Introductory address on fleas as a national danger : delivered at the opening of the Winter Session of the London School of Tropical Medicine on October 21st, 1907 / by Sir Lauder Brunton.

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CONSULTING PHYSICIAN TO ST. BARTHOLOMEW'S HOSPITAL.

Reprinted from THE LANCET, November 9, 1907.

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Mr. Chairman, Ladies, and Gentlemen,—The usual grounds upon which anyone is invited to give an opening address such as you have honoured me by asking me to deliver to-day are : that he has either distinguished himself by original investigations or that he possesses a profound knowledge of the subject upon which he is to speak. Now I am completely lacking in both these qualifications. There is, however, a third qualification—namely, that the selected individual is greatly interested in the branch of science on which he is to speak and is anxious to assist its progress ; and this qualification I do possess, for I have studied for well-nigh 40 years from time to time the manifestations of malaria, one of the most important of all tropical diseases, year in and year out, and at every hour of the day and the night. There is no patient in whom a medical man takes such a profound interest as himself, and there is no patient in whom he can observe so closely the symptoms of a disease or note so accurately the effects of various conditions upon it. About the end of March, 1868, while the Suez Canal was still in process of making, I travelled one night from Suez to Ismailia on the small fresh water canal which was first made many centuries ago by one of the Pharaohs. The boat was a small one, not at all unlike a barge such as you see in canals in this country. The small cabin was crowded with people and became so hot and stuffy that I was obliged to go and lie down outside. It was a clear starlight night with not a single cloud to act as a blanket and with perfect radiation of heat into space. I do not remember ever to have felt such intense cold in my life excepting once when I had to sit for a little time

on a bare rock near the top of an Alpine peak with a sharp wind blowing upon me from the glacier. For a long time I attributed the malaria from which I subsequently suffered to the chill and to a miasm which I supposed to have lain over the canal.

Four days afterwards I slept in the convent at Ramleh, about half way between Jaffa and Jerusalem, in a large, bare, whitewashed room containing about a dozen beds and without any mosquito curtains and with not a trace of a looking-glass. I had been very tired and slept soundly the whole night, but when I went to breakfast I was informed that my face was spotted all over with mosquito bites. It was only many years afterwards, however, that I attached any importance to this circumstance. A year afterwards I was studying physiological chemistry with Professor Kühne in Amsterdam who suffered at that time from periodical diarrhœa which attacked him every morning at the same hour and was not alleviated by ordinary astringents but yielded at once to the administration of quinine. Here again a malarial miasm was suspected as the cause of his illness. Previously to my cold journey on the Suez Canal I do not recollect ever having had a headache, but from that time onwards I became very subject to them and also to curious attacks of weakness, languor, and inability to work, accompanied by slight chilliness. One night a medical man came in and found me cowering over the fire. I was unable to tell him what was the matter. I had never taken my temperature before, but on taking it it turned out to be 103° F. At this time I was working with the late Sir Joseph Fayrer on the action of cobra venom, and when I told him my symptoms he at once said they were due to malaria, although I had never had any distinct rigor. Three or four years afterwards I made a tour through the north of Italy and shortly after my return I suddenly felt, at 2.30 on a Sunday afternoon, a sudden chill with well-marked rigor followed by a hot and sweating stage. This ague was remarkably punctual and the time of attack did not vary more than five minutes either way. Its rhythm was also peculiar, each alternate attack being slight. Thus on Sunday I would have a severe attack, Monday would be free, Tuesday a slight attack, Wednesday free, Thursday a severe attack, and so on. Under quinine the attacks soon ceased. About five years later, in crossing the Maremma, I seemed

to get a fresh infection, the cold stage of which came on between noon and one o'clock. It was not nearly so punctual as the other; it might come on a few minutes after 12 or not until nearly one. After a short time this attack also passed off, but about a year afterwards I got a severe chill which appeared to bring back both infections so mixed up together that I constantly had alternate chills and heats at intervals during the day, and these so broke down my strength that I was obliged to leave off work for over three months. It was then that my old friend Sir Joseph Fayrer said to me, "There are two courses open to you: you can either go away for three months or you can go into your coffin. You can take your choice." I need not say which course I took and at the end of three months I completely regained my strength.

