developed beings, whose feeble body retains an infantile appearance in adult age, and besides being very weak, they are very nervous and excitable. However, generally those destined for consumption are tall; Professor Landouzy compares them to poplars; they are slender, thin, and lean; their neck is long and graceful, reminding one of a swan's; the chest is narrow and flat; Laënnec lays stress on this narrowness of chest; the shoulder-blades are prominent, wing-like, as Aretæus says; the limbs are long and slender, not very muscular, and without vigour; the fingers are long, and easily lose their colour and become yellowish under the influence of cold. The ancients had noticed

that persons predisposed to consumption often have a special malformation of the fingers (Hippocratic fingers), which end in a club or palette. These fingers, which are often regularly formed as far as the last joint, but end abruptly in a rounded knob like a drumstick, are commonly seen in hereditary consumptives. The palette malformation is more frequent in women (Trousseau); the nails are incurved, tapering, and brittle.

The future victims of pulmonary tuberculosis often present a sort of morbid beauty, *tabidorum facies amabilis*. The skin, fine, transparent, and beautifully white, shows large blue veins; the prominences of the cheeks are of a bright red colour; the teeth are good; the eyes are deep-set, and encircled by a bluish ring; the lashes are remarkably long, the eyebrows bushy, and the hair fine and silky, often auburn-red. Professor Landouzy has noticed that in Paris persons with hair of the colour called by artists Venetian red are particularly liable to consumption.

"This deceitful disease," says Sales-Girons, "ever lends a charm to its victim, gives roses to the cheek, a sweet expression to the pale face, an angelic gentleness to the glance, a melodious tone to the voice; the father transmits it to his family like his fortune and his virtues; it does not wait for the birth of its

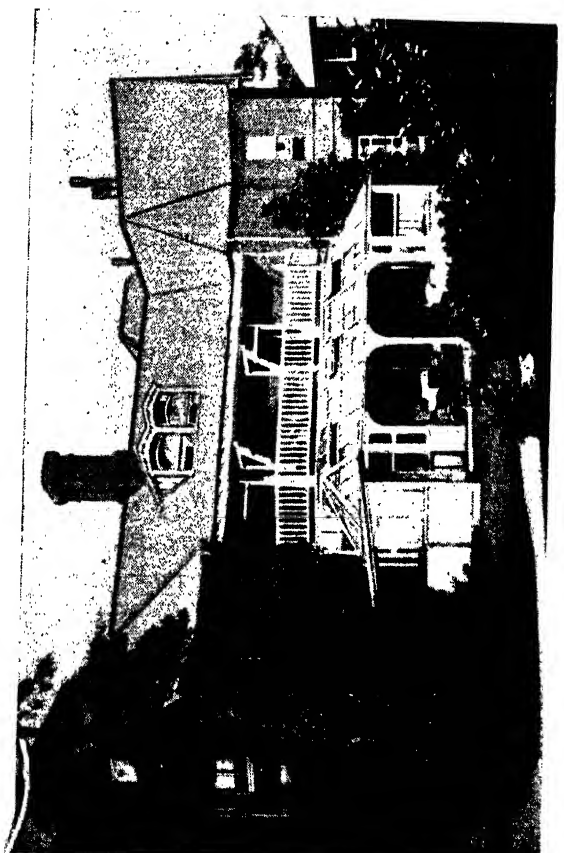

FIG. 4.—OPEN-AIR TREATMENT IN ENGLAND. OVERTON HALL SANATORIUM, BOURNEMOUTH.

victims to set on them its fatal seal; it hastens the spring but to bring on the autumn, and develops before due season but to crush before due time; it sows hope in the morning in a family, but it will fill it with grief before night."

We shall see by-and-by what hygienic treatment must be followed with children born with a predisposition to tuberculosis, in order to prevent the hereditary disease developing in them. A special liability in the child may not only result from tuberculosis in the parents; weakness, too advanced age, or any disease they may be suffering from at the time of procreation, react on the vitality and resisting power of the children, and make degenerates of them.

"Tuberculosis," says Professor Peter, "is the result and the evidence of degeneracy of the system." The bad state of health of the parents leads to this organic degeneracy in the children. All degenerates are predisposed to the disease. Thus tubercular meningitis is particularly liable to attack children of certain families. There are parents who lose, one after the other, two, three, even five children from this terrible disease, as in the instance from Professor Landouzy given above. In cases of this kind there may be either direct heredity or family predisposition; tuberculosis in the parents is

the chief element in the predisposition, but it is not indispensable. Children are found to succumb to meningitis one after the other in families where the father, mother, and collateral relatives are not consumptive. The most powerful predisposing cause is found in neurotic heredity; the parents of the children who succumb to tubercular meningitis are neurasthenic or hysteric subjects, epileptic, insane, or intemperate. Undoubtedly, the nervous system of the children of neurotics is particularly vulnerable, making them a choice soil for tuberculosis. The predisposing influence of neurotic heredity explains why tubercular meningitis is more frequent among the well-to-do classes than among the poor, and why it is more frequent in large towns (Marfan).

Heredity is not the only predisposing cause of tuberculosis; environment and the conditions of life have a powerful influence on the system. When the conditions are bad, they lead to debility and reduced resisting power, exaggerate the predisposition if it exists, and may even produce it in persons free from any degeneracy or hereditary weakness. In fact, as we know, tuberculosis is the result of a struggle between Koch's bacillus and the system. Any cause which enfeebles the latter reduces its vitality, and facilitates the invasion of the bacillus. Among the most evident causes

we must mention in the first rank life in towns, defective alimentation, intemperance, and certain diseases. The body is subject to the laws of the physical world of which it forms part; it is affected by the environment in which it lives, and cannot avoid the action of external agents, especially atmospheric agents; whence the influence of climate, season, temperature, humidity, etc., pointed out already by Hippocrates in his admirable treatise, *De aëre, aquâ, et locis* (Of Air, Water, and Places).

Consumption is found in all inhabited regions. For a long time it was believed that hot countries were exempt from the disease, whilst it was frequent in cold countries. This is not at all the case, and it seems on the contrary that consumption is rarer in cold countries than hot; and it is especially common in temperate climates. In fact, it is not the higher or lower temperature which favours its development, but frequent and sudden atmospheric changes; thus consumption is comparatively more frequent in extreme climates. Professor Martins has pointed out its rarity in Norway, under the 70th degree of latitude, where the climate is essentially equable. In the Esquimaux country, at Hudson's Bay, travellers agree in stating that consumption is rare; it is said to be equally rare on the steppes of Russia, notwithstanding the excessive cold of that region.

Again, notwithstanding the high mean temperature, consumption is not at all common in Ceylon and on the Senegal.

The seasons do not appear to have any marked influence. But since Hippocrates' time it has been known that consumptives die especially in autumn: *autumnus tabidis malus.* Damp cold has been especially accused of favouring the development of the disease. According to Dr. Marfan, cold and damp act chiefly by rousing into activity tubercular disease already existing in a latent form.

There is no belief more deeply rooted in the popular mind than that a chill is the origin of most diseases, especially affections of the chest. There is a great deal of truth in this belief. The sudden action of cold does greatly disturb the functions of the organs, affect nutrition, diminish the power of resistance to disease microbes, and create receptivity. But cold alone could not in any case produce tuberculosis without the presence of Koch's bacillus.

Tuberculosis is rare on elevated plateaux (Jaccoud). Above 4,200 feet hardly any consumptives are found. This immunity has been attributed to the purity of the air, the equability of the temperature, cold in winter, cool in summer, and to the lessened atmospheric pressure, which acts beneficially on the circulation and respiration. It is especially due to the

absence of microbes in the air at high altitudes, which are sparsely peopled, and where consequently Koch's bacilli are not numerous. Tuberculosis was unknown on the high pla-

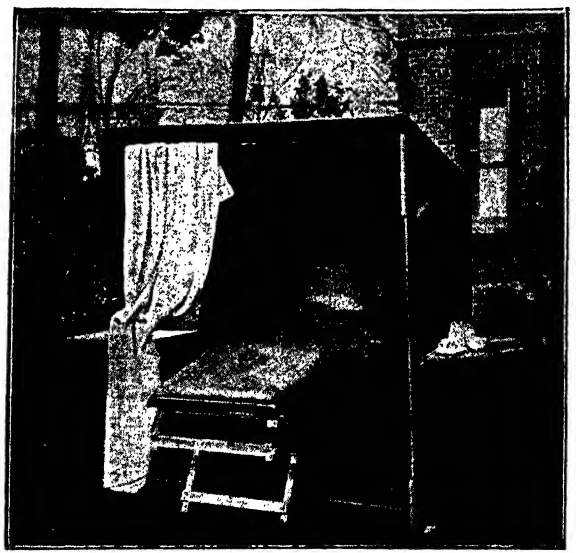

FIG. 5.—SUN HUT, SHOWING MOVABLE SIDES.

teaux of the Engadine till consumptive stations were established at Davos; at Mexico and at Madrid, though situated at the same altitude, it is very far from rare; it decimates the clock-makers of Joux and la Chaux-de-Fond (3,900

feet), and is common in the mountains of Hautes-Vosges and the Tyrol.

The fact is, the frequency of consumption in a country depends less on altitude, temperature, and dryness or humidity of atmosphere than on density of population. It is in urban districts, especially large towns, that tuberculosis makes most ravages. Not only is there far greater chance of contagion there, but the hygienic conditions are also bad, and all the causes of debility are found together: small and insanitary dwellings, defective or insufficient food, excessive toil or pleasure, intellectual and moral overstrain, drink, etc.

First of all, the inhabitants of towns do not get enough air and light. The air is insufficient and vitiated by a thousand causes: the crowding together of men and animals, the accumulation of impurities, the effluvia from drains and factories, etc. "It is just a warfare against life," says Peter, "a conspiracy of debilitating influences. Give me a marsh and a human organism, and I will produce you an intermittent fever; very well, give me a large town, with its unhealthy environment, and I will produce you a population of consumptives. One who would be horrified at the idea of drinking water from the sewer will without the least hesitation breathe the air of the concert-room or theatre, a veritable air sewer."

The air we breathe in towns is air already respired by millions of lungs; to use a very exact and faithful comparison, it is ruminated air. It contains less oxygen and nitrogen: in their place it is charged with poisonous gases, carbonic acid, carbonic oxide, and ammoniacal vapours. Brown-Sequard and d'Arsonval have extracted a powerful organic poison from it. Thus in towns the air is both defective in quality and deficient in quantity. The system, deprived of the oxygen indispensable to life, is enfeebled in a way analogous to the gradual exhaustion resulting from deficiency of food; it is inanition by the respiratory passages, which Professor Peter sets by the side of inanition by the digestive passages.

To the insufficiency of air must be added the dearth of sunshine. Sunshine not only exerts a powerful influence on nutrition; it is a disinfecting agent of the first order: sunshine dissipates damp, dries the ground, makes dwellings healthy, and hastens the oxidisation of organic matter and the destruction and disappearance of impurities; moreover, it destroys microbes, or at least attenuates their virulence; thus the bacillus of yellow fever, which lives a long time in sea water and resists desiccation, is killed in seven hours by the solar rays. The dictum of Professor Fonssagrive is therefore rigorously exact: "It is with disease as with mould; it

springs up in the shade." Where the sunshine does not enter, the doctor does.

Besides the lack of air and light, many other causes must be reckoned in. Overstrain is one of the principal: physical overstrain, resulting from the excessive toil at work or pleasure brought about by the rush and worry of the life of large towns; intellectual and moral overstrain, the product of the constant pre-occupations of the struggle for existence, the cares of ambition, the passions, the sorrows of life, grief, disappointment, reverses of fortune, or frustrated hopes, and also of the multiplication of emotions by newspapers, books, theatres, gambling, and town life. Laënnec laid stress on the influence of moral causes on the development and aggravation of consumption. These psychical causes are particularly powerful when associated with physical causes, such as change of climate; cases in point are the home-sickness of the young soldier, and the pre-occupations and cares, sometimes privations and misery, which assail the young man who leaves his home to seek a living in the town.

Privations and misery are two of the chief causes of consumption. Poor and insufficient food, dirty clothes, which afford slight protection from the cold, small and insanitary dwellings where whole families herd together

in sordid promiscuity, these are the choice conditions to give rise to tuberculosis, and the worst conditions to resist it. Thus, while 3 per cent. of the rich die of tuberculosis, the proportion among the poor is 33 per cent. Misery is too often assisted by drink. Acquired consumption in the town artisan is almost always due to this cause. Magnus Huss, the Swedish doctor, was the first to point out (1852) that at the autopsy of persons addicted to drink, tubercles are very often found in the lung. It is a proved fact to-day that alcohol prepares the soil for tuberculosis, and those who drink absinthe or aperients (such as bitters or vermouth) are especially predisposed to it. The action of alcohol is so powerful that it is sufficient to induce the disease in persons free from any hereditary taint, and it accelerates its fatal course in those already attacked.

"Statistics of the causes of mortality in England present a terrible picture of the ravages of tuberculosis among persons with whom the abuse of alcoholic drinks is a trade vice, such as café and restaurant-keepers, brewers, waiters, and coopers. From 1880 to 1882 the average mortality in England and Wales amounted to 1000 in 64,641 males between 25 and 65, consumption alone giving an annual average of 220 deaths. But while the mortality from pulmonary consumption

among farmers, agriculturists, gardeners, and fishermen does not exceed 100 to 120 per annum, it reaches 334 and 295 for brewers and wine-dealers respectively. File-cutters and cutlers, Cornwall miners, cab and 'bus drivers, potters, and hawkers, who are placed by their trade in particularly unfavourable hygienic conditions, alone show a still higher mortality from consumption" (A. Jaquet).

Certain trades favour the development of tuberculosis. These are such as place the individual in bad hygienic conditions, demand excessive toil, or do not yield a sufficient wage, and such as favour contagion by crowding too many workers in neglected and ill-ventilated rooms. All these causes are unfortunately too often found together. This is why the disease claims so many victims among the working classes in the great industrial centres, while it is less common in the country because there we get purer air, less crowding, a more regular mode of life, and as a rule better food. Thus it was found that in Brussels, out of 149 deaths from consumption, 27 occur among workers in the open air, 45 among those whose trade is sedentary, 66 among waiters (we pointed out above the disastrous effect of trade drinking), and only 11 among agriculturists.

Workers who are exposed by their trade to

irritant dust, especially miners, coal-dealers, stone-masons, potters, etc., appear to be more liable to tuberculosis, on account of the inflammation of the respiratory passages resulting from the inhalation of the dust, which prepares a fertile soil for Koch's bacillus.

The fatal influence of life in towns acts in a very marked manner on people who come from the country and are not acclimatised. A common story is that of the young servant-girls who come to Paris from the country, to seek places as maids of all work because they do not know how to do any. Too often treated like beasts of burden, overwhelmed with work, broken down with toil, insufficiently fed, and lodged in airless closets where the sun never penetrates, in a few months they go into hospital, consumptive. How many young people there are who leave their village for the town or the regiment full of life and health and return to their parents in a consumption!

What is true of towns is true to an even greater degree of institutions where crowding is carried beyond all reasonable limits, such as schools, barracks, workshops, prisons, convents, orphanages, insane asylums, etc.

