

Mr John Spear's report to the local government board upon the so-called "Woolsorters' Disease" as observed at Bradford and in neighbouring districts in the west Riding of Yorkshire.

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Publication/Creation

[London?] : publisher not identified, 1881.

Persistent URL

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**Mr. John Spear's Report to the Local Government Board upon
the so-called "Woolsorters' Disease" as observed at Bradford
and in Neighbouring Districts in the West Riding of Yorkshire.**

GEORGE BUCHANAN,
Medical Department,
May 24, 1881.

INTRODUCTION.

In the middle of May, 1880, the attention of the Local Government Board was directed to the occurrence in Bradford and neighbouring districts of an apparently very fatal malady, locally known as "The Woolsorters' Disease," attacking persons employed in processes of sorting various wools and hairs in worsted manufactories; and on the 17th of the month I received instructions to visit the district and inquire into the nature and cause thereof. It soon became apparent that for the due elucidation of the subject pathological experiments were necessary, and that detailed histological observations would be desirable; and for these purposes Dr. Greenfield, Professor Superintendent of the Brown Institution, was associated with me in the inquiry.

On my arrival in the district I found three men, all woolsorters, convalescing from typical malignant pustule. These were at that time the only cases of the disease under treatment. But these were not typical of the many cases that had excited so much attention and even alarm in the district, and so much difference of opinion amongst the medical faculty. Such cases had exhibited no external lesion, at least no malignant pustule. The symptoms were, it was said, involved in much obscurity; and whereas certain of the medical profession (amongst whom, as taking so distinctly a leading part in the investigation of this subject, it is not invidious to mention the name of Dr. Bell) held the disease to be a septicæmia, and some of the cases, so Dr. Bell affirmed, to be cases of anthrax, contracted in the sufferers' occupation, others, recognizing no essentially specific feature in the attacks, doubted these conclusions.

Of this form of the disease, without external manifestations, five fatal cases afterwards, during the progress of the inquiry, occurred. Four were rapidly fatal, and I only heard of them after their termination; one of the patients I saw once before death. But in all I obtained autopsies, and the nature of the disease was ascertained.*

The inquiry, it may be said at once, has established the etiological identity of these affections. The "Woolsorters' disease," positive experimental evidence declares it, and the statement need not therefore be delayed, is that anthrax fever which is only known to attack man by transmission from the lower animals; and which I shall speak of hereafter under the name of "anthrax" simply.

With this preliminary statement I propose to discuss the various subject-matters of the report in the following order:—

- (1.) The disease as it is known in the Bradford district:
 - (a.) Its general history there.
 - (b.) Its symptomatology, as gathered from the histories of cases.
 - (c.) Its morbid anatomy, as illustrated by cases occurring during the progress of this inquiry.
- (2.) The etiology of the disease: with consideration of
 - (a.) The Woolsorters.
 - (b.) Their mortality statistics.
 - (c.) Their occupation.
 - (d.) The history and relative circumstances of recent attacks of the disease.
- (3.) The preventive and remedial measures that suggest themselves.

* Besides these, I had an opportunity of seeing three patients who, in my opinion, were suffering from what I shall endeavour presently to show is the same disease in a mild or abortive form. Other cases, four of them fatal, occurred since the commencement of this inquiry, but in my absence from the district. They are included in the histories of recent attacks.

I.—THE DISEASE.

GENERAL HISTORY.

Anthrax, in its various clinical forms, has been known for centuries, both as affecting man and animals. But of late years the so-called internal form of the disease in man has received comparatively little attention; and in England, until a recent outbreak amongst horse-hair workers in a Glasgow factory, recorded by Dr. Russel, in the report of the Medical Officer to the Local Government Board (1878), its very existence was almost forgotten.*

In Bradford, until recently, it was not recognized as anthrax; it came to be called amongst those particularly interested, the "wool-sorters' disease"; in official records and death-registers it usually is designated after the most prominent symptoms observed in individual attacks (see section on mortality statistics of wool-sorters). Especially has this prominence been given to the lung symptoms; and whilst those of the profession who practised also amongst mill-hands could scarcely escape the conclusion that the disease bore some relation to the occupation, it came mostly to be looked upon by them as a sort of pneumonia induced by mechanical irritation of inspired dusty particles—at least that this latter was the powerful predisposing cause, if not the immediate cause of the acute manifestations and rapidly fatal issue.

The appearance of the disease in the district is popularly supposed to date from the importation and working of alpaca forty-three years ago. In some years it was comparatively absent, in others several cases would occur, and then the sorters, who appear from an early time to have associated the disease distinctly and immediately with their occupation, would become alarmed. About the year 1863, Van mohair, the fleece of the goat inhabiting the Van district in Asia Minor, was introduced as a textile fabric, and from that time it is said the cases became more numerous. This material came to be looked upon by the sorters as specially dangerous, so much so that some of them refused to work it; and a custom arose at certain of the mills for these employés to determine amongst themselves by drawing lots which of them should work upon it, or upon such of it as was regarded with any special apprehension. Public concern also began to be aroused. It had been suggested in the public papers and elsewhere that the disease was possibly the bubonic plague. It was pointed out that the fleeces were brought from parts where plague prevailed; and the idea of this identity no doubt gained confirmation from the rough analogy of the grosser symptoms that were observed, and publicly commented upon. It was under these circumstances that an inquiry was ordered by the Board.

It is unfortunate that there are, owing to various circumstances, (the disease is often so insidious in its appearance, so sudden in its termination) few or no cases of which complete and detailed clinical observations such as could be desired have been recorded. But I have obtained the histories, more or less complete, of some fifty cases, from medical practitioners, from the friends of sufferers, and from wool-sorters themselves (and the latter have watched the symptoms of the disease in their fellow workmen with minute attention and often with extraordinary intelligence); and this information, combined with my own very meagre personal experience, will enable me, I think, to draw a fairly accurate picture of the disease.

I assume, it will be seen, that these histories justify me in affirming the unity of the described disease with that which I myself witnessed during my inquiry: and I am sensible that the criticism will accompany me that from such histories, although the extreme probability of some form of blood poisoning may be established, the differential diagnosis of anthrax cannot be made. Against this objection the following considerations—considerations which must be taken as governing much that I hereafter advance—may be urged: (1) each one of the five fatal cases, recognised as more or less representative cases, that occurred during the course of this inquiry was found to be anthrax; † (2) in several others the diagnosis was placed beyond doubt by the appearance of the typical cutaneous localization of the disease, the malignant pustule; (3) in other cases the wool that had undoubtedly been the source of infection was likewise the apparent and only discoverable source of *unequivocal* attacks of anthrax in sheep and cattle; ‡

* *Synonyms*.—Anthrax (external, internal, intestinal, and apoplectic form anthrax) malignant pustule, charbon, malignant œdema, malignant vesicle, anthrax carbuncle, anthrax quinsy. Splenic fever, splenic apoplexy, milzbrand (inflammatory death of spleen) mycosis intestinalis, maladie de sang, mal de rate, sang de rate, Siberian plague, Siberian boil. (Persia) Atshac, al Humrah, or Persian fire. (Turkey) Dallack.

† For grounds for such conclusion, see histories of the cases in question. (Cases 20, 22, 25, 30, and 35.) The notes of the *post mortem* and microscopical examinations, together with the results of the experimental investigations of Dr. Greenfield, are in the Appendix, pages 36 to 39, 41, and 43. A sixth case (case 28) which occurred in my temporary absence from the district, and was investigated by Dr. Greenfield, was also proved to be anthrax.

‡ See p. 20 et seq., and Appendix, p. 42.

(4) all the cases, so far as could be ascertained by careful inquiry, occurred amongst persons brought into immediate contact with wool or hair of sheep and goats, the infection not even secondarily attacking other individuals; and the anthrax poison is the only one we know of that, whilst acting as an intense blood poison to man, is likely to show this exclusive choice of vehicle in transmission to him.*

PATHOLOGY.

SYMPTOMS.—Anthrax is usually divided into two principal varieties—that presenting a characteristic malignant pustule, and that having no characteristic external lesion (the so-called internal anthrax). The two forms are etiologically identical, but the morbid phenomena induced are so often different, that the distinction in a clinical review must be maintained. The relative frequency of these two forms, counting only *the fully developed attacks* of the constitutional infection, and their mortality, as shown by the experience in the Bradford district during the last few months (for such more specific information I have of necessity restricted my observation to a quite recent period), are as follows:—

NUMBER of CASES of this DISEASE in the BRADFORD, KEIGHLEY, and QUEENSBURY DISTRICTS during the months, November 1879—September 1880.

Form of Disease.	No. of Cases.	Deaths.
(I.) External Anthrax (typical malignant pustule) -	9	2
(II.) Internal Anthrax (fully developed)† -	23	19

† It must be noted that if mild or rudimentary attacks were included in this summary the fatality of this form of the disease would appear considerably less; and the proportion of attacks, to attacks of the external form, of course greater.

Of the so-called malignant œdema, which certain writers would distinguish as a third class of anthrax, I have no clear histories to record.‡

Of external anthrax or typical malignant pustule, I would distinguish three varieties:

- (a.) That which appears to form at the point of inoculation of the poison, and to remain throughout a purely local process;
- (b.) The same, accompanied or followed by constitutional symptoms;
- (c.) The same, formed by secondary localization of a constitutional infection;

There remains a fourth variety of external anthrax; namely, a minor pustule, or small slightly inflamed tumour or boil, not possessing the characteristic appearances of the malignant pustule before mentioned.

The typical malignant pustule, of which I saw five cases whilst in Bradford, is described in the principal text-books on Surgery. Of the nine cases above referred to, the pustule in all appeared in parts of the skin usually uncovered, viz., three on the forehead, two on the neck, two on the cheek, one on the lip, and one on the arm. Two of the nine, although receiving no active local treatment, were entirely unattended by constitutional symptoms (a); five (b) were accompanied or immediately followed by such symptoms of a more or less severe kind; whilst two, if not three, apparently supervened upon a general infection (c). Of the first variety I need give no example, it will suffice to say that the local lesion was characteristic malignant pustule; of the second, the following presents points of interest:—

(Case 1.) William E., aged 15, a weaver, did not work in the sorting-room, but was there playing on Wednesday, the 23rd of June, and had his head thrust into some Van mohair. On Friday he noticed a small

* The occasional presence of decomposing matters, dung, blood, pieces of flesh, &c., amongst the fleeces, has been much remarked upon as a possible cause of blood poisoning amongst the sorters. My experience leads me to believe that the frequency of such impurities has been considerably overstated. Moreover, we have no reason to believe that the products of ordinary decomposition of substances of this kind will give rise to an acute idiopathic septicæmia, supposing the disease under consideration were of this nature only.

‡ But see cases 18 and 22, in "Histories of Recent Attacks."

pimple on the left temple; he scratched the top off, and there was a little watery exudation. On Tuesday morning, the 29th, his eye and the side of his face were swollen, and he was obliged to leave work that afternoon, complaining of frontal headache, nausea, and great weariness. Two days later Dr. Logan saw him; he found a typical malignant pustule on the temple, and much swelling of the surrounding parts and of the neighbouring lymphatic glands. The patient was then in high fever and delirious, temperature 105° F., pulse very rapid and weak. He remained in a critical state for some five days. When I saw him on July 14th a thick, black, circular eschar, about the size of a florin, with a wide margin of demarcation, was separating; there was considerable brawny swelling of the surrounding tissues, and the lymphatic glands of the neck were enlarged and indurated. The patient was tremulous and complaining of weakness. Blood taken from the inflamed border of the pustule on the 6th of July was inoculated by Dr. Greenfield, without result, and contained no bacilli.

The following cases are interesting as being apparently instances of that somewhat rare combination of symptoms in which the local malignant pustule follows a constitutional infection.* They exhibit, too, a remittent or even intermittent character of attack, observed also in other cases:—

(Case 2.) James T., aged 35, hitherto a strong healthy man, had been working on a consignment of Vau mohair that had apparently caused several similar attacks amongst other sorters (page 20). He lived some distance from the mills, and, like other workmen, on the week days took his dinner to his work. He had refused to have a doctor, and, having a large family to maintain, had kept to his work in a very determined way almost throughout his sickness. The following account was, however, corroborated in various ways. On Saturday and Sunday, April 10th and 11th, he suffered from headache, feeling of lassitude, shivering, cramps in the legs, purging, and vomiting. He felt better on the Monday, and went to work, complaining only of feeling very tired and weak, until the following Saturday, April 17. Then urgent symptoms came on again, he was not purged now, but had a painful feeling of constriction in the chest, cold perspirations, feeling of numbness in the limbs, which efforts for a time failed in keeping warm, great restlessness, and at nights mild delirium; there was loss of appetite, thirst, slight sore throat, and the gums, as in another case of malignant pustule, were tender and swollen, indeed an aphthous condition of the lips and gums, the latter being still (May 20th), somewhat spongy and tender, was described. With these symptoms he was confined to bed until the 22nd April (5 days), when he again returned to work, and so remained, although feeling weak and exhausted, until I saw him. On the 6th of May a pimple appeared in the centre of the forehead, and when I saw it on the 20th of that month it had developed into a malignant pustule, having a very characteristic appearance, with a central black eschar a little less than a florin in size, and, encircling this like a wreath, a raised, white, weeping border, about a third of an inch in width, from which vesicles had two days before disappeared, after discharging a quantity of thin reddish fluid over the face.

The following case is one of the two that terminated fatally:—

(Case 3.) F. H., aged 26, always previously strong and healthy, a sorter of Persian wool, complained on Friday, April 23rd, of headache, shivering, pain in limbs, and vomited. At noon that day these symptoms obliged him to leave his work; but on the following Monday he felt better, and returned. He worked all that week, only complaining of lassitude and slight cough. On Sunday, the 2nd May, he seemed very well in the morning, ate a quantity of onions for dinner, and went for a walk. While out, however, he vomited, and came home feeling very ill. On the following morning, Mr. Tetley, who contributes the subjoined account, saw him:—
 “ On my visit he complained of excruciating pain in his legs and over the forehead, so much so that he could not bear his eyes open. The tongue was coated with a white fur; vomiting incessant; bowels confined; urine scanty and febrile; pulse 125; temperature $101^{\circ} \cdot 4$ F. In the centre of the forehead was a pimple not at all vesicular at that time, although it was when I saw it in the evening (the friends had not noticed it until I drew their attention to it). In the evening patient worse; vomiting continued; head no better; bowels slightly moved; pulse 130; temperature $102^{\circ} \cdot 6$; slight delirium. 4th, 10.30 a.m. Patient still worse; pain evidently very great; partially insensible; not vomited since my last visit; no action of bowels; pulse 140, T. 103° . 5 p.m. Much worse, looking ghastly; bowels moved once; no vomiting; urine scanty, and passed in bed; insensibility increased; pulse 156; temperature $106^{\circ} \cdot 8$. 11.30 p.m. Patient appearing worse; pulse dropped to 102; temperature $100^{\circ} \cdot 3$. Soon after this he was seized with convulsions, which continued until his death at 10.30 a.m. . . . The pustule had meanwhile considerably enlarged, and on the morning of his death there was a black slough in the centre.” The friends add that the body became quite blue during the last night of the illness, the extremities cold, and the eyes prominent and wild. Decomposition rapidly supervened.

In F. H.'s case the medical attendant did not consider the first ailment to be of the same specific nature that he discovered in the subsequent attack, and it will be observed in both cases (2 and 3) the sufferers were at work again on possibly infected material, after passing through the earlier and less definite set of symptoms.

The lesion I have spoken of as a fourth variety of anthrax pustule differs entirely in its appearance from the characteristic malignant pustule, and has not hitherto, I believe, been ascribed to the specific infection. It has no central black eschar, no raised vesiculated border. It commences as a papule, develops into a small tumour, or slightly inflamed eminence, with a raised central point, less prominent perhaps than in the ordinary furuncle. It terminates in resolution, or exudes only serosity (which latter may, however, under the influence of irritation, become purulent, or deep suppuration may under such circumstances occur). While the swelling itself gives rise to comparatively little pain, or even increased sensibility, there is often a tendency

* See also case 10, p. 18.

to a diffuse cellulitis. Abatement is followed by exfoliation of the cuticle, usually for some distance around, and by some local anæsthesia.

The woolsorters not infrequently suffer from this local lesion, and if they have a wound they are careful, they say, to keep it covered, knowing that such troubles are likely to occur. I did not happen to see any such pustules in woolsorters in the stage in which microscopical observation would be likely to be of value; the men indeed are so concerned about the fatal disease that they seem indisposed to pay attention to what they consider a mere inconvenience, and perhaps for this reason they would not come to me with this complaint. But when I met a deputation of some 30 sorters, four men, on my asking, showed quite recent scars, with the cuticle around for some distance still exfoliating; and on further inquiry, I found there was not a man in the room who could say he had not suffered similarly.* Medical practitioners in making post-mortem examinations in cases of "woolsorters' disease," are apt to suffer in like manner; as also are men engaged in slaughtering or dressing cattle affected by splenic fever.† It would seem inevitable to regard this lesion as owning the same nature as the more pronounced "malignant pustule"; differing in its manifestation from the latter according to a variety of circumstances, foremost, perhaps, amongst which are the peculiarities of species and of individuals, and the precise situation on the body at which the introduction of the poison occurs.‡ In this opinion, as regards the varied results of cutaneous inoculation in the human species, I find myself in accord with M. Colin in his observations as regards the carnivora (*Bulletin de l'Académie de Médecine*, No. 27, 1880). He found that in dogs much the same variety of local lesions as above described could be produced; the difference in the local manifestation, and with it the greater or less risk of secondary constitutional infection, appearing to depend largely upon the region of the body chosen for the inoculation of the poison. All varieties, however, of pustule, M. Colin says, are virulent, and are capable of producing, although with different degrees of probability, general and fatal infection. If this be so the practical importance of a careful study of this lesion is obvious.

I pass now to the consideration of the so-called "Internal Anthrax," the form of the disease which is the much more common one, at all events the more commonly recorded one, amongst woolsorters; which, so far at least as the fully-developed cases are concerned, is the much more fatal, and which has caused, as statistics presently to be given serve to indicate, a considerable mortality amongst the men engaged in this occupation.

Like all other infectious diseases, its course is divisible into stages. There are, first, the stage of incubation, and next, the stage of invasion or prodromata; in this disease one apparently of very variable duration, and marked sometimes by intermissions. Then follow, if the infective process progress, suddenly, the acute and stormy toxic manifestations that characterize the fully-developed disease. These latter symptoms, when developed in such degree as to keep the patient imperatively to his bed, would seem to terminate usually in death; and this commonly in from two to five days from the commencement of such symptoms. It is possible that this stage, thus developed, cannot truly last much longer (although, as presently to be noticed, relapses may apparently occur); seven days is the limit that Dr. Bell, who has seen many of these cases, places upon it; this, too, is the time, at about the sixth or seventh day after definite commencement of acute symptoms, that improvement, when recovery is to take place, commences. But although the patient pass this period, he may succumb later to secondary inflammatory processes; processes in which the lungs, as might be expected, are specially apt to be involved.

In 23 recent cases that entered fully upon this third or acute toxic stage, the mode of termination, and the duration, dating from the appearance of the urgent symptoms, may be expressed as follows:—

* I spoke to many sorters afterwards, however, who had not suffered in this way. Dr. Ibrelisle, in the *Annales d'Hygiène*, records the simultaneous occurrence in the prisoners working on hair in the prison of Metz of malignant pustule and of boils.

† The first of these statements I make on my own responsibility; instances that justify the latter are recorded, amongst others, by Mr. Jessop, of Leeds.

‡ This lesion, so far as my experience goes, almost invariably occurs on the hands, while the characteristic malignant pustule has mostly shown itself on the neck, face, and arms.

Stage of complete Constitutional Infection.

Number of Recent Cases.	Recoveries.	Fatal within					
		36 Hours.	2 Days.	3 Days.	4 Days.	5 Days.	8 Days.
23	4	3	2	6	2	4	2*

* Secondary septic inflammations.

NOTE.—To these might well be added in this classification six cases (making 29 in all) in which the malignant pustule was developed, and in which serious constitutional infection likewise occurred. Four of these six terminated in recovery; one was fatal on the third, and one on the fourth day, after the appearance of urgent symptoms.

But besides these developed cases there are, the evidence I think admits of no doubt, many cases of "internal anthrax" of a milder and rudimentary form. Often it happens that while one man will suffer from the marked and rapidly fatal malady, his comrade, working on the same material, will sicken in a precisely similar way. But, after various duration of the symptoms, at a point short of the intenser manifestations of the disease, evidences of improvement appear. The patient, according to the severity and duration of his attack, quickly returns to work or passes through a long and tedious convalescence. The histories of long-continued malaise, also, among men engaged in sorting certain wools (see histories of recent attacks), are too numerous to ignore. The symptoms described are much those of the prodromal stage of the acute infection—headache, depression, tendency to vomit, dimness of sight, cramps, restless sleep, &c. There is, too, an apparent periodicity of these symptoms sometimes observed; as indicated by the frequent opinion of the men that the dust in the opening of the bales has affected them each day afresh. Sometimes these manifestations culminate in an acute attack of the disease (in which case they may be regarded as prodromal symptoms); but this is by no means constant, and they may disappear spontaneously. It is possible there may be a condition of *chronic anthracoid poisoning*, the analogue of which would be found in malarial disease.

Period of Incubation.—I have little to record as to the probable duration of this period; the sufferers having usually worked for some time continuously up to the date of attack on possibly infected material. In one case (Case 35) it is extremely probable that for some weeks before his attack the sufferer was exposed on one occasion only to the risk of infection. He was a wool buyer, and had taken a sample of damaged camel hair to his employer, to show him how bad it was, about noon on the 20th May (one of two sorters employed on this same material suffered afterwards from symptoms that I have ascribed to abortive attacks). He, the wool buyer, never complained at his work of sickness, but left for the last time on Saturday, the 29th. At home, however, he had complained, I found, certainly all the previous week of general malaise; and severe symptoms appeared on Sunday, the 31st. In three other cases the period of incubation was probably not longer than two days, four days, and twelve days respectively (the sufferers were *probably* not exposed before that time to infection); in two other cases it apparently could not have been less than three days and 10 days respectively. In case 1, a case however of cutaneous inoculation, constitutional symptoms appeared six days after exposure.