Perhaps I am describing my own case at too great length but it seems to me to illustrate a number of minor points in regard to the action of malaria which, though not very fully discussed in text-books, appear to me to be very important to the sufferer.

The occasional long latency of malaria is well known and both my attacks came on after I had left the malarial district. There is also the condition which may be termed sublatent, or perhaps better subliminal, in which my temperature rose to 103° with malaise but without any rigor. The longest duration of latency, so far as I know, has not been settled, but in one of my patients it was no less than 32 years. The patient was a man, aged 65 years, and had resided in his youth on the West Coast of Africa. One day he came to me complaining of the same sensations that he used to have in Africa when about to have fever. He had come up from the country and had been dining with friends to a greater extent than was good for him. I assured him that there was nothing the matter with him but his liver was out of order for it was full and tender. I said that no case was known of ague coming on after a complete interval of 32 years. Many cases are, of course, known where ague has come on at this distance of time from the first infection, but in all those of which I have heard there have been intermediate attacks, so that there never has been such an interval as 32 years between the attacks. It is possible, however, that in his case there may have been sub-

liminal indications of malarial fever just as in my own case where there was the temperature of 103° without any rigor.

Another point which struck me, however, was the extraordinarily rapid onset of fever from a chill. One Sunday afternoon my wife and I went to church at Brighton and we were shown into a pew about the fifth or sixth from the door. The door was open to allow people to come in and the cold draught from it struck me on the back of the neck. In about five minutes I began to shiver and was obliged to go out with a well-marked ague fit. The parts of the body in which a chill will bring on an attack are the back of the neck, the abdomen, the shins, and the feet. A patient, who suffered from ague himself, first directed my attention to the shins and since then I have frequently observed that a chill to that part brings on malarial symptoms. Many sufferers from ague are unaware of this and by sitting between the door and the fireplace when a fire is burning in the grate they get their legs chilled by the draught and suffer accordingly. There can be little doubt, I think, that most of the symptoms are due to toxins formed by the plasmodium and these toxins have not all the same action. Some of them appear to produce almost irresistible drowsiness, so that in my own case I have actually fallen asleep between asking a question and receiving the answer. Another symptom is intense muscular weakness and languor, so that although muscular movements are possible there is the greatest reluctance to do anything and the person feels, I should say, like a man who had a dose of curare.

Another symptom that, so far as I know, has received little attention is the loss of memory which generally precedes, but sometimes follows, an attack. In my own case it has frequently preceded a rigor by two or three hours or more and this occurs in most cases where the symptom is present. In one case, however, it occurred subsequently to the rigor. This was a civil servant who consulted me because he feared he would be obliged to give up his post on account of his complete loss of memory for several hours after an attack. In him the ague came on first during an expedition on the Niger where he and his friends had got into some kind of a shallow lake where reeds grew to a height of nine or ten feet and he and his friends had for eleven days been obliged to push their boat along while they waded breast high in the water as they could not row on

account of the reeds. Another point which is little mentioned in text-books is the peculiar brown colour of the face in malaria. It is just as if a thin wash of sepia had been passed over the face. One day when going round the hospital at Lyons with my friend Professor Lépine I saw this colour very well marked in one of the patients. I accordingly asked Professor Lépine if the patient were suffering from malaria. He answered that the patient was in hospital for Bright's disease and there was no mention of malaria in the history of the case. On asking the man, however, we found that he had been a soldier in Algiers and had there suffered much from malaria. This brown colour is not always equally intense; it sometimes disappears altogether, but is likely to come on before an attack, which may sometimes be prevented by a dose of quinine being taken whenever the brown colour is noticed. And here I may say that my experience bears out the dictum of my friend the late Sir Joseph Fayrer that quinine does not exert its full action, or, indeed, may fail to act at all, if the liver is engorged, and that it is well to prepare the patient for a course of quinine by a mercurial followed by a saline.

Since I first began to suffer from malaria our ideas regarding the pathology of the disease have undergone several changes. At first it was supposed to be some kind of miasm the exact nature of which was unknown. Then it was supposed to be a bacillus and lastly it was found by Laveran to be of an animal nature.