In prisons the mortality is enormous: all the physical and moral conditions calculated to enfeeble the most robust constitutions and

make them fit subjects for tuberculosis are there conjoined. Nowhere does the influence of moral causes make itself more evidently felt. Indeed, while the number of deaths from

FIG. 6.—PORTABLE GARDEN HUT OR SUN-TRAP.

consumption reaches the enormous proportion of 64 per cent. among prisoners who live together, among the unfortunates subjected to the atrocious punishment of solitary confinement, though isolated in a cell and in some

measure shielded from contagion, the mortality is as much as 90 per cent.

Pulmonary tuberculosis is the scourge of convents; it especially attacks secluded nuns. Is not the influence of seclusion demonstrated by the instance of a convent mentioned by Laënnec, badly built, insanitary, and damp, in which all the nuns became consumptive except the portress, who alone enjoyed good health, because she alone could cross the threshold of the house?

In boarding-schools tuberculosis attacks the boarders more frequently than the day pupils, who live with their parents.

We have said that young soldiers often become the prey of tuberculosis. Every one knows the large number of consumptives in the French army as stated in the returns of the army doctors, a number which is daily increasing, not only from contagion favoured by the men's daily life in common in the messes, but also from the predisposing causes resulting from the excessive strain on the young recruits, poor food, and the dirty state of the quarters, to which must be added in many cases change of climate and the depressing moral influence of the low spirits caused by removal from home and friends.

One regrets to find, in going through the tables of the medical returns of the French

army published by the War Office, that the mortality in general, and the number of deaths from tuberculosis in particular, have been constantly increasing for some years.

We will return to the part played by contagion in the next chapter.

We have not come to the end of the predisposing causes of tuberculosis. "It is the common termination," says Professor Jaccoud, "of all constitutional deteriorations in the family or the individual." We have seen what part is played by heredity, and by the causes which debilitate the system, prepare the soil for infection, and create receptivity by their direct action. Among these latter an important place must be given to diseases which the person has had previously.

Tuberculosis often appears intercurrently to lingering diseases, such as progressive locomotor ataxy, lunacy, paralysis, cancer of the stomach, and diabetes. Professor Peter has drawn attention to the influence of inanition—*i.e.*, insufficient food, accompanying and consequent on certain chronic affections, especially those affecting the alimentary canal. The enfeebled system is more readily open to invasion by disease microbes, especially Koch's bacillus, which develops so much the better as the resistance of the system and the activity of the phagocytes are diminished by a chronic

illness. Among the diseases which prepare the way and favour the appearance of pulmonary tuberculosis a leading place must be given to acute affections of the respiratory passages.

Ordinary bronchitis often opens the door to Koch's bacillus. The public usually attribute the origin of the disease to a "neglected cold," and they are very often right. Professor Debove considers every person with even slight bronchitis as soil ready prepared for the development of pulmonary tuberculosis. "Every person who gets bronchitis," says he, "runs a real risk. If he neglects all precautions, and becomes consumptive, people will be right in saying that he has become so through a neglected cold." M. Debove advises his pupils not to attend the hospital when suffering from a cold.

Since a cold or bronchitis usually follows a chill or the effect of damp, the great importance attached by the public to these two causes will be understood, and as a matter of fact they are not mistaken.

Pasteur was the first to show what influence cold might have in connection with the development of an infectious disease. Cold diminishes the resistance of the system and produces a receptive state. Fowls, normally not liable to anthrax, become susceptible to it after immer-

sion in water at 77°, which reduces their temperature.

If rabbits are shaved and wetted, and then exposed to a draught so as to produce a rather severe chill by evaporation, they easily take a disease, pneumonia for instance, by inoculation with its microbe, while the test rabbits—*i.e.*, those which serve for comparison, not shaved or chilled—withstand the same inoculation. Even the slight cooling caused by shaving is enough to diminish the animal's resistance. In this state it becomes easier to infect them with tuberculosis by inhalation. It is found that animals which are chilled take the infection in a proportion four or five times greater than those not chilled.

The influence of bronchitis on the development of consumption is so real, that no single disease accompanied by bronchitis is known which does not predispose to consumption. Measles and whooping-cough have undeniably a particularly baneful influence on the development of tuberculosis. Measles, by the mere fact of producing bronchitis, creates an environment favourable to the culture of bacilli. Whooping-cough, like measles, and perhaps more frequently, is followed by tuberculisation. Both in hospital and in their town practice, doctors constantly have cases of hitherto robust and healthy children who have become tuber-

culous after even a slight and unimportant attack of measles or whooping-cough. Willis justly called these two affections *vestibulum tabis* (the entrance-hall of consumption).

Measles and whooping-cough especially become the exciting cause of the appearance of pulmonary tuberculosis in children and young people who have a hereditary predisposition to the disease, and it progresses much more rapidly than it would have done if the measles or whooping-cough had not hastened its development. If these diseases supervene during the actual course of consumption they give it an impetus and hasten its progress.

The *grippe*, or influenza—it is much preferable to call it by its old French name, which is so expressive and exact,—the *grippe* exercises a formidable influence on the development, and especially on the evolution of tuberculosis. When the *grippe* seizes a person in good health, it rarely has a fatal issue; but woe to the feeble and the old, woe above all to the consumptive!

Pulmonary tuberculosis is an extremely frequent sequel of pleurisy, in fact pleurisy is generally but the first manifestation of the disease (Landouzy). Every sufferer from pleurisy must be suspected of tuberculosis.

According to Professor Landouzy, small-pox prepares the way for tuberculosis: every small-

pox patient becomes a candidate for tuberculosis. This liability of small-pox patients to contract tuberculosis is a new and formal argument for compulsory vaccination, very mistakenly combated by anti-vaccinators.

Typhoid fever hastens the development of the disease in those who have a hereditary predisposition.

Scrofula was formerly given a leading place among the general diseases predisposing to tuberculosis. It is now known that scrofula is itself tuberculosis in an attenuated form, localised in the glands and the bony system, generally curable, but also liable to increase in virulence and become generalised. Scrofula is therefore more than a predisposition to tuberculosis, more than an excellent culture ground, it is ground already sown.

Wounds and bruises on the chest must be included among the predisposing or exciting causes of pulmonary consumption. Consumption originating from a wound has been mentioned by some doctors. Dr. Perroud has described traumatic consumption among the Rhone boatmen. To work their boat, they employ a long pole called *harpi,* the end of which presses on the chest under the collar-bone. The repeated pressure of this boat-hook produces a sort of chronic wound on the upper part of the chest, which reacts on the

apex of the lung, and favours the development there of Koch's bacillus. First there forms a point of chronic congestion at the apex of the lung, at the place where the *harpi* presses. The patient has a certain dull, deep-seated pain at this point, then he begins to cough.

In other cases pulmonary tuberculosis may be caused by a single severe bruise on the chest, even in persons whose family and personal antecedents show no morbid liability. Some cases of this kind have been collected by Dr. Mendelssohn of Berlin. He has recently published the case of a robust man, a coachman by trade, who came to consult him about a persistent cough. Ten years before, this man had had an attack of pleurisy consequent on an injury to the chest. He soon recovered, but it left him a cough which he could not get rid of. Bacteriological examination of his expectoration showed the presence of Koch's bacilli.

In many cases of the speedy appearance of consumption after an injury, the connection cannot be mistaken, but it is especially in the development of local tubercular disease, tuberculosis of the joints in particular, that injuries play the most prominent part. Injury creates a local predisposition, which induces the disease, by making the injured part a point of least resistance. In this way a fall, a bruise,

or a sprain, is often the starting-point of a white swelling. A white swelling can be produced at will experimentally in an animal which has been inoculated with Koch's bacillus; all that is necessary is to cause a traumatic lesion, a sprain for instance, at a joint (Max Schüller).

The general causes which favour the appearance of a white swelling are the same as those which prepare the way for consumption. White swellings occur in weakly, scrofulous children, whose parents are consumptive, intemperate, syphilitic, etc. Any degeneracy of the system predisposes to them, as do poor food, insanitary dwellings, antecedent diseases, etc.

Hip-joint disease attacks for preference poor children who are physically miserable as the result of bad hygienic conditions, insufficient food, lack of pure air, and life in a damp, cold, insanitary dwelling; but it is by no means rare among the wealthy classes, especially in children of tuberculous parents, and is often secondary to measles. Injuries play a considerable part in its development.

For Pott's disease, or any other form of tuberculosis, we find the same predisposing causes.

CHAPTER VII.

THE CAUSES OF TUBERCULOSIS:—II. CONTAGION—TRANSMISSION OF TUBERCULOSIS FROM MAN TO MAN.

WITH the exception of the rare cases of hereditary transmission of the germ, tuberculosis is always produced by contagion—*i.e.*, by transmission of the disease microbe from a sick person to a healthy one.

We have seen that Villemin has the honour of having established (1865) the infectious nature of tuberculosis experimentally, nearly twenty years before the discovery of the specific bacillus by Robert Koch (1882). We have cited the experimental demonstrations of Villemin, Tappeiner, and Chauveau, which indisputably established the fact that tuberculosis can be produced by inoculation under the skin, by inhalation, or by ingestion of tubercular matter.

But if the experimental proof of the contagiousness of tuberculosis and the modes in which contagion is effected belongs to modern

labours, the conception of it goes back to the first ages of medicine; Aristotle, Hippocrates, and Galen, among the ancients, admitted the contagiousness of consumption. G. Fracastoro, the celebrated poet-doctor of Verona (1483-1553), who sang the woes of Syphilis the shepherd, noticed and pointed out that the disease was transmissible by cohabitation, by the use of clothes worn by consumptives, and by occupying rooms where they had lived. J. B. Morgagni, the illustrious professor of Padua, who was the first anatomist of his time (1682-1771), and to whom history has justly given the name of the Prince of Anatomists, believed consumption to be contagious, and avoided as far as possible making autopsies and dissecting bodies of people who had died of this disease.

The contagiousness of consumption was then admitted by all doctors; thus Ferdinand IV. of Naples, under the influence of current ideas, issued an edict at that time (1782) containing wise and stringent measures of public hygiene intended to prevent the spread of the disease. Professor Bouchard had this royal decree before him. It was issued as the result of a consultation of the Naples Faculty of Medicine. "In the recital," says Professor Bouchard, "all the prophylactic means—*i.e.*, precautions to be taken to prevent the development of the disease

—calculated to eradicate the evil are mentioned; it is not a matter of the amelioration of the conditions of life; consumptives are simply to be sequestrated as soon as the disease is recognised, their beds and furniture taken right away and fumigated, metal objects washed with sea-water, vinegar, or brandy, books with lemon juice, walls with sea-water, etc. And in order that these precautions may be thoroughly carried out, those who omit them, if *ignobili,* will be condemned to the galleys for three years; if noble, to three years' confinement and a fine of three hundred ducats. Doctors who do not notify their cases of consumption will be fined three hundred ducats for the first offence, and banished for ten years for the second. Persons aiding in the concealment of a case of consumption will be imprisoned for six months. Regular or secular clergy failing to assist in carrying out these measures will be condemned to ten years' banishment. This is what was proclaimed with sound of trumpets in the streets and squares of Naples on September 20th, 1782, in the reign of Ferdinand." And one hundred and twenty-one years later, after the labours of Villemin and the discovery of Koch, consumptives are not isolated at the hospitals, the notification by the doctor of infectious disease, obligatory under penalty of fine for typhoid fever, small-pox, scarlatina,

etc., is not required for tuberculosis; disinfection of the dwelling, bedding, linen, and clothing of patients is not compulsory for tuberculosis!

Dr. Raulin, in his *Traité de la phthisie pulmonaire* (Paris, 1784), expresses himself thus:—"Pulmonary consumption is contagious; it is communicated to healthy persons by septic matter from the pulmonary exhalations of the patients. This matter enters the body and internal organs of healthy persons by respiration of the air surrounding the patient. It usually settles in the lungs, where it causes irreparable injury, and sows the seeds of the terrible symptoms of an often fatal illness.

"Such an effect of pulmonary consumption," adds Raulin, "may be prevented; it is not impossible to ward it off; and when the disease is established, it is curable." Raulin then indicates the measures of disinfection necessary to prevent the communication of the disease. "There are few districts," says he, "where the contagion of pulmonary consumption is so much dreaded as in Provence. As soon as a consumptive is recognised as such, his bed, sheets, table-linen, knife and fork, everything he habitually uses, are marked, and no one else ever uses them. As soon as he is dead, his room is dismantled, the walls and partitions

scraped and plastered, and the floor washed; his bed and linen are not used again; often they are burned, or sold after being washed several times. If the room had hangings, they are put out in the open air for a whole year. Generally speaking, nothing is used without the utmost reluctance that has served for the consumptive, whatever precautions have been taken."

If we were wise enough now to take these judicious precautions, we should not have to deplore the death of the 60,000 consumptives who perish annually in England.

Unfortunately, this well-founded doctrine of contagion was abandoned later by most doctors, until the labours of Villemin and the discovery of the specific bacillus by Koch demonstrated the truth of the old conception. Laënnec himself scarcely believed in the contagiousness of consumption. Yet he relates that when making an autopsy on a consumptive, he wounded his index finger, and a tubercle formed at the wound; and, as we know, twenty years later, by a terrible irony of fate, he was dying of consumption.

While doctors forgot or rejected the old ideas, the popular belief in the contagiousness of pulmonary consumption remained strong, especially in the south of Europe, in Spain and Italy.

In Italy at the beginning of last century the most careful precautions were taken to prevent the transmission of the disease; after the death of a consumptive, the most valuable furniture was burned, the wainscotting and even the fireplaces of the room were destroyed, "as if he had had the plague," says Creusé de Lesser (*Travels in Italy,* 1806). The question of the transmissibility of consumption from a sick person to a healthy one did not begin to come up again definitely till after Villemin's labours.

In 1879 De Musgrave-Clay read a remarkable paper before the Paris Faculty of Medicine on the contagiousness of pulmonary consumption. He mentions one hundred and eleven observed cases in which contagion appears to admit of no doubt. One of the most remarkable is the following:—

J. A., born of consumptive parents, marries A. A., born of parents free from tuberculosis. Soon symptoms of consumption appear in J. A. He dies. His wife marries again, and afterwards dies in consumption, after having transmitted the disease to her second husband. Disaster does not end there; in the last months of her illness, A. A. had been nursed by one of her nieces, M. M., the wife of J. B., quite free from consumption and born of perfectly healthy parents. M. M. succumbs to consumption, and

transmits the disease to her husband, J. B., who also dies of it.

Cases of the following kind are not rare:—A man whose parents are healthy becomes consumptive in the army; he returns home, and transmits tuberculosis to his parents and his two brothers, who had always enjoyed excellent health.

Transmission takes place most often from husband to wife, or wife to husband, and De Musgrave-Clay considers that persons living together are particularly liable to contagion, especially during the night in a room where the ventilation is inadequate.

The labours of Villemin, Tappeiner, and Chauveau have proved that tuberculosis is inoculable, is contagious at a distance, and may invade the system in three different ways, by cutaneous inoculation, by entry into the respiratory passages, and by ingestion into the digestive passages.

Koch's discovery has established the fact that the sole active cause of the disease is the bacillus, which is found in abundance in all tubercular matter, and especially in the expectoration of consumptives.

Unless spontaneous generation of the bacillus is admitted, it must be acknowledged that every case of tuberculosis arises from another case by transmission of the specific bacillus.

We cannot here discuss the question of spontaneous generation: we will only remind the reader that the theory has been entirely disposed of by the luminous experiments of Pasteur, after a controversy with Pouchet which is still famous.

We have, therefore, to investigate how the pathogenic bacillus is conveyed from a sick person to one in good health.