It is quite possible, it seems to me, that there may be sometimes, perhaps not unfrequently, long periods of latency of the disease germs within the system; to be followed by development only when favourable conditions of system arise. Certain cases suggest this; but still more forcibly, I think, does the general behaviour of the disease.*

Prodromal Stage.—The sufferer usually first complains of chilliness, not often amounting to distinct rigors, bodily weariness often very great, and mental depression.† There are usually more or less profuse perspirations, and irregular flushings

* I have discussed this subject more fully in a note appended to this report; as to individual cases, in 1874, W. E. I. died of all the symptoms of the "wool-sorters disease," his death being certified "Congestion of the lungs, 2 days." For six weeks before his death he had been employed as a house-painter; before that in sorting alpacas, that had apparently given rise to other attacks. (See also Cases 6, 7, 8, as well as several others the histories of which *may* admit of a similar interpretation.) The possibility of the latency of the poison had been forced upon the attention of the sorters themselves, from the facts they had collected as to the behaviour of the disease; and I was asked by a deputation of the men whether such a thing was possible.

† The influence upon the emotional nervous centres is often marked; as evidenced in one case by a strong man coming home on the day of his leaving work crying and sobbing; and the choking sensation that is sometimes complained of in the throat is probably another evidence of this influence.

of the face, which may appear congested or pallid, usually the former; sleep is restless or there is sleeplessness. The respiratory centres are commonly early involved in this nervous disturbance; there is a sense of constriction of the chest, accompanied by shortness of breath, frequent sighing and yawning, and later, perhaps, by cough. Aching of the limbs is usually complained of, perhaps cramps in the calves; and there may be peculiar feelings of numbness or formication in the extremities; or less commonly loss of power and staggering gait. Not quite so commonly perhaps as some of these other symptoms, but still frequently, there is headache, slight pain or stiffness in the neck, dizziness, nausea, and vomiting; and vomiting may indeed be the initial symptom.

Should the disease progress, in a variable time, sometimes in a few hours, more commonly perhaps in from two to five or six days, these symptoms, especially the sense of weariness and prostration, increase, or others more alarming present themselves, so that the patient finds himself incapacitated from work. In other cases it seems that distinct intermissions occur; and if we could be sure that in the histories of such attacks the first symptoms were rightly ascribed to the specific cause, and if we could eliminate the possibility of a fresh or intermediate infection, it would appear that weeks might intervene with intermittent prodromata before the final stage was reached. The frequency of distinct remissions at this time is unquestionable. In the case just mentioned (Case 35) the man only complained in the evening, when probably the nervous system was exhausted with the day's work; periods too of excitement may alternate with those of lassitude and weariness. Thus it not unfrequently happens that when a man has given up work and taken to bed feeling utterly prostrate, he will think he can, and sometimes does, return; and he may thus work again for a few hours before his final discontinuance of active exertion.

The Stage of full Development.—Although prodromal symptoms may have been prolonged, the actual commencement of the stage of full development is usually sudden and unexpected. The prostration and restlessness become more marked; the face may be deeply flushed or pallid; the respirations are almost always greatly accelerated, to 30 or 40 perhaps, while the pulse rises to 100 to 130 or 140 per minute, and is usually weak and compressible. The temperature is reported to show in several cases no considerable rise above the normal, and to be moreover very variable, not only in different individuals, but irregularly so in the same patient; but further thermometrical observations are required.* At this early period, 12 to 24 or 48 hours after appearance of urgent symptoms, whilst normal respiration may still be heard, but with increasing precordial anxiety and dyspnoea, with signs of less and less complete filling of arteries, with coldness of surface, and deep cyanotic hue of skin, the patient may sink into a state of fatal collapse. Or, apparently, a similar condition, or perhaps one of asphyxia, may be induced at this time quite unexpectedly, with a previous temperature only moderately high, and a cardiac weakness not excessive, from the rapid pouring out of a vast serous effusion into the pleural cavities (Case 30, and perhaps 28, for example, with autopsies, in Appendix A.). But the case is usually a little more prolonged; some reaction takes place, and the symptoms above enumerated are supplemented or accompanied throughout by others. There may be more marked and continued fever, with a temperature rising to 104° or 105°; but always accompanied seemingly by a tendency to irregular downfalls, and the breaking out of more or less profuse perspirations. The symptoms of the prodromal stage are all increased; violent headache, incessant vomiting, increased restlessness and excitement, vigilance, delirium or somnolence; or, perhaps more frequently, the sufferer retains his mental faculties, only comparatively impaired, until the end. Often quite early in the disease symptoms of various acute local congestions arise. The lungs are specially apt to be affected; and the physical signs of that condition, with the occurrence of a copious frothy blood-stained expectoration, are noted; and a fatal œdema may supervene (Case 20, with autopsy); or more copious hæmoptysis, as might be expected from the pathological conditions, may occur. Similarly, more or less severe gastro-intestinal symptoms may appear. From the first there has probably been loss of appetite, with a moist furred tongue; now colicky pains may trouble the patient, with vomiting (probably of different significance to that of the initial stage),

* Or heat may, of course, with approaching collapse, be irregularly distributed: case of Dr. Bells ("Lancet," June 5, 1880); temperature (day before death), axilla, 97°·6 F.; under tongue, 98°·1; in rectum, 102°·2. Day of death; axilla, 96°·6, rectum, 102°·5. See also Case 24, and in Appendix, Case 11.

and diarrhoea (Appendix, Case 25), and sometimes jaundice (Appendix, Case 22). Hæmorrhage from the bowels has not been observed in the cases on which this description is founded; but it has been noticed elsewhere.*

Sometimes there may occur a remission of all the more distressing symptoms (Case 15, for example); the breathing becomes easier; the colicky pains and vomiting cease; the restlessness and sense of oppression diminish, and a little sleep even may be obtained. The patient and his friends believe that recovery is close at hand. But the profound impression that has been made upon the circulatory system soon manifests itself anew. Perhaps it is suddenly discovered that the extremities are stone cold; or syncope, lasting only a few minutes, may suddenly occur (Cases 28 and 15); cyanosis, before noticeable at the lips and finger-nails, gradually spreads and deepens; the indications of cerebral mischief may now become more direct and violent, with spasmodic knitting of the brow, wild delirium and convulsions; or another group of symptoms, referable perhaps to the implication of the spinal cord in the prevailing morbid changes, may be developed; two cases of tetanic spasms, one commencing with trismus, were described to me, as associated with the other symptoms; or the sufferer sinks into profound coma from cerebral hæmorrhage (Appendix, Case 35), from which there is no arousing; or the stages of a typical asphyxia may close the scene.

Should the patient survive this stage of full development he may still, as already stated, succumb to inflammatory processes set up during its continuance (Appendix, Autopsies, 22 and 25); or apparently a true and fatal relapse may occur (page 31).

But recovery after this stage, I am led by this inquiry to believe, is not so rare as hitherto supposed. Besides the abortive cases before referred to, several, running more or less the course I have described, were related to me, where complete recovery supervened (see histories of recent attacks). The convalescence will be long and tedious (the average duration of absence from work averaged between seven and eight weeks in eighteen such cases whose histories I have collected); a tremulous and feeble condition of the muscular system is left; the cutaneous sensations noted in the prodromal stage (numbness, "furry" feeling) will very likely continue for a time; muscular cramps may continue to trouble the patient; the epidermis sometimes desquamates, in two of the cases above referred to the finger-nails came off; various eruptions are apt to appear; herpes, boils, and sometimes, it would seem, gangrene. And these latter manifestations may occur during the acute stage.†

Finally, judging from the histories I have recorded, it would appear that one attack of this disease successfully overcome confers no immunity from subsequent infection.

PATHOLOGICAL ANATOMY.—Notes on autopsies are contained in the Appendix. Various evidences of early decomposition are commonly met with, parts of the body being considerably swollen and discoloured, especially around the neck and about the chest and arms, where, also, there is frequently an emphysematous condition of the subcutaneous tissues. Besides these early post-mortem changes, various pathological conditions of the skin may be present; petechiæ being apparently the most common. The heart is often flabby, and its muscular substance dark in colour and containing sometimes minute hæmorrhagic extravasations; the blood in its cavities and in the large vessels is generally quite fluid, and of a dark cherry colour, and the endocardium, unless the autopsy be made very early after death, usually shows (owing to early disintegration of the red blood corpuscles and consequent escape of coloring matter) a corresponding tint. There is often a considerable pericardial effusion; and both pleural cavities are often found filled with a straw-coloured serous fluid. The lungs may be normal, or more usually they exhibit signs of considerable hyperæmia, combined, it may be, with œdema. This hyperæmic condition may it is probable in later cases go on to a true pneumonia; or metastatic pneumonic processes may be set up, with the formation of numerous small infarcts and abscesses. The lungs, too, like other organs, may be the seat of larger hæmorrhages, presenting here the characteristic appearance of hæmorrhagic infarctions. But, while the smaller hæmorrhages may depend upon obstruction of vessels by masses of bacilli, it is to be doubted whether the larger ones are always of embolic origin; and, indeed, we can scarcely account for the large and widely pervading hæmorrhagic and œdematous effusions that so often characterize the

* It occurred in animals that, as I shall presently have to show, contracted the disease in this district from a similar source.

† Two deaths, both probably, and one from the history almost certainly, from this disease, were certified as due to "senile gangrene," the ages being respectively 55 and 58. In two other suspicious cases the deaths were certified "enteritis, gangrene." One death that was certainly due to this disease was certified "herpes zoster."

anatomy of anthrax without supposing some acute nutritive disturbance of the walls of blood vessels and of surrounding tissues, with coexistent favouring conditions of blood and of blood circulation—conditions that there are other pathological and clinical reasons for believing to be present in this disease. The bronchial glands are very usually swollen, soft, and, infiltrated with blood, of a purple or blackish colour. The bronchial mucous membrane may or may not be reddened, small hæmorrhagic extravasations are frequently to be seen beneath its substance, and in the bronchi blood-stained mucus is sometimes found. The mucous membrane of the pharynx and trachea is commonly hyperæmic. In the abdominal organs, also, signs of congestion, with various hæmorrhages, are usually met with. The spleen is usually, although not constantly, enlarged, its substance soft and even diffuent; the liver is less frequently hyperæmic, may indeed appear anæmic; the kidneys are usually much congested, and show signs of cloudy swelling. The mucous membrane of the intestinal tract occasionally exhibits signs of acute catarrh, and the mesenteric glands will probably then be congested and swollen; but this condition is far from constant, nor have I been able to find anthrax carbuncles, such as are spoken of by some authors, in any part of the digestive tract. The bladder in two of the five autopsies conducted by myself was quite empty, in two the urine contained albumen. The brain may exhibit no conspicuous lesion, or there may be extensive hæmorrhages into its substance or in the membranes. Perhaps the most constant and striking lesions are the serous, or sero-hæmorrhagic jelly-like infiltrations in various connective tissues. They abound sometimes in all the loose connective tissues of the body; especially in those of the neck, in the mediastinum, in the sub-pleural cellular tissue, and in the loose connective tissue around the kidneys. They give the organs and vessels in the neck the appearance of being embedded in and surrounded by a jelly-like plasma, and the lungs of having jelly-like masses appended to them; they may be of a yellow or straw colour, or of various blood tints; or the blood sometimes appears to have been extravasated over an already gelatinised effusion. Lastly, the specific contagium of the disease, the bacillus anthracis, will usually, in my small experience always, be found, although in widely varying quantity and unequally distributed, in the blood and extra-vascular fluids.

It will be seen that many points have arisen in the foregoing pages that call for discussion. The pronounced symptomatology of anthrax would, one would think, in the light of its known parasitic nature, and its observed anatomy, render possible an interpretation of the pathological conditions which constitute the disease. A *theory of disease*, if only approximately true, is still of practical utility to the practitioner, and, when true, is of high scientific value. The question as to the channels by which the poison reaches the system is obviously one of moment. The apparent latency at times of the disease germs; the ill-health of indefinite features and duration from which those who are exposed to infection often suffer, and which sometimes ushers in the fully developed disease; the sudden onset of the latter under such circumstances, and its then specific course, are all observations that, if we could rightly interpret their significance, might prove of vast importance, not only in their bearing upon the disease immediately in question, but on infective processes in general. But in their consideration one must necessarily tread upon speculative ground; the views that can at present be advanced can only be tentative, and consequently one is in a sense debarred from the discussion in an official report. I propose, however, to consider certain of these questions in an appended note. Meanwhile, I will say this much only, and I would beg that opinion upon the hypothesis be reserved until I have had an opportunity of developing the evidence and arguments which support it, namely, that there are certain curious circumstances and coincidences associated with attacks of this anthrax disease in man that would seem to suggest that the food supply of the sufferers may be in some sense related to certain of the phenomena I have remarked upon—would seem to suggest that such influence may determine in some degree the onset of the stage of full development of the disease, the sudden appearance, and in some cases the recurrence, of the violent symptoms. It is conceivable that alimentary substances may bring about in the body such chemical or morphological change as will render its fluids a richer field for the proliferation of disease germs.

II.—THE ETIOLOGY OF THE DISEASE.

At the commencement of the inquiry every effort was made to discover the occurrence of sickness, of a similar character to that now described, amongst others than those engaged in the manipulation of wool and hair; and, amongst those so engaged, to trace the disease to other possible sources of infection than such as were connected with the occupation. Search was made for the existence of anthrax or splenic fever amongst the sheep and cattle of the neighbourhood, and three recent outbreaks of the kind were investigated. But efforts entirely failed to associate, in a causal sense, any circumstance but that of the sufferers' occupation with the attacks that I was investigating in man. No like sickness amongst the general population could be shown, with even a fair approach to probability, to have occurred; although rumoured occurrences of the kind were followed up. Not even in the families of suffering woolworkers, where all were apparently exposed to the same home influences, dietetic and other, were any but the one engaged in the occupation attacked. Further, with doubtful exceptions presently to be referred to, all the cases I could discover occurred amongst men engaged on certain classes of wools and hair, that is to say, *on the dry foreign material*, and, with rare exceptions, amongst these, only those suffered who were employed in the first manipulation—in the *sorting process*. The evidence gained has indeed justified the local name which the disease has received: it will be shown to be "the Woolsorters' disease."

The above general conclusions, establishing a *prima facie* case against the wool, or certain classes of it, as being the medium of infection, and against certain of the trade processes, represent the information obtainable from the history of the earlier cases of the disease. My more detailed inquiries into the origin of the more recent cases will be given later on.

First, however, it will be convenient to refer to the woolsorters, as a class, and their mortality statistics; and to describe as briefly as possible the occupation, and the material used.

THE WOOLSORTERS: THEIR MORTALITY STATISTICS.

The woolsorters, as a class, are a steady, industrious, and most intelligent body of men. They constitute scarcely 10 per cent., in some worsted factories not more than 5 per cent., of the total number of employés; and their occupation is looked upon as a skilled one, necessitating a long apprenticeship. Far from being a fluctuating or changeable body, the occupation is sometimes affected by families for generations; a father bringing up his sons to, and teaching them himself, his own trade. Lads are, it is said, usually apprenticed to the trade at about the age of 16 or 17 years; but for a year or two they are kept at other employment, "odd jobs, and so on," so that they do not begin sorting until they are about 18 years. No deaths below this age are recorded in their mortality returns.* They earn good wages, averaging 31s. a week, and they are, for the most part, exceptionally well housed. They stand to their work in rooms which are, as a rule, spacious, and which would be considered, were it not for the dust, well-ventilated; and their hours of labour, since work can only be carried on by daylight, are, especially in winter, not excessive. On the whole, the ordinary hygienic conditions of their lives are favourable to a long and healthy existence; but they have two special evil influences to contend with,—dust and the special danger of infection; and these raise what should be an exceptionally low mortality-rate to one above the average proportions.

In seeking to estimate the influence of the occupation on health by means of statistics of mortality, the difficulty first encountered arises from the unavoidable meagreness of these statistics, owing to the comparative smallness of the class from which they must be drawn, and also from the absence of a census of that class; and secondly, the nomenclature of fatal disease is, for reasons already given, not to be trusted to as indicating the causative influence of the occupation upon that disease, still less as

* Certain information that Dr. Bell obtained, in attempting to collect statistics of the sickness of woolsorters, bears upon the above observations. Of 236 sorters, he found the average age was 33 years, and the average time they had been engaged in the employment, 12 years and 10 months; giving a mean age upon entering of 20 years. The average length of time these men had occupied their last situations was 7½ years.

differentiating between the influence of dust to which these men are so much exposed, as such, and of dust possessed of specific qualities.

For these reasons our present statistical information must be deemed inapplicable for the foundation of absolute conclusions. Nevertheless it affords considerable confirmatory evidence of experience gained in this inquiry; and while I have placed certain of these statistics in the Appendix (B.) as a possible basis for further investigation, I will here shortly discuss their apparent bearing.

It would seem: (1.) That amongst woolsorters a high general mortality prevails. (2.) That their greater mortality is due to an excessive number of deaths ascribed in the register (*a*) to pneumonia, congestion of the lungs, and bronchitis; (*b*) to consumption; (*c*) to the less common forms of zymotic disease (pyæmia, &c.); and (*d*) to causes ill-defined. Lastly, there are cogent reasons which favour the assumption that what may be termed the surplus deaths from those of the *acute* diseases above named are really attributable, not to the causes assigned, but to the specific infection in which this investigation is mainly concerned.

I have emphasised above the term *acute diseases*; for the influence of *dust*, as such, in producing chronic lung affections, cannot be ignored, and the subject requires a word of notice here. Until quite recently it was, as I have said, the general opinion amongst the profession at Bradford that the dustiness of the occupation, if not a sovereign cause, was at least the major one, in determining a high mortality amongst sorters. Dr. Rabagliati, of Bradford, discussing this subject in an article on "Health and Disease in Industrial Occupations," arrives at the conclusion that bronchial catarrhs are induced in these men by the mechanical irritation of inspired dusty particles, and that this bronchitis, or the catarrhal pneumonia that may follow, may determine the occurrence of pulmonary consumption. Still, it is a noteworthy fact that as the diseases of sorters come to be more fully investigated, this influence of dust, as such, retires more into the background, and a *specific* infective agency comes to be a more and more prominent feature in the scene. Probably no medical authority at Bradford now denies the fact (Dr. Rabagliati in the above-mentioned paper fully recognized it, and Dr. Bell has for long maintained that it is so), that very many of the deaths amongst sorters certified as from "acute bronchitis," "pneumonia," "congestion of the lungs," &c. &c., were really cases of the specific infection that this report describes. Then, as regards this evidence of the prevalence of "consumption"—evidence, it must be remarked, that does not stand prominently forward in the statistics, and which, but for current medical belief, might perhaps for the present be ignored—it would be impossible to define the limits of the influence of dust in producing disease known under that and the like names; we know of that influence among workers in cotton, as well as in wool, and among people employed in weaving as much as those engaged with raw materials. Nevertheless, we cannot overlook another origin of a consumptive disease really tubercular in nature—a real development of tubercle after an acute febrile affection, as after measles, whooping-cough, enteric fever; and it must needs arise for consideration whether such an origin of real tubercular phthisis may not be found, apart from any question of dust, in the prevalence of disease of the nature of anthrax; a disease characterised by obscure febrile symptoms of greater or less duration and intensity; and characterised also by anatomical lesions, infiltrations of glandular and other organs, that may, we may readily believe, if we accept the theory of auto-inoculation, result in the formation of foci of tubercular disease. It must be observed that Dr. Rabagliati inclines to the opinion held often by employers, that a predisposition to consumption may exist with more than ordinary frequency in sorters. That the occupation "being light, entirely confined to men, and at the same time well paid, is much sought after by delicate persons." Perhaps there is a certain presumption in favour of this supposition, although, since the occupation is one requiring a long apprenticeship, and not one that can be taken up at any time by a person feeling unequal to other labour, I cannot well understand the amount of foresight that is implied. Moreover, I could myself find no evidence of the prevalence of such a practice; the sorters, who are for the most part men of fair physique, deny that such a consideration actuates them in their choice of employment; and the opinion of Dr. Bell is against the supposition.

To return to the mortality statistics: it is suggestive of some not only unusual, but violent influence—an influence unlike that which *dust* alone would produce—when we find that the excessive mortality is brought about principally by deaths from *acute* diseases; thus (amongst other evidence in this direction) of the large number of deaths (127) registered from the three diseases, bronchitis, pneumonia, and congestion of the lungs, 67, or 53 per cent. of the total number, were ascribed to the two latter

acute affections. Amongst the general population the corresponding proportion is not more than 32 per cent.

The evidence that is obtainable as to individual deaths amongst woolsorters points strongly in the same direction.

I have elsewhere stated my reasons for not looking lightly upon the opinion formed by the men themselves as to the nature of these sudden attacks amongst their comrades; and the information given below, the registered causes of such deaths as were returned by the men of certain factories as due in their opinion to "Woolsorters disease," is suggestive often of causes of fatality at any rate other than those officially recorded.

[This return is from three factories only. For although I have the necessary return from *the factory* at Queensbury, the registered causes of death in this district have not been supplied me. The cases are, of course, as they were given, none being excluded.]

REGISTERED CAUSES OF FIFTY-FOUR DEATHS believed by the WOOLSORTERS to have been due to the "WOOLSORTERS DISEASE."