If science had been more richly endowed in this country both the transmission of malaria by mosquitoes and the intra-corporeal and extra-corporeal life of the plasmodium might have been ascertained sooner than it was, because in 1895 Sir Patrick Manson applied to the Scientific Grants Committee of the Royal Society for a grant of £300 to enable him to go to Demerara and work out its transmission by a suctorial insect. Unfortunately, the yearly grant of the Government to the Royal Society to be distributed amongst all branches of science only amounts to £4000 in all. Applications for nearly double the amount were received and it was felt that the society could not give such a large grant as Sir Patrick Manson required. He accordingly mentioned his hypothesis to Ross who brought definite proof of the part played by mosquitoes in the transmission of disease. Very few discoveries have had such important bearings upon

the possibility of life in the tropics and already it has saved very many lives and rendered residence in malarial districts almost free from danger when certain precautions are adopted. Thus in the Campagna, where nearly one-third of the railway officials used to die off every year, the mortality from ague has been almost abolished by the simple precaution of having the windows and doorways of the houses covered with mosquito-proof iron netting and taking care that the inhabitants do not go out until after a certain time after sunrise and again enter before sundown. By destroying the puddles in which mosquitoes breed or by covering the surface of the water with petroleum so that the larvæ are suffocated the numbers of mosquitoes are greatly diminished with a corresponding fall in the incidence of malaria.

Yellow fever, which was formerly so much dreaded in the Southern States of America, has now been shown to depend upon inoculation of the disease germ by a species of mosquito. It has in some districts been almost entirely stamped out by destroying mosquitoes in the same way as for malaria.

A disease which is now attracting more attention than even yellow fever is the sleeping sickness. This disease appears to have existed from time immemorial on the West Coast of Africa, but it was confined there because the various tribes were at war with one another. It was impossible for anyone to cross the continent and thus the eastern side was perfectly immune. But the stoppage of intertribal wars has produced a result that no one could have foreseen. As Colonel D. Bruce, R.A.M.C., has expressed it, we have introduced the *Pax Britannica* to the districts surrounding the Lake Nyanza with the result that the population has been almost exterminated by the pestilence which the stoppage of intertribal wars and increased facilities for commerce have introduced. This disease does not, as was at first supposed, only attack the natives. It attacks white men as well, and it threatens to spread along the Nile valley and how far it may do so and with what results to the Soudan and Egypt no one knows.

The disease germ here is a trypanosome which is transferred from one infected patient to another by the glossina palpalis, very similar in appearance to the tsetse fly. When wild game are killed off the trypanosome of the tsetse

disease disappears with them, but in the case of sleeping sickness the trypanosome is harboured in human bodies and so the only chance of stopping the spread of the disease is by destroying the biting fly. In order to do this a thorough investigation is required of the life-history of the fly, of the conditions which favours its propagation, and of the other insects or birds which may destroy it.

If the trypanosome which causes sleeping sickness could be destroyed by remedies not only would the patient be cured but the disease would be exterminated. Some hope that such a result may be achieved is afforded by the experiments of Moore, Nierenstein, and Todd, who consider that parasitic protozoa which show different phases in the life-history may be attacked at one phase by a drug which is entirely inert and therapeutically useless at another phase, and conversely a drug which is without action on the first phase may be specific in its action on the second phase. They find that atoxyl causes trypanosomes to disappear from the blood rapidly but that after a time new generations of trypanosomes appear which resist the action of atoxyl. When, however, a salt of mercury is administered after the trypanosomes have been removed by atoxyl a permanent cure may be effected. At present this treatment is only experimental and until an efficient method of destroying the trypanosome in man has been discovered the only plan available is to destroy the flies which convey the disease.

What is true of the glossina palpalis is true of other flies also and as ticks and bugs are likewise most important as carriers of other diseases there really ought to be established by Government a chair, or still better an institute, of scientific entomology well endowed and having attached to it a number of men who could carry on original investigations. Such a chair or institute if thoroughly well endowed and having money lavishly expended upon it would repay the expenditure a thousand-fold, for the study of tropical diseases is becoming to a great extent identified with the study of the insects which transmit them.