The problem of the transmission of tuberculosis is twofold: it includes (1) the dissemination of the specific bacilli by patients; (2) the penetration of the bacilli into a healthy system.

We have seen that Koch's bacillus is found in very large quantities in the sputa of consumptives; one consumptive expectorates daily 1,200,000,000 virulent microbes; patients spit about continually, and when the dried sputa are reduced to dust, the bacilli are disseminated in the air. Their resistance to the various destructive agencies is considerable, and they preserve their virulence a very long time; if left alone in a sick-room the sputa do not lose their contagion for several months, and in the dark they preserve their virulence indefinitely; but the combined action of desiccation, sunshine, and fresh air attenuates their virulence, even to vanishing point. It will therefore be clear what great danger there is in ill-venti-

lated, dark, damp rooms, where the bacilli retain their activity, while the body languishes.

In the ground the tubercle bacillus preserves its vitality for several years. If we think of the number of tuberculous persons in a town, or a hospital, who spit on the ground continually, in the streets, on floors, in theatres, cafés, public conveyances, everywhere; and if we think again of the very great resistance of the tubercle bacillus to destructive agencies, and the ease with which it can be carried about, it will not be difficult to understand how tuberculosis may be spread at a distance, without any direct communication between the sick persons from whom the bacillus came and the person in whom the bacillus settles and develops. Typhoid fever, dysentery, and cholera spread in an analogous manner by indirect transmission, by means of the drinking water in the majority of cases. But the great importance properly attributed to water as a germ-carrier must not cause us to lose sight of the similar function of the air.

The organic or inorganic dust raised from the ground by human agency or the wind in streets and houses, and held in suspension in the air, conveys infectious agents more often perhaps than water. Infection by the respiratory passages is not less common than by the alimentary canal. Dust and water are equally

answerable for the spread of epidemics. Dust is especially the occasion of outbreaks of disease in isolated cases or groups of cases in the same house or room. It is undoubtedly the cause in many cases where disease occurs without contagion of known origin, defies investigation, and leaves the source of infection shrouded in mystery. Similar cases are often found in the army. Typhoid fever, measles, scarlatina, or diphtheria appears in a mess-room among a limited group of men, whom a full and searching investigation exonerates from all suspicion of doubtful contact. These outbreaks, being confined to limited areas, without any possibility of importation, definitely indicate these areas as containing the pathogenic agent, and everything points to the belief that the cracks in the floor or the space underneath are the mysterious retreats where, through our careless habits, it is accumulated and preserved until some chance circumstance, such as the decay of a board, or the mere tremor of the ground under the men's tread, frees it from its accidental prison and leaves it at the mercy of the passing draught, which at length deposits it on the external mucous membranes. Most common diseases, such as eruptive fevers, diphtheria, pneumonia, and especially tuberculosis, almost always arise from germs pre-

served in the dust, when they cannot be traced to direct contagion.

This assertion applies especially to collective dwellings, such as public schools, workshops in large towns, hospitals, and barracks, that afford the careful observer opportunities of appreciating the effect of dust on the production of infectious diseases which have the precision of a scientific experiment. There is permanent danger of an outbreak of infectious disease in these places; it is no exaggeration to say that the floors are one vast culture ground of microbes, which is continually being sown with all the germs deposited by traffic, and that that hot-bed of multiplication of micro-organisms, the space underneath the floor, is always ready to yield a hundred-fold what it receives from the numbers crowded on the surface. We consider that many infectious diseases which appear in collective dwellings, not imported ready-made by contagion, are caused by dust containing dormant germs, deposited by previous epidemics or by boots which bring with them the traces of their contact with the pollutions scattered about outside (Kelsch).

Tuberculosis is usually spread in this way. The usual media of contagion are dried sputa containing bacilli, but tuberculosis can also be transmitted by certain products of the bodies of

patients which may at any time get into the air, such as dirt from the nails, cuttings from the beard, hairs, etc. The tubercle bacillus may enter the body at any point of the surface, either of the skin or the mucous membranes of the air-passages or alimentary canal. Sometimes it penetrates into the interior at once; sometimes, hidden in the least inequality of the skin or the smallest fold of the mucous membrane of the respiratory passages, it waits a favourable opportunity to invade the system (chill, injury, etc.).

The bacillus enters the system especially by the respiratory passages, and this fact explains the prevalence of tuberculosis of the lung. We have seen that the bacilli when inhaled settle especially at the apex of the lung, but they also often merely pass through the respiratory passages and enter the blood to infect another organ, or a bone or joint.

The danger of dust charged with tubercle bacilli does not arise only from inhalation. It settles on the objects that surround us, and on the food we eat. "I was busy one day," writes Schnirer of Vienna, "with bacteriological work at Weichselbaum laboratory, and during a rest I sent for some grapes as a refreshment. These had been some time in a basket outside, and were so covered with dust that the water in which I washed them was absolutely dirty and

dark-coloured. As I looked at this water, I reflected that the neighbouring street was frequented by large numbers of consumptives who came to the consulting-room, and that these people did not hesitate to spit on the ground. The dust, so plentiful at Vienna, might therefore very well contain bacilli. To ascertain if this were so, I injected one-fifteenth of a gill of the water into three guinea-pigs. One of them died in two days of peritonitis, whilst the other two succumbed in forty-five and fifty-eight days respectively, showing manifest tubercular lesions starting from the point of injection. I will add that the water for the washing was taken from the spring-water tap at the time it was used, that the glass which held it had been carefully sterilised, and that neither the boy who brought the grapes nor the dealer who sold them are tuberculous. This shows clearly what danger there is in the indiscriminate discharge of tubercular sputa, and in the dust containing them, from the point of view of the public health."

The stalls with which French, and especially Parisian, shopkeepers encumber the pavements are most dangerous, and too much protest cannot be made against the practice when the goods are food-stuffs, especially such as can be consumed without preparation, as fruit, butter, or cheese. Articles exposed in this way

constantly catch street dust raised by vehicles and passers-by, to say nothing of dust from carpets and clothes shaken out at the windows.

Bacilli abound on the ground, and on the floors or carpets of rooms, just as in the dust of the streets or the sand of the public promenades. A child soils his hands as he plays, then he puts them to his mouth, and may thus get the infection. The microbes may also penetrate the system through an accident, from even a trifling or unnoticed wound, if soiled with mud or dust. Army Doctor Ruotte adduces the following curious case:—

A healthy young soldier, with no personal or hereditary predisposition, in January 1894 got a slight excoriation on the sole of his foot. Notwithstanding rest and suitable treatment, the little wound showed no signs of cicatrisation, and became a tubercular ulcer the size of a sixpence, which Dr. Ruotte was going to scrape and cauterise, when in September symptoms of meningitis suddenly developed, and the patient succumbed in a few days. Dr. Ruotte considers that in this case the virus entered the system through the wound on the sole, at some time when the bare foot came in contact with a floor soiled by the sputa of consumptives.

Objects used by tuberculous persons and contaminated by their expectoration are particularly dangerous. Dr. Merklen notes the case

of a robust woman of twenty-six, who for three years had been the assiduous nurse of her consumptive husband: a tubercular ulceration appeared on the hand she used to clean the sick man's spittoon, and soon signs of tuberculosis showed themselves at the apex of the lung; but, fortunately, pulmonary consumption was afterwards arrested.

Doctors and anatomists know how dangerous it is to dissect or make a *post-mortem* examination of the bodies of tuberculous persons. Morgagni carefully avoided it; Laënnec fell a victim to it; Verneuil relates the case of a student who pricked himself with the instrument while making a *post-mortem* on a consumptive and was attacked by Pott's disease.

But these are accidents which only interest a limited number of persons; the scattering about of tuberculous expectoration, on the contrary, constitutes a public danger. Certain places are particularly dangerous from this point of view: such are schools, barracks, offices, workshops, hospitals, rooms in hotels, and public conveyances and railway carriages, in which large numbers of patients travel. Dr. Marfan relates an account of an epidemic of tuberculosis in an office employing twenty-two persons. In 1878 two consumptives entered it, and were there several years, coughing and often spitting on the floor, in a small and ill-

ventilated area. The clerks arrived at the office early, when the air was laden with dust from the morning sweeping. Thirteen of them died of consumption between 1884 and 1889. Contagion was evidently effected by the air, which held in suspension bacilli from dried sputa on the floor. At Dr. Marfan's suggestion, the management had the office evacuated, the floor burned, and the place repaired, and made hygienic rules to prevent the occurrence of a similar result again. Since that time no fresh case of tuberculosis has appeared.

Contagion is extremely frequent in workmen's houses, where families, crowded together in dwellings that are too small, live in dangerous promiscuity, scarcely separated by thin partitions, and where tenants follow one another without the place ever being cleaned, without even the floors being washed. Furnished apartments and hotel rooms, where the furniture and hangings are never renewed, nor even thoroughly cleansed, must also be held accountable. Cases of infection thus produced are not rare in districts where consumptives go for their health, where they contaminate the hotel rooms in which one follows another, and create a serious danger to healthy persons who may occupy them afterwards.

In hospitals, where so many tuberculous persons are met with, one in every three of

the patients in the Paris hospitals, the transmission of tuberculosis is very frequent. Consumptives in hospital are not isolated from other patients, and they cough and spit day and night, and fill the air with their emanations and the yards with their sputa; accordingly one often finds that unfortunate people who have entered the common ward for a different affection rapidly succumb to acute tuberculosis, or carry out with them the fatal germ.

Tuberculosis is very common among hospital staffs. It decimates the nurses. At the hôpital Necker, half of them are struck down by consumption. Those who perform their duties most zealously and devotedly are the ones attacked (Marfan). Professor Terrier considers that tuberculosis is very frequently caught in hospitals. It cannot be mathematically proved that the disease originated there as regards the patients, as they leave the hospital, but the mortality among the employés, attendants, and others is fearful; if all do not die, nearly all are affected. The number of students who become tuberculous is also considerable, and from what Professor Terrier has seen, it is those especially who work most at the hospital that are attacked. Moreover, the management does absolutely nothing to prevent such contamination; thus the stoving of the mattresses is so perfunctory that after the pro-

cess one can find live vermin in them. They do not even trouble to carefully destroy the expectoration. At the hôpital Bichat there are wards which have not been disinfected since 1883; they never disinfect the places where tuberculous employés have died, and the management even refuse to do so when requested.

Isolation of tuberculous persons in special wards, or better, in hospitals reserved for them, disinfection of bedding after each patient leaves, and systematic disinfection of the wards at regular and frequent intervals, are the measures that must be taken in order to alter this deplorable state of things. Regular disinfection should also be required in barracks, offices, workshops, schools, hotel rooms, furnished apartments, public conveyances, and railway carriages. Doctors should order disinfection in case of tuberculosis. Above all, consumptives must be prevented from scattering the germs of the disease about them, by being absolutely forbidden ever to spit anywhere but in a spittoon. We will return to all this later, however.

CHAPTER VIII.

THE CAUSES OF TUBERCULOSIS: — III. ANIMAL TUBERCULOSIS — TRANSMISSION OF TUBERCULOSIS FROM ANIMALS TO MAN—DEFENCES OF THE SYSTEM AGAINST MICROBES.

THE human race has not the melancholy monopoly of tuberculosis. Certain animals, especially the cow and pig, are very liable to it; it is rather frequent in the monkey; it is rare in the horse, sheep, goat, dog, and cat.

Bovine tuberculosis, together with that of the pig, presents most interest, as it constitutes an important cause of contamination to man. It is found in almost all countries, but is especially common in hot countries, and particularly so in Italy, where it assumes the characteristics of a veritable scourge. In France certain districts are almost free from it, *e.g.* Auvergne, Limousin, and the greater part of Normandy; but other districts are seriously affected, especially Brittany, Champagne, Nivernais, Bearn, Beauce, and Brie. Tuberculosis is much more common among milch cows kept in sheds in

large towns. Permanent housing in damp, ill-ventilated sheds, in a vitiated atmosphere, favours its appearance.

An attentive study of the too few papers existing on the subject leads to the somewhat grave deduction that bovine tuberculosis is increasing everywhere; and in certain parts its progress is alarming. In Denmark it was almost unknown at the beginning of last century, and was imported about 1840 by the Holstein and Schleswig breeders, developing so greatly that in 1895, out of 45,000 head of horned cattle, 19,000, or nearly 40 per cent., were found to be tuberculous.

The infection of tuberculosis shows itself, in animals as in man, sometimes in an acute generalised form comparable to acute tuberculosis in man, sometimes by lesions of the lungs or intestines, and sometimes by local tubercular disease. Pulmonary tuberculosis in cattle, known in France as *pommelière*, is the most frequent form of the disease. It begins by the appearance in the lungs of small transparent miliary tubercles, which by their union form large masses the size of a nut or sometimes of the fist, and the shape of an apple, whence the name *pommelière* given to the disease, from *pommelle*, little apple. These rounded masses rapidly become infiltrated with calcareous salts, and rarely disintegrate. The disease cannot be

recognised until an advanced stage; then the animal at length becomes thin and coughs; greyish matter is passed from the nostrils; diarrhœa supervenes, and at last carries it off. On *post-mortem* examination we find tubercular modifications in the liver, spleen, kidneys, peritoneum, etc.

Among local forms of tuberculosis the most important is that of the udder. It is a common affection, compatible with good general condition, and characterised by swelling and hardening of the gland. Bacteriological examination of the milk reveals the presence of Koch's bacillus. The milk of cows suffering from pulmonary tuberculosis, even when there is no tubercular lesion of the udder, often contains the specific bacillus.

The great importance of tuberculosis in oxen, milch cows, and pigs will be understood in view of Chauveau's experiments. These, often repeated since, prove that ingestion of tuberculous matter, even in minute quantities, is enough to cause tuberculosis. The experiment also proves that foods (butcher's meat, milk) from tuberculous animals are capable of producing tuberculosis in healthy animals.

Numerous instances prove that animal tuberculosis can be transmitted to man. While making a *post-mortem* on a tuberculous cow, a Weimar veterinary surgeon, aged thirty-four,

of good constitution, and with no hereditary predisposition, made a severe cut on his left thumb; the wound readily healed, but ten months afterwards he showed unequivocal symptoms of pulmonary tuberculosis, and his expectoration contained bacilli; he died two and a half years after the injury.

Man may also contract tuberculosis through using meat from animals suffering from it which has only been slightly cooked, as well as by ingestion of unboiled milk from cows with pulmonary tuberculosis or tuberculosis of the udder. This is a common cause of tubercular affections; animal tuberculosis constitutes a grave danger to public health. The danger is all the greater that the disease is difficult to recognise in the ox; there are few general symptoms, and the animal preserves its fleshiness till an advanced stage; it may even become fatter, so that tubercular lesions are found sometimes in the internal organs of prize beasts.

In the abattoirs of large towns inspectors examine the animals killed, and seize suspected meat, which is not allowed to be passed on to the consumer; but unfortunately, when breeders know a beast to be tuberculous, they too often have it killed at an illicit slaughter-house and sell the meat cut up, cleaned, and dressed. Thus, at the Toulouse abattoir, the proportion

of beasts found to be tuberculous was 10 per cent. up to 1889; but when the inspector enforced seizure of tuberculous meat, the proportion of animals brought to the abattoir fell to $2\frac{1}{2}$ per cent.; the remainder had been killed in uninspected slaughter-houses and the meat brought into the city in the condition of foreign meat. At the Bucharest abattoir the seizures made by the inspector had gradually reduced the proportion of tuberculous animals to less than 3 per cent.; but when the municipality decided that owners should receive an indemnity equal to one-third the value of the meat seized, the proportion found to be tuberculous at the abattoir rose to 30 per cent., or ten times as many (Nocard).