SALTAIRE. Years, 1872—Sept. 1880. 26 deaths.		Messrs. MITCHELL BROTHERS. Years, 1874—Sept. 1880. 21 deaths.		Messrs. MITCHELL & SHEPHERD. Years, 1869—Sept. 1880. 7 deaths.	
Age.	Registered Cause; Duration.	Age.	Registered Cause; Duration.	Age.	Registered Cause; Duration.
46	Not known.	31	Pneumonia, 3 days.	32	Bronchitis, 3 days.
45	Bronchitis; heart disease.	21	Cerebral meningitis, 10 days; pneumonia, 7 days.	43	Perforation of stomach.
57	Morbus cordis, bronchitis, 3 days.	38	Spasmodic closure of trachea.	55	Herpes zoster.
25	Enteritis, collapse.	43	Emphysema and bronchitis, mitral regurgitation.	21	Erysipelas of face and head, 4 days; convulsions and asphyxia: metastasis to brain, 4 hours.
66	Bronchitis, 4 days.	26	Pneumonia, 9 days.	41	Pneumonia.
42	Congestion of lungs, 4 days.	50	Acute gastritis, 4 days.	44	Blood poisoning.
33	Pneumonia.	21	Encephalitis, 10 days.	43	Blood poisoning.
41	Bronchitis.	25	Pneumonia, 6 days.		
31	Heart disease.	30	Not known.		
45	Pneumonia, collapse.	27	Sorter's disease, infection from mohair, 12 days; double pneumonia, 5 days.		
26	Do. 10 days.				
47	Woolsorters disease, 30 hours.	26	Pyæmia, caused by breathing vitiated air whilst sorting mohair.		
44	Acute bronchitis.				
32	Congestion of lungs, 2 days.	28	Bronchitis, 4 days.		
40	Natural causes.	22	Broncho-pneumonia.		
54	Pneumonia, 4 days.	48	Not known.		
28	Do. 12 days.	23	Meningitis.		
25	Do. 3 days.	60	Woolsorters disease (relapse), 3 months and 8 days.		
57	Do. 2 days.	24	Pneumonia, 21 days; peritonitis, 7 days.		
25	Do. 5 days.	46	Woolsorters disease.		
27	Woolsorters disease, 1 day.	70	Bronchitis.*		
58	Poison from Alpaca, 18 hours.	20	Pneumonia.*		
21	Diffuse cellulitis (4 days), exhaustion.	19	Woolsorters disease.		
47	Pneumonia, 9 days; gangrene of lung.				
45	Pneumonia.				
25	Pneumonia, 6 days.				

* Found on post-mortem examination to be "woolsorters' disease."

I have spoken of deaths from *ill-defined causes* as having swollen the mortality; and I wish to apply the term not only to those cases in which the nomenclature is in itself enigmatical (instances of which may be found in the above table), but also in regard to those cases in which the assigned cause of death is so rare as an idiopathic affection that we are compelled to regard its unduly frequent appearance in the death register as an indication that secondary and accidental lesions have been mistaken for fundamental processes. And if we have reason to believe that a disease, which may often give rise to such secondary lesions, is prevalent, and to a great extent unrecognized, a well-founded suspicion may be entertained that in such disease will often be found the true cause of death. The following facts are peculiarly suggestive, having regard to the symptomatology of the disease under consideration (see appropriate section) of such a conclusion in this case:—Of the 455 deaths amongst sorters, from all

causes, seven are ascribed to "meningitis"—a proportion of deaths from this cause equal to 17·8 per 1,000 of the total number of deaths from all causes. The corresponding proportional number amongst males above the age of 15 in England (including deaths from tubercular meningitis) is 6·4. Six deaths (two of them said to be complicated with gangrene as a secondary affection) are referred to "enteritis," a proportion equal to 13·2 per 1,000 of the total mortality, as compared with 3·4 the corresponding proportional number in England. Two deaths were ascribed to "perforation of the stomach;" one to "acute gastritis (four days);" one to "tympanitis;" two to "peritonitis," and two to "hæmatemesis." The number of deaths referred to apoplexy per 1,000 of the total mortality is 57·1; amongst the general male population it is 42·8. From "gangrene" amongst woolsorters, this proportional number is 13·2, amongst the general population it is 4·6.

Dr. Bell has attempted to obtain statistics of non-fatal sickness amongst the sorters. He obtained replies to the form of queries he issued from 236 men (employed on both English and foreign wools), and these he has kindly placed at my disposal. I fear, however, they are too indefinite to admit of being dealt with in detail. They show that sorters of foreign wools complain much of the indefinite symptoms that I have suggested may be due to a chronic or abortive anthrax infection. "Oppression of breathing," "tightness of the chest," "dizziness," &c., &c., figure very largely amongst their complaints. Dr. Bell, reviewing the evidence so far as it relates to non-fatal sickness necessitating discontinuance of employment, states that, whereas workers on English and colonial wools lost on an average $22\frac{3}{4}$ hours per man per year, workers on foreign wools lost $41\frac{1}{4}$ hours from this cause.

THE OCCUPATION.

From what has preceded it will be found that the description of the trade processes may be confined to such as are connected with the first or early manipulation of foreign wool and hair in the worsted manufacture. It of course by no means follows, because this inquiry does not show it, that the disease does not affect workmen engaged in other allied trades. We know indeed that those handling the flesh and hides of animals—tanners, knackers, &c., suffer at times from malignant pustule;* and we might expect that the internal form of the disease, as I have described it, would be found occasionally amongst the workmen of all trades in which the manipulation of the fleeces of animals is engaged in, *e.g.*, in the carpet and felt manufactures, and in the woollen manufacture generally. But this report is concerned only with disease occurring among persons employed in the worsted manufacture, and it is with this manufacture only that I propose to deal.

Sorting is the first process. It consists in dividing or sorting the "wool," and in this term is included the wool and hair of sheep, goats, and camels of various species, into qualities, according to the colour, length, or fineness of fibre. Sometimes only two or three such qualities are made of one fleece (or lot of hair, for it is not all in fleeces), sometimes as many as fifteen, or any intermediate number; according to the kind of "wool" and the material into which it is intended it should be worked. The sorters are of two classes, "packmen," who open the bales and do the first or rougher sorting, and "day men," who look over this work, and perhaps again sub-divide the wool; but this second operation is only gone through with the finer qualities. The sorting rooms are generally the warehouse rooms, and consequently contain large quantities of stored wool in bales. The men stand at their work, before sorting boards or hurdles arranged in a row facing the windows. Over these hurdles, the heavier dust falling through their wire lattice work, the wool is sorted. Each man, the usual custom is, has his bale of wool allotted to him; he opens it in the sorting room and sorts it as described. The different qualities accumulate in piles around him, and as the piles grow each sort is loosely packed in "sheets" and weighed. If not immediately required for use the several kinds are then stored (usually in the sorting rooms, and they are sometimes so stored for years), or, if at once required, they are taken direct to the washing bowl. Or it may be the sorted wool is shot *unpacked* down a shaft from the sorting room above to a packing room, or direct to the washing room, operations in which, when dealing with the dry foreign wools, a large amount of dust, against the wide distribution of which sufficient care is not usually taken, arises. In the washing room, the

* Being in Wetherby at this time on another inquiry, distinct histories of two recent cases of what must certainly have been malignant pustule, occurring in workers at a tannery in that town, were related to me by the Health Officer.

wool is passed through two, or sometimes three, "suds" (soap and water) at a temperature of from 110° to 130° or 140° F., and dried, or partially dried, by having a warm air blast passed (usually drawn, sometimes blown) through it, whilst spread in the drying room over wire lattice work; or it may be dried in a ventilated hot air chamber (temp. about 150° F.). It is then taken at once, while still a little damp, to the combing room. Here, by its successive passage through complicated machinery, it is manufactured into "topplings," and is then ready for the spinning processes. It is only in the first process of sorting that the wool is subjected to much manipulation, afterwards machinery takes the place of hand labour; and moreover, on its arrival in the combing room after passing the washing bowl, it is clean and moist. We might have expected consequently this first process to be associated with by far the greatest danger to the workmen, from any harmful particulate matter that the wool might contain, and experience shows this to be so; the packmen and day-men suffering almost equally. The power of the wool for mischief cannot, however, be said to be exhausted here, for in the combing room the material may possibly prove infective. (Cases 19 and 21.)

Residual Products.—It will be remarked that much dust from the wool falls through the sorters' hurdles; that the wool is washed in sud water; and that blasts of warm air are driven afterwards through it. It is necessary to inquire what becomes of this dust, this slop-water, and the warm air currents; since if the wool itself contain the material of disease, each of these three agents may be expected to operate in its distribution. The dust from the sorting boards, and that which collects in the room, is taken into out premises, and either deposited, along with manure and other refuse, for a considerable time, and then applied mostly to arable land, or it is sold at once to manure manufacturers. Whether such manure, carried into water-courses by the rain, or settling upon grass or hay, ever causes splenic fever (anthrax) in cattle, is a point to be determined. Possibly when mixed as described with ordinary manure the decomposition which the mass undergoes suffices to destroy the virus.

The sud-water from the washing bowl is run into settling tanks. Short hairs and dirt settle here; and this refuse is added to the dust previously referred to, and used for manure. The supernatant liquid is run into vats, where it is slightly acidulated with sulphuric acid, and at the same time usually warmed and agitated by a jet of steam. This "breaks" the "sud," and separates the grease of the soap (and in the case of greasy wools, of the wool), which rises to the surface and is recovered. The liquid, which is now either neutral or slightly acid, passes into the drains; and there exists the strongest evidence to show that this liquid remains capable of infecting sheep and cattle when run direct upon pasture land. Further, it would appear that in some cases streams which furnish considerable populations with drinking water may be contaminated with this liquid; but I have no evidence that disease has been caused thereby.

The air blasts that are forced by fans through the wool for the purpose of drying it, or which are used by some firms as a means of removing dust from the wool before sorting, pass to the roof of the factory; and the latter is often seen covered with short hairs and dust from this source. These dusty particles are blown by the wind far and wide, and washed by the rain into the sewers. The bags that the "wool" comes packed in from abroad, after being brushed by the sorters so as to remove the wool adhering to their sides, are sold, usually unwashed, and distributed over the country; they are used for various purposes, as floor coverings in the houses of the poor, as horse-cloths, &c. &c.; or, after going through what I understand is a thorough process of cleansing they may be torn to shreds and used as stuffing for cheap upholstery.

THE WOOL.—I have said that those looked upon as dangerous are the dusty foreign wools; the English and Australian sheep wools have never, so the workmen and the manufacturers and the medical men say, been known to cause the disease.* Now as any circumstance, besides the greater freedom of the English and Australian animal from the disease, that may explain this exemption, may serve also to indicate the direction which preventive measures should take as applied to other wool, the differential circumstances of the two classes are worthy of attention.

The most noticeable differences are, first, the *greasiness* of the home and colonial grown wool, a condition arising from the "yelk," a natural secretion of the animal's

* A rapidly fatal case of illness occurred during my absence from Bradford, in a man who sorted only English wool. It was attended with symptoms very similar in many respects to those ascribed to the specific disease, so as to arouse the medical attendant's suspicions. A post-mortem examination was not made; and the death was certified as from pneumonia.

skin; and secondly, its much greater cleanliness, by far the greater part having, unlike most of the foreign wool, been carefully washed before the shearing. It follows that in the sorting of it no dust or short hairs arise; the atmosphere of the sorting room appears perfectly free from dust, whilst in the sorting of the other it is greatly charged with such impurity. A third, and probably still more important difference, is the fact that in these English and colonial wools "fallen fleeces," *i.e.*, the fleeces of dead animals, are comparatively rarely found. The wool is subjected to more careful examination at the time of buying, and "fallen fleeces," if found mixed with others, an occurrence which it is said is most unusual, are excluded. Now to these "fallen fleeces" great interest attaches, for inasmuch as anthrax is a rapidly fatal disease amongst sheep and goats, infected fleeces, or at least those originally infected, must, one would suppose, in the vast majority of cases, be shorn from dead animals. Even in the foreign wool these fallen fleeces are found only exceptionally in the better qualities, and amongst the inferior qualities they are mixed in a more or less surreptitious way, being found often pulled to pieces and hidden as it were in the centre of a "bump" or roll of fleeces. But they are readily distinguishable; not having reached maturity (as must most often be the case) the hair is shorter in the fibre; it has, too, lost its elasticity, is limp and lustreless.

From our knowledge of the pathology of the disease and the nature of the contagium, we should, as I have said, expect the danger to lie with these fallen fleeces; and there is some evidence that this danger is proportionate to their number and frequency.

The dry foreign "wool," then, is that to which attention must be particularly directed. The term includes the following classes that are used in the Bradford district, enumerated so far as present experience permits, somewhat in the order of their apparent noxiousness:—

(1) Van Mohair; (2) Persian wool; (3) Camel's hair; (4) Alpaca; (5) Turkey mohair; (*a*) average; (*b*) inferior; (*c*) locks; (6) Pellitan; (7) Cape mohair; (*a*) superior; (*b*) inferior; (*c*) locks; (8) Cashmere.

Van Mohair, the fleece of the Mohair, a species of goat, that is raised in flocks by the wandering Arab tribes of Kurdistan in Asiatic Turkey. About 9,000 bales, (a bale weighing 180 lbs.), are imported annually into England, and about 8,700 of these (the remaining 300 going to Norwich) are brought into the Bradford district. The "wool" is long and coarse in fibre, is often very dirty, and is sorted usually into only a few qualities, four or five. The mode of its collection and transportation are as follow: the Kurdish tribes attend with their flocks, once a year, a great fair, Bitlis, Djezireh, and Mogoul being the principal seats of these gatherings, and there the goats are sheared; or in other cases petty dealers collect from the country round, and bring the wool to these market towns. It is bought there by agents, and sent overland, or partly overland and partly by the Black Sea, to Constantinople. There it is roughly divided into four classes, according to its colour and quality (white, brown, grey, and locks), by men, mostly Greeks, employed for the purpose; packed, and sent to England. Here each class is again sorted as above described.

Such is the usual channel by which this wool or hair reaches England. Some consignments, however, have recently been sent through Bagdad, Bassora, and the Persian Gulf, and by this route the material is classed still more roughly and only according to the colour before exportation. Some small quantity, again, may be exceptionally delayed in the transit. It is said that a Kurdish family, when not in immediate want of money, will often store up the wool in their tent or dwelling; that it will be used then as a bed in sickness and so on; to be brought out for sale when necessity arises. I have no evidence, however, of its being a vehicle for the transmission of human contagia.

Persian Wool is a sheep's wool, and, as its name implies, comes from Persia. About 16,000 bales are imported, chiefly through Bagdad, to this country, and most of this (unless, as happens in some years, a considerable quantity be re-exported to other countries) finds its way to Yorkshire. It is a fine but very dusty wool; not classified before reaching this country; and indeed subjected to little sorting here, the process being one rather of selection according to the colour of the hair, the unraveling of the knotted portions, and the subsequent blending of the colours, to procure the proper shades. At present these processes, all very dusty ones, are gone through before the wool is washed.

Camel Hair, about 9,000 bales of which are imported, in about equal proportion from Russia and China, is likewise a very dusty material. It, too, is only roughly sorted; and not at all before it reaches England. The great bulk of the above amount is

utilised in the Bradford district. It is supposed that anthrax sometimes causes a large mortality amongst camels.

Alpaca.—Of this well-known hair about 25,000 bales are imported, practically all to the Bradford district, annually. It is shipped chiefly at the port of Arequipa in Peru; the centre of the district where the Paca is found. At this port it is classified, the work being largely done by native women, into three sorts: "superior," "inferior," and "locks." The two first are what their names imply; the "locks" are for the most part the clippings or trimmings of the fleeces before the latter are shorn from the animal. Each class is in England sorted into a number of qualities, about six or seven on an average; and subsequently these are blended according to the colour. On the whole this wool undergoes much manipulation, and there is much dust in the processes. I have been unable to obtain distinct evidence of the occurrence of anthrax in the paca, and the disease has not it appears been recognised amongst the native sorters in Peru. "Fallen" fleeces, however, are found in the "inferiors" and "locks" occasionally; very rarely indeed, it is said, in the "superiors"; and while there is considerable evidence that anthrax is occasionally contracted by the sorters of the two former, I have failed to find even suspicious cases amongst the sorters of the "superiors." The evidence indeed in this direction, so far as general negative evidence can be, is promising. Two firms, employing on an average some 100 men, in sorting this material, including all three classes of it, have lost 15 of these men during the last 19 years, (taking the average period for which I have returns from the two firms), with symptoms of blood-poisoning;* at two other firms where some 50 men are on an average so employed, but where only "superiors" containing few or no fallen fleeces are used, I could on the strictest inquiry hear of no cases of suspicious sickness for the last 20 years. There was no difference in the manner of sorting, and there were no extra precautions employed; the occupation was very dusty, and the men complained of the consequent discomfort; but so far as I could find there was no specific disease.

Turkey Mohair.—This is the hair of the Angora goat, which inhabits extensive districts around the city of Angora in Asiatic Turkey. The hair is long and fine, and nearly 35,000 bales, of which all but about 1,500 come to the Bradford district, are exported annually from Constantinople. Three distinct classes reach this country, as in the case of alpaca; they are "average," "inferiors," and "locks." "Average" is from the goat of the pure Angora breed, and in the best qualities the fleeces are clean, and the hair long and silky. The "inferior" comes from a mongrel race of goats; "locks" are, as in alpaca, the clippings or trimmings of fleeces. It is all dry hair, but the "inferior" and "locks" are decidedly the most dusty; and these classes contain, it is said, a larger number of fallen fleeces, and are, in the opinion of the sorters, and judging it would seem from experience, decidedly the most apt to produce mischief. In Constantinople the mohair is classed as above; here each class is again divided into from three to eight sorts or qualities.

Pellitan.—Is a brown mohair from nearly the same district in Asia Minor. It is coarser in fibre than the Angora, and is very dusty. Only some 1,000 bales are imported, all into this district.

Cape Mohair.—This is the same goat as the Angora, acclimatised to South Africa. The hair so produced is much of the same quality as that of the native breed, except that it is shorter. About 4,000 bales are imported into this country, all to the Bradford district. It is roughly classified at the port of embarkation, and the better qualities, although dry and consequently more or less dusty, are clean. Fallen fleeces are sometimes found, mostly, it is said, in the inferior qualities. In England the hair is again classified, often into as many as 14 sorts.

Cashmir, from the Tibet goat, is only used to a very small extent (about 1,000 bales annually), and that only for the past three or four years. It is a fine but very dusty hair; but I have heard of no specific ill effects arising from its manipulation.

* In 1876 two men, W. J. and S. S., working at the same consignment of alpaca locks, at adjacent sorting boards, died, the one on February 2nd and the other on February 19th, after four and five days illness respectively; the symptoms being those of the woolsorters disease. On March 14th of the same year, another man, J. W., who had been employed in the same workshop on the same material, died with similar symptoms.

HISTORIES OF THE RECENT ATTACKS OF THE DISEASE.

I had intended to confine this record of cases to such as occurred during the present year (1880), but I find it will be convenient to carry the history back to the last months of 1879, so as to include certain cases that would appear to be grouped in their causation with others that were afterwards observed.

(Case 4.) On Wednesday, the 29th October 1879, J. W., aged 41, employed as a packman (*i.e.*, a first sorter), at Messrs. Mitchell and Shepherd's, worsted spinners, complained, after leaving work at the usual hour, of feeling poorly and tired. He passed a very restless night, with cold perspirations, but next day was somewhat better, although he did not attempt work. That night the restlessness was greater, and there was much oppression of breathing, cold perspirations, and great depression. On Friday medical assistance was obtained. Always during the day he seemed to rally, but "every night they thought he was dying"; he never slept throughout, the breathing was very oppressed, and a sort of fainting fit would sometimes come over him, although he never apparently entirely lost consciousness. A duskiness of the face and chest was noticed on Saturday, and this increased to marked cyanosis before he died. On Sunday night he vomited frequently, and he died early the following morning. Extensive post-mortem discolouration and swelling of the tissues around the neck were almost immediately observed. The death was certified as from pneumonia; although at the time, and always since, it appears, recognised and spoken of as from the disease to which sorters are subject.

For four days previous to leaving work he had been employed, in a large, fairly-ventilated warehouse-room, in sorting Van mohair; before that in sorting camel's hair. No reason but that of his occupation could be assigned for his illness, and from what subsequently transpired it was believed to be the Van mohair that was at fault.

(Case 5.) On Saturday, the 16th November, J. F., aged 43, employed as a "day man" (a second sorter), in sorting at the same factory the same material, but in a room below that in which J. W. worked, left his work at the usual hour. He complained at home of chilliness; passed a restless night, and on the following morning vomited. He seemed better during the day, until 9 p.m., when he had to take to bed; and when seen next (Monday) morning by Dr. McKenzie, he was breathing with difficulty, his extremities were cold, he looked distressed, and was perspiring profusely. The pulse was feeble, but there was no pain. In the evening there was more general coldness of the surface, and he died early the following morning. Throughout there was great depression, cold perspirations, and vomiting. Animals inoculated with blood taken twelve hours before death all died within three days.*

An inquest into the cause of death was held, and a verdict returned to the effect that the death was due to the sorting of Van mohair; while certain recommendations as to the steaming or washing of the wool before sorting were made during the inquest, and indorsed by the jury.

(Case 6.) Another man, it was popularly supposed, was infected from this same Van mohair; but this may be considered doubtful. J. L. (aged 53), had been working in this factory on the same material, but only for four days (he had sorted only two bales). He left the employment on the 17th October, and went to another factory where only English and Australian wools (supposed to be a perfectly innocent material) were used. He had, however, since this time complained of malaise, increasing at times and then again disappearing; and thought that the "Van," or the camel hair that he had been sorting previously, had affected him. On Saturday, November 29 (six weeks after having worked on foreign wool), he left his work as above at the usual time, seemed rather better than usual that day, and only complained next (Sunday) morning. That night he was suffering from the ordinary symptoms of the disease, and he died on the following Wednesday night. The symptoms described were numbness of extremities, sense of oppression of the chest, profuse perspirations, restlessness at night, and mild delirium. At times there was great prostration, but at other times he would feel better, and

* Dr. Bell, "Lancet," July 12, 1880.

every day until he died he dressed and came downstairs. On Wednesday he was purged moderately; his extremities were observed to be cold and clammy, his face stone cold, and there was blueness of the finger nails and lips. He died that night, a typical asphyxiation being well described. Almost immediately afterwards the ears and neck became black and swollen. The doctor, in attendance during the last two days, suspected "woolsorters" disease; and Dr. Bell was asked to see the patient, but came too late. The death was certified as from "bronchitis."