It is very difficult indeed to arouse people to take an interest in, and to spend money upon, objects which they think do not directly concern themselves, and although malaria and sleeping sickness are of imperial importance yet they do not directly affect the health or the well-being of the tax- or rate-payers of this country. But there is another

disease which is liable almost at any time to do this—namely, the plague. Everyone knows of the terrible ravages of this disease in Europe in the fourteenth century under the name of the Black Death and again in the seventeenth century. The disease began in the East and travelled along the routes of commerce. The mortality produced was excessive and the condition of terror amongst the population was almost indescribable, "for the terror was such that brother even fled from brother, wife from husband, nay, the parent from her own child. The sick could obtain help only from the few who still obeyed the law of charity, or from hired servants who demanded extravagant wages and were fit for little else than to hand what was asked for, and to note when the patient died. Even such paid helpers were scarce and their desire of gain frequently cost them their lives. The rich passed out of the world without a single person to aid them; few had the tears of friends at their departure. The corpse was attended to the grave only by fellows hired for the purpose who would put the bier on their shoulders and hurry with it to the nearest church, where it was consigned to the tomb without any ceremony whatever and wherever there was room. With regard to the lower classes, and, indeed, in the case of many of the middle rank of life, the scenes enacted were sadder still. They fell sick by thousands, and, having no one whatever to attend them, most of them died. Some breathed their last in the streets, others shut up in their own houses when the effluvia which came from their corpses was the first intimation of their deaths. An arrangement was now made for the neighbours, assisted by such bearers as they could get, to clear the houses, and every morning to lay the bodies of the dead at their doors. Thence the corpses were carried to the grave on a bier, two or three at a time. There was no one to follow, no one to shed tears, for things had come to such a pass that men's lives were no more thought of than those of beasts."[1] In the country the ravages were equally great and in different parts of England agricultural ground became waste as the tenants were all dead. "In other places there are no court fees, no services performed, no mills used, because all on the land are dead;

[1] Boccaccio quoted by Gasquet, The Great Pestilence, p. 23. London Simpkin, Marshall, and Co.

houses and tenements also are in hand, and rents everywhere are reduced or are nothing at all, because some or all of those who held the lands and cottages have been swept away."[2] It may be that the days for such an evil epidemic are past and gone and owing to the spread of sanitary science we may rest secure in the belief that such plague will not again recur. But sanitary science is no use unless it is put to practical application and in India at the present moment the ravages of plague, though not so great as those of the Black Death or of the Great Plague in London, are nevertheless dreadful.

I am informed by Professor W. J. R. Simpson that during the first six months of this year no less than 1,060,000 deaths from plague occurred in India and out of these 632,000 occurred in the Punjab which has a population of only 25,000,000, that is to say, 1 in every 40 inhabitants in this district has died from plague between January and June. But because this awful mortality occurs far from home and amongst those who are our fellow subjects but belong to an alien race many people contemplate it with equanimity. There is, however, a property of the plague poison which is worthy of attention. Its virulence is capable of great increase and great decrease. At first it seems too feeble to attack man but it is able to attack small animals such as rats. By passing successively through numerous rats it becomes more and more virulent. At length it attacks man and as the epidemic proceeds the poison becomes stronger and stronger and the mortality greater and greater. After some months a decline in virulence sets in and finally it fades away.

It has long been observed that great mortality in rats is apt to precede pestilence and Mr. D'Arcy Power informs me that dancing mice, that is, I suppose, mice which were either affected by giddiness or convulsions, were looked on as a precursor of plague. My friend Mr. E. H. Hankin suggests that the well-known story of the Pied Piper of Hamelin is a legendary account of a plague epidemic. A similar explanation has been given by Mr. J. S. Mackintosh in THE LANCET of April 2nd, 1904, p. 970. The Pied Piper came from abroad and at his first visit killed off all the rats

[2] Lipscombe's History of Buckinghamshire, quoted by Gasquet, Op. cit., p. 101.

in the place, but not being paid his stipulated fee he came to the city again and killed off all the children. Major Leonard Rogers, I.M.S., tells me that in the Kamoan Hills in India a form of plague is more or less indigenous but that the natives, as soon as the rats begin to die, desert the village and run away for some months.

The connexion between mice or rats and the plague of boils which affected the Philistines after they had taken the Ark of the Covenant from Israel has been noticed by others, but I have not seen any note of the connexion between mice and the plague which destroyed the army of Sennacherib. The account of this, as given in II. Kings xix. 35, is: "And it came to pass that night, that the angel of the Lord went out, and smote in the camp of the Assyrians an hundred fourscore and five thousand: and when they arose early in the morning, behold, they were all dead corpses." But in Herodotus (II., 141) the destruction of Sennacherib's army is attributed to mice and the historian says: "And to this day the stone statue of this king stands on the Temple of Vulcan[3] with a mouse in his hand and an inscription to the following effect: 'Whoever looks on me let him revere the gods.'"

Although the connexion between mortality in rats and plague has been long observed it is only recently that its nature has been ascertained. The disease germ which occasions plague is a short, thick cocco-bacillus with rounded ends to which the name of bacillus pestis has been given. It was discovered by Kitasato and also by Yersin and numerous experiments have proved without doubt that this bacillus is the cause of the plague. But how is it conveyed from rats to men? In the case of the Black Death we read "that the disease was communicated by the sick to those in health and seemed daily to gain head and increase in violence just as fire will do by casting fresh fuel on it. The contagion was conveyed, not only by conversation with others who were sick, but also by approaching them too closely or only by merely handling their clothes or anything they had previously touched."[4] Such a description would seem to indi-

[3] Ptah the chief of the Egyptians' gods, the Greek Hephæstus, vide section on Religion in Baedeker's Handbook to Lower Egypt.

[4] Boccaccio quoted by Gasquet, Op. cit., p. 21.

cate that the poison might be propagated by the breath or by the touch of infected persons, but experiments did not sustain this theory and the idea was first proposed by Simonds that the real transmitters of the virus were fleas. These insects, having fed upon rats or patients infected with plague, absorbed the bacillus, which multiplies within them, and is transmitted to the next animal or person they bite. Simonds's theory explains the propagation of the disease to the healthy from infected persons or their neighbourhood. It has been supported by experiment by Gautier, Raybaud, and Dr. J. Ashburton Thompson, but some of the most convincing experiments were made by Captain W. G. Liston, I.M.S., who found that 61 per cent. of white rats and 52 per cent. of Bombay rats contracted plague from fleas which had fed upon infected rats. He then found that fleas would infect guinea-pigs. He chloroformed the animals and removed all the fleas. Some of them he put into plague houses and these contracted rat fleas. Others he put into pure houses and on examining them found that they were free from fleas. The fleas that he found on the infected animals were rat fleas, some of which contained the bacillus pestis in their stomachs, and some of the guinea-pigs used as flea traps died from the plague. He further showed that guinea-pigs did not catch plague if they were protected from fleas either by placing them in fine wire gauze cages through which fleas could not pass or by suspending them in open cages at such a height above the ground that fleas could not jump into them, or by surrounding the cage with so much tanglefoot, a kind of adhesive fly-paper, that fleas could not jump across it but were caught upon it. His experiments were confirmed and extended by the Advisory Committee appointed by the Secretary of State for India, the Royal Society, and the Lister Institute which concluded from its experiments that : 1. Close contact with infected animals does not give rise to plague epidemic among guinea-pigs when fleas are excluded, even when food and huts are extensively soiled with urine, fæces, and pus of plague-infected animals. 2. If fleas are present epidemic starts at once. 3. An epidemic may be started when no contact with plague-infected animal is allowed when fleas from infected animals are introduced. 4. Infection can take place without the animal being in contact with the ground. Thus a guinea-pig put in a wire cage

and suspended two inches from the ground contracted the disease. 5. Aerial infection did not take place if the cage was two feet (that is more than fleas jump) from the ground. 6. In all the animals thus naturally infected the large proportion, 90 per cent. (nearly), of the buboes were in the neck. 179 animals were examined and in obtaining fleas from animals 65·3 per cent. were obtained from the head and neck. The committee also found that rat fleas bite human beings and it seems to be demonstrated beyond the possibility of doubt that, although in some instances, infected food may possibly produce the disease, yet fleas are the main instrument of disseminating the infection of plague and that in places where they exist in large numbers a nidus exists where plague once introduced may become more and more virulent and spreading like wildfire along railway lines may overspread the country.

The great difficulties in the way of preventive measures are ignorance and apathy, to which in some parts of India, at least, we have superadded superstition. The plan which I believe is now adopted in Hong-Kong and Bombay is to treat any house in which a dead rat is found as "plague infected" and to evacuate it and disinfect it with crude petroleum. Possibly the introduction of more cats might be useful, as Colonel Buchanan has found that where there are many cats there is little or no plague. But in order to carry out any efficient sanitary measures there must be a staff of sanitary officers and Professor Simpson suggests that sanitation should be taught in the colleges and that native men and women should be trained in hygiene. This would not only greatly aid the carrying-out of all sanitary measures but it would remove amongst many of the natives a source of dissatisfaction. At present the ambitious medical officers have no means of attaining high rank but in such a service as this the best men might attain a position of much importance.

In some parts of India there is a great prejudice against taking life of any kind but this is not universal because in some parts goats are offered to Kalee, the goddess of Destruction. If the Brahmins could persuade the natives that the sacrifice of a dead rat as often as possible to Kalee would avert pestilence rats would very soon be destroyed and plague would be at an end. In all probability it would be very difficult for Europeans to effect this but if we have

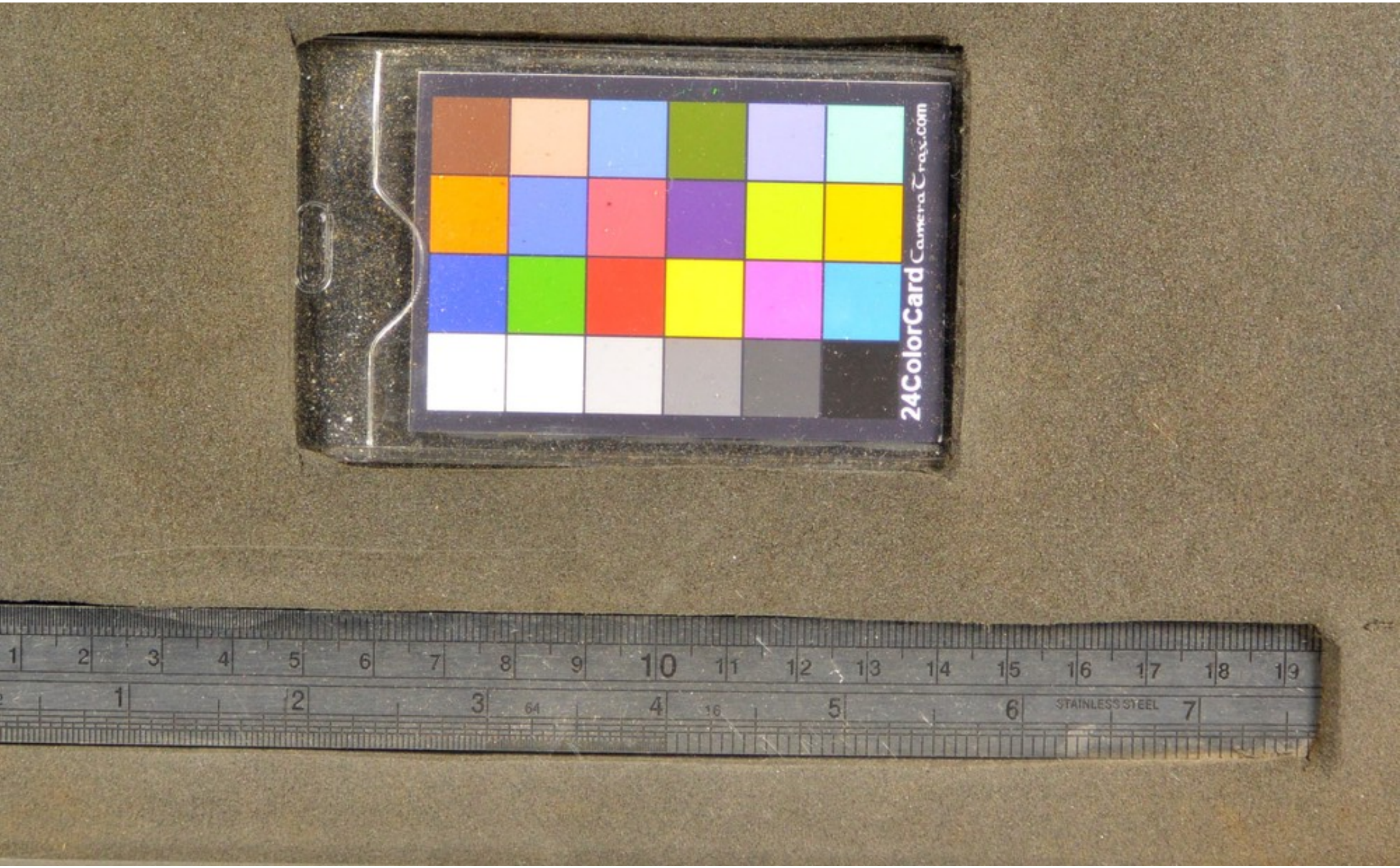
native medical officers of high caste they might be able to do it. Such a proposal as this I have made may perhaps greatly offend the religious feelings of many good people who would not give the slightest countenance to what they look upon as a false religion. But it should be remembered that any converts who have been made by the missionaries to the Christian faith will not do this; it is only those whom the missionaries have failed to touch and when Naaman, the Syrian, after being healed of his leprosy bowed himself in the house of the heathen god Rimmon he was pardoned for doing so because it was in the discharge of his duty. (2 Kings v. 18.)

What I have already said does not directly touch the health of this country, excepting so far as an extensive plague in India affords constant opportunities for its spread along channels of commerce, and more especially along steamship routes. Cases of plague arrive from time to time at the Port of London and I am told that every now and again they also arrive from the Far East at Vancouver. Although precautions may be taken to isolate cases of plague yet rats may become infected, may creep along ropes to the shore, and there infecting other rats might begin a pestilence. This would probably remain for some time limited but by acquiring virulence like the plagues of old might spread along the railway lines to every part of the kingdom.

In Canada, from which I have just returned, forest fires are a great evil. Many of them are started by cinders from the railway locomotives. To avert the danger a broad strip is kept ploughed along either side of the railway line so that any cinders lighting upon it shall die out and no fire shall spread. What would we think of the conduct of those who instead of pursuing this course should carefully place along the railway lines dried leaves, dried hay, or inflammable stuff which would inevitably blaze up if a burning cinder were to fall upon it? We should certainly say that they were fools or worse, and yet this is very much the course we are pursuing by allowing rat- and flea-infested districts to exist in the East-end of London and Vancouver, places which are in daily danger of infection by plague.

In conclusion, I beg to return you my best thanks for the honour you have done me in asking me to deliver this address, and I must apologise for its many imperfections. ts

imperfections would have been much greater had it not been for the help I have received from Sir A. E. Wright, Captain S. R. Douglas, I.M.S., Professor Simpson, and Major Leonard Rogers, I.M.S., and the assistance I have obtained from the new edition of Sir Patrick Manson's work on "Tropical Diseases," Clifford Allbutt's "System of Medicine," and Osler's "Modern Medicine." What I have said is, perhaps, to many of you, perhaps to all of you, a mere repetition of what you already know better than I do. My excuse for it is that a recrudescence of the blood poisoning by staphylococcus and streptococcus which I unfortunately contracted at St. Bartholomew's Hospital five years ago has lessened both the time and the energy which I proposed to devote to its preparation. All that I can hope for is that I may have drawn attention to what is already well known to all of you—the great need there is for the endowment of what might be called "pathological entomology," and to the fact that such minute and despised creatures as fleas may actually constitute a national danger.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