The consumption of tuberculous meat is the more to be dreaded since cooking does not remove all danger of infection. To be efficacious the cooking ought to be much more thorough than it is; the inside is usually not exposed to a high enough temperature to kill the bacillus.

The transmission of tuberculosis to man by using milk from tuberculous cows is proved by well-authenticated facts. The milk is still more dangerous than the meat, but only when it is drunk as it is, without being boiled; boiling does away with all danger. A little boy, whose parents and grandparents were perfectly

healthy, and who had no hereditary weakness, unfortunately had a bad nurse, and for months was given cow's milk not boiled, sometimes of unknown origin. At eighteen months old he had serious abdominal troubles, colic, and diarrhœa. He recovered, but the abdomen remained distended and streaked with large blue veins. He continued to be thin and ill-developed, and was subject to frequent colics. Several times he had sanguinolent diarrhœa. At four years old he was ill for a fortnight with an attack of fever, which, for want of a better term, was called mucous fever, so as not to alarm the family. Six months later he was dying of meningitis (Grancher and Hutinel).

Dr. Stang, of Amorbach, was called in to a boy five years old, apparently of good constitution and born of healthy parents, whose families on both sides were free from any hereditary disease; the child died in a few weeks from *sequelæ* of tuberculosis of the lungs. A short time before the parents had had a cow killed, which the veterinary surgeon at the abattoir found to have pulmonary phthisis. This cow had been a good milker, and for a long time the child had had his milk fresh from the animal.

These facts compel the conclusion that animal tuberculosis, especially in the cow or pig, is transmissible to man. Contagion is effected by

the entrance of meat or milk from tuberculous animals into the digestive passages. The most stringent measures should be taken to prevent the sale of infected meat. As regards milk, boiling suffices to make it harmless. The consumption of fresh milk being the most frequent cause of tuberculosis arising from foods, the systematic boiling of milk should be an invariable rule of practical hygiene.

We have seen that the microbe of tuberculosis is everywhere, on the ground we tread, in the dust blown up by the wind, in the air we breathe, on the fruit and in the meat and milk we use for our food. We live surrounded by invisible but formidable enemies, who only await a favourable opportunity to strike.

How is it we are not all victims to this scourge?

Professor Hanot says: "The pathogenic agent of tuberculosis comes from everywhere, and penetrates the system at all points of its surface and at every moment of its life. It would indeed be surprising if the system, thus open to attack and besieged in such a way and for so long, escaped the infecting germ. And, as a matter of fact, not many do escape entirely. If we included the unrecognised cases of tuberculosis with such as are evident, we should certainly get a very high percentage; if all do not die, the majority are attacked."

It is certain that many cases of tuberculosis pass unnoticed; a considerable number of people are tuberculous who have no suspicion of it; many have been tuberculous who have never suspected it; the disease, due to but a slight infection, or developing in the unfavourable soil of a strong constitution with good resisting power, has ended in recovery before any manifest symptoms revealed its presence. It must accordingly be admitted that the cure of tuberculosis is frequent, and the fact is proved by autopsies on persons who have died from quite a different cause, and in whom traces of healed tubercular lesions have been found. Moreover, it is not enough for the specific bacillus to get into the system to cause fatal tubercular disease. "For the actual production of the disease," says Professor Bouchard, "the combination of two factors is necessary. The first, necessarily, is the infecting germ; the second, equally indispensable, is the aid of the system itself, which provides the germ with the set of physical and chemical conditions which constitute its proper environment. If only one man in five dies of tuberculosis, the inference undoubtedly is that the human body is not a favourable environment for tuberculosis; that in one-fifth the number of cases only man loses his ordinary means of defence against tuberculosis through certain modifica-

tions which his system has undergone; and that the soil, so to speak, has been gone over, turned up, and modified in such a way that the germs which fall on it, yesterday sterile, become fertile to-day."

We have seen that when the bacillus gets into the system the living cells maintain a struggle against the invader, which usually ends in their victory when there is no unfortunate hereditary or personal predisposition. Besides, in spite of the multiplicity of ways open to it, the pathogenic agent does not penetrate to the interior of the body without difficulty. By way of the skin, it is necessary that there should be an injury, causing a solution of continuity; in the same way, there must be some previous affection of the mucous membranes of the respiratory and digestive passages before the bacillus can pass these natural barriers.

Finally, we have still other means of preservation. The air we breathe is filtered as it traverses the nasal passages, where dust is kept back by the vibrissæ, and bacilli destroyed by the mucus, which possesses germicide properties. This protective function of the nasal passages in regard to the respiratory passages is illustrated by the inflammation of the larynx and bronchi, so often produced in patients who are only able to breathe through

the mouth from obstruction of the nasal cavities by a tumour or polypus. It is found that they are particularly liable to contract tuberculosis.

When the bacillus gets into the bronchi, if these are not already out of order, it may be removed by the vibratile cilia with which they are covered, and whose movements directed outwards, carry the dust, which has penetrated into the respiratory passages with the air inspired, towards the larynx, to be expelled by the cough with the mucous matter.

By way of the digestive passages, the bacilli may be destroyed by the action of the digestive secretions, especially the saliva and the gastric juice.

It is reassuring to find, in ending our study of the causes of tuberculosis, that if we are all exposed to the contagion, we are happily not all good culture grounds, and that if our defences are sometimes inadequate, the affection is often slight and recovery follows.

PREVENTION AND CURE OF CONSUMPTION.

CHAPTER IX.

THE PREVENTION OF TUBERCULOSIS—MARRIAGE OF CONSUMPTIVES.

THE measures calculated to prevent the disease follow naturally from the study of its causes.

Knowing the nature and causes of tuberculosis, and also its modes of propagation, it is easy to establish by what means the disease can be prevented from spreading.

Unfortunately, though it is easy to formulate rules, the difficulty is to put them in practice. The greatest obstacle to the employment of the most simple means is the ignorance of the public. It is a duty to spread the ideas which will put people on their guard against the danger of contagion, to teach them the means by which they can protect themselves, and above all to make them understand the utility and efficacy of these means. The struggle against tuberculosis will only become effective when *everybody* knows what has to be done; when *each one* understands the necessity of the

rules of preventive hygiene and observes them, the scourge will be vanquished.

Private and public hygienic measures for the prevention of tuberculosis are of two kinds: some aim at preventing the transmission of the disease germ and opposing a barrier to contagion, others are directed to combating the influences and removing the causes which create the predisposition.

To prevent the contagion of the disease it is evident that it is necessary and sufficient to prevent the dissemination of the bacilli and destroy them.

We have seen that the principal disseminating agency is the desiccation and pulverisation of expectoration from consumptives.

The air from tuberculous lungs is pure. Tyndall has demonstrated that the air expired is, as he puts it, optically pure—*i.e.*, a pencil of light traversing it in a dark room does not show a luminous track; this air therefore holds in suspension no particles capable of diffusing the light; therefore it does not contain bacilli and cannot be a means of contagion. It is different with the sputa. The most frequent and most formidable source of contagion lies there. Almost harmless while in a fluid state, it is especially when reduced to dust that they become dangerous. They quickly assume this form when discharged on

the ground, floors, pavements, or walls; and when they soil clothing, bed-clothes and belongings, carpets, and curtains, and when they are received into handkerchiefs or serviettes. Then, dried and powdered, they are put in motion by the sweeping, dusting, beating, or brushing of the hangings, furniture, bed-clothes, or clothes. This dust, suspended in the air, penetrates the respiratory passages, or settles on any places on the skin and mucous membranes without their protection of epidermis, or on ordinary objects used for serving food, and thus becomes a permanent danger to those who live in the atmosphere thus contaminated (Villemin).

FIG. 7.—SPITTING CUP.

Some authors have doubted whether tuberculosis is spread by dried sputa inhaled with the dust in the air.

Dr. Cornet, of Berlin, has supplied a fresh proof of the reality of the danger created by the inhalation of tuberculosis dust. He scattered sputa of sufferers from pulmonary tuberculosis over a carpet laid in a room and left them to dry for two days. He then installed forty-eight guinea-pigs there


FIG. 8.—FEEDING CUP.

in cages at different heights, and from time to time raised a cloud of dust by sweeping the carpet with a coarse broom. Of the forty-eight guinea-pigs forty-six became tuberculous. The experimenter himself was protected from infection by breathing through a mask which filtered the air each time he entered the experiment room.

The sputa of patients should therefore be systematically and scrupulously collected and destroyed. They should always and everywhere be received into spittoons containing liquid, and not powdery matter such as bran, sand, or ashes; these should be emptied into the fire every day and cleansed with boiling water.

Unfortunately, it is extremely difficult to enforce these very simple precautions. Up to an advanced stage of the disease the consumptive lives in common with his friends and expectorates in his handkerchief, on the floor, or in the street. He must be forbidden to spit on the ground or in his handkerchief; he must be made to understand that by doing so he is scattering death around him and constitutes a public danger; he must be induced to use the spittoon voluntarily, always and everywhere. Very convenient pocket spittoons for consumptives are now made, and it is to be hoped that the use of them will spread.

The prohibition of spitting on the ground should, moreover, not be for acknowledged consumptives only; it should be general, and ought to be enforced by law; for how many people there are whose sputa contain Koch's bacillus, but who have no idea of it!

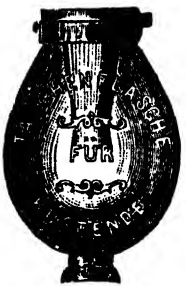

FIG. 9.—DE TWELLER'S POCKET SPITTOON.

This question of expectoration is of the utmost importance in the struggle against tuberculosis. If the public could be prevented from spitting on the ground, indoors or out, the ravages of the disease would be diminished to a considerable extent. It would be necessary to prohibit spitting on the ground under penalty of fine, as has already been done in some towns; but, above all, it would be necessary to make the public understand *why* they should not spit on the ground. Notices should be posted in all public places, pointing out the ravages of tuberculosis, and explaining its

FIG. 10.—LIEBE'S SPUTUM BOTTLE.

causes and modes of contagion ; and principles of practical hygiene might be taught in the elementary and secondary schools, which would in time bear fruit.

Co-habitation with a tuberculous subject is particularly dangerous; his linen, clothes, and bed, and the hangings in his room are full of bacilli.

Consumptives at home, as well as in the hospitals, should be isolated. They should have their own room as far away as possible from those used by the rest of the family. The room should be large and airy, with plenty of sunshine; it should not contain any kind of carpet, curtains, or hangings; the floor should be washed, not swept; the linen, clothes, and all articles used by the patient should be frequently disinfected. In hospitals tuberculous persons should be isolated in special wards, or better, in special buildings.

As a general rule, all tuberculous matters (sputa, evacuations, etc.) from man or animals should be destroyed; all objects and places contaminated by them should be disinfected. The bodies of consumptives ought to be cremated.

We have already indicated the measures taken to prevent the sale and consumption of meat from infected animals, when speaking of animal tuberculosis and its transmission to man. As

a general rule, for greater safety, it is best for meat to be well cooked. As to milk, it ought always to be boiled before use.

Among the chief predisposing causes of tuberculosis we have placed lack of air and light, insufficiency and poor quality of food, excessive toil, and overstrain in any form. Most of these only exercise their fatal influence among the poor. Misery is one of the most powerful factors in pulmonary consumption.

What is needed is to secure large, clean, airy dwellings for the working classes, into which health enters with sunshine; to assure good, nourishing food to the workers; to give the workman enough time daily for rest to repair his energies; above all, to have pity on the unhappy women who earn a miserable pittance by desperate toil, only able to get their bread at the expense of their health, until they go under; to prevent young countrymen from abandoning the fields for the factory, and young girls from leaving their villages to get places in the town. These problems are for the philanthropist and the economist to solve.

Another powerful cause of debility and predisposition to consumption is drink. A serious question this, whose solution is imperative. The means of combating this scourge are known; they have been successfully put in

practice in some countries; it is the legislator's province to apply them.

Let us come back to the domain of the hygienist and the doctor, to what every one can accomplish for himself.

Air your rooms; tuberculosis can only be caused by the presence of Koch's bacillus in the air breathed, but vitiated air is a cause of anæmia, debility, and diminished resistance. Let your sleeping apartment be as roomy as possible; get rid of all unnecessary hangings; they catch the dust and harbour microbes; at least let them be often shaken, beaten, and aired.

Let plenty of light into your house; air and sunshine diminish the virulence of microbes.

Let your food be good and plentiful. Money saved in food is put by for the doctor.

Avoid overstrain, especially useless toil, late hours, and excesses.

Avoid frequent prolonged attendance at theatres and cafés, where the air one breathes is impure and contains dust which is a source of danger.

If your business compels you to live in an office, workshop, or warehouse, take open air exercise and country walks as often as possible; if you can, go to the country, the mountains, or the seaside every year to recuperate.

Carefully avoid strong drink; remember that

alcohol is useless and dangerous; that a person may become addicted to drink, and consequently an easy prey to tuberculosis, without ever getting drunk; that any individual who regularly drinks more than a pint of wine per day is addicted to drink; that any person who regularly drinks even one small glass of any kind of spirits every day is addicted to drink. Above all, keep away from absinthe and its brothers, bitters and vermouth; in default of consumption, they will lead you to idiocy, epilepsy, insanity, suicide, or crime.

FIG. 11.—THE "A. AND H." CLINICAL THERMOMETER.

To avoid the causes of debility is not everything; we must combat the predisposition when it exists, and especially in those who are predisposed by heredity. This may be done by rational physical culture directed to the development of the chest and muscles by means of gymnastics and sport, by habituation to fresh air and cold water, and by plentiful and nourishing food.

A child of tuberculous parents should be

separated from them from his birth, sent into the country, and entrusted to a strong, healthy nurse. As he grows he should be removed from all the influences whose fatal effect on the development of tuberculosis is known to us. He should be educated in the country. Games in the open air, said Goethe, are a tried remedy for making children strong and healthful.

To make a country lad of the child, to replace town life by country life, life in rooms by life in the fields, deprivation of sunshine by exposure to sunshine, fear of cold by enjoyment of it, hot baths by river bathing, rest by activity, intellectual by muscular exercises; in a word, to let him live a natural life; these, says Professor Peter, are the true means of preventing consumption. Life in the open air, physical culture, hygiene, and food; this is the way, as Professor Bouchard puts it, to make an inferior constitution into a better and a stronger one.

Care must be taken not to shut up children threatened with tuberculosis in a boarding-school. The confinement, the work, too hard for them, the life in common in a limited area where air and sunshine are often lacking, sometimes accompanied by insufficient or unsuitable food, are fatal conditions to impair the development and strength of young people. One must know how to sacrifice their instruc-

tion to their health; a man can be happy and useful without having a degree.

The study of the means calculated to stop the spread of tuberculosis now brings us to a most interesting question; that of the marriage of tuberculous persons.

FIG. 12.—CYLINDER FOR DISTINGUISHING THE CONSUMPTIVE'S SERVIETTE.

The marriage of tuberculous persons is a very important factor in the spread of tuberculosis in all its forms. In fact, when a tuberculous person marries, he not only may, and often does, communicate the disease to his partner, but, moreover, if the union is not sterile, his children are predisposed to it, and though by no means born tuberculous, have every chance of becoming so, by heredity and by contact with their parents.