If this case be one of infection from the Van mohair, the following may possibly owe the same origin:—

(Cases 7 and 8.) G. A. and S. H., two young healthy men, employed up to November 30th, the one as a day man, the other as a packman, in sorting the same Van mohair in this factory, at adjacent "boards," were taken from this work on the date named and put upon inferior Turkey mohair, a dusty wool, but less dangerous, it is supposed than "Van."* G. A. sickened on Sunday night, December 21st, not having previously complained, with what there is little doubt was the same disease. There was an initial rigor, dizziness, vomiting, which continued for a week, purging, oppression of the chest, great restlessness, and delirium. These symptoms subsided in about a week, and during the convalescence the epidermis desquamated and the finger-nails came off. He was three weeks in bed and six weeks off work.

(Case 8.) S. H. sickened on January 1st, 1880, and suffered from similar symptoms, but without the shedding of the cuticle and nails. The convalescence was very tedious (he was off work seven weeks), and he suffered much from weakness.

After J. F.'s death Messrs. Mitchell and Shepherd, at some sacrifice of course, ordered the remainder of the "Van" to be worked up without sorting; and no more of this material, it chanced, was brought into the factory until towards the end of February 1880. Then, adopting the suggestions made at the inquest above referred to, the material was "steamed" before being sorted. An apparatus was provided in which the wool was placed, and steam under pressure forced through it. The process, however, was said both by the masters and the men to injure the wool; it "fixed the dirt," it was said, in it, and injured the colour. Moreover, the process, so it is stated, caused an abominable and all-pervading odour, so that after one lot of wool had been worked up it was discontinued, and a process of washing substituted. This was about the end of March.

Meanwhile other cases of infection had occurred.

(Case 9.) A. E., aged 27, who had been employed exclusively for three weeks in sorting the steamed Van (it being still damp, and having a bad smell), felt chilly, with headache and muscular pains, on Monday, March 22nd. He thought he would work until the following Friday, being Good Friday and a holiday, and did so, but left work earlier than usual on the Thursday. On Saturday he was very ill, and medical assistance was then obtained. Dr. Lodge, who attended him, recognized the case as one of "woolsorters" disease, he says the most prominent symptoms then were "rapid pulse, profuse foetid perspirations, difficult breathing, great restlessness, and prostration." Signs of improvement appeared, however, in a week; he was confined to bed 17 days, and off work five weeks.

(Case 10.) S. O., aged 36, a warehouseman, whose duty it was to place the Van mohair in the steaming apparatus, and afterwards remove it therefrom, and who complained much of the offensive character of the work, saying, too, that the steam "condensed on his face," was away from work through illness, presenting the usual symptoms of a mild attack, from Saturday, March 13th, to Monday, March 22nd. About the time he returned the firm gave up steaming, and commenced to wash the Van mohair before it was sorted, and it was S. O.'s duty to unpack it and take it to the washing bowl. He was feeling very poorly all this time (chilly, aching limbs, weariness), and on Sunday, April 18th, was again confined to bed with symptoms similar to those of his previous attack, but more severe. Two days before this, on the Friday, a

* No other suspicious cases arose, it may be said, from the handling of this Turkey mohair, although a large quantity was used.

pimple had been noticed on the temple, and this developed in usual course into a typical malignant pustule, the slough of which had not separated when I saw him a month later.

I have said that the firm had now taken to *washing* the Van mohair as the first process. It was unpacked, passed through two "suds" (soap and water) at a temperature of about 120° F., and then partially dried in a ventilated hot-air chamber (temperature of about 160° F.), through which it passed on moving shelves, its transit occupying about 20 minutes.

(Case 11.) S. F., aged 43, had been sorting as a "day man" this washed "Van" from the Friday morning, April 30th, until the following day, when he left work at the usual hour (1 o'clock) for the last time, apparently in his usual good health. Prior to the Friday he had been sorting for some weeks Cape mohair. He complained first at 7 o'clock on Saturday evening of nausea, shivering, and oppression of the chest. On Sunday he was worse; medical assistance was obtained on Monday evening, but he died on Wednesday night with all the symptoms of the disease. (Notes of case and autopsy in Appendix.)

(Cases 12 and 13.) On May 6th and May 7th respectively, F. S. and J. B., two young men who had commenced to sort this washed Van mohair at the same time (that is a week before this date) as the last man referred to, but in a different part of the factory, went home feeling unwell. In the first case there was an initial vomit, a feeling of chilliness, headache, pain in back and limbs. For two days the patient was in bed, and had profuse perspirations, and feverish nights. He returned to work, feeling weak, six days after leaving. The second, J. B., was only off work three days, and suffered from symptoms of a still more mild and indefinite kind, but of the same character.

(Case 14.) E. E. (aged 21), worked on this same Van mohair until the 12th of May, on that day he commenced to sort "average Turkey mohair." On Friday, two days later, he felt poorly, with pains in the head, back, and limbs, and later in the day left work. That night his breathing became oppressed, there were cold perspirations, great prostration, restlessness and mild delirium. Medical assistance was obtained, and in about a week, after many exacerbations and remissions of the above symptoms, evidences of improvement set in. Great weakness remained, and he was confined to bed a fortnight. There had been typhoid fever in the house; and the doctor in attendance was inclined to attach importance to this fact in the diagnosis.

This is the history of the disease, or what was with greatest probability this disease, amongst the sorters at this factory. An unusually large number, about 60 men, were employed, upon different wools, at this time; and during seven months three died of the disease, five others suffered severely, and there were two apparently abortive cases. Another man died who had left the employment six weeks, but whose infection was possibly, if the views as to the pathology of the disease expressed in this report be correct, contracted here. Moreover, it seems to me probable, when the different series of cases are considered, that the infection in each case was derived from the Van mohair. The case of S. F. (No. 11) was supposed at the coroner's inquest that was held to be attributable to the sorting of the Cape mohair, on which the deceased had been employed at an earlier period; but it will be seen there is nothing in the circumstances of the attack, besides the supposed disinfection by washing of the material (an obviously inadmissible argument), and an unusually short period of incubation, to militate against the belief that the Van mohair was the infective medium; while, favouring this latter conclusion, are the facts that three other men a few days later, working on the same washed Van, suffered from what were apparently attacks of the disease, although in two cases abortive; and also that the Cape mohair, although a much larger amount had been in use (12 men had been employed upon it for four months) was not known to have been productive of other mischief. If, however, the doctrine of latency of the disease germs be a true one, as I believe it to be, it will obviously be often impossible, when the material in the sorter's hands is so constantly changed, to determine which of these materials was the source of infection. We can only then judge of the probability from a series of cases. Regarded in this light, the case against the "Van" at this factory stands as follows:—During seven months 612 bales were sorted, and in this work 11 men on an average were employed, in all, but at scattered periods, 12 weeks. Seven of these men, while working upon the material, suffered; three from fatal attacks, one from malignant pustule, one from an acute attack of the internal form of the disease, and two from apparently abortive

attacks; four other men, after having discontinued the work for periods ranging from two days to six weeks, suffered from apparently the acute internal form of the infection, and one of these, a man who had not, so far as it could be discovered on the most careful inquiry, been exposed during the interval to what has hitherto been looked upon as dangerous wool, died.

If these cases be taken as being due with most probability (I think we can go so far, but no further) to infection from the Van mohair, it will be seen they occurred in spite of the precautions that were taken, and it must in justice be said that the firm took and were anxious to take, to the best of their knowledge at that time, every precaution; and the cases might then again be classified as follows:—In sorting 360 bales of the "wool" in its "raw" state, three fatal and two non-fatal attacks were probably brought about; in sorting 110 bales of steamed wool, one non-fatal case occurred, and the man whose duty it was to steam it likewise suffered; in sorting 140 bales of the washed material one fatal attack, one non-fatal, and two mild or abortive ones were apparently induced. The firm have not used Van mohair since April, and no other case of the disease has been known to occur amongst their employés.

The following are details of cases occurring at other factories about this time amongst the sorters of Van mohair:—

(Case 15.) J. F., aged 28, was one of eight or nine sorters employed upon Van mohair by Messrs. C. F. Taylor & Co., worsted spinners. He left work on Saturday afternoon, November 22nd, 1879, apparently in his usual good health, and showed no symptoms of illness until Sunday morning about 8 o'clock, when he shivered, and complained of cold. On Sunday night he was very restless, complained of no pain, but his breathing was oppressed, and he could not get warm. In the morning he found he was too weak to get up, or he had thought of going to work. During the day he got worse, vomited, and seemed sometimes in a fainting condition. On Tuesday a doctor was sent for, and when he came the patient had so far temporarily revived that a "cold" was diagnosed. Later, however, urgent symptoms set in with added violence. That night he was in a cold perspiration, vomiting frequently, and gasping for breath. Again, in the morning when the doctor came, the alarming symptoms had disappeared, and the former diagnosis was confirmed. The patient, however, died cyanotic on the following morning at 4 o'clock. Swelling about the face and neck, with great discoloration of the skin, were observed the same day.

This exacerbation and remission of symptoms, noticed more or less in most forms of blood poisoning, is often peculiarly marked in this disease. In a well-marked case, occurring rather too early to bring into my "recent attacks," the wife of the sufferer sent for her husband's relatives, believing he was dying. The relatives, when they came, appeared to think a practical joke had been played upon them, and the wife, too, thinking she had been deceived, "felt quite ashamed." The man, however, died a few hours later.

A series of cases occurred at Messrs. Watmuff's mills at Harden, near Keighley, amongst the sorters of Van mohair, much of which was found not only to be from the same district and of the same clipping, but from the same dealers, and of the same consignment, as that which seemed to be productive of so much mischief at Messrs. Mitchell and Shepherd's factory.

At the mill in question some 20 sorters were employed, and practically only Van mohair and English wools were used. Of these 20 men, during the month of April, two died of the internal form of the disease, and two suffered from malignant pustule with constitutional symptoms. In the combing room, where the next process of the manufacture is carried on, one man suffered from malignant pustule and one from what was very probably a non-fatal attack of the internal form of the malady. Later, a boy from the sorting room suffered from malignant pustule; and the master himself who had, as I had myself seen, exposed himself greatly to the risk of infection from the wool, died under circumstances not free from suspicion. It was here too, on fields upon which the sud-water of the mill was allowed to flow, that sheep and cattle died of splenic fever.

The sorting in this mill is carried on principally in one upper room, where sorting boards are ranged the whole length, opposite the windows, on either side. Down the centre of the room a quantity of "wool" in bales, occupying nearly a third of the cubical space, and facilitating the collection of much dust, is stored. The wool when sorted is shot through a trap door in the floor to the "packing room" below, and in its fall clouds of dust arise. Nevertheless this packing room was also used occasionally as a sorting room, one, sometimes two men, being so employed in it.

On Saturday, April 10th, 1880, James T., one of the men employed in the packing room, sickened from what appeared to be a recurring attack of the disease. (Case 2, p. 4.) He returned to work on the 12th, and was again ill

on the 17th. Subsequently a malignant pustule appeared. For a month previous to the 10th of April, with the exception of three days from the 31st March to the 2nd April when he was sorting English wool, this man was employed in sorting Van mohair, and he continued working upon this material until he finally left the employment.*

The other attacks amongst the sorters of this factory were all subsequent to J. T.'s return to work on the 12th April, whilst still suffering from the symptoms of the disease; but for reasons discussed in another part of the report, the possibility of personal contagion may be excluded.

(Case 16.) On Thursday, April 15th, S. C., aged 33, working for the past month, except for the last two days, in the large upper sorting room, on the same Van mohair, left work at the usual time, feeling unwell. He had been poorly for two or three days, and his work had, in consequence, been changed from the Van to English wool. On Friday he felt better, but he lived four miles from the mill, and consequently did not go to work that day. On Saturday he went to the neighbouring town of Keighley, and remained there walking about all day, and having dinner there, until the evening. On his return, he was thought to have a severe cold, and during the night and following morning, he complained much of thirst. He was seen by a medical man on Sunday afternoon, but he died at 1 a.m. on Monday morning; evidences of extreme collapse and cyanosis having for some time preceded. Rapid decomposition immediately ensued.

(Case 17.) On Saturday, April 24th, S. H., aged 26, a powerful man, employed in the same room, and upon the same material as the above, left work feeling ill. He stated that ever since he had commenced to sort this Van mohair, for some six weeks before, he had felt poorly, with dizziness and an inclination sometimes to vomit, and thought that every time he opened a bale he was worse. Two or three days before leaving work he had noticed a pimple on his neck, and the parts around were now considerably swollen. An unmistakable malignant pustule developed, with much constitutional disturbance, including frequent vomiting, mild delirium, with a pulse at one time as high as 140, and a temperature rising to 105° F. For a week his life was considered by Dr. Tetley to be in danger, but when I saw him on May 21st convalescence was established, and the local eschar had just separated.

(Case 18.) On Saturday, May 1st, Edwin S., aged 28, who had been working for nearly seven weeks as a "packer" in the dusty packing-room before referred to, left work at the usual time, and went to a cricket match. In the evening, on his return, he first complained of feeling cold and chilly. On Sunday the feeling of malaise continued, and later in the day he vomited, complained of pain in chest and bowels, stiffness of the throat, and difficulty of breathing; his countenance was leaden, and his eyelids appeared swollen; he was purged, the vomiting, with feeling of great prostration, continued, and through the night he was restless and excited, "could not keep still a moment." On Monday morning he got up and went out, thinking he would go to work, but had immediately to return. He complained much of thirst, and the symptoms all increased. On Tuesday the pain left his chest, but the vomiting was then incessant, and the restlessness extreme. On Wednesday morning at 10 o'clock, when Dr. Logan first saw him, he was cyanotic and pulseless, and the extremities cold. About noon he became delirious, offensive perspirations broke out, and he died at 2 p.m. Decomposition quickly supervened.

It must be mentioned that at the time of his illness he had a small abrasion on one of his fingers from a trifling injury three weeks before. But there was no pustule, and the sore had nearly healed.

On the 21st of May I visited this factory, and in passing through the combing room saw a man there employed with a suspicious-looking cicatrix on the cheek, as from a malignant pustule or carbuncle, and with considerable brawny swelling of the tissues around. The case was interesting if one of anthrax, as occurring in a man, who,

* He sorted during this time nine different "brands" of Van, but they were all probably from the same "clipping." Besides the danger from the wool he was himself sorting, he was, in the room where employed, exposed, as above stated, to much dust from the whole bulk sorted in the factory.

although working on the same Van mohair, was employed only in the combing room (a room having no connexion with the sorting rooms), and would consequently only come in contact with the material after being thoroughly washed. The history that I subsequently obtained of his illness leaves but little room for doubt as to its specific nature. Mr. James Crocker, of Bingley, writes as follows:

(Case 19.) "I saw J. J., aged 58, a man of intemperate habits, on the 15th of April. The history I obtained was that after a brief period of malaise a small boil or pimple appeared on the cheek, which he pricked with a needle. Now (April 15) there was inflammation of skin and subjacent tissues, involving nearly the whole of the cheek with œdema of eyelids and spreading redness on the forehead. He was exceedingly prostrate, brown dry tongue, quick pulse, and fever. Purulent infiltration and sloughing of the skin and areolar tissue of cheek took place, causing a deep ulcer; granulation began in about a week, and the wound quickly healed, leaving a scar."

Working in the same combing room, on the same washed "Van," was another man, J. R., who suffered also from what there is strong probability was an attack of this disease. Dr. MacGregor, who attended him, was inclined at first to think the case one of typhoid fever, "but," he writes, "the fever, diarrhœa, and bronchitic symptoms began gradually to subside in about a week after I first saw him (on May 5th), leaving him in a feeble and depressed state for some weeks afterwards." He was taken ill on May 2nd.

These, so far as I know, are all the cases that occurred at Messrs. Watmuff's mill at this time. The sorters became so alarmed that they refused any longer to sort the Van mohair, although to allay their fears it was spread out in the mill-yard to air. Eventually, I believe, much of the material was worked up practically without being sorted. Later, however, at the end of June, still another case of malignant pustule occurred, and it also could be traced with greatest probability to infection from the same material (Case 1, p. 3).

Meanwhile other circumstances of the utmost significance had come to light. At the time of my inspection of the mill it was found that the slop-water from the washing bowl in which the Van mohair and other wools are washed at a temperature of about 120° F., was first run, as is usual, into a settling tank, slightly acidulated there with sulphuric acid so as to facilitate the separation of the grease which it contains; and then, this separation complete, the liquid was allowed to flow into the village drain, and thence on to two grass fields, over which, with the sewage of the village, it was distributed by irrigation channels. Now at the end of May a rumour was heard that one of a number of cows pastured on these sewage fields had died suddenly; but two or three days had then elapsed, and nothing definite could be ascertained beyond the fact that a rough examination of the carcase had been made, and blood had been found extravasated in the intestines; but it was sufficient to cause a sharp outlook to be kept on the remaining sheep and cattle pastured in the fields in question. Other deaths amongst these cattle subsequently occurred, and Mr. Roberts, the Medical Officer of Health for Keighley, who investigated the circumstances for me in my absence, reports as follows:

"History of the Cows on Mr. Dunlop's Farm at the Grange, Bingley."

The cow-herd told me that about the 1st of May 1880 he had 12 cows, and that he divided them into three lots, A., B., and C.

A. lot consisted of five cows, which were placed on the sewage ground.

B. lot consisted of four cows.

C. lot consisted of three cows.

B. and C. lots were not then placed on the sewage ground.

One cow of A. lot died on the 27th of May (cow referred to in text above).

The other four of A. lot were removed from the sewage ground. Of these four, three were ailing, but recovered without having any medicine. One passed blood from the womb.

After a fortnight, these remaining four of A. lot and all B. lot were mixed together.

These eight were placed on the sewage ground for a half-day each day.

On Wednesday, 30th June 1880, the cow of A. lot which had not been previously ill died suddenly.

After this died, on the same day, the remaining seven were taken altogether from the sewage ground.

On Sunday, 4th July, one of B. lot died suddenly.

During the time that these cows were on the sewage ground, two of the sheep, which pastured on the sewage ground were found dead, but there was not any careful post-mortem made.

Some of the remaining cows were ailing, but up to the time of writing this report none had died.

First Death, Cow, A. Lot.—This beast was a Scotch heifer and died on the 27th of May.

The cow-herd first noticed that the beast would not take its food, that it slavered at its mouth, and had difficulty of breathing. It appeared dull, and heavy with its eyes.

A veterinary surgeon was sent for, but it died before he arrived.

There was no careful post-mortem made, but I was told that there was a large quantity of blood in the bowels.

Second Death, Cow, A. Lot.—The cow-herd told me that on Tuesday, 29th June, this cow took its cake quite well along with the other beasts in the morning.

About 3 p.m. he saw her and noticed that she was lying down and looked dull and heavy.

Mr. Horner, veterinary surgeon of Keighley, saw her about 10 o'clock.

She was standing up, looked sunk and feeble, was breathing quickly, and slavered at the mouth. Did not appear to suffer any pain.

They would not have taken any notice of her if the other cow had not died so suddenly.

Cow died on Wednesday about 14 hours after the first symptoms of illness were noticed.

Third Death, Cow, B. Lot.—This cow was first noticed to be ill on Sunday, 4th July, about 6 o'clock in the morning.

She would not take her food, was dull and heavy and breathed badly. She died about 11 o'clock."

In the case of the two last cows a post-mortem examination at which Mr. Roberts and Dr. Bell, of Bradford, were kindly present, was made. The usual pathological appearances after death from anthrax were observed—hæmorrhagic extravasations, more or less extensive, in various organs, in the muscular substance of the heart, beneath the endocardium, in the lungs (which but for small infarcts appeared healthy) into the substance of various muscles, and into the cavity of the intestine. The spleen was in both cases enlarged to about twice its normal size and softened; the blood was entirely fluid, and there was some fluid exudation into the large serous cavities. In the second case the alimentary canal was opened throughout, but although a large quantity of blood was found within it, and there were spots of ecchymosis on the mucous membrane, no pustule or carbuncle was discovered. Specimens of the blood and fluids of these animals were sent to Dr. Greenfield, were found to contain the bacillus anthracis, and were used successfully for inoculation of other animals. (Appendix, p. 42.)

This disease amongst the cattle, in short, was demonstrated to be identical with that amongst the woolsorters, and it seems certain that the infection was obtained from the same source. No animals were affected but those pastured on the fields over which the sud-water and sewage were distributed; and as regards these no suspicion of external source of infection could be, on the most careful inquiry both by Mr. Roberts and myself, discovered. It must be said, however, that deaths amongst sheep, as to which no precise information was obtainable, had on previous occasions occurred on these fields; and the circumstance may, it is possible, suggest the suspicion that the pasturage itself, apart from the sewage, was infected. There are four fields, and only the two on which the sewage ran were implicated in this outbreak; animals pastured on these—animals, indeed, that had been seen to drink the sewage waters, suffered, and no others; and again, it was only since the irrigation by sud-water and sewage had been carried out that the above-mentioned deaths among sheep had occurred. On the whole I think the possibility I have suggested may be considered remote. The question still remains whether any other vehicle but the sud-water from the mills could have conveyed the infection to the fields; and to answer this the circumstances of the sewage distribution must be more closely considered. The fields stand upon an elevation, "saddled-backed" in form, sloping on either side to a brook; and consequently are not naturally the drainage receptacle of any part. The village and the mills in question, however, stand, although on the other side of one of the brooks, at a greater elevation, so that their drainage may be conveyed by gravitation, the intervening hollow being crossed by iron pipes, to the lesser elevation of the sewage fields. This is the method of sewage disposal adopted by the local authority, and the fields consequently receive, besides the natural rainfall, the matter discharged by the public sewer, and this only. It is with this only, therefore, that we have to deal.

The village consists of some 200 houses or cottages, and the one worsted factory. The latter discharges into the public sewer, besides the effluent from the soap or settling tanks previously referred to, the surface water of the mill-yard. Upon this yard, it has been noticed, the suspected Van mohair had, a short time before the outbreak amongst the cattle, been spread out that the wind might blow over it; upon it also the dust and refuse from the sorting is habitually deposited. The mill is situated towards the hollow, near to the sewage fields, so that its drainage would not probably always be intimately, or for long, mixed with the sewage of the village, before it reached the irrigation channels; moreover, less than half of the village houses drain into the public sewer, and the drains of one half of these were not in working order. At the time, indeed, I was told that practically no sewage was running on to the fields (certainly none was so conveyed from houses in which cases of the disease occurred in man), but only surface water, and the liquid refuse from the mills; and my own observations tended to corroborate this statement, for the liquid in the tanks into which the sewer first empties itself, and which are placed at the summit of the sewage

fields, and the liquid likewise in the irrigation trenches, both looked and smelt like mill refuse, whilst the odour of ordinary sewage was entirely absent.

It may be taken, then, that wool-washings, unchanged by decomposition, were upon these fields; the animals had been seen to drink of this liquid, and they suffered as described.

On the 27th of July a sheep died suddenly on the sewage field; and again another a little later. Examination of the carcase of the first by Mr. Roberts revealed similar post-mortem appearances; the bacillus was found abundantly in the fluids, and inoculation of other animals by Dr. Greenfield produced positive results (Appendix A). At this time, owing to the stoppage of the mills, no sud-water from the latter had been run upon the fields for more than three weeks; but refuse still remained deposited in the mill-yard, and short hairs, &c., from the wool, were still to be seen in the irrigation trenches.*

The Van mohair that I have been referring to was of several consignments. As regards that used at Messrs. Mitchell and Shepherd's and at Messrs. Watmuff's mills, an attempt was made to trace it to its exact source: but it had come from so many different merchants, and in Constantinople some of it had changed hands so frequently, that the task was abandoned as hopeless. Probably, too, all the information needful was gained. It all came from the Van district, and the very large bulk of it, perhaps all of it, was of one clipping, *i.e.*, of one year's growth, that of 1879. There is evidence that the woolsorters in Constantinople, who had the handling of this material there, suffered in like manner to the English sorters (Appendix D, 2.); and, further, that a disease named in Turkey "Dallack," which is almost certainly anthrax, exists amongst the goats from which this wool or hair is derived.

So far as this Van mohair is concerned, therefore, the evidence as to its being a medium for the conveyance of anthrax infection to man may be said to be complete. Although the direct experimental infection of animals from the material has not yet been accomplished, owing probably to the difficulties with which the experiment is surrounded.

The above cases are those that can be traced with a great degree of probability to Van mohair (see also Cases 25 and 28); others occurred in which the circumstances of the sufferers' occupation forbid an opinion as to which particular wool was the infective medium. The following are instances:

(Case 20.) T. C., aged 71, was employed in Messrs. Mitchell Brothers' factory as a "washer." It was his duty to wash all sorts of wools, amongst others Van mohair (the latter directly it left the bales, for here this material is washed, or rather steeped, before being sorted). On Saturday, the 15th of May 1880, he left work in his usual health, and went that afternoon on a holiday excursion to Kidderminster. He complained on Monday, whilst still in Kidderminster, of feeling unwell, and again on Tuesday of pains in chest and abdomen, and cold; when he reached home on the Wednesday evening he was prostrate, looked blue, had been purged in the carriage, and was in a cold perspiration. He passed a most restless night, and when seen by a medical man the following morning he was breathing with great difficulty, râles were heard over the entire thorax, and bronchitis was diagnosed. He died, however, early the following morning (Friday), and the autopsy and microscopical examination of the blood (Case 20, Appendix) revealed the nature of the disease.†

(Case 21.) W. O., a comber, aged 63, worked in the same factory as the above, but in the combing room, and had nothing to do with the sorting of wools, but only with their manipulation after they had been exposed to the scouring necessary for their manufacture into yarn; he might, however, have gone of his own accord into the sorting room, which was near his work. A little pimple on the lower lip had been noticed on Saturday morning, August 28th; and that evening he was complaining. Next day the lip was much swollen, but he said it was "not so painful as it looked." In the afternoon he vomited. He passed a restless night, and on Monday remained in bed, complaining much of pain in the side, chilliness, and depression. Another

* At another mill, at Buttershaw, an elaborate process of filtration of this waste liquid, through a series of bricked tanks filled with saw-dust, was found in operation; and I learned on inquiry that this method of dealing with it had been adopted some years before, when the mill-owner had to pay compensation to a neighbouring farmer for the loss by the latter of cattle supposed to have died through drinking the liquid.

† His wife stated that he had suffered from a similar, although much less severe, attack, at Christmas time preceding; his illness commencing on Christmas Day. His occupation then was the same.

restless night, a continuance of the symptoms, with oppression of breathing, and a more alarming appearance of the pustule, which was now getting black, induced his daughter, on the following evening to obtain medical aid. On Wednesday he was better; slept in the morning, had a fair day, and passed a good night. On Thursday he seemed much better; and the doctor, who saw him in the morning, was able to give a favourable prognosis. About 5 o'clock that evening he said he felt "getting worse," and went to bed, for he had been up and down stairs all day. A little later a "great change came over him;" he got excited, his breathing became oppressed, "he could scarcely get a bit of breath," his extremities grew cold. About 10 o'clock he became violently delirious, and at 4 a.m. unconscious, with laboured breathing. He never regained consciousness, and died at 2 p.m. The pimple had meanwhile developed into a typical malignant pustule. (Dr. McKenzie's clinical notes in Appendix.)

At the time that T. C. (Case 20), the washer, was ill, there was evidence that certain of the wools other than Van, used in this factory, were infected.

(Case 22.) Moulson C. died on the 27th of May from the internal form of the disease, associated with secondary inflammatory processes (clinical record, contributed by Dr. McKenzie, and notes on autopsy in Appendix). He first felt poorly on Whit Tuesday (May 18th), when one eyelid and cheek were noticed to be swollen ("puffy and shiney"). He tried to resume work on the following day (after the holidays) but could not, and returned before breakfast time. He had been engaged for six months prior to his illness exclusively in sorting Cape mohair.*

(Case 23.) A. C., brother of the above, and a woolsorter in the same factory, but living in another house and under different home conditions, left his work on Saturday, May 15th. On Sunday he complained of chilliness, headache, and nausea, and he subsequently suffered from a sense of oppression of the chest, and difficulty of breathing. He was very restless, and at nights there was a tendency to delirium. He was convalescing, but complaining of great weakness, and had not returned to work when I saw him on the 25th of the month. He had been working exclusively on "average" Turkey mohair.

These cases have led me to speak of Cape mohair and Angora or Turkey mohair, as a source of infection. The two wools, as I have stated in dealing with the occupation, are from the same breed of goat, only in one case the animal is acclimatized to South Africa. The case of Moulson C. is the only one that has occurred recently to which "Cape" can with any degree of certainty be said to have been the source of mischief; the evidence with regard to the other, although in many of the following cases incomplete, is less scanty.

(Case 24.) S. F., aged 48, was sorting in the same factory (Messrs. Mitchell Brothers) average mohair. He left at the usual hour on Saturday, January 17, 1880, and not feeling well that night and on Sunday was thought to have a cold and remained in bed. On Monday he felt better and went to work, but came home in the afternoon shivering, and complaining of pain in the chest, and of some difficulty of breathing. About 8 p.m. on Tuesday he became worse, "kept on falling asleep," and at 10 o'clock a doctor saw him; he died at 6 o'clock the following morning, having been unconscious,

* Another man (W. I.) who was sorting this Cape mohair at the same factory, but in a different room, and who was feeling very unwell from the effects, as he believed, of his occupation at the time of Moulson C.'s death, writes me as follows: "My symptoms were headache at times, aching limbs, cramps in my fingers, thighs, and calves (often had to jump out of bed at nights with cramps in my legs), very sore and raw nostrils, breathing through the nostrils hot and painful, a dull aching pain across the eyes, breathing sometimes quick and difficult, the least exertion thoroughly exhausting me. After meals heavy and very sleepy. No sound sleep at night, vomiting occasionally after meals, and first thing in the morning. I was obliged through circumstances to stick to my work as long as I possibly could, did not stay away more than a day and half a day at a time, till obliged to leave it."

- Again one is reminded, by the numerous histories of this kind obtainable (often apparently associated too with fatal attacks in others), of the so-called "malarial cachexia" of malarious regions. Becchi, for example, says that a high degree of atmospheric moisture in a malarious district that will produce attacks of fever in susceptible individuals, leads to an *indescribable unrest, lassitude, and muscular debility* in many strong robust men. All the other chronic symptoms, too, complained of by the woolsorters, dizziness, disposition to vomit, headache, dry and sore nostrils and mouth, oppression of chest and hurried respirations, perspirations, with an apparent periodicity and similar sequence of these symptoms, and an occasional appearance of petechiæ upon the skin, are all found in this malarial cachexia (or as it is termed by the populace in certain parts of Holland "*binnen koorts*," or inward fever). There is obviously an analogous constitutional disturbance.

with laboured breathing, from 11 o'clock on the preceding night. His death was certified as due to "wool-sorters disease."*

(Case 25.) J. W. S., aged 20, was a sorter in this factory, and had been employed for some time on average mohair, but it was his duty also to assist in sweeping the sorting rooms, and he had, too, been engaged in brushing bags in which Van mohair had been packed. He left work on Saturday, September 4th; complained of being poorly that evening, and on the following evening Mr. Tordoff, of Bradford, was sent for. The patient died on the 13th. The clinical record which Mr. Tordoff contributes, and the notes on the autopsy, which he kindly permitted me to conduct, are in the Appendix (page 43). The case was one of the two (Case 22 being the other) that terminated fatally after the seventh day, with the supervention upon the infection of secondary inflammatory processes. Seven months before, in February, Mr. Tordoff had attended this lad for what he considered to be an attack of the same disease; the symptoms being of the same type, but of less severity. He was then confined to bed only three days, and was away from work three weeks.

(Case 26.) J. H. (aged 36) was working until Monday, August 30th, at the next sorting board to J. W. S. (the preceding case), and on the same material, but was then removed to Cape mohair. He had that morning, however (August 30th), complained of headache, dizziness, aching of limbs, and languor; and these symptoms continued until Sunday, September the 12th, when he took to bed. Mr. Tordoff has kindly supplied me with a clinical history from this time (Appendix, Case 26). Through his courtesy also, I saw the case myself two or three times, and agreed with him in regarding it as one probably of the undeveloped and more chronic form of the disease.

Two other men (William Spencer and Spencer Ackroyd) were off work from this mill at this time, suffering from similar symptoms. One was working at the next board but one to J. W. S. (Case 26), on "average," the other at the next board to J. H. (Case 27) on "Cape." They were last seen at work on Saturday, September the 11th.†

The following series of cases is significant in the light of the evidence we possess of abortive attacks. The men referred to were all sorters at Messrs. Lund and Son's Mills, Keighley, working in one room on average mohair:

(Cases 27.) (a.) J. K. went home on Monday, April 19th, feeling unwell, complained of "chilliness, pain in chest and arms, and sore throat." The medical assistant who attended him thought he had dyspepsia; he was in bed only three days, and off work a month.

(b.) T. S. left work on May 12th, suffered from nausea, abdominal pain, and general malaise. Returned to work on the 24th of the month.

(c.) E. G., W. P., and J. H. all left work on Saturday, May 15th, with the Whitsuntide holidays before them. The first on the following day suffered from chilliness, headache, pains in limbs, and loss of appetite. He was away from work about ten days.

The second, W. P., suffered from similar symptoms, he vomited on Saturday, shivered, had headache, pains in limbs and oppression of breathing. The symptoms at first were such as to lead Dr. Dobie, who attended him, to think of typhoid fever; the temperature, however, fell to normal during the second week; it had ranged between 99° and 101° F., and the pulse had sometimes reached but never exceeded 100. Through Dr. Dobie's courtesy I saw the patient myself on the 24th of the month. He then presented much the appearance of a man convalescing from typhoid fever. The temperature had fallen to (evening) 99° 0 F. He was suffering from weakness, but there were no definite objective symptoms. Microscopical examination of the blood at

* Dr. Hamilton, who saw him, says he found him very drowsy with a small hard and very rapid pulse, pupils contracted, and body perspiring freely. An hour before death (when he was seen by Dr. Bell also) the surface temperature was higher, and the rectal temp. lower than normal.

† I had not an opportunity of inquiring fully into Spencer Ackroyd's case. The other man first felt ill on the Saturday night of his leaving work, with headache, shivering, sensation of "burning in the chest," and restlessness. He was better the next day, but the symptoms returned the following night; and again at intervals during the next week, so that he did not go to work. These very indefinite cases are not, of course, included in my summaries.

that time gave negative results. Convalescence, I heard, was gradually established.

(Case 28.) Peculiar interest attaches to the third case, that of J. H., for this man suffered from a fatal attack of the disease three months later; a somewhat more distinct set of symptoms, too, in this first attack were evoked. He was a powerful healthy man, aged 39, always steady and now a total abstainer. He left work, as stated, on Saturday (May 12). That evening he was poorly, and the next day, in addition to the general symptoms of malaise, there was disturbance of vision—transitory optical illusions (whilst there appeared no mental derangement), and a blurring of objects in the field of vision; there seemed also some deficiency of the power of deglutition, and a “lump in the throat” was complained of. These symptoms, especially the optical illusions (he saw imaginary objects in the room, but was readily persuaded they were not there), considerably alarmed his wife, but he refused to allow her to obtain medical assistance; the symptoms passed off, and he resumed work when the mill re-opened on the following Wednesday.

At this time he was working on average Turkey mohair (he had been so employed since the 20th of March) and he continued sorting this material, apparently, after recovering from this attack, in good health, until the 24th of July. Then he commenced to sort Van mohair, of the same brand as was used in Messrs. Mitchell's and Shepherd's and Messrs. Watmuff's mills, when their sorters suffered. Only two men besides himself sorted this material, usually only one, and of this one I shall presently have to speak. From the time he commenced this work, until he left it before his fatal illness, he always, his wife says, when he opened the bales (he would often open three or four at a time so that the wool might get a preliminary airing, and he would sort on average nearly a bale and a half a day) come home complaining of headache, and sometimes of dizziness and oppression of the chest; this would consequently happen every two or three days. On Friday, the 27th of August, he opened his last bale; and on the following day (Saturday) worked up to pay-time (11 a.m.). At home that morning he complained of lassitude; but later in the day seemed well and hearty. He passed a restless night, however, and next morning remained in bed. During the day at intervals his breathing was hurried, and he complained of tightness on the chest, and once he vomited; he perspired, too, copiously; he was however quite cheerful and said he had no pain. In the afternoon in attempting to rise he seemed to faint; but he still would not permit a doctor to be sent for, and seemed better in the evening. All night he was most restless, complained of a sense of oppression; his breathing was rapid and at times apparently difficult. Still in the morning he was easier, and, as his wife afterwards imagined, was getting up to go to work; but in attempting this he fell across the bed in another fainting fit, and medical aid was then sought. Mr. Chaffers, found him at 9 a.m. in a state of approaching asphyxia. He died at 2 p.m. Clinical notes, with notes of the post-mortem examination, experimental inoculations, &c., are in the Appendix, p. 39.

(Case 29.) F. N. worked with the above, at the next sorting board and on the same Van mohair (he was usually the only other one so employed). For some days he had been complaining of nausea, dizziness, languor, and pains in the limbs, and “little round blue spots” had appeared on his arms and legs; he had to leave work in consequence of the malaise on August 27th, the day before J. H. left work, but returned on the 30th. When I saw him on September the 18th, he showed me several petechial spots, in various stages of absorption, on his arms.

The Black Dyke Mills, at Queensbury, are large well-conducted mills, where cleanliness and ventilation and the comfort of the workmen are much regarded. The number of sorters and packers employed is now about 140 or 150; and nearly all kinds and classes of wools are used. At the time now under consideration, five sorters were employed on “average mohair locks,” an inferior class of Turkish (Angora) mohair, consisting in great part of “pieces” (in contradistinction of whole fleeces), “cuttings,” and “beards.” But these “locks” were not all of the same consignment, or from one consigne, although from the same district, and probably of the same year's clipping. One lot was regarded as inferior, and consequently washed (passed through one “sud” at a temperature of 120° F.), before being put into the sorter's hands. Three men were engaged on this lot, and two on the other. The following is the history at this time:—

(Case 30.) J. G., aged 48, was engaged for six weeks exclusively in sorting the *washed* mohair locks; he might have been in other parts of the factory, and was indeed noticed in the alpaca sorting room a few days before his illness; other sorts of wool, too, in bales, were stored in his own work-room. On Saturday, July 17, he was out in a drenching rain, and on Sunday he complained of chilliness and thought he had a cold. He continued working until Thursday the 22nd, complaining occasionally of soreness of the limbs and chilliness; and on the day named he came home from work at dinner time, and saying he would have a "good sweat," went to bed and drank a quantity of "balm-tea." At night he was very restless, and the breathing rapid and oppressed, he was in a cold perspiration, his lips looked blue, his feet were cold, and he seemed prostrate. In the morning Dr. White saw him. The patient was conscious, perspiring profusely, face flushed, breathing oppressed, respirations 30 per minute, râles audible over thorax, pulse rapid and weak, axillary temperature 102°·5 F. He died, cyanotic, two hours later, at noon. The notes on the autopsy, which I was permitted to conduct, are in the Appendix (page 39). Microscopical examination showed unequivocally the abundant presence of the bacillus anthracis; while inoculation gave positive results. (Appendix.)

At this time I left the district, but immediately afterwards another death amongst these five lock-sorters occurred. The circumstances of the attack were as follows:—

(Case 31.) S. F. was one of two men employed in sorting the *unwashed* locks. He left work on Saturday, July 24th, not having complained before that date at home, but at work, having said at times that he felt tired and dizzy. On the Sunday evening he was complaining of malaise, and pains in the chest. He passed a restless night, remained in bed the next day (Monday), during which the cough and oppression of breathing and pain in the chest increased, and vomiting commenced. In the evening medical assistance was obtained, but he died on Wednesday morning at 6 o'clock. The clinical and post-mortem notes, by Dr. Britton, health officer, are in the Appendix. Bacilli were found by Dr. Bell in the blood taken at the autopsy (29 hours after death), but not in the specimen taken during life, nor in the one taken immediately after death.

The only other man who sorted these unwashed locks at this time, and who worked at the next board to the above, was sick. Dr. Britton reports as follows: "There was a third alleged case. L. G. (history), worked in hayfield on Sunday (July 25); drank cold beer; symptoms, foul tongue, pain in bowels, vomiting, and diarrhoea; well in three days." He was away from work three weeks.*

I now only have to speak of cases that would seem to have arisen through the handling of alpaca, camel-hair, and Persian wool. As to the first, although many well-authenticated cases in earlier times are on record (indeed it was amongst the sorters of this material that the disease first attracted attention) the cases in recent months are few and not unequivocal. The circumstances of the following were investigated by Mr. Harris Butterfield, health officer for Bradford, who reports as follows:—

(Case 32.) "Wm. Y., 43 years. Wool-sorter at Messrs. Sugden and Briggs for four years, employed on alpaca. A year ago had 'inflammation of lungs,' since then his health has been very indifferent. On Friday, June 11th, 1880, he was pretty well, enjoyed his meals, and went in the evening to Horton Park. When he came home he complained of feeling very cold, but did not shiver, eat a good supper, slept well at night, and went to work as usual. He did not, however, eat his breakfast which he had taken with him to the sorting-room. He came home at mid-day (usual hour of leaving work on Saturday) feeling sickly, and could not eat his dinner. He had some tea and went to Schallmoor cemetery, the weather being very warm, and planted some flowers; came home about 5 p.m. sweating and very thirsty. After his tea, which he enjoyed, he went to the market, returning at 9 p.m., complaining of feeling very poorly. He took some salts, which did not operate until the following evening (Sunday). He did not sleep, and vomited all he took on Sunday except some 'balm tea.' On Monday he had a cough and pain in the chest, which becoming worse Mr. Fawcett was sent

* Another of those cases which, considered alone, show nothing; but which, in the light of their frequent, almost constant occurrence in connexion with unequivocal cases, seem to me to mean much.

“ for, who diagnosed double pneumonia and bronchitis. On Tuesday diarrhoea set in, which continued to his death at midnight on Friday. His countenance was not dusky, and he seemed to die rather from exhaustion than asphyxia. When I saw the body 12 hours after death there was no alteration in the appearance of his countenance, nor was there any discharge from the nostrils or mouth. There was livid discoloration on the side of neck, and upper part of thorax; scrotum and penis much discoloured. There were violet patches on the thighs. Nothing would induce the relatives to permit a post-mortem, and the coroner being out of town, an order from him could not be obtained.”

(Case 33.) Another man, J. B., aged 21, working at this factory on the same alpaca, left work on the Saturday previous (June 5th) at the usual hour, and was afterwards ill from what Dr. Whalley, who attended him, regarded as a mild attack of sorters' disease. The symptoms were headache, sore throat, restlessness, profuse perspirations, depression, muscular debility, and cramps. The patient was never confined to bed, but was off-work six weeks.

The following case was also investigated by Mr. Butterfield:—

(Case 34.) “ Wm. B., 35 years employed as a wool sorter at Messrs. Foster, of Queensbury, for the past 10 months has been sorting alpaca. After a few days ailing, with loss of appetite and sense of debility, he was seized on June 8th, 1880, with burning pain in stomach and chest, and vomited contents of stomach mixed with ‘slime of a dirty stringy nature.’ (He had a week previously had diarrhoea and vomiting.) He had ‘shudderings and heats,’ with feeling of nausea. He was insensible two days and nights, and had convulsions. Had never had fits before. After a good purgation with medicine he was better, and has continued to improve ever since. Since he commenced to improve he has had copious perspirations. *At present* (June 16th) his pulse is 88 and respiration 24. He is lying, dressed, on the sofa. Countenance slightly flushed and more dusky than usual; three pustules resembling acne on forehead. Tongue clean and moist, no headache, but feels giddy when he rises. Sleeps well. There is much cough, and he expectorates mucus streaked with blood. Deep inspirations causes pain at base of right lung. Resonance fairly good all over chest. There is coarse crepitus at base of right lung. Attended by Mr. Jackson, of Clayton.”

Two men, Fergus Sutcliffe and Henry Jowitt, employed by this firm in sorting alpaca, died from what was believed by their fellow workmen to be “wool-sorters disease,” the one in October the other in December, 1879. Detailed particulars of their attacks, however, were not obtained.

The following can be traced with most probability to the manipulation of camel-hair:—

(Case 35.) Jacob B., aged 36, a wool buyer, had, it appeared on very careful inquiry, not come in contact with foreign wool, except on one occasion, for months. This was on the 20th of May, 1880, when he examined an inferior consignment of camel-hair, and brought a sample of the damaged material to show his employer. He did not complain afterwards at his work; but had complained at home since about this date of unaccustomed weariness and fatigue. On Saturday the 29th he left his work at the usual hour for the last time. On Sunday severe symptoms manifested themselves; but the case was looked upon as one of fever, and was not reported to me until after death on the following Friday. The autopsy, and the microscopical examination, and subsequently the successful inoculation by Dr. Greenfield of animals, demonstrated the nature of the disease. (Notes of case, autopsy, &c. in Appendix.)

Two men were engaged in sorting the camel-hair that I have suggested may have infected Jacob B. One of these, Benjamin H., the one who sorted the greater part of it, suffered whilst so engaged from what may have been a rudimentary attack, with headache, dizziness, and lassitude, and had to change his employment.

(Case 36.) William F., aged 29, had been sorting camel-hair, at Messrs. Scriveners and Dawson's factory, for the last six months. On Saturday, April 17, he came home in his usual good health, and was out and about all that and evening. Whilst in bed, about 3 o'clock on Sunday morning, he awoke.

shivered violently, could not get warm, and afterwards commenced to vomit. Dr. Lodge saw him on the following day, when he was suffering from the above symptoms and muscular spasms. "The next day," Dr. Lodge writes, "he had pulmonary congestion, followed by hæmoptysis, which continued four days. On the morning of the fifth he was cold, almost livid. At noon there was so far reaction that his pulse was 130, and temperature 103.5° F., respirations 56; at 10 p.m. pulse 130, temperature 102.9°, respiration 60; profuse and foetid perspirations." Dr. Lodge thought he would see what effect a small bleeding had on the pulmonary congestion. "I bled to the extent of two ounces; and I have," he says, "in my time bled hundreds of people, but never saw blood like this, it was not merely dark and opaque, but strangely fluid; seemed to have lost something of its plastic character. . . . The respirations immediately fell to 48. Eight days from the invasion of the disease there appeared upon the skin, principally of the back, a herpetic eruption. . . . From this time he continued to improve." Stains, and a few small scales, the remains of this eruption, still remained when I saw this man on May 19th.

The following constitutes the recent evidence against Persian wool :

(Case 37.) Miles M., aged 49, a very steady man, "neither drank nor smoked"; a foreman of sorters in Messrs. Sugden and Keighley's mills, Keighley, where only English and Persian wools are used. He was quite well on Sunday, March 7th, 1880, and on Monday at dinner time he seemed particularly hearty. But at 4 o'clock he had to leave work through illness; said his "back was stiff," and that he felt cold; he seemed very depressed on reaching home, and cried and sobbed. That night he was very restless, and although he got up and moved about the house, the symptoms continued the following day. Towards evening he vomited, seemed prostrate, and Dr. Dobie was called in. He says, "The patient was complaining of nausea and weakness; on the following day (10th) his breathing became laboured; temperature, normal; pulse, weak; skin, pale and moist. No dulness on any part of chest, but minute moist crepitation generally audible. That evening got much worse; the face became livid; and there were cold perspirations. The breathing became very laboured, so as to suggest paralysis of respiratory muscles. At times slight frothy expectoration. He died the following morning. No p.m."

(Case 3.) F. H., whose case is recorded on page 4, was a sorter of Persian wool at the same factory, and was generally in the same room (a very dusty one, where a "willowing machine" was at work), with Miles M., until the latter's death. He left work for the last time on Saturday, May 1st, and died on the 5th. He had only sorted Persian wool.

(Case 38.) G. P., aged 39, worked as a "packer" of Persian wool at Messrs. Rowse & Co.'s mill, Bradford, where only English and Persian wools are used. He had been engaged in this work six weeks prior to his death, and for three weeks he had complained of malaise, having before that enjoyed good health. On Saturday, May 8th, and on Sunday he was so complaining, and on the last-named day he vomited frequently; he, however, went to work on Monday but had to give up during the morning, and went with difficulty from his lodgings to his sister's house the following day. The symptoms here rapidly increased; there was intense restlessness, constant vomiting, coldness of extremities that could not be relieved, rapid and oppressed breathing, cold sweats, and lividity of countenance. Medical assistance was then obtained; but during the doctor's visit he seemed greatly to have revived; he died, however, with increase of the above symptoms, on Friday afternoon; decomposition speedily followed.

In the following case the man was the subject of heart disease; and as he died very suddenly his medical attendant concluded that his chronic malady was the cause of his death. Dr. Bell, however, noticing that the corpse presented the appearances of early decomposition and livid discolorations, noticed so often in blood poisonings, examined the blood, and found bacilli identical in appearance with the bacillus anthracis; inoculation of a mouse, too, resulted in the death of the animal, with the crowding up of the spleen with the same organism. The case must, therefore, it is to be supposed, be looked upon as one of this disease. The history is as follows:—

(Case 39.) P. M., aged 40, was an overlooker in the combing department of Messrs. Bastow's mills, where no wool at all is sorted; the wool that he would

come in contact with would all be scoured ready for its manufacture into "toppings." Ten days before his fatal illness he had been engaged on this washed Persian wool, subsequently to that on English wool. On Thursday, September 9th, 1880, he was poorly, complained of a pain in his side, and had a very restless night. On Friday at 1 o'clock he was obliged to leave work in a cab, and at home had to be assisted to bed; he perspired very freely that night, was restless, and seemed at times very depressed. On Saturday he was better, and was downstairs, talking cheerfully with his friends. At 6.30 that evening he, however, became suddenly unconscious, and died in less than half an hour.*

(Case 40.) J. G., aged 30, was a sorter of Persian and Bokhara wools at Messrs. Feathers and Sons, Bradford. In June 1880 he suffered from a typical malignant pustule on the arm, but the case throughout was unaccompanied by any symptoms of general infection. Lymph taken by Dr. Bell from the encircling vesicles of the pustule was used for inoculation with positive results (Appendix, page 41).

This, with the few cases in the Appendix, concludes the history of recent attacks. I find, however, that no instance of distinct relapse after the apparent termination of an acute attack, an occurrence of which I have spoken, is included among them. Three such cases, the nature of the disease being declared at the time by the medical attendants, were related to me as having occurred within the last two years, although the records are unfortunately only from memory, and no post-mortem examinations were made. One of these was the case of C. W., aged 60, who had been working on inferior Turkey mohair. He was taken suddenly ill on Saturday night, August 29, 1879, or Sunday morning, whilst in bed. Dr. Foster, who attended him, and Dr. Bell, who saw him in consultation, agreed in looking upon the case as one of woolsorters' disease, with the ordinary acute symptoms. He so far recovered as to be able to come downstairs in four weeks time; and although feeling weak (he never returned to work) was moving about, and the doctor had discontinued his visits. Another attack in these circumstances (the severe symptoms again appearing on a Saturday night) occurred; and the patient died with the symptoms of the disease on December 8th; the death being certified "Woolsorters' disease, 3 months and 8 days."

The following is reported as a case of relapse, but perhaps the history would rather suggest secondary inflammatory or metastatic processes. In either case it is of interest.

(Case 41.) Joseph D., aged 25, a healthy man, had been working at Messrs. Mitchell Brothers' on average mohair. He appeared quite well on Sunday, February 9th, 1879, and dined with a friend that day. Next morning he felt so poorly and weak that he left work and did not return. Prodromal symptoms continued until Friday, when Mr. Tordoff was called in. He found him suffering from the usual symptoms ascribed to this disease, with hæmoptysis, and afterwards hæmatemesis, and mild delirium at night. He continued in this condition, with many exacerbations and remissions of the symptoms for seven or eight days, when improvement apparently set in. On Sunday and Monday, March 2nd and 3rd, the patient was downstairs, and the doctor was discontinuing the frequency of his visits, the only symptoms now being weakness and continued restless nights (and it was said by his friends, and the statement Mr. Tordoff believed, that the patient had scarcely slept for the whole three weeks). On Monday night this restlessness was more marked, and on Tuesday morning "he seemed not to be at all himself." His articulation was indistinct, he spoke slowly and hesitatingly. Towards noon he became unconscious, and died apparently comatose soon afterwards. The ears, neck, and chest showed dark purple discoloration within a quarter of an hour of death.

A warehouseman at the same factory suffered at the same time from what was regarded as a fatal attack of the sorters' disease.

* One might suppose that the heart disease contributed to the rapidly fatal termination.

III.—REMEDIAL MEASURES.

Certain measures, having for their object the protection of the woolsorters against the disease, have been advocated; and the chief of these were embodied in a presentment recently made by a coroner's jury that had inquired into the cause of a woolsorter's death. That presentment was as follows:—

"That in the opinion of the jury the sorting of Van mohair, Cape hair, Persian wools, and all dry Eastern wools and hair is dangerous to life, except under effective precautions; and that they recommend that the following precautions be adopted:—

"(1.) Before the bale is opened it be steeped in hot water, and remain in water not less than twelve hours; and in case the covering does not freely admit the water, it be opened so as to admit the water.

"(2.) After the bale has been in water the necessary time, the hair or wool be placed in a sud of hot water, washed, passed through rollers, and again washed in a fresh sud of hot water, partly dried, but sorted when damp, and as early as possible after washing; that the temperature of the hot water be 120 degrees at least.

"(4.) That the sorting-room be well ventilated, the floor swept daily, the walls and ceiling swept once a month and thoroughly cleansed, and the walls whitewashed every six months with lime mixed with carbolic acid; no wool, or hair, or other material be stored in the sorting-room; no meals to be taken in the sorting-room, nor food kept there.

"(5.) That proper provision be made for sorters to wash in water near the sorting-room.

"The jury do further recommend that if no sufficient legal authority exists for enforcing proper regulations connected with the sorting of wool or hair before referred to, statutory powers ought to be obtained for the purpose, applicable to the United Kingdom, with the object of placing the sorting of wools or hair under the control and inspection of the factory inspectors; and that a copy of this presentment and recommendation be forwarded to the Local Government Board, also to the Sanitary Committee of the Bradford Town Council."

A Committee of the Bradford Town Council, that had been appointed to consider the subject of this disease, coincided in these recommendations, and invited the manufacturers to apply them. The latter in their turn, after several meetings, adopted the following resolutions:—

"1st. That all Van mohair, camels-hair, and Persian wool, and all damaged wools are noxious and must be dealt with before sorting.

"2nd. That all average mohair, Cape hair, Peliton and alpaca are to be sorted as usual. (Damaged excepted).

"3rd. That in dealing with 'noxious wools' before a bale is opened, it shall be steeped in hot or cold water for a period of not less than 10 hours. In case the covering does not freely admit the water, it shall be opened so as to do so.

"4th. That after the bale has been in the water the necessary time, the hair or wool shall be placed in a sud of hot water and washed, then passed through rollers, partly dried and sorted whilst still damp, as early as possible after washing. The heat of the water to be 100 to 120 degrees.

"5th. That sorting-rooms shall be well ventilated; the floors swept daily; the walls and ceilings swept once in *three months* and thoroughly cleansed; and the walls limewashed with lime mixed with carbolic acid once in *twelve months*.

"6th. That no bale wool shall be stored in the sorting-room, and no wool, hair, or other material shall be kept in the said room so as to interfere with the proper ventilation thereof.

"7th. That no meals shall be taken in the sorting-room, or food kept there. Also that proper provision be made for the sorters to wash in or near to the sorting-room."

It will be seen that the chief difference between these resolutions is as to what is to be regarded as "noxious" wools. The manufacturers wish to exclude Turkey and Cape mohair and alpaca (more than 60 per cent. of the bulk of these dusty wools) from this designation, whilst the other resolutions seek to include them all. That these wools are occasionally infective, not perhaps so often as Van mohair, but still not infrequently, cannot, I think, from the evidence already adduced, be gainsayed; they may be and sometimes are "noxious" in the sense that term is used in the resolutions. But this does not settle the question. The manufacturers say further that it is impracticable to wash these wools before sorting; that by reason of the fineness of their fibre, and of the many different qualities into which they are required to be sorted, the latter process, after the whole bulk had been intermixed in the washing bowl, would become practically impossible. That it would be a work of much greater time and difficulty, no one, looking at this wool and at the sorting process, can doubt; and the sorters themselves admit this, and hesitate to say that they would wish washing enforced in respect of certain wools. The following are the resolutions they passed after considering the masters' views:—

"That 'inferior grey' (an inferior class of Turkey mohair) and all Cape hair, as well as those mentioned by the employers, are injurious, and ought to be washed before sorting.

"That Alpaca, Pelitan, and other dusty wools ought to be opened over a fan blast to remove the dust before sorting.

"That all damaged wools ought to be treated with chemical disinfectants or steeped in hot, not cold, water, before the usual process of washing.

"That to prevent disputes, "noxious" wools should be explicitly defined.

"That the process of disinfection must be thorough, as damaged hair often smells worse after washing than before.

"That the foregoing treatment can only be considered as provisional and experimental; for experience may show it to be insufficient to destroy the source of the disease."

With this last clause I must entirely concur. Supposing it were found practicable to wash all suspected wools, I must say I can see myself no sufficient ground for expecta-

tion that this washing, in the way in which it is now effected as a first process before the sorting, will be found a sufficient protective. If the washing meant the absolute cleansing of every fibre, the case would be different, but this now it does not mean; the process consists either of a mere steeping, or this combined with a very gingerly agitation of the wool in a warm "sud." For it is naturally a prime object to prevent the entangling and mixing of the hair; a sorter will even unroll a fleece carefully, to prevent the different qualities of hair which are found in one fleece in its different parts from being intermingled. To think of preserving the same distinction between different parts of the same fleece, the same unity of the fibres, so to speak, and at the same time to subject the material to a thorough scouring process, seems to me futile. In effect, the process, as I have said, resolves itself into one of mere steeping; it may be looked upon as analogous in its results to the ordinary *steaming* of the wool, another measure advocated. Its effect is, that the material, as it comes to the sorter, is more or less damp, and consequently in its manipulation less visible dust arises; but the impurities, it can be seen, are abundantly present. In point of fact it is this "laying of the dust" that is looked upon as the protective factor; along with the dust it is hoped that the contagium will be allayed. But will our knowledge of the behaviour of contagia in general justify such a hope? The general law that the lower fungi flourish best in presence of abundant moisture would suggest in the first place the possibility, even probability, that the immersion of the infected wool in water may serve to endow the disease germs, in their hitherto dry state at a minimum of life, with more active vitality; to determine indeed their growth and propagation. Then as to the mechanical suppression of the contagium, we are not in a position to deny that moist exhalations, no visible dust being present, may be the bearers of minute solid particles; that (under conditions not wholly understood) water given off from one and another wet surface can carry with it such organisms as are here in question, and even larger bodies; and that it is through such conveyance of disease-producing particles that the exhalations from sewers and marshes come to possess their injurious properties. For these reasons, although I wish not to discredit any measure that is still, it may be said, on its trial, I think we must be prepared for the adoption of other courses than those the manufacturers yet propose to themselves.

If it be true that danger, in the first instance, lies in chief part, if not almost entirely, amongst the "fallen fleeces," as, if our views upon the pathology of the disease be correct it almost necessarily follows, it would seem that a reasonable chance is offered for a very important practical division of these wools; one class, consisting of little more on an average than 5 per cent. of the entire bulk, being the fallen fleeces, which may be infected; the remainder, which are full grown, and have been shorn in the ordinary way from living animals, being probably free from that suspicion. These "fallen fleeces," as I have before explained, are easily recognised, are often found in separate parcels in the interior before they come into the dealers' hands; and, if mixed, can easily be again separated by the initiated. This is the purport of the information I have from Constantinople, and from those who are conversant with the trade there. At present wools are divided into classes in Constantinople; "fallen fleeces" might, I am told, readily form an additional class. If manufacturers were to combine together to discourage their purchase in any other way; or if the Legislature would intervene to prohibit, except when classed separately, their importation, such pressure, I am told, would be brought to bear upon the native growers that these fallen fleeces would be kept apart; or, were they mixed in the interior, they would be separated (of course at some risk to men so employed) in Constantinople. "Fallen fleeces" might then be regarded as *infected*, and be dealt with accordingly.

In this there would probably be little difficulty or hardship. Constituting a small and inferior class, the manufacturers would find little difficulty in having these fleeces scoured thoroughly, or disinfected in other approved ways, before placing them in the sorters' hands. It is the enormous bulk of the material to be dealt with at the present time that constitutes the great difficulty.

The course suggested would perhaps be preferable to a prohibition of the importation of "fallen fleeces"; for the great bulk even of these are not, at least in ordinary times, it must be remembered, from infected animals (the difference of course not being demonstrable); and an endeavour to exclude them wholly from the country would be more likely to lead to attempts at their surreptitious introduction. To guard against this latter contingency, in any case, the mixing of small pieces of wool along with whole fleeces, a practice that now often prevails, should be discouraged in every possible way by the buyers here. In a word, full grown fleeces, shorn in the ordinary way, should be sent over, without removal of "locks" or clippings, intact,

and would be recognized as probably *innocent*; "fallen" fleeces, and detached pieces of wool, would be treated with suspicion as a class apart. Were such a classification prescribed by legislative enactment—that is to say, were it unlawful for the masters knowingly to allow the sorting, without previous disinfection of such wools as I have included in the second of the above categories, the readiness with which infringement of the law would be detected by the sorters themselves would probably suffice to insure its observance.

Some importers are endeavouring to bring about a practice of washing the fleeces abroad, as English sheep are washed at home; it is much to be desired that such efforts will be successful.

As to measures of disinfection, I propose to speak only in general terms. Precise recommendations as to processes to be adopted, or as to the chemical agents to be employed, could only be ventured upon in the light of more extended observations than we now possess as to the effect of such agents upon the bacillus and its germs. Hopes may, however, be entertained that this want will before long be supplied through the labours of a local Medical Commission that is at present engaged in inquiring into the subject.

Heat, either moist or dry, could not, it seems, be applied in sufficient degree without materially injuring the wool and its spinning qualities; at least, manufacturers unanimously affirm that to subject the wool to water or air of a temperature much beyond 140° or 150° F., and then only for a limited time, would have a decidedly injurious effect; and the sorters do not deny that this has been found to be so. Such temperatures, it would appear, are decidedly insufficient for the destruction of bacterial germs. Cold, on the other hand, would seem to be valueless; a freezing, or even lower temperature does not seem to impair for long the vitality of such a contagium. Certain chemical disinfectants, applied in a liquid form, will at once suggest themselves; solutions of sulphurous acid, of chloride of lime, or chlorine water, sulphate or chloride of zinc, and of carbolic acid, &c., &c.; of all these—of their act on upon the bacillus and its germs, and of the strength in which it is necessary to apply them—more precise information is required; as well as with regard to their effect upon the wool in relation to the manufacturing processes (spinning, dyeing, and so on,) which it has afterwards to undergo. It would appear not at all improbable, however, with regard to this latter consideration, that some disinfectant of the kind may be found, the application of which to the wool may be a positive advantage in a manufacturing point of view. It is suggested, for example, that the steeping of the wool in solutions of sulphurous acid would facilitate its subsequent cleansing, and possibly improve its spinning qualities, while it might well be expected that such treatment would assist in protecting the wool from the ravages of moths, which now, I understand, when as often happens the material after sorting has to be stored, are frequently so great as to entail a considerable loss upon the manufacturer.

Gaseous disinfectants, principally sulphurous acid and the vapour of carbolic acid, have been recommended. As to the former, a considerable quantity would probably have to be used; and as regards the latter, while recent experiments have thrown great doubt on its powers as a true disinfectant, in contradistinction to its properties as an antiseptic, in a liquid state, its value in a gaseous form is still more problematical; in fact, it must be taken, I think, as proved that, applied in this form, it may restrain for a time the growth of low organisms and the development of their germs, but will not destroy them. There is an obvious and, it seems to me, paramount difficulty, also, in the application of disinfectants in this way; fumigation can certainly only be effective when the infected material is well opened out and exposed to the fumes.*

Certain other measures that may be termed palliative have, it will be seen, received attention. Very important amongst these are the frequent cleansing and disinfecting of the sorting-rooms; their free ventilation, and the restriction of their use to the sorting operations. Hitherto it has been the practice to use the warehouse-rooms as sorting-rooms; and the consequence has been that the dust generated in the sorting operation has accumulated on the bales and in the rooms (which did not admit under such circumstances of thorough cleansing) for months and years. Now as this dust may sometimes contain infectious matter, the condition described may be said to be analogous to that of a fever-stricken room half filled with furniture, and burdened with curtains and hangings of a retentive material. It is beginning to

* An apparatus has been devised for blowing sulphurous acid, or air impregnated with carbolic acid, through bales of wool. It consists of an iron cylinder, having an upright tube, spiked at the top, and perforated by many holes, in the centre. Upon this spike the bale of wool is as it were impaled; and then the vapour is blown by steam power through the perforations in the tube, and so into and through the wool. It seems most improbable that the vapour would be so diffused as to reach every part and fibre of the wool, in any reasonable time.

be recognised that here, where infectious material is occasionally dealt with, the precautions should as nearly as possible approach to those observed in a fever ward—no facilities for the lodgment of dust, scrupulous cleanliness, and free ventilation. It has been remarked that at certain factories—those at Saltaire and Queensbury for example—cases of this disease have been much less frequent since improvement has been instituted in this direction; and this is the experience too in other places, notably amongst the hair factories in Philadelphia. It is to be hoped that the manufacturers in general will soon act upon this better knowledge. Meanwhile, the subject is one specially deserving the attention of those having the administration of the Factory Acts.

My remarks (page 14) upon "Residual products" will serve to indicate other necessary precautions. Dust thrown to the roof of the factory by the fan-blast should not be left to be blown over the district, but intercepted by any one of several easily applied contrivances that will at once suggest themselves. This dust, together with that collected in the rooms, should be burnt. The bags in which the wool has been imported should be disinfected, not only before being sold, but before being brushed by the sorters. Care is obviously necessary in the disposal of the wool washings.

It will be seen from the resolutions of the masters that they have very properly determined to prohibit the eating of meals in the sorting or warehouse rooms, and that they propose to provide proper lavatory accommodation for their men; in some factories it is intended to provide dining-rooms for their use also.

It has long been the custom for sorters, in order to protect their persons and clothing from dust, to wear long over-garments or gabardines at their work, and this is a very proper practice. They should not, however, as many of them do, wear these garments habitually to their homes; nor should coats, as I have frequently seen them, be hung in the sorting-room. All the precautions, in short, applicable in an infected room, now generally known, should be observed down to the most minute detail.

I have spoken in various parts of this report of the large amount of dust in the atmosphere of the sorting-room when the dry foreign wool is in hand, and of the consequent mischief that may thus, apart from specific infection, accrue to the workmen. The general recognition of this evil has led to the adoption in most factories of some mode or other of diminishing the amount of dust, or of its effect upon the workmen. Thus in some factories it is customary to change at intervals the material on which a man is working; if he is found to suffer from one class of wool, he is put upon less dusty material; and this apparently with excellent effect, although, as I have shown, the chronic symptoms relieved by the change are often not to be attributed to the mere irritation of dusty particles. Then, too, there are certain mechanical contrivances. One is that of opening the bales and shaking the wool over a wire lattice screen, through which a current of air, maintained by a fan blast, is being drawn. Each man, the custom is, opens his own bale and shakes the wool by hand over the screen; a primitive method, and one that could perhaps be easily improved upon. Of course the amount of dust removed is in proportion to the amount of shaking the wool receives; perhaps 50 per cent. of it is got rid of in this way, and if the fan blast be a good one, and the machinery intelligently devised, a good deal of the dust will be drawn from the atmosphere. Then, in two or three works, the hurdles over which the men sort the wool are acted upon by a fan blast in a similar manner; but in practice it is found, it seemed to me, that while there may be a good current of air at the board next to the fan, at those further removed there is little or none. Still the idea is a good one, and with greater attention to due proportions in original construction, and more regard to detail, the appliance might be of much value.

Respirators, it is said, have been supplied to the men, but they will not use them; and, remembering how soon they must get choked with the amount of dust in the atmosphere, this is not to be wondered at. Could this objection to their use be removed, efficient respirators might be expected to be of value.

Before concluding this Report I would wish to express my obligation to the medical gentlemen and the manufacturers and others of the Bradford district for the assistance that has been so freely and frankly afforded me. I am indebted for much information, also, as to the mode of dealing with wools abroad (a subject of which I find little is known at home) to Messrs. Binns and Gatherall, of Constantinople, and to Mr. Henry Harrison, of Arequipa, Peru.

JOHN SPEAR.

APPENDICES.

A.

CLINICAL NOTES, NOTES ON AUTOPSIES, OF MICROSCOPICAL EXAMINATIONS AND OF PATHOLOGICAL EXPERIMENTS.

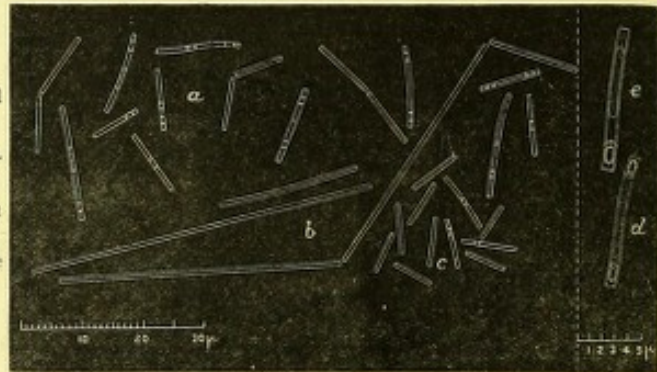
[The cases in which Dr. Greenfield carried out pathological experiments are those first recorded here.]

(Case 20, for history, page 24) *Autopsy*.—T. C., aged 71, died 21st May 1880. Autopsy 30 hours after death. Body well developed. Rigor mortis fairly marked, but decomposition considerably advanced. Much dark discolouration of skin (hypostasis and cyanosis), especially of back, arms, neck, and face, which latter was also swollen. A frothy blood-stained fluid issued from mouth and nostrils. Subcutaneous cellular tissue of neck, arms, chest, and, in patches, in various parts of the body and limbs, emphysematous; a crackling sensation being produced on pressure. The epidermis raised in blisters in some of the more dependent parts, and in moving the body is detached in large strips. *Thorax*.—Considerable jelly-like œdema of the mediastinal connective tissue; copious straw-coloured serous effusion in pleural cavities; lungs showing deep hypostatic congestion, and much general œdema. The mucous membrane of the trachea and larger bronchi somewhat hyperæmic, and containing some blood-stained frothy mucus; the bronchial glands swollen and congested. The pericardium contains about 3 ozs. of reddish serum, its surface smooth and lustrous. The heart flaccid, and full of dark cherry-coloured fluid blood, the endocardium being stained with its colouring matter. The *abdominal cavity* contains a small quantity of blood-stained serous exudation; the peritoneum injected. The gastric mucous membrane softened and separated in parts from the muscular coat (most marked at fundus and probably p.m.); small intestine in parts much congested, and containing liquid fæces, but no blood; mesenteric and retro-peritoneal glands enlarged and congested; the mesentery infiltrated with exudation now gelatinised. The spleen moderately enlarged, dark and pulpy; kidneys deeply congested, the surrounding connective tissue infiltrated with serum; the liver and other organs apparently normal. Brain not examined.

In the blood and other fluids examined immediately after completion of autopsy bacilli were found. Dr. Greenfield's report is as follows:—

"Case 20. T. C., died May 21, 3 a.m.; material received May 23rd, 4.30 a.m. Examination made and inoculations performed 5 to 7 a.m., 50 hours after death. Blood from the spleen; the tissues and

FIG. 1.



T. C.—Blood, showing the bacterial organisms found in it.

- a. Single and jointed bacilli, several containing spores.
- b. Long filaments.
- c. Shorter rods forming groups, of which only a part is represented.
- d and e. Two of the rods resembling those at a, more highly magnified.

This and the other figures, to which a scale is appended, were drawn to scale when fresh, under a magnifying power of 400 diameters, and are represented as enlarged to twice that size. The more highly magnified were drawn under a power of 800 diameters, and are also enlarged to twice natural size. In some of the woodcuts the bacilli are made to appear somewhat too thick. The unit of measurement, μ , a micro-millimetre, equals $\frac{1}{250000}$ of an inch.

bloody fluid from the spleen smelt as if decomposed; they contained a very large number of rods, most of which measured from 5 to 8 μ , but many longer, 10 to 15 μ . The smaller ones resembled both in diameter and shape short rods of bacillus anthracis, but the shorter rods were rounder at the ends than usual. The longer rods were blunt at the ends and contained typical spores. All were motionless. No bacterium termo, but some micrococci.

"The serous fluid from pleura contained many very long rods measuring from 50 to 150 μ . in length, straight or jointed, together with many other shorter rods, in which spores in course of formation or fully formed were visible.

"Sanguineous fluid from the lung also contained abundant long and medium-sized rods of somewhat variable diameter, 1.2 to 1.8 μ .

"Inoculations with these fluids were entirely unsuccessful, and need not therefore be detailed."

(Case 22, page 25.)—Clinical notes by Mr. McKenzie, as follows:—

"Moulson C., æt. 30, a woolsorter, a muscular, athletic, healthy-looking man, who has always previously enjoyed good health. Family history good. States that on the 8th of May 1880 he played at a cricket match and perspired freely, became chilly afterwards, and has not since felt well. He has been sorting Cape hair for the last six months, and feels sure he has got the 'sorters disease,' and it

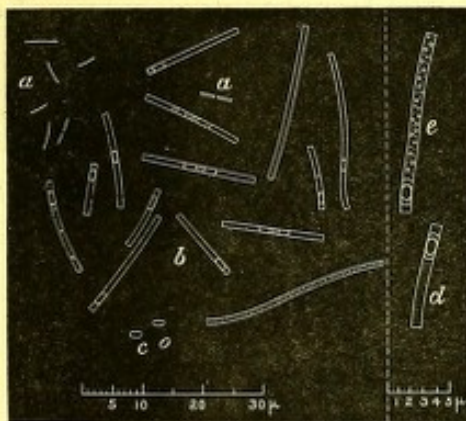
seems has always lived in dread of it. *Present Condition.* 19th May.—Has felt shivery and cold; anxious expression; breathing slightly hurried; bathed in copious perspiration; tongue moist and slightly coated; bowels open. Morning temperature 103°, pulse regular, full, 128; slight dry cough. Physical examination did not reveal anything abnormal. 20th May.—Complains of pain 'all over,' particularly in left side. Expectoration slightly rusty; minute crepitation heard over lower portion of left lung posteriorly. No marked dulness. Temperature 104°·2; pulse 130, regular. 21st May.—No improvement; breathing hurried. Temperature 104°; pulse 128. Bowels open; takes nourishment freely. Face jaundiced; urine scanty, high coloured. 22nd May.—Passed restless night. Complains much of catching pain in left side. Upper part of chest, neck, and ears covered with sudamina. 24th May.—Pain in left side still troublesome. Tubular breathing heard over lower portion of left lung posteriorly; dulness marked over same region, and slightly over lower portion of right lung behind. Temperature 103°·2; pulse, regular, 130. 26th May.—Seemed rather better to-day; troublesome cough. Expectoration not copious, but glairy and tough. Not sweating quite so much. Sat up while I was there and took a pint of mutton-broth with bread. No improvement discovered from examination of chest. 27th May.—Was sent for hurriedly as he was much worse. Found him insensible, breathing noisy. Pulse 136, weak and irregular. He died shortly after I saw him."

Autopsy 23 hours after death.—Body well developed. P. m. rigidity well marked. Same p. m. discolouration as in preceding case observed, and likewise the emphysematous condition of subcutaneous cellular tissue about neck and shoulders; petechiæ on chest and abdomen. Subcutaneous tissue of chest œdematous. On opening thorax a quantity of purulent fluid gushed from the left pleural cavity, where, about opposite the sixth rib anteriorly as a centre, it had been encapsuled. Recent pleuritic adhesions on both sides. Both lungs large, firm, and heavy, not sinking but showing diminished buoyancy in water; on section, in nearly every part an engorged and moist cut surface presented; the engorgement and œdema being most marked in the lower lobes posteriorly, where a copious, red, serous fluid, filled with minute air-bubbles, is poured out on section. Scattered sparsely through both lungs, but more thickly in the left lower lobe, corresponding with the empyema, are small mostly minute collections of purulent matter (yellow, grey, and blackish in colour); mostly surrounded perceptibly by a zone of more highly inflamed lung tissue. Bronchial glands swollen, soft, and infiltrated with blood. The trachea and bronchi contained some blood-stained frothy mucus; the pericardium a small quantity of reddish serum; the right side of heart filled with dark mostly fluid blood, but having a few small soft clots; the endocardium stained with the colouring matter of the blood. The *abdominal cavity* contained a small quantity of blood-stained fluid; the connective tissue around the left kidney claret-coloured from effused blood and œdematous. The kidneys greatly congested, and in the right, in the pyramidal portion, were two or three small collections, about the size of a pin's head, of purulent matter. The spleen swollen to twice its natural size, although the capsule is wrinkled, showing that the swelling had been greater; the parenchyma of the organ diffluent. The mucous membrane of the stomach showed punctate ecchymoses; intestine and liver normal. The brain was not examined. Bacilli, identical in appearance with the bacillus anthracis, were found in the blood and extravascular fluids.

Dr. Greenfield reports on this case as follows:—

"Case 22.—Moulson C., died May 26th, 11 a.m.; blood and pericardial serum in capillary tubes received May 28th, 5 p.m., 54 hours after death.

FIG. 2.



M. C.—Pericardial fluid.

- a. Small decomposition bacteria.
- b. Bacilli of various length, many containing spores.
- c. Isolated spores.
- d. Short bacillus rod containing a spore seen under higher magnifying power.
- e. Portion of a longer filament, containing a spore.

"*Microscopic Examination.*—The blood was quite fluid. The red corpuscles appeared quite natural, no sign of escape of hæmoglobin. A very prolonged examination of the blood was made, alone and mixed with serum on the warm stage, and also after dilution with various reagents. In the course of examination of a number of slides only six bacteria of any kind were discovered. These were straight, rather thick, and from 6 to 10 μ long; one was in progressive movement, like that of active bacterium termo, the other quiescent, but of exactly the same general appearance. No sign of subdivision or of spore formation was seen in any of these bacteria, and they did not grow in length on the warm stage. No micrococci were discovered in any of the specimens examined.

"*Inoculation experiments* with this blood were without any result.

"*Cultivation* of the blood in aqueous humour did not produce any bacilli, only some common decomposition bacteria.

"*Pericardial serum* contained numerous bacilli, measuring from $8\ \mu$ to $20\ \mu$ or longer, the average being about $12\ \mu$ in length, and 1.2 to $1.5\ \mu$ in width.

"These bacilli had all the characters of anthrax bacilli, and in many spores had been formed. Some were granular, as if in process of decomposition. A few free spores were also seen.

"In addition to these motionless bacilli, a number of ordinary bacteria in active movement were seen, these measuring from 3 to $5\ \mu$ in length, and about $.75\ \mu$ in maximum thickness; they were in active division.

"*Spleen*.—In the fluid from the spleen were a few bacilli, measuring from 10 to $20\ \mu$ in length."

Case 35, p. 29.—Mr. Roberts contributes the following clinical history.

"I was called to see Jacob Bolton (aged 36), of Exley Head, Keighley, on Monday 31st May 1880. He gave me the following history of his illness. He began to feel not quite so well about three weeks ago, and though he had not felt ill enough to leave his work, he had gradually lost strength. He was a wool-buyer, and only bought Scotch and English wools, but he said that three weeks ago* he examined some foreign wool and felt a smell from it. He, however, said that he did not think that this had anything to do with his illness, and that it was simply the result of cold. The Wednesday before I saw him he had neglected to take his overcoat, and he had felt very cold, and towards evening had had some cold shivers. The cold shivers continued on the Thursday, Friday, and Saturday, when he left work at usual time. He was in bed all day on Sunday and Monday. I saw him about 7.30 on Monday evening, when his condition was as follows: temperature $104^{\circ}0$ in the axilla; respirations 40; pulse 120; base of right lung, dull on percussion, both back and front; slight crepitation. *Tuesday, 1st June, morning*, temperature $102^{\circ}0$; respiration 40; pulse 120; no expectoration; complained of severe frontal headache; bowels had acted freely; not slept at all during the night. *Evening*.—Temperature, pulse, respirations, were all the same; no expectoration. *Wednesday, 2nd June, morning*.—Temperature 102° ; pulse 130; respiration 40. He said that his breathing varied, but was generally very rapid; no pain in the chest; headache relieved. *Evening, 8 p.m.*—I was called in a great hurry, because they thought he was dying. On arriving I found him comatose. His pupils responded to light; temperature 102° ; pulse 120; respiration 40. His wife told me that the pain in his head had been worse during the afternoon, and that just before he became unconscious, he said the pain had left his forehead, running across the head to back and down his neck. He never recovered consciousness, and died at 4.30 on Thursday morning."

Jacob Bolton, aged 36, *Autopsy* nine hours after death. Body well developed. Rigor mortis progressing; marked hypostasis and cyanosis, and numerous petechiæ on chest and abdomen. *Thorax*.—Large extravasations of blood into the connective tissue of the mediastinum. About 2 ozs. of fluid in the pericardium. Hæmorrhages into the sub-pericardial fatty tissue. Left ventricle contracted; right distended with dark fluid blood. Endocardium normal and not stained. More than a quart of clear straw-coloured fluid effusion in each pleural cavity. In both lungs, mostly at the periphery, are several, apparently fresh, hæmorrhagic infarctions; their consistency being that of blood-clot, and their outline distinct from the surrounding tissue. The mucous membrane of the trachea and bronchi injected; the bronchial glands swollen and hyperæmic. The mucous membrane of the pharynx of a dark red colour, the glands of the neck swollen and infiltrated with blood; the pharyngeal and retropharyngeal connective tissues œdematous, and containing large hæmorrhages. *Abdomen*.—The mucous membrane of the digestive tract normal, except for what appeared to be a hæmorrhagic erosion on the posterior wall of the stomach. Spleen moderately enlarged, kidneys congested, and the urine contains albumen. *Head*.—Extensive hæmorrhages in the pia mater.

Dr. Greenfield reports:—

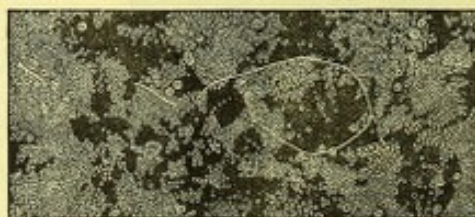
"Case 35.—Jacob Bolton, died June 3rd, 4.30 a.m. Fluids, &c. received June 4th, 4 p.m., 36 hours after death, and examined at once, and experimental inoculations made.

"*Microscopical Examination*.—*Spleen* quite natural. No bacilli discovered. *Pericardial fluid* mixed with blood. Otherwise the fluid quite natural, no bacteria or bacilli discovered.

"*Pleural fluid* quite natural; no bacteria or bacilli. One or two extremely minute micrococci discovered on a prolonged search.

"*Blood* still fluid, and of natural red colour. The red corpuscles appear fairly natural. Leucocytes in the field scanty, but those seen natural.

FIG. 3.



Blood from the case of J. B., containing bacilli.
From a photo-micrograph by Dr. Maddox.
Magnified about 100 diameters.

"Here and there, mostly in groups, were seen very long, motionless bacilli varying in length from $50\ \mu$ upwards, some being $200\ \mu$ ($\frac{1}{2}$ inch) long. Their average diameter was $1.5\ \mu$. Some of these were made up of two or more rods joined at an acute angle, but the majority were curved, some forming complete circles (*vide* photograph). They were comparatively very scanty, several fields (of

* But as to this, see history, afterwards carefully worked out at his place of business.

No. 10, Hartnack obj., No. 3 oc. being passed without seeing any, then fields in which one, two, or three filaments appeared.

"On minute examination with high powers they all showed a pretty uniform transverse marking, dividing them into shorter rods or rather segmenting their protoplasm, the outer sheath shewing no divisions. With colouring reagents or with osmic acid, this condition was much more clearly seen. No spores were visible in any of the rods, nor were free spores discovered.

"Inoculation with this blood proved rapidly fatal both in the mouse and the guinea-pig with typical symptoms and post-mortem appearances of anthrax; and the nature of the disease was further proved by subsequent inoculations from these animals, and by separate cultivation of the bacilli.

"The details of these experiments will be given in a separate report."

Case 30 (for history, page 28).—J. G., aged 48 years.—*Autopsy*. July 23rd, nine hours after death, body fairly developed; rigor mortis fairly marked. Hypostasis on back well marked; no external swelling or petechiæ. *Thorax*.—Connective tissue of mediastinum is infiltrated with serum which has become gelatinised. Most copious straw-coloured effusion in both plural cavities; about 3 ozs. similar fluid in the pericardium. *Heart*.—Left ventricle moderately contracted; cavities full of dark thin fluid blood. *Lungs*.—The sub-serous areolar tissue is œdematous, forming yellow gelatinous masses at the dependent parts of each lobe; the œdema extending into interlobular tissue. A similar condition in the tissues at the root of the lung, where also are small extravasations of blood especially around the bronchial glands. The bronchial glands mostly swollen, soft, and show hæmorrhagic foci. The pulmonary parenchyma appears normal (slate coloured from carbonaceous pigment, containing little blood, but showing a little local emphysema). The trachea and bronchi contain a little blood-stained frothy mucus; and beneath the mucous membrane, in various places, but especially at the bifurcation of the trachea, are hæmorrhagic extravasations. The pharyngeal mucous membrane is dark red; and the loose connective tissues of the neck are the seat of the jelly-like sero-sanguinolent infiltration before described. Other organs of the body, including spleen and brain, appear healthy.

Dr. Greenfield reports on this case as follows:—

"Case 30.—J. G., died July 23rd, at 12 noon. Blood received at 3 p.m., July 24th, which had been taken from the arm by Dr. Bell shortly after death. Other fluids, &c., brought by Mr. Spear at 8 p.m.

"Blood from the arm contained only very few bacilli, having the ordinary appearance of anthrax bacilli. Inoculation of a guinea-pig with this blood proved fatal in about 30 hours with typical anthrax.

"Pleural serum, taken from the pleura eight hours after death, contained very numerous bacilli varying from 10 to 45 μ in length, some being 150 μ long. They were in all respects like ordinary anthrax bacilli under cultivation, but did not contain any spores. In one of the tubes masses of long convoluted filaments, some of which were measured to the length of 16 fields of the microscope (nearly a quarter of an inch). These convoluted filaments were arranged in bundles and spirals exactly as in artificial cultivation of anthrax bacillus after about 12 hours, which indeed they exactly resembled.

"Fluid expressed from a bronchial gland contained only a few shorter rods, from 8 to 12 μ in length, but of very typical character.

"Blood from the heart, a very few bacilli were found.

"Blood from the spleen, very few could be found.

"Inoculation of the guinea-pig with these fluids produced typical anthrax."

(Case 28, p. 27).—The following are the clinical notes and the notes of the post-mortem examination in the case of J. H.; they are contributed by Mr. Chaffers, of Keighley:—

"I found the patient at 9 a.m. (August 30th) in a state of approaching asphyxia, respiration, 46; pulse 120, very intermittent and weak, not to be counted at wrist, but in femoral artery. Temp. 98° F. tongue coated thinly with whitish fur. Respiratory sounds exaggerated, and bronchial breathing over upper halves of both lungs, back and front; intense dulness and absence of respiratory murmur below. Remarkable lividity of surface at back of chest; lividity of face, with cold clammy sweat; cold and livid extremities; not the slightest symptoms referable to any brain lesion."

"J. H., p. m. 24 hours after death; body muscular and well developed; neck swollen; neck, face, hands, and fingers livid. On removing the sternum there was found an emphysematous condition of the cellular tissue in the anterior mediastinum, which was afterwards found to extend to the abdominal sub-peritoneal cellular tissue. There was a layer of gelatinous material one inch thick between fibrous and serous layers of pericardium, and considerable quantities of same deposit on surface of pericardium. The sac contained about two ounces of fluid. *Pleura*.—No adhesions. There was a large quantity of fluid in both cavities (over two quarts). *Heart* healthy; muscles dark. *Right* side unusually soft and flabby. *Left* side firmly contracted. All valves healthy and not stained. Ascending portion of aorta slightly stained yellow. *Stomach* healthy. *Right kidney* and *left* both congested, and neither had any hæmorrhage on surface. *Liver* healthy, but very full of blood. *Stomach* and *bowels* healthy. *Bladder* empty. *Lungs* healthy. *Bronchial glands*.—Hæmorrhage into their substance causing breaking down."

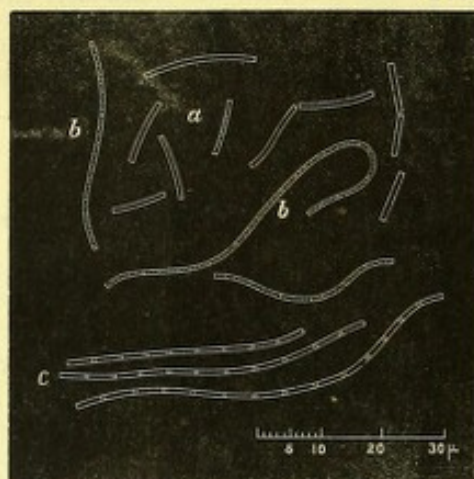
Dr. Greenfield reports:

"Case 28.—J. H., æt. 39; died August 30th, at 2 p.m. Post-mortem August 31. Specimens received from Dr. Roberts on September 1st. Examined 2 p.m., 48 hours after death.

"Spleen contains masses of felted filaments of considerable length, which are seen to be made up of shorter rods of nearly equal length. Around these masses the splenic tissue was in a condition of liquefaction, the corpuscular elements being apparently destroyed; in other parts the latter seemed quite natural.

" *Pericardial serum*.—No bacilli were discovered. Fluid expressed from the lung contained very numerous bacilli in various stages of growth. Many single bacilli measuring from 8 to 12 μ . in length, and others much longer.

FIG. 4.



Bacilli in the fluids from the lung and spleen of J. H.

a. Single bacilli from the fluid exuded from the lung.

b. Long jointed bacilli from the lung, of more granular appearance.

c. From the spleen; very long jointed filaments.

" Many of these bacilli contained spores, in others the protoplasm showed the large granules sometimes seen during spore formation. No trace of decomposition was seen in the fluid; no other bacteria.

" Inoculation with these fluids produced typical anthrax in the guinea-pig."

Case 11, p. 19.—The following clinical and post-mortem notes were contributed by Dr. Bell to the "Lancet," of May 22, 1880:—

" S. F., *æt.* 43, had complained of sickness since Saturday, May 1st. On Monday, at 5 p.m., Dr. Bell saw him. He says "the patient complained only of feeling rather sick and weak; no pain; slight cough; no expectoration; tongue, thin white fur; chest, percussion in front and behind clear; respiratory murmur over right lung, very feeble and imperfect; no moist sounds. Respiration 24; pulse 126, firm, sharp, regular; temperature: armpit 100°·4. There was nothing apparent in his general condition to cause or correspond with the dangerous character of the pulse. 4th, 10 a.m.—Has had little sleep; respiration 28; pulse 120, small, feeble, uneven; temperature: armpit 98°·1, mouth 100°, rectum 102°·4. 7 p.m.—Complains of nothing but sickness, has vomited frequently; extremities cold; respiration 28; pulse 116; temperature: armpit 97°·6, mouth 99°, rectum 101°·4. 10.20 p.m.—Visited by Drs. Tibbits and Rabagliati. Right lung-sounds very feeble, no decided dulness; respiration 30; pulse 116, very weak; temperature: armpit 97°·3, mouth 97°·9, rectum 101°. 5th, 4 a.m.—Has slept a little, frequently; skin moist; slight cough and expectoration; no pain; vomiting frequently; respiration 28; pulse 112; temperature: armpit 97°, mouth 98°, rectum 100°·8. 10 a.m.—Seen by Drs. Tibbits and Rabagliati. Lungs resonant, no crepitation; tongue moist; extremities cold. 1.45 p.m.—Collapse increasing; respiration 40; pulse 120, scarcely countable. 5 p.m.—Lungs anteriorly resonant; pulse almost imperceptible; respiration, 48; very restless. At 8 p.m. he died. Duration of illness four days. The treatment consisted of stimulants, and carbolic acid by lungs, stomach, and rectum. Blood was taken three times from the finger; it did not form *rouleaux*; white corpuscles were numerous; no bacilli. Blood twice drawn by leech from the chest; injected under skin of rabbit had no effect."

" *Autopsy 48 hours after death*.—Rigor mortis well marked. Claret discoloration on chest, sides of abdomen, upper surfaces of penis and scrotum. Percussion right side of chest duller than left. Muscles good colour. Pleuræ: right contained three to four pints of tolerably clear yellowish fluid; left, two to three pints of blood-stained fluid. Visceral and parietal layers smooth and transparent. No ecchymosis. Lungs: right, anterior border of middle lobe collapsed and airless, sank in water; left, apex adherent (old), contained a small nodule of granular cheesy matter; both were *œdematous*. Bronchial glands: right much enlarged, and contained blood clot; left natural. Bronchial tubes, the lining membrane was of a dark claret colour. The pericardium about the base of the heart, and tissues covering the large vessels under the sternum, were of a dark red colour from extravasated blood. The pericardium contained three ounces of sanguinolent serum. On cutting through the large vessels, a quantity of dark fluid blood escaped from the aorta and pulmonary veins; their internal coats were of a bright red colour, that of the latter being darker. In the aorta was a considerable patch from blood effused in the sub-serous tissue. Heart: size natural; cavities dark, staining throughout; the right side being darker than the left. In the substance of the tricuspid valve, at the points of attachment of the cords, were numerous small blood clots. On section, a thin, dark red, even layer is seen between the serous layers of the valve. These are more numerous than I have noticed in other cases. There were several similar clots in the mitral valve, also in one flap of the aortic around the corpus Arantii; in another was a minute gritty substance. Peritoneum: visceral and parietal natural; no ecchymoses; no fluid in cavity; stomach healthy; liver very tough, spleen four and a quarter ounces; kidney, and bladder natural; brain natural."

Blood from this case was sent to Dr. Greenfield. He reports:—

" Case 11.—S. F., died May 5th, 8 p.m. Post-mortem May 7th. Blood received in capillary tubes on May 12th, and examined at 3 p.m. The blood presented evidences of marked chemical changes, the red corpuscles having to a large extent disappeared through discharge of hæmoglobin (a decomposition change).

"In the blood were found large numbers of typical anthrax bacilli, in the form of motionless rods measuring from 10 to 25 μ in length, many containing spores. Longer filaments were also seen, but none more than 50 to 60 μ in length. Some of the rods appeared to be in a state of partial decomposition, shewn by the presence of oily globules in their protoplasm.

"Scarcely any ordinary decomposition bacteria were seen in the specimens examined.

"Inoculations with this blood (162 hours after death) were without effect, except in the following case: Experiment I.—A mouse inoculated in the tail with a minute quantity of the blood at 1 p.m. on

FIG. 5.



Bacilli found in the blood of S. F.

May 12th was found dead on the morning of May 14th. Examined at 3 p.m.; no local swelling at the seat of inoculation nor in the abdominal wall. Spleen not in the least enlarged; all the viscera apparently healthy. On microscopic examination of all the viscera, and of fluids from all the serous cavities, no traces either of bacillus anthracis or of micrococci were discovered."

Case 21 (page 24). Clinical Report on the case of Wm. Otley by Mr. McKenzie:—

"I was called on Tuesday evening the 31st August to attend William Otley, age 63. Found him in bed lying on his back, complaining of pain in his chest and difficulty of breathing, feeling generally poorly. He was a man who was always complaining and troubled with a cough. He had been at work at Messrs. Mitchell Bros. up to, and on, the previous Friday night (he was a night man) as a 'preparer' of wool, which had previously been washed. He mentioned that he had had a pimple on his chin for about two weeks and that he had picked the top off it. Last Saturday he noticed his lip swelling and a hard inflammatory area round the pimple. Had a walk out on Saturday night, felt worse on Sunday, went to bed on Sunday night at 8 p.m., passed a restless night, and got up at 4 a.m. on Monday. He got no better and I was called on the Tuesday. His breathing was laboured mucous râles heard all over the chest, and with a muco-purulent expectoration. Chest throughout resonant on percussion. Tongue coated with white fur and moist. Bowels regular; skin wet with sweat; pulse full, 108, regular. Urine scanty and high coloured; not examined for albumen. An eruption existed immediately below the under lip in the middle line, and presented the following characters when first observed by me: It was about the size of a shilling, the central portion, about $\frac{1}{4}$ in. less in diameter, being dried and gangrenous looking, its circumference in parts slightly everted, leaving a fissure between it and the outer or vesicular portion from which exuded a thin sero-sanguinolent fluid which trickled down the chin on to the neck; the vesicular rim seemed to grow by additions to its outer edge, the whole planted on a firm inflamed base. The lip itself was swollen about three times its natural size, livid and gorged with blood. A little to the right of this pustule, and isolated from it, an herpetic cluster of vesicles began to form on the Wednesday, having a blunt papular appearance; first it had all the appearance of forming a similar lesion to the one described. The submaxillary glands were also enlarged and painful. The patient felt better the two following days (Wednesday and Thursday). In the evening of Thursday he however became delirious. Unconscious at 4 a.m. on Friday; the condition was the same when I saw him at 6 a.m. At 10 a.m. his pulse was 140, regular; respirations 44. Temperature in the mouth 102°; in the axilla 103°. Urine contained a trace of albumen. He died exhausted at 2 p.m. Treatment adopted in this case consisted of sinapisms to chest; expectorants; soups liberally. Pustule too advanced for any treatment."

Dr. Greenfield reports:—

"Case 21. W. Otley. Malignant pustule. Capillary tubes containing serum and blood received from Dr. Bell on September 4th.

"The serum and blood contained only a very few long and some short bacilli, only five or six being found in a field. They had the usual characters of anthrax bacilli. No inoculations were made with this fluid."

The following are the results of Dr. Greenfield's investigations in other cases referred to in the text:—

"Case 40.—Joseph Greenhough, æt. 36. Blood and serum in capillary tubes taken by Dr. Bell from a malignant pustule on the arm on June 22nd, received June 23rd, 10 a.m.

"In the serous exudation were found a few long typical bacilli. In the blood only one or two were found on a prolonged examination.

"Inoculation of a guinea-pig with the serum produced typical anthrax, fatal in 53 hours."

"Case 1 (text).—Everitt. Blood from the margin of a malignant pustule on the face taken by Dr. Roberts, of Keighley, on July 6th, received July 8th.

"Blood contained no bacilli and appeared normal. Inoculation with it produced no result."

On the results of his experiments in the above cases, Dr. Greenfield makes the following remarks:—

"On comparing the experimental results in these cases with the facts discovered by microscopic examination, there appears at first sight to be a remarkable discrepancy.

"Out of nine cases in all, either of malignant pustule or of supposed internal anthrax, seven of which were fatal, experiments were made with seven, and in four only were any results obtained, by inoculation of rodent animals, which are well known to be highly susceptible to the disease.

"Yet in all the fatal cases the microscopical examination revealed the presence of bacilli in one or more of the fluids or tissues of the body. The apparent discrepancy, which tends to throw discredit on the diagnostic value of microscopic examinations in these cases, is at once explained when the length of time which elapsed between death and the inoculation experiments is considered. For when decomposition has already set in before the post-mortem is made, it is exceptional to produce results by inoculation with the blood or other fluids. This fact is so well known, and the delay in obtaining post-mortem examinations was so evidently likely to prejudice the result of the inquiry, that I did not expect any results from the earlier inoculations, and urged very strongly the importance of early examination of the body. The result is seen in the fact that whilst in the three earlier cases [Cases 11, 20, and 22], of internal anthrax no result was obtained, in every one of the later ones the inoculation experiments were successful, and, as I shall show, the intensity of the poisoning was proportional to the shortness of the interval between death and the examination of the body. It is important to mention this fact, lest an erroneous view should be taken of the results in these cases. In all of the three animals, both the microscopical and experimental results were conclusive of the nature of the disease."

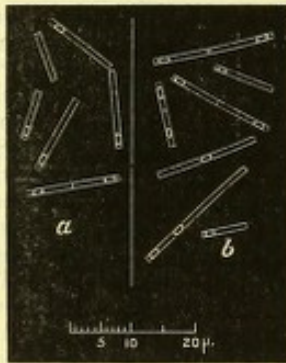
ANIMALS AT HARDEN. (Page 22 in text of Report.)

(DR. GREENFIELD'S REPORT.)

"Material was received from three out of four cases of animals which died at Harden Grange, from two cows and one sheep. All of these proved to be cases of anthrax.

"I. Cow No. 2 (A. Lot, page 23). Died June 30th, fluid received at _____ on July 3rd.

FIG. 6.



Bacilli from the spleen, *a*; and pericardial serum, *b*; of cow No. 2.

"Peritoneal serum contained a very few long bacilli of the usual characters.

"Pericardial serum contained a large number of typical bacilli.

"Spleen, a moderate number.

"Inoculations with the pericardial fluid and the spleen produced typical anthrax in the guinea pig.

"II. Cow No. 3 (B. Lot). Died July 4th. Material received July 7th.

"Serum taken from the cellular tissue in front of the trachea 24 hours after death was deeply blood-stained, and contained a considerable number of bacilli in various stages of degeneration, the majority more or less granular. These bacilli from 13 to 35 μ in length, some, however, being longer.

FIG. 7.



Bacilli in blood from the spleen of cow No. 3.

a. Long flexuous filaments.

b. Part of a filament containing spores.

c. Spore-containing filaments.

d. Groups of spores.

"Serum from the pericardium swarms with similar bacilli in various stages of spore formation, no other bacteria being observed.

"Blood from the spleen contains very numerous long rods, some degenerating, others containing spores, also masses of spores.

"Inoculation with the fluids from the pericardium and spleen produced anthrax in the guinea-pig.

"III. Sheep which died at Harden Grange July 27th. Fluids received at 10 p.m., July 28th, 34 hours after death. Examined and inoculations made at once.

"Pleural serum, blood-stained. No signs of decomposition under the microscope; it contains numerous very long bacilli, measuring from 50 μ to nearly 200 μ , and forming beautiful convoluted masses as in the pleural serum of J. G. (Case 30). In all other respects they resembled ordinary anthrax bacilli.

"Peritoneal serum contained only very few bacilli, not more than 30 μ long.

"Pericardial serum contained very numerous rods, the majority not more than 12 to 15 μ in length, in various stages of spore formation.

"Blood from heart contained only a few rods.

"Spleen.—In this were found very numerous rods, many of which were of very considerable length, but occupying very limited areas, large masses of the splenic tissue being entirely devoid of them. They were arranged in linear areas, probably the course of blood vessels, and surrounded by amorphous translucent material, which resembled liquefied coagulum. The bacilli here found were very clearly seen to be made up of shorter rods not separated.

"Inoculation of mice with the spleen and pleural serum caused typical anthrax."

SOME FURTHER CLINICAL AND POST-MORTEM NOTES.

(Case 25, p. 26.)—The following clinical notes of this case are contributed by Mr. Tordoff:—

"J. W. S., aged 20, seven months ago was attended by me for an attack of a similar but milder character. First saw him now on Sunday, September 5th, at 8 p.m. Complaining of headache, slight difficulty of breathing, profuse perspirations. No particular physical signs; pulse 120; temperature 105° F.; respiration 27. September 6th, morning.—Little change, prostrate; thought he was sinking; temperature 104°. 10 p.m.—Pulse 120, respiration 24; temperature 101.4; seemed better and was cheerful; slight crepitation, and slight indistinct dullness over base of right lung. September 7th.—Thought him better, pulse 110; respiration 24; temperature 102°; no increase in physical signs; in profuse perspiration. September 8th.—Diarrhoea commenced; pulmonary symptoms the same. Evening. Diarrhoea continues; pulse 120; temperature 103°. September 9th.—Still a copious diarrhoea, which continued from this time until his death. Evening.—Pulse 125. September 11th, morning.—Cyanotic; face and finger-nails blue; extremities cold. Evening.—Seemed better; rather excited; said he felt well enough to get up and go out; drank two pints of cocoa. September 12th. Morning.—Much the same; breathing hurried. Evening.—Pulse 140; temperature 103.8. He died on Monday at 10 a.m."

The *post-mortem* examination was not made until Wednesday morning at 11 o'clock (49 hours after death), when I was able to be present. The following are the notes:—

Autopsy (Case 25).—Commencing decomposition; hypostasis and *post-mortem* lividity general, especially on back, chest, and neck. *Thorax*.—Recent pleuritic adhesions on both sides, and few old adhesions at base of left lung. Over half a pint of blood-stained fluid in right pleura; small quantity of same in left. At the base of the right lung, posteriorly, is a cavity, size of a walnut,* containing muco-purulent fluid. In a localized area above this cavity is a condition of lobular pneumonia, and around deep congestion and œdema. At the more dependent part of the upper lobe is a similar and distinct abscess, the cavity appearing in the softened and easily broken down lung tissue larger than the other. In the middle lobe at the periphery is a small, apparently not very recent, infarction; depressed at the surface, the pleura being there covered with inflammatory exudation, firm on section, about the size of a walnut, triangular in form, and distinct from the surrounding lung tissue, which is hyperæmic and œdematous. The left lung, partially collapsed, breaks up readily in removing it. Lower lobe shows numerous small cavities, filled with puriform detritus, at periphery. The bronchial glands are generally softened and hyperæmic; the mucous membrane of the bronchi reddened and containing blood-stained mucus. The mucous membrane of the pharynx and trachea greenish from decomposition, but showing also patches of hæmorrhagic extravasation beneath the membrane. Glands around but little swollen, but soft and dark, and showing hæmorrhagic foci. Heart, soft and flaccid, and distended with blood; blood clots in left ventricle; points of extravasation in muscular substance and in aortic valve.

Abdominal Viscera.—Liver apparently normal, some, probably *post-mortem*, patchy discoloration, Kidneys, tissue around œdematous, both show marked signs of cloudy swelling; small but distinct hæmorrhagic extravasations in capsule and cortical substance of right kidney; the same but fewer in number and less distinct in appearance, in left. On the surface of this kidney were numerous, in places closely aggregated, yellow or greyish points, extending only very superficially into the cortical substance, in no case traceable through it, and in no case apparently surrounded by any distinct halo of inflammation.† The urine contained a small quantity of albumen. Spleen enlarged to about twice its normal size, soft and pulpy; the capsule wrinkled, showing that the enlargement had been greater. The mucous membrane of the stomach soft, and showing extensive ecchymosis; an acute catarrhal condition in parts of the small intestine, which contained a thin yellow fluid; only one Peyer's patch distinct, and that perfectly healthy (typhoid fever had been thought of). The mesentery œdematous. Brain, to the naked eye, apparently natural.

Microscopical examination (by Dr. Bell and myself) of the blood, cerebro-spinal, and pericardial fluids showed the presence of numerous motionless bacilli, similar in all respects to the bacillus anthracis, many of those in the serous fluids having the typical appearance described by Dr. Greenfield as presented by the bacillus anthracis under cultivation ("long convoluted filaments sometimes arranged in bundles and spirals"). Numerous bacteria of decomposition were also observed.

Dr. Britton, the Health Officer of the Halifax combined districts, reports the following:—

(Case 31, p. 28.)—S. F. aged 34, was seen by Mr. Fawthorpe on Monday evening (July 26th), patient had been in bed all day; now restless; perspiring; had been vomiting; complained of cough. "Temperature 103° F., pulse 126. Tuesday morning I saw him; pulse 118, temperature 101.2; sweating,

* The size of the cavities, from *post-mortem* softening and from consequent possible injury in removing the lung, might have been deceptive.

† The specimen taken for microscopical examination was afterwards found to be unfortunately, owing to decomposition, useless for the purpose. No distinct tubercle was found in any organ.

“ especially on brow ; anxious expression of countenance ; tongue brownish ; fur cleaning at edges, moist ;
 “ difficulty of breathing. Ale of nose working with each inspiration ; severe cough ; dirty rusty expectora-
 “ tion ; bowels regular ; urine dark coloured but clear. Left lung and heart normal. Right lung, base
 “ dull on percussion ; respiratory murmur absent. Apex, crepitant sounds, in fact the ordinary sounds
 “ of pneumonia. Wednesday morning, died 4 a.m.

“ Post-mortem made 29 hours after death by Dr. Bell, Dr. Britton, and others :—

“ External appearance : Black purple discoloration of ears, neck, scrotum (upper surface), and penis. Purple discoloration of arms (superior surface), fingers and nails of both hands. Emphysema under sternum (left half). Right plural cavity, four pints of clear serous fluid. Collapse of middle lobe of lung. Congestion posteriorly. Inferior lobe very highly congested, does not float in water. Bronchial glands softening down and much enlarged. Left lung covered with recent and old adhesion ; inferior lobe congested (floats) ; both bronchi congested, of a deep claret colour, the left more deeply. Thin bloody effusion under mucous membrane. Heart natural size ; deep staining of serous surface of aorta (dark pink) ; valves stained also, right side a deeper colour than left. