For the very early cases, in the hope of arresting the disease, sanatoriums should be erected, and one might suffice for two or three counties. These sanatoriums should be made of some cheap material, say wood, so as to be burned at times, and not of costly brick or stone, and the cheaper they are the better, if only efficient in other respects. For those intermediate between the early and the advanced cases who are able still to be at their work but too advanced for sanatorium treatment the greatest efforts should be made to instruct them (and indeed the whole people) as to the danger of tuberculosis and how much they can do by carefully disinfecting their expectoration and by not indulging in the filthy and dangerous habit of spitting, which should be made an offence punishable by a heavy fine. Everything that tends to educate the people of Ireland as to the danger of tuberculosis, such as lectures and exhibitions—like the one that is here—is to be encouraged, and I believe the visits among the poor in order to instruct them as to what is now known in regard to tuberculosis (especially as to cleanliness, sleeping in a room by themselves, and the treatment of the sputum) by the members of the various branches of the Women's National Health Association of Ireland will be of enormous aid. In the larger towns a dispensary for tuberculous patients should be instituted.

3. We must educate the people more and more as to the importance of keeping their houses clean and sanitary, well ventilated, not overcrowded, and so situated as to be properly lighted by the sun, and they must be taught what measures they can adopt to prevent the onset and spread of the disease; in other words, we must teach the people that they themselves have it in their own power largely to control the disease.

4. Temperance in all things should be inculcated, as well as the use of nourishing properly cooked food, and the laws of hygiene and temperance should be taught in the primary schools, which should be medically inspected.

5. As to meat, every person, rich or poor, should have a guarantee that all meat used by him has been inspected, and the veterinary inspectors in my opinion should be State officials. There should be public abattoirs or slaughter-houses and all private ones should be abolished. The same type of inspection of meat should prevail in town and country.

6. Considering the teaching of the recent report of the Royal Commission appointed to inquire into the relations of human and animal tuberculosis all cows with tuberculous disease of the udders should be forthwith slaughtered and those that react to the tuberculin test should be branded. The control of our milk-supply is so important that I believe it will never be managed rightly until the State takes it under its care, the regulations for inspection of the dairies (medical and veterinary), and for the clean production, conveyance, and distribution of milk being enforced by experts responsible to the State. It is time the truth was realised that the conditions which maintain health in the cows are very similar to those which we advise for the human race—that is, fresh air, proper ventilation, sunlight, suitable food, pure water, and cleanliness. The Department of Agriculture and Technical Instruction for Ireland and the various agricultural shows and societies, I trust, will unite with the Government in devising means for getting rid of tuberculosis in animals. I admit all these measures I have suggested will cost money and it is clear compensation for loss of cattle will have to be paid; but are we really to speak of money when, on the other hand, we contemplate almost 12,000 lives lost annually (with 120,000 ill) through a disease which science and experience show us is preventable? What money has been expended freely to stamp out cattle plague, foot and mouth disease, pleuro-pneumonia, glanders, swine fever, &c.? Are human beings of less value? To those who think that to rid Ireland of the white plague is an impossible task I reply in the words of the Spanish proverb in Don Quixote, "The beginning of health is to know the disease." We are now thoroughly acquainted with tuberculosis as we never were before and the experience of other countries shows what could be done in Ireland by combined effort. We are no longer in the doubtful position of the sailor of whom Ovid writes: "Hope it is which makes the shipwrecked sailor strike out with his arms in the midst of the sea, even though on all sides he can see no land."

"Haec [spes] facit, ut videat cum terras undique nullas,
Naufragus in mediis brachia jactet aquis."

We now see other lands where years ago tuberculosis was

far more prevalent than with us, they have since largely got rid of it, why can we not profit by their experience and follow their methods?