Matrimonial contagion is well attested and extremely common. Marriage realises all the conditions which favour contagion. If it is the husband who is consumptive, the wife passes her days and nights in a room which he contaminates with his emanations and secretions, living the same life, and breathing the

same air. "The constant contact, the sharing of bed and board, the life in a vitiated atmosphere, in which infectious matter is always floating, would be enough to make the unfortunate wife's situation a perilous one, even if night watches, present sorrow, fears for the future, privations and often misery, pregnancy, confinement and nursing, did not unite to throw her into a state of mental prostration and physical debility well calculated to prepare the soil for the development of the disease. If it is the wife who has the disease, the danger for the husband is perhaps less. Compelled to go out to work to earn the family's living, he has at least the advantage of breathing a purer air in the daytime. It is only at night that he is shut up in contaminated air. Accordingly, what do statistics say? That consumption is commonly transmitted between man and wife, and that the woman is more often the victim than the man" (Grancher and Hutinel).

This is not all; marriage exercises a sinister influence on tuberculosis; for the female especially, it should be definitely discouraged: "Maid, no marriage; wife, no children; mother, no nursing." Such is the rule formulated by Professor Peter, and to-day accepted by all doctors.

Pregnancy is a powerful cause of debility; and not only does it accelerate the course of

tuberculosis, it also increases the predisposition. In a woman predisposed to consumption by temperament or hereditary antecedents, pregnancy, especially if repeated and frequent, wonderfully facilitates the appearance and progress of pulmonary tuberculosis.

Nursing is a further cause of exhaustion to the mother, not to speak of the danger of contagion to which it exposes the child. Its influence is particularly fatal, and it should be discountenanced, in the interests of both mother and child; the latter, as we have already said, should be removed, sent into the country, and entrusted to a nurse as healthy as possible. The phthisical should therefore be advised not to marry, marriage being a fatal step for themselves, their partner, and their children, who will be born weakly and destined for the same disease; unfortunately, they consult their affections or their interests about getting married, and not their doctor.

For tuberculous persons who are cured marriage is permissible. "When the tuberculous man or woman has been well for five or six years they may marry, if they have enough resources not to have to work too hard to keep their family. A woman who has been cured of tuberculosis will have enough to do in pregnancy, without having to nurse; in managing the household and bringing up the children,

without taking part in the housework or carrying the children about herself. A man who has had tuberculosis must have a wife who does not require him to pass all his nights in the ball-room or the theatre, or in select pleasure parties; one must go to bed early when one has a weak spot. Tuberculous persons who are cured and married should be able to lead the same hygienic, careful, rational life they led before marriage. As to the children of the marriage, they are not born tuberculous; but it must not be forgotten that children born of parents formerly consumptive are delicate, and that they should have plenty of nourishment and live in the open air" (Daremberg).

CHAPTER X.

THE CURABILITY OF TUBERCULOSIS.

PROFESSOR GRANCHER tells us that tuberculosis is the most curable of all chronic diseases. Indeed, at the autopsy of people who have died of diseases quite other than pulmonary tuberculosis, we often find old cicatrised tubercular lesions, which prove beyond doubt that they have once had tuberculosis.

We had occasion above to mention the fact that in many cases tuberculosis escapes observation and ends in a spontaneous cure, without the disease ever being revealed by any manifest symptoms, and consequently without any special treatment being followed. We may therefore conclude not only that tuberculosis is curable, but, moreover, that it naturally tends to a cure. But these are cases of latent tuberculosis, which do not constitute consumption in the true sense of the word. Is confirmed consumption also curable? Many authors say yes. Laënnec, the master of masters on this subject, boldly asserts it. "A number of facts," says he,

"have proved to me that in some cases a patient may recover after having had in his lungs tubercles which have disintegrated and formed an ulcerated cavity."

We learn from all sides that "the infection of tuberculosis can be overcome by the human organism" (Cohnheim), that "pulmonary consumption is curable at all stages" (Jaccoud), that "this disease, the scourge of humanity, is curable in the majority of cases" (Bouchard), that "there is probably no doctor who cannot point to cases of consumption cured" (Debove).

Tuberculosis is extremely common, and it may be admitted from statistics obtained from autopsies, that 50 per cent. of mankind have tuberculosis at some time in their lives, two-thirds of them in the pulmonary form. As, on the other hand, tuberculosis only shows a mortality of 14 per cent., it is evident that it is curable.

The curableness of consumption is therefore a firmly established axiom; and it is equally well attested that if consumption is curable, it is not by chance, but by essential destination, by virtue of a natural tendency, on which Professor Grancher has thrown much light. Even at the stage of excavation it is possible for consumption to stop in its evolution, and even to end in complete and final recovery. Sometimes the cure is absolute and final, but often

it is only apparent, and the still smouldering disease may be rekindled. "I know patients," says Dr. Noel Gueneau de Mussy, "in whom cavities were found to exist by me, and by observers whose authority is far superior to mine, ten, fifteen, and twenty years ago, and who now enjoy good health."

In cases of this kind pulmonary tuberculosis is often still progressing, but with diminished energy and speed, hardly at all. Professor Hanot mentions some striking instances:—"I recently received a lady who brought a sick relation to consult me; incidentally she spoke to me of her own health. She was sixty years of age, of almost athletic carriage and splendid appearance. I was astonished when she told me that forty years before she had had hæmoptyses, and on the advice of Barth had spent several winters in the South. For more than twenty years she had remained in the condition in which I saw her, always having a good appetite and being very active. At variable intervals, however, especially in winter, she coughs and spits again for several weeks, is slightly feverish in the evening, has less appetite, and is obliged to keep her room. I employed auscultation, and found a focus of tubercular lesions at the apex of one lung."

It must be borne in mind that the terms "pulmonary tuberculosis" and "phthisis," if

we preserve the old meaning of "consumption" for the latter, are not absolutely synonymous and do not exactly correspond, and that sometimes pulmonary tuberculosis pursues its course without the machinery of phthisis, and reaches a more or less advanced stage under the guise of health. Generally speaking, every case of phthisis is at first latent, and may even remain unrecognised for a very long time; Laënnec speaks of a case of phthisis which remained latent ten years. Even in cases where the disease is absolutely certain, and, moreover, has reached a very advanced stage, there may be periods of arrest. Every doctor has observed these "truces" of tuberculosis.

Tuberculosis may undergo arrest at any stage; the intermissions are more frequent and prolonged at the commencement, but they may occur even with consumptives at the stage of excavation and wasting. An improvement, sometimes very rapid and remarkable, will be seen in an acknowledged consumptive suffering from hectic fever, repeated vomitings, profuse night sweats, diarrhœa, and very pronounced loss of flesh; the cough becomes less violent and the expectoration less copious, appetite returns, the vomitings, sweats, and fever disappear, flesh is regained; sometimes the patient is even able to resume his occupation. He appears to be cured.

These apparent cures, or truces of tuberculosis, are sometimes very prolonged, and may last several years—even fifteen, thirty years, or more (L. H. Petit).

Thus pulmonary tuberculosis is liable to undergo arrest, even at an advanced stage, and the health may again become good enough to give rise to the belief that it is a radical cure. The quiescent period may last many years, and in some cases, from its duration, it really is as good as a cure.

These periods of quiescence may be secured by treatment, but they are usually the work of nature (Marfan).

The predisposing causes which favour a first infection have a powerful influence on the recrudescence of tuberculosis: over-strain, life in a confined atmosphere, misery, intemperance, accouchement, and affections of the respiratory passages, especially influenza.

Consumption is susceptible of a complete and final cure; even desperate cases may recover (N. Gueneau de Mussy).

A few years ago the President of the French Republic sent the cross of the Legion of Honour to one of the last survivors of the *Grande Armée,* 103 years of age; this man had been discharged after Waterloo as an undoubted consumptive.

It is easy to cite illustrious examples of cured

consumptives; as Goethe, who was given up as hopeless at nineteen, and died at eighty-one; Napoleon I., who had pulmonary tuberculosis at the time of the siege of Toulon. Nearer our own time, we might mention the cases of Dr. Péan, F. Coppée, etc.

For a person formerly tuberculous to be declared cured, time must be the proof; a cure can only be affirmed in the absence of all morbid phenomena attributable to the disease, and if, during a long time and after repeated examination, no more bacilli are found in the sputa.

In closing this chapter we may then conclude, and the reader will bear in mind, that tuberculosis is curable, and curable spontaneously; that recovery is frequent, especially at the beginning, and possible even at the most advanced stages and in desperate cases; and that failing an absolute cure, an arrest of the disease or "truce" of long duration may be hoped for.

Tubercular lesions having a natural tendency to evolve towards a cure, the logical treatment of tuberculosis will consist in supporting the system in its struggle against the disease, so as to aid the curative efforts of nature.

CHAPTER XI.

THE CURE OF TUBERCULOSIS:—I. VARIOUS METHODS OF TREATING TUBERCULOSIS—DRUGS WHICH ACT ON THE BACILLUS—KOCH'S LYMPH—TREATMENT BY SERUM—SURGICAL TREATMENT.

THE means which can be employed in the cure of tuberculosis are of three kinds.

Some are intended to combat the disease by acting directly on its cause, the bacillus. Others aim at extirpating it at one stroke by surgical operation, by removing the organs or parts of organs affected. Still others have as their object simply to act on the body and sustain it in its struggle against the bacillus, to repair its strength and increase its resisting power, and to assist recovery by aiding the curative efforts of nature.

Knowing the cause of the disease, it seems at first sight an easy matter to cure it. Since the author of all the mischief is a microbe living in our tissues, the microbe must be killed.

Tape-worm is cured by administering to the sufferer a drug which kills the worm. To cure tuberculosis the patient must be made to absorb some medicament which kills the bacillus. This is true; but, unfortunately, such a medicament has not yet been found.

But, it may be said, there are innumerable antiseptics which hinder the development of microbes and kill them. Are not wounds disinfected with corrosive sublimate, carbolic acid, etc.? Will not these powerful antiseptics kill Koch's bacillus? Yes; but when it is a wound that has to be disinfected, it is easy to act on it direct, and to bring the antiseptics in contact with it in sufficient quantity to be effective: the antiseptic here acts locally, without penetrating the system. But when the bacilli are deep down in the tissues, like Koch's bacilli in pulmonary tuberculosis, medicaments can only reach them through the circulation. The antiseptic cannot come in contact with them till it has been absorbed, and has entered and circulated in the blood, which conveys it to all the organs. Now, these antiseptics which kill the microbes also act on the cells of the body; they are strong poisons, and the doses necessary to kill the bacilli would be fatal to the patient.

At present no substance is known which, when absorbed by the phthisical patient, will certainly destroy the bacilli which grow in the

tubercular foci of his body. But there are several things which appear to impede the growth of Koch's bacillus to some extent.

According to Professor Bouchard, among all the remedies suggested for pulmonary tuberculosis the least bad is creosote. Creosote is a powerful general antiseptic, not very poisonous, and capable, in moderate doses, of reaching the agents of infection through the circulation, without giving rise to symptoms of poisoning, and if it does not destroy the microbes, at least it hinders their development and propagation. Unfortunately its action is most uncertain; in other words, creosote is not a specific for tuberculosis. A medicine is said to be the specific for a disease when it possesses the property of acting definitely and with certainty on it; thus quinine is the specific for marsh fever, and salicylic acid for rheumatic fever. This is not the case with creosote with regard to tuberculosis; it is one of the best medicines that can be given to the tuberculous, but it cannot be administered to all alike.

The number of medicines employed in the treatment of tuberculosis is immense: arsenic, iodine, oil of turpentine, and tannic acid are the best known. Notwithstanding the richness of the therapeutic arsenal, we have as yet no specific remedy for tuberculosis. However, new therapeutic methods have been discovered

in recent years, which will perhaps some day solve the problem of the treatment of tuberculosis.

It is well known that infectious diseases, such as small-pox and typhoid fever, do not recur, and that a first attack of the disease confers immunity for the future, *i.e.* renders the system proof against a new infection.

From time immemorial the Chinese and Persians have known how to produce, by inoculation of small-pox, a slight attack, unattended with danger, which would protect from the disease in future by conferring absolute immunity on the person inoculated. This practice was introduced into England from Constantinople in 1721 by the wife of an Ambassador, Lady Montague, and successfully employed until Jenner's discovery substituted vaccination for inoculation. In the same way inoculation of the rot, or small-pox in sheep, is practised by farmers, both to prevent the disease and, when it does break out among a flock, to keep the epizoötic from becoming deadly. The system can be rendered proof against the development or the action of a microbe either by inoculation with the microbe diminished in virulence by special processes of culture, or by the introduction into the system of toxic products or toxins produced by the microbe. This provokes the elaboration by

the cells of the body of certain substances, some of which, called anti-bacillar or germicide substances, diminish the activity of the microbes, whilst others, called anti-toxins, increase the resistance of the system to the bacillar toxins.

Robert Koch had found by experiments on animals that the system can be modified by the products of the tubercle bacillus, and thus receive a certain degree of immunity. This led him to try if tuberculosis could not be combated by means of the products secreted by its infecting agent. He believed he had found the specific remedy for the disease, and announced at the Berlin Congress of Medicine in 1890 that he had succeeded in rendering animals proof against inoculation with the tubercle bacillus, and in arresting the progress of the disease in animals already inoculated. The reader will remember the stir, the hopes, and the enthusiasm aroused by Koch's tuberculin, or lymph, and the bitter disillusionment which soon followed. Professor Koch has since presented the medical world with a new tuberculin, much disputed, even in the country of its origin; but examination of the new product and experiments that have been made show that this tuberculin can no more be relied on than the first.

The curative effect of Koch's tuberculin is *nil*, and it is absolutely abandoned as a remedy

for tuberculosis; it is now only used for its diagnostic power. An injection of tuberculin does provoke in tuberculous subjects, and in them only, a febrile reaction which reveals any tubercular affection, and permits of its discovery, however unsuspected or obscure. It is much used in veterinary medicine for the diagnosis of tuberculosis in oxen (Nocard), and can also be employed for an early diagnosis of human tuberculosis in doubtful cases. We know how important it is that tuberculosis should be discovered early, in order to commence treatment, which will be the more effective the earlier it is begun. From this point of view Koch's lymph may yet be of service, but how far we are from the results announced by Professor Koch!

Since the discovery of serum therapeutics, we may hope again, and trust that some day it will be possible to apply this new method to the cure of tuberculosis. But "though the progress of the new therapeutics should be marvellous, however perfectly curable tuberculosis may become, it will never be so easily cured as avoided" (Landouzy).

Every one to-day has heard of serum therapeutics. Everybody knows that the serum of Dr. Roux, of the Pasteur Institute, cures diphtheria and croup, and that, thanks to it, the majority of children are now saved, where they

used to succumb to this terrible disease. Serum therapeutics is the name given to treatment of an infectious disease by injections of serum—that is, the clear yellowish fluid which separates from the clot when the blood coagulates—from the blood of animals made proof against the disease. This method rests on the anti-bacillar properties possessed by the serum of an animal rendered immune, and on the effect it has, not only on the microbes, but also on their poisons. Thus, a horse is made immune from diphtheria by the injection of gradually increased quantities of diphtheritic toxin; the horse is then bled, and the serum of the blood collected. This serum, injected into patients suffering from diphtheria, not only impedes the growth of the diphtheria bacillus, but also destroys the power of the poisons secreted by the microbe and disseminated through the system.

The principle of serum therapeutics is applicable to all infectious diseases, as erysipelas, typhoid fever, tetanus, the plague, and small-pox, but hitherto the method has only been thoroughly tested and introduced into practice for diphtheria. Efforts have been made to apply serum therapeutics to tuberculosis. Dr. Marigliano employed the serum of an animal, such as an ass or horse, made immune by injections of toxins from cultures of Koch's bacillus. In some cases he found considerable

improvement in the general condition, with diminution of fever, increase in the weight of the body, and reduction of the number of bacilli in the sputa. Trials have also been made with the serum of animals which naturally resist tuberculosis, such as the goat and dog, with serum from the blood of a goat inoculated with tuberculin, and with ordinary human serum taken from persons free from tuberculosis.

Hitherto none of the serums experimented with have given any certain result, and one cannot yet judge of their value. But we may reasonably hope that the method which has given such brilliant results for diphtheria will at length supply us with the means of curing tuberculosis by striking at the cause of the disease, by killing the bacillus and neutralising its toxins. Indeed, it is not enough to kill the bacilli. The dead bacilli continue their action by means of the toxins they contain. If we inject into an animal's veins dead tubercle bacilli, killed by a temperature of 257° Fahr., on autopsy we find tubercles with these dead bacilli at their centre. This experimental disease is called necro-tuberculosis. It proves that the bacillus, penetrating to the tissues, causes the formation there of tubercular matter by the poisons which it produces, and which are retained in it after death.

What we know of the destructive necrosing action of the dead bacilli on the cells of our tissues indicates that, to bring about the recovery of an individual suffering from tuberculosis, it is not enough to prevent the propagation of the bacilli, or even to kill those contained in the organs; it is also necessary to deal with the effects on the system of these bacilli, which, though lifeless, still contain toxic products capable of bringing on suppuration and mortification of the tissues around them. The rational treatment of tuberculosis will therefore consist in killing the bacilli which have invaded the system, or at least in diminishing their vitality so as to hinder their multiplication and the formation of the toxins; and in destroying, neutralising the action, or provoking the elimination of the toxins accumulated in the system, which continue to be produced as long as virulent bacilli exist in the body. To attain this object one means alone is at present within our reach; this consists in fortifying the vital energy of the affected organism, so as to enable it by its own efforts to overcome the disease, destroy the bacilli, and annihilate and throw off their toxins.

Observation has shown that tuberculosis is curable spontaneously, and that hygienic treatment alone is effective. The principal aim of the treatment must therefore be to get the

patient into the best physical and mental condition, so as to increase his resisting power, and favour nature's tendency to recovery by seconding her efforts. "It has been too often forgotten of late years," says Dr. Marfan, "that the bacillus is not everything in pulmonary tuberculosis. When the bacillus gets in, in order that it may grow the system must give consent. The bacillus can do nothing unless there has previously been some internal trouble which permits it to germinate; such a trouble is realised by all the predisposing causes of consumption we are acquainted with, or by hereditary predisposition." It may be concluded that in perfect health our system carries within itself means of defence against the invasion of tubercle, and that the predisposition consists in the loss of these. We are thus led to think that perhaps the best means of curing consumption is to transform the predisposed organism in such a way as to bring it as nearly as possible into the condition of a perfectly healthy organism.

Experience proves that those treatments succeed best which are guided by this principle. "After incalculable labour," says Professor Peter, "modern medicine, like common-sense, reaches the conclusion that the best treatment for tuberculosis is hygiene, which prevents the

tuberculisable from becoming tuberculous, and the tuberculous from becoming more tuberculisable."

A regulated diet and mode of life, coupled with certain pharmaceutical preparations, can in fact radically transform a system which is not too far gone, and it is this transformation which should be the object of therapeutic efforts. If this can be effected, tuberculosis will often be found to stop in its evolution, retrograde, or even completely disappear.

Before passing on to the study of the treatment which aims at transforming the system of the consumptive, we must mention the surgical operations which aim at destroying the tubercular foci. These operations are especially performed in cases of local tubercular disease of the glands, bones, joints, etc. In late years, however, daring surgeons have attempted to extirpate tubercular foci in the lung. Surgical treatment of tubercular peritonitis is regularly practised, and in a large number of cases renders it possible to save patients otherwise doomed.

In view of the exceptional rarity of recovery from tubercular meningitis, and the happy results obtained by surgical intervention in cases of peritonitis, endeavours have been made to cure meningitis by trepanning the

skull and incising the meninges, but hitherto the results have not been encouraging.

For local tubercular disease, and especially lesions of the bones and joints, surgical treatment is brilliantly successful. We cannot here enter into the detail of the multifarious operations performed in cases of tubercular abscess, ostitis, or arthritis. The object aimed at is always the destruction of the whole tubercular focus as completely as possible; the smallest fragment of virulent matter escaping the surgeon is enough to perpetuate the disease.

The surgical treatment of tubercular affections, wherever situated, must necessarily be supplemented by general treatment for tuberculosis, and especially by the practice of the hygienic means which we have now to study.

CHAPTER XII.

THE CURE OF TUBERCULOSIS:—II. THE HYGIENIC TREATMENT OF CONSUMPTION—REST—THE AIR CURE — SANATORIA — THE MOUNTAIN CURE—THE SEA CURE — DIET — NUTRIENT MEDICINES — STIMULATION OF THE SKIN — HYDROPATHY.

We have already said, and it cannot be repeated too often, that tuberculosis is capable of spontaneous cure, and that treatment need have no other object than to transform the system of the consumptive so as to put him in a condition to overcome the tubercular infection himself. To attain this end hygienic treatment alone is effectual.

A life of rest in the open air; this is the most powerful means we possess of transforming the system of a consumptive. Moreover, this method is never contra-indicated; it is applicable to all patients and to all forms of tuberculosis (Marfan). The regulation of life will be combined with regulation of diet, nutrient medicines, such as cod liver oil, arsenic, and

phosphorus, and lung gymnastics and stimulation of the skin. With the aid of these means, especially the regulation of life, time and patience will make a consumptive a healthy man.

Rest is the only means of preventing wear and tear of the system; the consumptive needs all his strength to fight the disease; he must be economical, avaricious, with it, and so rest must be as complete as possible. At the outset of the disease the consumptive may still take extremely moderate exercise in the open air, but in the more advanced stages he must remain almost absolutely at rest. This rest must not only be bodily, it must be accompanied by the cessation of all intellectual work, and as far as possible by moral tranquillity. This means that it is necessary for the patient to give up his daily occupation entirely and devote himself solely to the treatment of his disease.

We mentioned in a previous chapter the influence of moral causes on the development of tuberculosis; they are not less important from the point of view of treatment. Moral tranquillity and well-being, faith and hope, are powerful factors in the cure. "The moral duty of a doctor called in to a consumptive is no less important than difficult," says Dr. Marfan. "When he has diagnosed the disease

the first difficulty that presents itself is, shall he enlighten the patient on the nature of his trouble? Even yesterday every doctor would have answered no. It was considered a duty of humanity not to tell the patient that he had a disease whose reputation as being incurable appeared, unfortunately, well-merited. To-day the conditions are changed; it is established that the best treatment of consumption consists

FIG. 13.—OPEN-AIR SHELTER.

in a special regulation of life, which must be rigorously and minutely followed out. Can a patient be expected to radically change his mode of life without being given to understand the seriousness of his condition? We think not. So, unless the case is hopeless, or there are special circumstances, the value of which the doctor will judge for each individual case, we regard it as a duty to inform the patient of his condition."

The patient must know what he has got in order to understand the necessity of the treatment imposed on him. It must not be concealed from him that recovery can only be secured by perhaps very prolonged treatment, and by absolute submission to the doctor's orders, but he must be convinced that his recovery is possible, and his physical strength and his will must be kept up by hope. "To recover," says Professor Grancher, "it is above all necessary to wish it, to will it, to will it a long time." The patient must therefore, in full knowledge of the facts, devote himself solely to the treatment of his disease; he must give up all physical labour and put aside all mental and moral pre-occupations; his sole care must be to get better. To do this he need not shut himself up at home or seclude himself in his room, as patients with affections of the chest are too apt to do.

"I know of nothing more abominably fetid," says Professor Peter, "than a rich consumptive's room. The place is carefully closed up, and air, like hope, is forbidden to enter. There are draught-pads on the doors, draught-pads on the windows, thick curtains round the bed; there the unfortunate consumptive stews in his own steam, in the air he has breathed twenty times already, contaminated twenty times already with his ulcerated lungs. And

the air is not contaminated by him alone, but also by the wife or nurse who attends him, the night-light on the table, the lamp, and the fire on the hearth, and still more by the odour of drugs and decoctions, and the fetid emanations of perspiration, expectoration, and evacuations. The result is odiously repulsive." On the contrary, what the consumptive needs is air, as much as possible, and as pure as possible. Disordered lungs need pure air just as an overwrought stomach needs light food of best quality. "A disordered stomach," says Dr. Charrin, "must be given delicate food, easily reducible to pulp, so as to be more readily digested; for disordered bronchi and lungs it is important to avoid unrenewed air; one might as well give bad meat to a dyspeptic."

The bedroom of the consumptive should be as roomy as possible, plenty of light should get into it, and ventilation should be constant. We pointed out above the powerful influence on microbes of the sun's rays, which kill them, or at least hinder their development and enfeeble their virulence. Moreover, light acts on our system as a stimulant of nutrition. "Of all flowers," excellently says Michelet, "the human flower has most need of sunshine." The powerful influence of light on the mind and the imagination is no less important. The sun is a magician, who transforms and

beautifies, consoles and cheers, gives joy and hope. "I would like," says De Goncourt, "a room flooded with sunlight, furniture all eaten by the sun, and hangings whose colours are all gone, faded by the southern rays. There would I live in golden imaginings, with my heart warmed, and my spirit cradled and bathed in light, in the melodious sweetness of a great

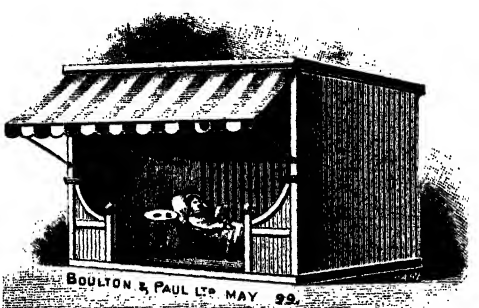

FIG. 14.—OPEN-AIR SHELTER.

peace." Such should be the room of the consumptive.

All doctors are agreed in advising constant ventilation of a consumptive's room; the windows should remain open all night, whatever the weather. In the daytime, the patient will live in the open air. This practice constitutes the *air cure*, and it gives excellent results.

Unfortunately, it is difficult to put in practice in the town, where the air is not pure enough; it requires the patient to stay in the country; moreover, life in the open air and rest are very difficult things to get patients, and especially their friends, to accept. Thus it is generally in special institutions or sanatoria, closed to outsiders, that the air cure is applied. There, sheltered from all that might disturb their treatment, the patients are subjected to a severe and inflexible course of discipline, extremely favourable to the success of the cure.

Institutions for the cure of pulmonary tuberculosis by constant fresh air and rest should be established away from towns. Pure air and sunshine being the most powerful enemies of tuberculosis, a climate must be chosen for sanatoria which combines these two elements, and also possesses an equability which allows of exposure to the open air for the largest possible number of hours daily.

The first sanatorium for consumption was founded at Göbersdorf (Silesia). The principal establishments of the kind are those at Falkenstein (Taunus), Davos (Engadine), and Leysin (Switzerland); and in France those of Le Canigou, at Vernet-les-Bains (Pyrénées Orientales), Trespoey, near Pau, Château-de-Durtol (Puy-de-Dôme), and the smaller ones at Meung-sur-Loire, and Gorbio, near Mentone. At length

much has been done in England to combat the ravages of consumption, and, as will be seen from Chapter XV., sanatoria exist in the best parts of the country. At Le Canigou patients do the cure in pavilions and glazed galleries, at various altitudes from 2,100 to 2,300 feet, connected by gently sloping roads which make it easy to pass from one to another. These pavilions and galleries are open to the south-west. They get the sun from before noon to sunset. While the patients are there they are *constantly open;* they are only closed in the exceptional event of a gale. At Le Canigou and Trespoey, as at the German sanatoria, the patients spend the greater part of the day, from 9 A.M. to 10 P.M., lying on long chairs in the pavilions and galleries. Each patient has by his side a table, where he puts the things he may want, such as his spittoon, books, ink-stand, blotting-paper, and permitted games (chess, draughts, dominoes, and backgammon). A circumstance worthy of remark, and not least surprising to those who visit the sanatorium, is the atmosphere of gaiety which prevails. The consumptives who are doing the cure, having regained their appetite, and seeing their cough and night sweats rapidly diminish, once rid of these troublesome symptoms, take heart again; they see that their disease is not irremediable, and thus with

hope recover a moral tranquillity which contributes powerfully to their recovery.

Now this is how a consumptive passes his day in a sanatorium. At the signal for rising, about 8 A.M., a servant enters the rooms and closes the windows, *which have remained open all night;* he lights a fire, rubs the patient down dry or with spirits, and serves a first breakfast. Then the patient comes down and goes to the "cure"; he settles down on his long chair till the eleven o'clock meal, with his legs wrapped in a rug and his feet on a hot-water bottle. "One takes cold by the body, not by respiration," says Professor Peter; "cover yourself well in bed, breathe pure cold air, and you will be warm." At eleven, breakfast proper, after which the patients take a walk, the distance varying according to the doctor's orders. After the walk, the patients return to the "cure"—*i.e.,* resume their long chairs, and spend the whole afternoon in almost absolute rest. At six the patients dine. On leaving the table, another walk, shorter than the afternoon one, and "cure" again till 10 P.M. Ten is the hour for retiring; the patients sleep in flannel night-shirts. *All night, whatever the weather, the window remains more or less open;* the foot of the bed is protected by a screen. Such are the regulations to which the patients are subjected, *whatever the weather.*

The facility with which the consumptives get used to the cold is most remarkable. As soon as they are acclimatised, there is an improvement in the general condition, and in particular a marked diminution of the cough. Moreover, the patients are taught to govern their cough, and only to cough when expectoration will follow. There are two kinds of cough in pulmonary consumption: one is caused by irritation of the bronchi, while the other is occasioned by the presence of secretions which must be expelled. The first is useless and should be combated. The patient should resist the inclination to cough when he knows that the cough will not be followed by expectoration. The fever diminishes, and the almost invariable result of this is the prompt and complete cessation of the night sweats. It often happens that the mere fact of sleeping with the window open stops the sweats. After a short time the digestion recovers, the flesh is regained, and the spirits revive. The bacilli in the sputa are found to be reduced, and then disappear.

In the galleries, the patients pass the day in a sunlit place, but are never exposed to the sun's rays. The cure must be done in the shade; the mere exposure to the sun is capable of maintaining fever and bringing on headache and hæmoptysis.

Besides the meals, patients whose cure does not necessitate extra food are in no way bound to take food regularly, as is the case abroad.

On entering the sanatorium, each patient undertakes, on pain of expulsion, never to spit on the ground nor into a handkerchief. Each has two spittoons at his disposal, a pocket spittoon for walking, and a hand spittoon for use at the cure day or night. Spittoons are also scattered everywhere about the establishment where patients can go. All spittoons always contain a quantity of antiseptic fluid. Every morning their contents are mixed with sawdust, so as to form a semi-solid mass, and burned. All the patients' linen is disinfected by fumigation before being taken to the wash. When patients leave, the rooms they have occupied are subjected to a thorough disinfection. On the average, 40 per cent. are cured, and as many more improved in health.

The rules adopted at sanatoria can be put into practice at private houses in the country; but patients at liberty have much difficulty in rigorously observing the discipline essential to the success of the cure; from every point of view, residence at a sanatorium is preferable.

The open air and rest cure can be done anywhere where the temperature only varies slightly, where sunshine is plentiful, the air pure and free from fogs, and the soil dry.

Residence at an elevation, or the *mountain cure,* is particularly favourable to consumptives. Elevated stations, from the purity of the air, free from germs and dust, the activity of respiration and circulation induced by the lessened atmospheric pressure, and the intensity of the light, give truly remarkable results both for improvement and cure (Dieulafoy).

Most sanatoria are situated at considerable altitudes. Falkenstein is situated at 1,640 feet, Château-de-Durtol 1,700 feet, Göbersdorf 1,830 feet, Le Canigou 2,300 feet; the most elevated stations are Davos-Platz 5,100 feet, Samaden 5,720 feet, and St. Moritz 6,090 feet, in Switzerland. In France we may mention Amélie-les-Bains and St. Gervais, 2,870 feet, in the Mont Blanc region; Gréoulx in Basses-Alpes, 1,150 feet, and Grasse (Alpes-Maritimes).

Alongside of the mountain cure we may put the *sea cure.* The ancients had found that the sea air is favourable to the cure of tuberculosis. Aretæus and Pliny already advised sea voyages.

Laënnec was convinced of the beneficial action of sea air on consumption. "Of all the means hitherto tried against consumption," says he, "none has been more often followed by the suppression or total cessation of the disease than change of scene. The seaside, especially in mild and temperate climates, is

undoubtedly the place where the greatest number of consumptives are found to recover."

The happy effects of the sea cure are most clear and indisputable in a large number of troubles, rickets, scrofula, tuberculosis, especially local tubercular disease, such as white swellings, hip-joint disease, and Pott's disease. The seaside climate is a powerful aid to nutri-

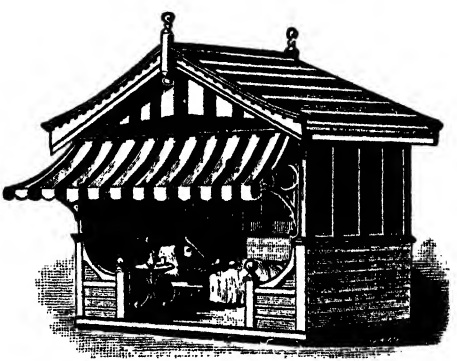

FIG. 15.—OPEN-AIR SHELTER.

tion; it gives tone to the system, induces improved respiration, and stimulates digestion. It is particularly favourable to those predisposed to tuberculosis. The stations most recommended are Biarritz and Arcachon. The climate of Arcachon is especially recommended to persons suffering from pulmonary tuberculosis. Besides the influence of the seaside

climate, one gets also that of the resinous forest air (Lalesque).

A number of seaside sanatoria have been founded for the treatment of tuberculous children; those of Berck-sur-Mer, St. Pol-sur-Mer, and Pen-Bron are well known. The results obtained are excellent; the estimated average of cures is 80 per cent. The children have to stay there a very long time, several years, five or six sometimes.

The Verneuil institute at Escoublac-la-Baule is at once a sanatorium and an educational establishment. It is to be hoped that establishments of this kind will multiply, not only for rich children, but for poor ones too.

The Œuvre des hôpitaux marins (Seaside Hospital Society) in particular should be mentioned and encouraged. Its object is to take in, relieve, and cure the innumerable wards of the Departmental Guardians, formerly known as foundlings, who, born in the most wretched social and material conditions, for the most part owe to their conditions the development of rickets, scrofula, and tuberculosis, when they have not the germ at birth. Now these diseases, so varied in their forms, can be cured by the seaside treatment, which straightens the limbs, heals the running sores, and picks up the constitutions of these ill-developed, sickly, deformed children, and thus succeeds in making

them into healthy people; and turns invalids who are a charge on society into strong, able-bodied persons, useful both to themselves and to their country. Such are the remarkable and precious results obtained at the sanatoria of Banyuls-sur-Mer (Pyrénées Orientales) and St. Trojan (Ile d'Oléron), which both belong to the Œuvre des hôpitaux marins. They are solely due to the sea, which penetrates those poor, feeble bodies, purifies their blood, eliminates the evil elements due to heredity or misery, and little by little gives them vigour and health.

The sea and the mountains are equally good. The value of both, before all and above all, lies in the purity of the air. Both give marvellous results from the rigorous practice of the air and rest cure. The essential thing is the air and rest cure. The only conditions necessary in the place of the cure are purity of air, equability of temperature, rarity of wind, and exposure to sunshine.

The Mediterranean winter resorts, Hyères and Costebelle, Cannes and le Canet, Antibes, Villefranche, Beaulieu and Mentone, Ajaccio, Algiers, and Madeira in the Atlantic, offer very favourable climates for consumptives, on condition that they subject themselves there, as everywhere, to the rest and open air cure. We may also mention as watering-places, Les Eaux-

Bonnes in Basses-Pyrénées (2,450 feet) and Mont-Dore in Puy-de-Dôme (3,430 feet). The choice of a station is of much less importance than the kind of life one leads there.

Patients must above all adopt a residence and do the cure there; the cure must be uninterrupted. Some patients at winter stations return home when March arrives; others are

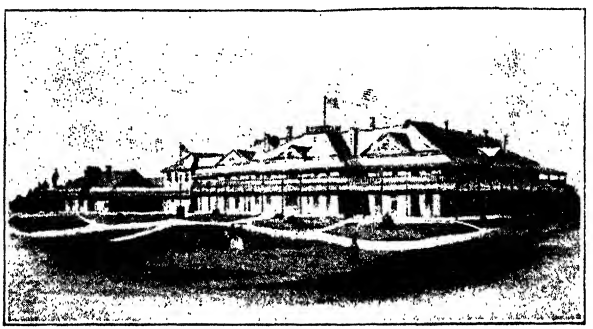

FIG. 16.—THE KIMBERLEY SANATORIUM, SOUTH AFRICA.

constantly travelling about, from one resort to another, from sea to mountains. These changes are extremely prejudicial to the success of the treatment by rendering any regular system impossible. The open air and rest cure should be uninterruptedly followed, not for months, but years.

One very important conclusion follows from

what we have been saying, that patients can very well be treated in the district where they usually live, provided that the air is pure, and they have enough good sense and will power to regulate their life, without which the climate, whatever it be, will have no effect. In fact, as Littré has said, "It is not enough to give the patients a better climate, they must also be taught the daily means of profiting by it."

The cure by rest and constant exposure to the air is as yet hardly possible to any but those who enjoy the leisure of wealth.

It is a matter of necessity to establish sanatoria near all large towns for the treatment of the poor. The establishments that have been founded are still too few, and are almost exclusively for tuberculous children. We have already spoken of the Œuvre des hôpitaux des marins. We must also mention the Œuvre des enfants tuberculeux (Tuberculous Children's Society), Ormesson hospital, and the Etablissement de Villepinte (near Paris), founded for anæmic and consumptive young girls and children. Up to the present there are in France two sanatoria only, with two hundred beds, open for the treatment of the adult poor according to the new methods. These efforts should be encouraged and imitated. To secure to every consumptive, whatever his social position, his wealth or poverty, the attention

necessary for recovery, it is a duty both of humanity and of public interest.

Every effort must be made by those consumptives who cannot think of giving up their occupation to get constant fresh air at it as far as possible. They must choose an exposed dwelling, where plenty of air and light get in; upper storeys are favoured in this respect, and have the advantage of being less exposed to the dust of the street. Narrow dark streets where the sun never penetrates must be avoided. The windows of the bedroom must be partly open at night, and widely opened to the sunshine during the day. They must only be closed during the patient's toilet.

Whatever rules the consumptive follows, if he practises the air and rest cure, and especially if he continues to work, his food must be particularly choice, wholesome, and plentiful. The consumptive loses a very large amount of nutritive substances through the incessant losses resulting from fever, expectoration, sweats, and diarrhœa. It is therefore a prime necessity for him to eat as much and as well as possible, as far as the state of his digestion will allow. The success of the treatment depends on the patient's ability to digest and assimilate his food; the consumptive's digestion should be the object of the most careful attention, pious care, as Professor Peter puts

it. The diet should therefore be varied according to the condition and strength of the digestive organs. Generally speaking, the amount of nourishment which corresponds to the appetite of a healthy man is insufficient for a consumptive.

What the consumptive needs is not merely food enough to sustain his system, but a surplus to modify it. He requires a double ration, the sustenance necessary for every individual, plus an allowance for his cure (Grancher). With such additional food a general improvement is soon noticed; the sweats cease, the cough and expectoration diminish and then disappear, the strength increases, and the patient regains flesh.

The consumptive should live especially on meat (roast meats and raw meat), eggs, fatty foods, and milk; he should eat few farinaceous foods, and still fewer green vegetables; for drink, he should take tea with a little alcohol in it, or beer, rather than wine. As a general rule, all foods are good, on condition that they are digested.

The hours of the day spent in eating and digesting good meals, and those of the night in that excellent restorative, sound sleep,—such is the programme for a consumptive, whoever he be, if he wants to get well.

To diet must be added the use of nutrient

medicines, or special nutritive foods. In the front rank comes cod liver oil, which is eminently useful to consumptives, if it is tolerated well and taken in sufficient doses, in large glassfuls. Chloride of sodium and the phosphates are also much used as nutrient medicines; their administration supplies the enormous loss which results from expectoration, as pointed out above. Moreover, chloride of sodium stimulates nutrition.

The air and rest cure, and food, must also be supplemented by the powerful influence of stimulation of the skin by friction and hydropathy. Through the action on the skin the consumptive's nervous system and nutritive functions are stimulated, and his general condition improved.

CHAPTER XIII.

THE CURE OF TUBERCULOSIS:—III. GENERAL TREATMENT OF LOCAL TUBERCULAR AFFECTIONS—HIP-JOINT DISEASE—POTT'S DISEASE.

WE cannot here speak of the multifarious operations performed in cases of local tubercular disease. The hygienic treatment, which is the indispensable complement of all surgical intervention, and which often suffices to induce recovery even without any operation, is the same as for pulmonary tuberculosis.

The air cure and diet are the first conditions of the treatment. The sea cure gives especially remarkable results in the treatment of local tubercular affections. Tuberculous children are much better for a stay at the seaside; this is evidenced by the marvellous results obtained at Berck and St. Pol-sur-Mer.

In tuberculosis of the joints a most important part, both from the curative and the protective point of view, devolves on the methods which secure rest to the parts, while preventing bad attitudes, and deformities like those of the vertebral column, which would otherwise be inevitable.

Treatment by immobilisation and rest in the horizontal position, applied from the outset to Pott's disease, or tubercular arthritis of the leg, together with fresh air, especially at the sea-side, and diet, induces a greater number of cures in young persons than any other method.

In cases of white swelling, or of hip-joint disease, the joint must be given absolute rest from the outset. This is the best of all means, and the only essential one, without which all others are useless. The patient must be kept in bed, lying horizontally on his back. If the limb is in a bad position, it must be straightened and immobilised in a good one. Immobilisation must be applied from the beginning of the symptoms, without any interruption, for a very long time, sometimes for two or three years. This is the way to secure complete recovery from tubercular hip-joint disease without complications, and the cure will be the more speedy the earlier the treatment.

The same with Pott's disease, the only effective way to stop the progress of the initial tubercular focus and prevent the formation of angular curvature is rest on the back and early and prolonged immobilisation of the vertebral column.

In all tubercular disease of the bones and joints the cure must be chiefly the work of nature, time, and rest.

CHAPTER XIV.

CONCLUSIONS.

FROM what we have seen we may draw the following conclusions:—

Tuberculosis is the most terrible of human diseases.

Tuberculosis is a formidable *contagious* disease.

The active cause of the disease is a microbe, Koch's bacillus.

Contagion is most often effected by the expectoration of tuberculous persons, and by milk and meat from tuberculous animals.

It is possible to prevent tuberculosis:

(1) By all means calculated to prevent contagion or the dissemination of the bacilli; isolation of tuberculous persons at home or in hospital; regulations against spitting on the ground; use of spittoons; disinfection of all places and articles contaminated by tuberculous persons; inspection of meat at the abattoirs; boiling of milk before consumption.

(2) By preventing and combating the predis-

position by means of hygiene, fresh air, and diet.

It is possible to cure tuberculosis by hygienic treatment, consisting chiefly in rest, life in the open air, and abundant food. To recover it needs determination, perseverance, and absolute submission to the discipline and rules prescribed by the doctor.

Sanatoria for the treatment of tuberculosis by the rest and open air cure must be multiplied, especially for consumptives of the middle and working classes, who cannot have attention at home.

From the social point of view, the crux of the question is not in cure, but prevention; and its eventual solution is not to be found in the establishment of sanatoria, but in the amelioration of the conditions of life. Tuberculosis preys especially on the poor, who are badly housed, underfed because underpaid, overworked, and often addicted to drink, and who have besides insufficient rest, fresh air, and sunshine. It is obvious that these predisposing causes, in their larger issues, are beyond the control either of doctor or patient. They are intimately connected with the housing and labour problems, in dealing with which the Legislature must be stimulated and supported by the public conscience.

CHAPTER XV.

THE ENGLISH ASPECT OF TUBERCULOSIS.

THE situation in England, though not nearly so bad as in France, is serious enough. Every one beyond the age of childhood has known some friend or acquaintance who has died of consumption.

The death-rate from consumption in France is 3.02 per 1000; in England, where it has been reduced 45 per cent. in forty years, it is now 1.35, or about 7 per cent. of the total; that is to say, one person in every fourteen dies of consumption; and if we include all forms of tubercular disease, the proportion is one in nine.

The article, "The Associations of Phthisis in England," published in the *Catalogue of the Museum of the British Congress of Tuberculosis, 1901*, was illustrated by charts and tables, some of which Sir Hugh Beevor has allowed us to reproduce. The facts collated from the most recently available official returns are calculated to assist in describing the situation of phthisis in England.

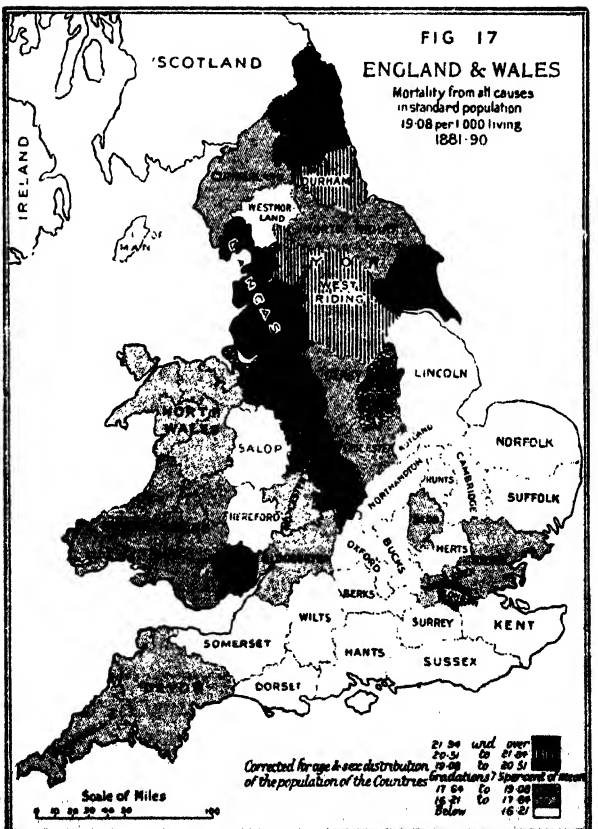
FIG 17
ENGLAND & WALES
Mortality from all causes
in standard population
19·08 per 1 000 living
1881·90
SCOTLAND
IRELAND
DURHAM
WESTMOR LAND
I. of Man
WEST RIDING
LINCOLN
NORTH WALES
SALOP
NORFOLK
NORTHAMPTON
HUNTS
CAMBRIDGE
SUFFOLK
HEREFORD
OXFORD
BUCKS
HERTS
BERKS
WILTS
SURREY
KENT
SOMERSET
HANTS
SUSSEX
DORSET
Corrected for age & sex distribution of the population of the Countries
Scale of Miles
0 10 20 30 40 50 100

The favourable comparison of England with France, and of the present with the past, is owing, among other causes, to the better sanitary conditions, better food, and generally higher standard of living now prevailing in this country, especially among the working classes. But it must not be forgotten that even now sixty thousand persons die of tuberculosis every year in England and Wales.

Much has been done by private and public enterprise, especially during the last five years, in the erection of sanatoria, and the education of public opinion on the subject. There are at present about a score of private open-air sanatoria in various parts of the country, with accommodation for about four hundred to five hundred patients in all. In England, the largest are the London Open Air Sanatorium, Pinewood, Wokingham; Stourfield Park Sanatorium, Pokesdown, Bournemouth; Nordrach-upon-Mendip, Blagdon, Bristol; and the East Anglian Sanatorium, Nayland, Suffolk; and there are others at Wells, Stroud, Bournemouth, and Cheltenham, in the west of England, Farnham and Wallingford, in the southern counties, Mundesley, Norfolk, and Shotley Bridge, Durham; as well as at Conway, in Wales; Milnathort, Banchory, and Edinburgh, in Scotland; and Rostrevor, in Ireland. These have all been opened within the last

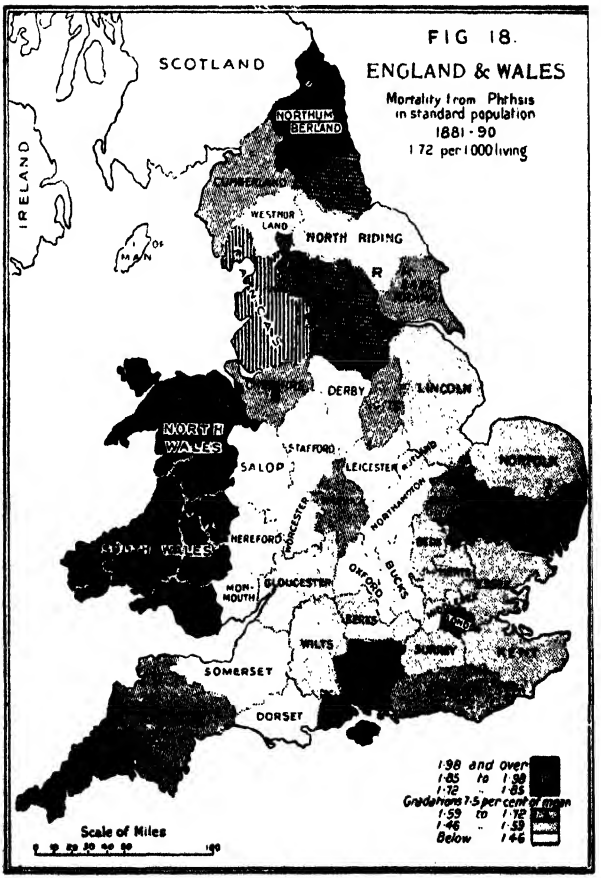
FIG 18.
ENGLAND & WALES
Mortality from Phthsis
in standard population
1881-90
1·72 per 1000 living
SCOTLAND
IRELAND
NORTHUM BERLAND
WESTMOR LAND
NORTH RIDING
I. of MAN
DERBY
LINCOLN
NORTH WALES
STAFFORD
SALOP
LEICESTER
HEREFORD
GLOUCESTER
MON-MOUTH
OXFORD
BUCKS
BERKS
WILTS
SURREY
SOMERSET
DORSET
1·98 and over
1·85 to 1·98
1·72 " 1·85
Gradations 7·5 per cent of mean
1·59 to 1·72
1·46 " 1·59
Below 1·46
Scale of Miles
0 10 20 30 40 50 100

three or four years. They average about twenty-five to thirty beds each, and the charges range from two and a half to six guineas weekly.

The private sanatoria are, of course, only for the comparatively well-to-do; but efforts are being made to bring the treatment within the reach of all classes. Besides the various London Hospitals for Diseases of the Chest, some of which, as well as several provincial hospitals, are now providing open-air treatment, a number of special sanatoria have been established. Horn Hall, Stanhope, Durham, is partly supported by patients' fees, partly by local authorities, partly by workmen's subscriptions, and partly by private subscriptions. The workmen have the first claim on the accommodation; while free beds are also allotted on subscribers' recommendations, and other cases are admitted on payment of £2 2s. per week, or (after investigation) what they can afford, if that sum is beyond their means. Out of one hundred and seventy cases discharged after treatment, one hundred are now at work; the great majority of these were admitted at an early stage. The Westmorland Sanatorium, at Meathop, near Kendal, is supported by the County Council and various other local authorities in the county, as well as by private subscriptions. Each subscribing district or body is allotted one free bed

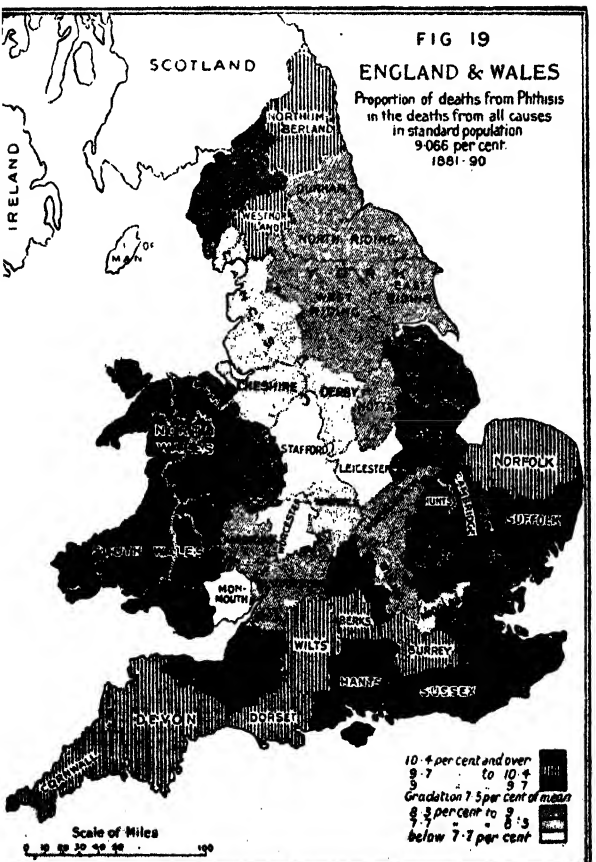
FIG 19
ENGLAND & WALES
Proportion of deaths from Phthisis in the deaths from all causes in standard population 9·066 per cent. 1881-90
SCOTLAND
IRELAND
NORTHUMBERLAND
WESTMORLAND AND CUMBERLAND
NORTH RIDING
CHESHIRE
DERBY
STAFFORD
LEICESTER
NORFOLK
SUFFOLK
MONMOUTH
WILTS
BERKS
SURREY
KENT
SUSSEX
DEVON
DORSET
CORNWALL
10·4 per cent and over
9·7 to 10·4
9 " 9·7
Gradation 7·5 per cent of mean
8·3 per cent to 9
7·7 " " 8·3
below 7·7 per cent
Scale of Miles
0 10 20 30 40 50 100

for each £50 subscribed, and other cases from the county are admitted, on certain conditions, at £1 weekly; cases from outside are admitted, if room, at £2 2s. per week. The average length of stay at Stanhope and Meathop is found to be three or four months. Other sanatoria on similar lines are actually open, in course of erection, or projected, for Liverpool, Bradford, Leeds, Notts, Devon and Cornwall, Gloucester, Somerset, and Wilts, Glasgow, Cumberland, and West Wales; and there is also the old-established National Sanatorium at Bournemouth, for the whole country. Many of these establishments owe their initiative to the work of the National Association for the Prevention of Consumption and other forms of Tuberculosis (which was founded under Royal patronage in 1898, and now has local branches in many parts of the country), and to the munificence of private donors.

The accommodation of three thousand cases per year, however, only touches the fringe of the matter; ten times this number can be dealt with in Germany. There is much yet to be done, both in the provision of sanatoria, and the establishment of Homes for advanced consumptives, of which there are only five in England. Advanced cases are not admitted into sanatoria as a rule, and therefore have to remain at home; yet the risk of infection

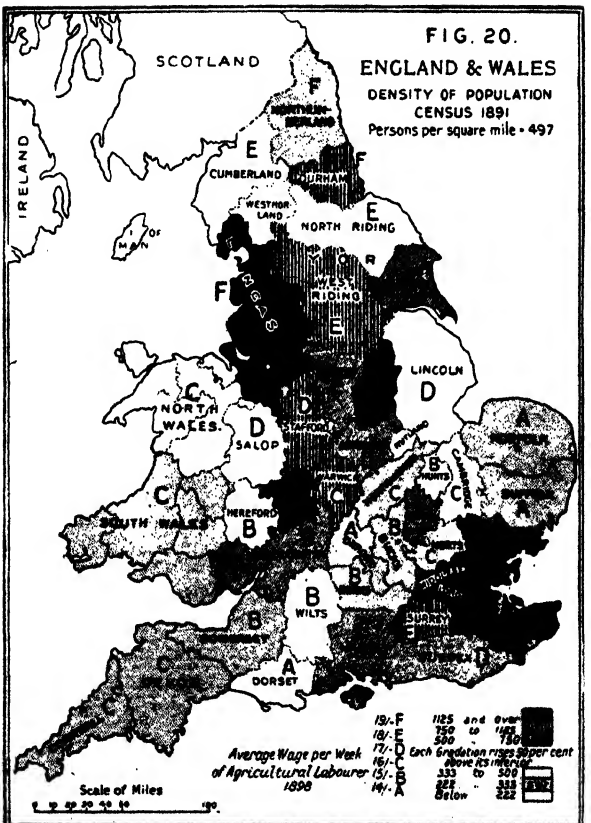
FIG. 20.
ENGLAND & WALES
DENSITY OF POPULATION
CENSUS 1891
Persons per square mile = 497
SCOTLAND
IRELAND
I. OF MAN
NORTHUMBERLAND
CUMBERLAND
DURHAM
WESTMOR LAND
NORTH RIDING
WEST RIDING
LINCOLN
NORTH WALES
SALOP
HEREFORD
SOUTH WALES
WILTS
DORSET
Average Wage per Week of Agricultural Labourer 1898
19/- F
18/- E
17/- D
16/- C
15/- B
14/- A
1125 and over
750 to 1125
333 to 500
Below 333
Each Gradation rises 5 per cent above its inferior
Scale of Miles
0 10 20 30 40 50 100

from them is far greater than from cases at an early stage.

The National Association is also doing excellent service in educating public opinion by means of literature and lectures, and in influencing public bodies, etc. The sanitary authorities in many towns have adopted voluntary notification of phthisis cases, and some of them also give free disinfection of premises that have been occupied by consumptives. Bye-laws against spitting in public places have been made in some towns by the municipal authorities, and in others, where this has not yet been done, notices conveying a warning against spitting have been posted in public places, and distributed in factories, etc.

The public generally are beginning to realise that consumption is not only curable, but preventable by simple precautions. When these are habitually observed by all, and supported where necessary or desirable by the action of public authorities and of Parliament, we may hope that the scourge of tuberculosis will be a thing of the past.

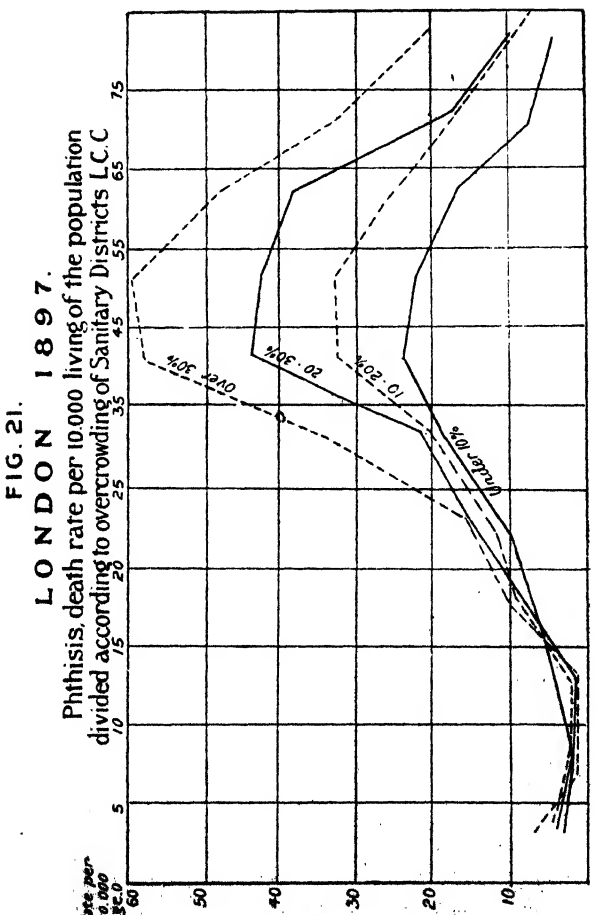

FIG. 21.

LONDON 1897.

Phthisis, death rate per 10.000 living of the population divided according to overcrowding of Sanitary Districts L.C.C

There are about 8000 people die in London every year of phthisis, and year after year the deaths are distributed among the population according to the chart on previous page. Each line groups the districts of London according to the proportion of the overcrowded population it contains, overcrowding referring to those who live more than two in a room, in tenements of one, two, three, or four rooms. About one-tenth only of the population are living in sanitary districts whose phthisis mortality experience may be traced in the lowest line—the best,—under 10 per cent. of overcrowding. As many as one-sixth reside in the districts whose experience is depicted in the highest line—the worst,—where over 30 per cent. of the population is overcrowded.

Table showing the Comparative Mortality of some Males from 25 to 65 Years of Age (1890-92) *from Phthisis.* (*Part II., Supplement, 55th Report of the Registrar-General.*)

	Phthisis (occupied males taken as 100).
Costermonger	239
Docker	175
Innkeeper	169
Tobacconist	151
Law clerk	147
Tailor	146
Chimney-sweep	140
Cab service	123
Seaman	123
Commercial clerk	117
Coalheaver...	116
Carman	105
Railway office clerk	104
Domestic servant	100
Occupied males	100
Carpenter	93
Milkseller	90
Manufacturing chemist	87
Railway guard, porter, etc.	79
Grocer	70
Agricultural labourer	62
Farmer	42
Engine-driver on railway	41
Clergyman...	36

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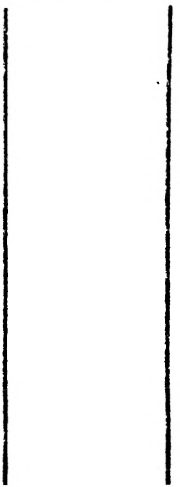

Del Langoles

Consumption