I rejoice to know that the public of Lurgan are joining the rest of their fellow countrymen in this glorious campaign to free our land from a plague that too long—largely owing to our want of education—has prevailed among us; but now that our mothers and our wives and our sisters have been awakened—thanks to the splendid efforts of one of the ablest, most benevolent, and large-hearted women that ever lived, Her Excellency the Countess of Aberdeen—we are all full of hope that a better time is in store for our beloved country and that the cloud and the stigma that hang over Ireland at present for her high mortality from a preventable disease will in time be completely removed.

THE EPIDEMIOLOGY OF PLAGUE.

WITH SPECIAL REFERENCE TO ITS MODE OF SPREAD AND THE MEANS BY WHICH IT MAY BE COMBATED.¹

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THE prevention of plague, even if judged merely from the hygienic and epidemiological standpoint, involves difficult problems which render the subject one of peculiar interest to those who in various lands have the care of the public health. My knowledge of the complicated bearings of the question is derived from the fact that for the past two years I have been studying these problems as they present themselves in the epidemic which is creating such havoc in India. One of the objects of this paper will be to show that there are reasonable grounds for believing that the pandemic of plague now chiefly affecting India may, in the near future, extend itself widely over the world, and by again visiting Europe cause another of those devastating epidemics with which history has made us acquainted.

On the present occasion I will keep as much as possible to the purely practical side of the question, without entering into the clinical, bacteriological, or other aspects of plague.

The subject may be conveniently arranged under the following three heads. 1. The course of the present pandemic of plague from its origin to the present time. 2. The mode of spread of the disease: (a) within an infected area, and (b) from an infected to an uninfected area. 3. The methods by which the disease may be combated: (a) prophylactic measures in uninfected areas, and (b) preventive measures in the epidemic zone.

The Course of the Present Pandemic.

For a proper appreciation of the dangers of the situation in which we are placed it is necessary to consider the course and history of the present pandemic from its origin to the present time. Two well-marked centres of endemic plague are now recognised to exist and the forms of the disease to which they respectively give rise are not in all respects alike. The differences, however, are not sufficiently distinct to warrant them being termed "varieties"; they are more correctly spoken of as different "strains" of the same disease and they have been named in accordance with their geographical distribution (1) the Western Asian strain and (2) the Indo-Chinese strain. Of the differences in their characters the two most striking are the greater virulence and power of extension of the Indo-Chinese "strain" and its marked association with rat mortality.

Plague has long been known to exist in Western Asia, but on account of its mildness and lack of power of extension it has come to be regarded with indifference, and public opinion in Europe has come to regard the disease as a purely Eastern one and as possessing no significance for modern Europe. It must be remembered, however, as a very important point, that the disease with which we have to deal nowadays is the virulent and diffusible Indo-Chinese strain of plague and not the milder and less important Western Asian strain. So far as is known the Indo-Chinese strain of plague originated in Yunnan, a province of Western China, about the year 1860, though in all probability it had existed in this little known province some

¹ Abstract of a paper contributed to the International Congress of Hygiene and Demography, held at Berlin in September, 1907.

years previously. From here it appears to have spread slowly and in an uncertain manner in an almost due easterly direction until it reached the coast. The line of its extension corresponds accurately with the chief trade route in this region and it is by reason of its following this course that the Chinese province to the north and India to the south with their teeming millions escaped infection at this time. It reached Pakhoi on the Tonquin Gulf in the year 1867, from which place, and also directly from Yunnan, it travelled to Canton which it reached in 1894; Hong-Kong which is in close proximity to and in intimate commercial relationship with, Canton became infected in the same year. Bombay was infected in 1896, a date which marks an important epoch in the history of the pandemic, for previously no extension inland on a large scale had taken place from any of the infected ports. How the disease was imported into Bombay is not exactly known. Plague cases and dead rats were first discovered in the vicinity of the docks accommodating cargo steamers from Hong-Kong. It commenced in a slow and insidious manner and it was some time before its real nature was recognised. The plague history of Bombay since 1896 has been marked by two features; first, the annual recrudescence of the disease in an epidemic form; and secondly, its extension inland, so that this city has acquired the character of being the great distributing centre from which the disease has spread nearly all over India. The rapidity and extent with which this has taken place have been further increased by the fact that perhaps now, for the first time in the history of the present pandemic, modern facilities of locomotion became available for its dissemination by land.

It was not until 1901 that the epidemic appeared to reach the Punjab, the most northerly province of India; in the spring of 1907 Peshawar, a city in the extreme north-west corner of India, was infected for the first time, and cases of the disease have recently been reported from Jellalabad and Kabul in Afghanistan. In addition the disease is slowly spreading westwards along other trade routes leading from India into Afghanistan; thus Dera Ismail Khan at the head of the Gomul trade route and Edwardesabad at the head of the Tochi valley have this year become infected. Further south, by another route, Seistan is already infected, so that the disease is showing a marked tendency to spread westwards by various channels of communication leading from India. It therefore appears highly probable that sooner or later the disease will make its appearance on the confines of Europe, and whenever this may happen, in consequence of its intimate commercial relations with the East, Constantinople is not likely to escape long. The historical facts of previous known pandemics show that in the first of them which occurred in the sixth century Constantinople (Byzantium) was infected from Pelusium in Egypt and from this city the disease spread widely over Europe. In the second pandemic which commenced in the eleventh century and was afterwards known in England as "The Black Death" the disease, similarly starting from the East, entered Europe by way of Constantinople.

The Mode of Spread of Plague.

The mode of extension of plague epidemics is well illustrated by the occurrences in the Punjab. First of all it is necessary to state that plague exhibits a seasonal periodicity which, though not the same in all places, tends to recur about the same time each year in any particular place. Thus in the Punjab it is only during the period from February to June that plague assumes epidemic proportions.

During the "free season," or that portion of the year in which the epidemic is not present, the disease may be introduced with impunity. For instance, during the period from August, 1906, to February, 1907, plague was imported on 15 occasions into the Jhelum district without it spreading to the inhabitants of the village or, as far as could be ascertained, causing rat mortality. As to the reason for this I am unable to offer any certain explanation, but the disease did not appear to remain latent until the arrival of the epidemic season, for no influence, either immediate or remote, could be traced to its importation at this time. In the month of February when the "plague season" commences a very different story is elicited. The occurrence of imported cases still continues and perhaps becomes more frequent, but now they give rise to rat mortality and to the occurrence of indigenous cases of the plague in man. The various modes by which this may take place will now be considered *seriatim*.

Spread by pneumonic plague.—It is a curious fact that pneumonic plague appears to be strictly confined to the first two months of the epidemic, a point recognised by Guy de Chauliac as long ago as 1348 but which recently does not appear to have attracted much attention, though its existence as a disease since its discovery by Lieutenant-Colonel L. F. Childe, I.M.S., in 1897 is a matter of common knowledge. As to the frequency with which it occurs, this appears to vary from year to year. During the present year, from personal investigations made at the time of the outbreak in 56 villages, pneumonic plague was responsible for the epidemic in nine, or 16 per cent., of the total. All of these occurred in the months of February or March—i.e., during the first two months of the epidemic. During this period it is responsible to a considerable extent for the spread of plague. Thus the effect of the introduction of one case was followed up and traced to five villages where, in spite of efforts made to stamp it out, it caused the death of 27 persons. But this was not all, for in addition it was also responsible for subsequent outbreaks of bubonic plague in two of these villages, with the result that 54 individuals also died from this form of the disease.

The history in all these cases is very similar and shows that the outbreak of the disease closely follows the arrival in the village of an individual suffering from, or incubating, pneumonic plague. It quickly spreads to the other inmates of the same house, often with such virulence that every individual is wiped out in the space of a few days. In my experience recovery rarely, if ever, takes place. The disease also spreads with alarming certainty to those who come in contact with the sick or tend the dying. By these it is spread to other households, who in turn infect their friends and relatives. From the evidence which has been collected it is impossible to resist the conclusion that the infection in pneumonic plague is direct from man to man but that it can also pass with ease from man to rat, and when this takes place an outbreak of bubonic plague on the usual lines follows.

Spread by the agency of man.—So much for the spread of the disease by pneumonic plague. This is, however, not the most usual course of events, for the history obtainable in the majority of cases is that at the onset of the plague season rat mortality was the first sign of the approaching epidemic. In the case of endemic areas no cause for this can be assigned, but in previously uninfected villages it will frequently appear that this has been preceded by the arrival of a person suffering from plague or who developed the disease shortly after arrival. A typical history of such cases is that about one week or ten days after the disease was thus imported by an infected individual dead rats began to be noticed in the vicinity of the house occupied by this individual.

The future course of the disease is characteristic. Starting from the house forming the original focus of infection the area in which dead rats are discovered gradually increases, then in the vicinity of the house in which dead rats were first found a plague case occurs. From this time the epidemic may be said to begin, at first slowly, with perhaps only one or two cases a day; subsequently, as the infected area becomes larger, the plague figures rapidly rise, so that 50, 100, or more fresh cases occur daily. After lasting usually from one month to six weeks it declines and finally ceases in the same order as it commenced.

It is usual to find in bubonic plague epidemics that the rat mortality precedes the occurrence of plague in man, thus giving a warning of approaching danger. Heralded in this manner by the rat epizootic, the epidemic can often be seen to travel from the house forming the original source of infection slowly up and down the street, frequently keeping for some time to one side of the road before crossing over.

In the epidemic in the Punjab this is, in my experience, by far the commonest history obtainable. Thus, of the 56 villages in which during the present year the cause of the outbreak was investigated at the time of its occurrence, in 36, or 64·2 per cent. of the total, the course of events conformed in all essential details to the above.

Spread by infected clothing or merchandise.—At the end of March, 1907, a small merchant visited the village of Lehri, a plague-free area, having come from an infected village some 40 miles distant. He stayed in the house of a relative for four days and then left for Rawal Pindi in his usual health. About two weeks after his departure dead rats were found in the house he had occupied. A few days later, on April 19th, a case of plague occurred in this house; subsequently a rat

epizootic followed by a small epidemic, radiating from this house, spread through the village. No other person was stated to have recently visited the village, which occupies a very isolated position, and was at that time at least 20 miles distant from the nearest infected village. This illustration strongly suggests that the disease was conveyed to the village on the clothing or person of the man or in his baggage, while he himself escaped the disease. In the 56 epidemics analysed, this mode of infection occurred in two, or 3.6 per cent. of the total, and in six others, or 10.8 per cent. of the total, it was thought to have taken place, but accurate information was lacking.

Spread by the migration of rats.—A fourth mode of spread of the disease has been described—namely, that under the influence of the panic occasioned by the epizootic migration of rats from village to village takes place with the result that the infection is conveyed in this manner. My observations on the common rat of India, the black rat (*mus rattus*), go to show that, as regards this rodent, the spread of the disease between villages can rarely if ever take place by this means. The accidental transportation of infected rats in ships and merchandise is, however, a fruitful source of the disease being conveyed long distances.

A few words are necessary as to the manner in which man becomes infected. This we have seen in the case of pneumonic plague is "direct" from sick to healthy, in the case of the bubonic variety a link between man and the rat appears necessary; that this is supplied, in the majority of cases, by the rat flea, *pulex cheopis* (Rothschild), the work of the Indian Plague Commission leaves but little room for doubt. But this is not the only mode of infection, as accidental inoculation in the case of man, feeding experiments and infection through the shaved skin in the case of animals abundantly prove. Any method by which the bacillus is introduced into the body is capable of producing the disease. More knowledge is required concerning the habits of the rat flea before its influence can be fully determined, but at first sight the fact that infection may take place in a variety of ways and that in the most virulent type of the disease—pneumonic plague—this insect is not concerned, would suggest that the rôle of the rat flea in the transmission of the disease is a passive one. It has recently been suggested that the occurrence of the annual epidemics are dependent on and associated with the prevalence of the rat flea, but though some relationship does exist between flea prevalence and plague prevalence, this does not appear to warrant the assumption that the flea is anything more than one of the factors in the case.

Preventive Measures.

Up to the present the measures which have been chiefly relied on, and which obtained official recognition at the International Sanitary Convention of Paris (1903), have been confined to the prevention of the importation of the disease and to methods of stamping it out when it has occurred on board ship or elsewhere. These no doubt are very necessary, but they are not sufficient, for it is not always possible to detect every case of plague even in the most favourable circumstances, and, furthermore, a case of human plague is not an essential preliminary to an outbreak of the disease. It is for this reason that the large sums of money spent in the past on disinfection and similar measures have not been attended with success, with the result that not only has the progress of the disease not been arrested, but all anti-plague measures have fallen into discredit.

It therefore becomes necessary to consider what other means are available to remedy this defect. One of the essential requisites is that every sanitary authority should possess a special plague department, the sole duty of which it should be to frame and to carry out the measures suited to the requirements of the area under its control.

The chief means of the spread of bubonic plague from place to place is, we have seen, by the agency of man, and methods designed for the protection of uninfected areas may therefore be directed to the control and supervision of individuals coming from infected areas. It is chiefly on such control that most anti-plague measures in the past have been based but they have not met with invariable success. As regards bubonic plague they are open to obvious objections—namely, that adequate supervision is extremely difficult and that they take no account of the possibility of infection by infected merchandise, clothing, or rats, which, as we have seen, are occasionally responsible for the transfer of the disease from place to place. While therefore not

underrating these measures, which should form part of all methods of plague prevention, it is necessary to remember that although man is the agency by which the disease is conveyed from place to place, the rat is the means by which the disease, once imported into a given area, is afterwards disseminated throughout it. On this account I believe that the destruction of rats, combined with the other methods already indicated, will be completely successful in preventing outbreaks of plague in uninfected areas. In my opinion it is to the neglect of this factor of the rat that the failure of anti-plague measures in the past is to be largely attributed.

Any seaport in communication by shipping with an infected port is liable to infection. Here the principal danger lies in the disease being conveyed by infected rats rather than by human agency. Regulations on the following lines are, therefore, necessary and should be made obligatory: (1) all ships communicating directly or indirectly with infected ports should be periodically cleared of rats by the Clayton process or some similar method; (2) in addition other methods of destroying rats should be carried out, such as periodical poisoning or the permanent use of rat-traps, a certain number of which it should be obligatory on all ships to carry; and (3) inspections by the sanitary authorities of ports should be made from time to time to see that these measures are being carried out. To prevent the transfer of rats from the dock to the ship all gangways or other communications between the ship and the shore should be removed at night and a circular iron sheet having a diameter of three feet and a thickness of about a quarter of an inch should be affixed to each hawser or cable both near its attachment to the ship and also at its shoreward extremity. These "rat-shields" would effectually prevent any rats passing from the shore to the ship or *vice versa*. They should be immediately put in place on coming into port on all occasions.

By the adoption of these measures all danger of infection from the side of the ship would be abolished except in so far as infected merchandise is concerned. Since it is by the inclusion of infected rats, or by infection derived from them, that merchandise usually becomes contaminated the destruction of these animals will materially reduce the danger of this taking place.

Similarly, to insure a condition of safety on shore it is essential that the destruction of rats in all ports liable to infection should be also carried out; and this is particularly necessary in the vicinity of all docks, wharves, and warehouses. Herein lies the necessity for a special plague department, for the work requires to be carried out systematically under careful supervision, such, for instance, as is now the case at Bombay and other places in India. Some central dépôt in each town or city is necessary to which all rats captured may be taken for identification and if necessary bacteriological examination for plague bacilli. The question of species is important in view of the fact determined by Liston that the black rat (*mus rattus*) is by reason of its habits more concerned with the spread of plague than the brown rat (*mus decumanus*). The relative distribution of these two therefore becomes a matter of importance, but since they are both equally susceptible to the disease their extermination is necessary.

As regards the methods of combating the disease in an infected area reliance must not be placed on any one particular measure, for the greatest hope of success lies in the suitable combination of all methods. Thus the access of infected persons to uninfected areas should, where possible, be prevented. The destruction of rats should be carried out by the best means available, since there is good reason to believe that it is by means of chronic plague in the rat that the disease is carried over from one epidemic to another. It should be carried out in the "free season," and if poisoning is the means adopted it should be carried out just before the breeding season of the rat. On plague breaking out evacuation of infected houses should be immediately resorted to, but much harm will result if the inhabitants flee to uninfected areas; hence, where possible, arrangements should be made to accommodate them temporarily in the vicinity of their homes. Disinfection, except at the very commencement of an epidemic, is entirely useless, but for carrying it out at this time and also for dealing with imported cases a staff for disinfection purpose must be provided and, since the rat-flea is an important means of infection, they should be supplied with a solution such as phenol, which is both a pulicide

and a bactericide. Haffkine's prophylactic should also be available in quantity so that it may be immediately distributed in case of necessity to all those willing to resort to it. As regards medicinal treatment no drugs in my hands have yielded results worthy of mention. Cases of plague appear to be best treated on general principles with the free exhibition of cardiac tonics. In India, at any rate, there is no doubt that a large number of unnecessary deaths take place from heart failure, due either to leaving the recumbent attitude too soon or sometimes directly to fear.

Jhelum, Punjab, India.

GRADUATED LABOUR IN PULMONARY TUBERCULOSIS.¹

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THE Brompton Hospital Sanatorium is situated on the Chobham Ridges, about two and a half miles from Frimley station, at an altitude of 380 feet. It contains 108 beds, 78 for men and 30 for women. Patients are not admitted directly to the sanatorium but are selected from the in-patients of the Brompton Hospital by the physicians of the hospital.

Early in 1905, while resident medical officer of the Brompton Hospital, I was asked by the committee to organise the new sanatorium which was on the point of completion. I had observed that many tuberculous patients who had followed their ordinary occupations up to the time of admission were in a very fair condition of health. The case of a navvy may be cited as an example. He had worked for 40 hours almost without a rest, altering a water main, a few days previously, and although he had a considerable amount of disease, was apparently none the worse for such arduous work. It occurred to me that, if some consumptive persons under adverse circumstances, and without any medical guidance, could act thus without apparent injury they ought, under ideal conditions and with the work carefully graduated in accordance with their physical state, to be able to undertake useful labour. On this assumption manual work should be of great advantage to patients undergoing treatment in a sanatorium, as, first, it would do much to meet the objection that members of the working classes are liable to have their energy sapped, and to acquire lazy habits by such treatment; secondly, it would make them more resistant to the disease, by improving their physical condition; and thirdly, would enable them by its effect upon their muscles to return to their work immediately after their discharge. The idea was a new one and in opposition to the generally accepted medical opinion on the subject. It had, however, been shown by Dr. Otto Walther of Nordrach that excellent results could be obtained by graduated walking exercise, especially when, in suitable cases, this exercise was pushed to the extent of walking 20 miles a day. In this form of exertion, however, the muscles used were chiefly those of the lower limbs. I had it in mind to employ also the upper limbs which are supposed to have a more direct influence on the expansion of the lungs. The objections naturally raised to this method of treatment were: (1) that the disease would become active again under the strain; and (2) that the exertion would tend to produce hæmoptysis.

At the outset great care had to be exercised, not only from the fear that as the views which had led to the adoption of the method were possibly unsound, harm might be done, but also because the patients did not take kindly to the work, it being absolutely contrary to their preconceived views of treatment, suitable to their condition. Some of them imagined for a time that it was not designed for their benefit but purely for the advantage of the institution, and they regarded me rather as a labour master trying to get so much work out of them than as a medical man who was endeavouring to cure their disease. Care was especially necessary in the selection of patients for the work, as had there been a case of severe hæmoptysis, or of high fever or pleurisy, it would probably have been impossible to convince the patients that the method was sound and they would have refused to work.

Walking exercise was first ordered, the distance being gradually increased up to 10 miles a day. When a patient had reached this stage he was given a basket in which to carry mould for spreading on the lawns, &c. No case of hæmoptysis or of pyrexia occurred among these patients. When they had been on this grade with nothing but beneficial results for from three weeks to a month, they were given boys' spades with which to dig for five minutes, followed by an interval of five minutes for a rest. After a few weeks several of the patients on this work, who were doing well, were allowed to work as hard as possible with their small spades without any intervals for rest. As they had all improved on this labour larger shovels were obtained, and it was found that the patients were able to use them without the occurrence of hæmoptysis or of a rise of temperature. About this time many of the patients were feeling so well that it became necessary to restrain them from doing too much. The tradition of absolute obedience to the orders as to the amount of work to be done had not yet been firmly established, and one of the patients who had improved most of all was found wheeling a heavy barrow full of sand without permission. When admonished for infringing his instructions he replied that he felt quite fit for such work, and as he would have to leave shortly and do hard work he wanted to get into condition for it. This argument appeared to be sound, and as he was willing to take the risk he was allowed to continue to wheel the barrow for the full labour period, which at that time was three hours a day. He suffered no ill-effects, but, on the contrary, did exceedingly well, and has since been at work for over two years. It was thus shown that a tuberculous man could, in certain instances, do heavy manual labour and continue to improve in health. I accordingly decided to work out a carefully graduated scale of labour.

At the end of the first six months a great advance had been made, for the tradition of work as a method of treatment was firmly established and the patients saw clearly that it was for their own benefit. The extension of the system required great care and minute supervision, for the patients, far from objecting to, or attempting to shirk, their appointed labour, now had a tendency to do more than they were ordered. Harder work was first prescribed for those patients who could be trusted. It was found that they could gradually be trained to use the heaviest spades, shovels, and 5-pound pickaxes with advantage to their physical condition, and without any attack of hæmoptysis or rise of temperature. The patients all expressed the opinion that the work did them good and that the harder they worked the better they felt. Many patients have since written to say that they date their improvement from the commencement of the labour and that they think that the hardest work did them the most good. Within the first year there were several patients who would, despite all instructions, over-exert themselves and use heavier tools than they should have done. In most instances no serious harm resulted but several of them developed fever and subsequently pleurisy. Pleurisy, indeed, appears to be a frequent result of any excessive work. One of these patients was laid up for nearly two months and was much worse at the end of that time, although eventually he did well and is now at work, but the extent of his disease was increased by the over-exertion. The necessity of absolute obedience to the medical officer's orders was firmly established by such cases. Each patient on admission is told that he will be treated by prescribed rest and exercise and that as he does not himself know the amount of rest or exercise which he requires he must do exactly as he is told, and that whilst harm will result if he does too much he will not receive proportionate benefit if he does too little. It is also pointed out that he must consider himself under treatment for the whole day, the amount of rest and exercise being definitely fixed for the 24 hours.

Details of the System of Graduated Labour.

1. *Results of physical examination.*—Each patient on arrival at the sanatorium is examined and the extent of the disease as indicated by physical signs is noted. The patients are then divided into two classes: (a) Those with early disease—i.e., slight signs in one or two lobes; and (b) those with more extensive disease—i.e., with either extensive infiltration of one lobe, or infiltration of two, three, or four lobes of some duration, the lesions often showing signs of fibrosis.

2. *General condition.*—The next points noted are the facial expression and the general physical development of the

¹ A paper read before the Medical Society of London on Jan. 13th, 1908.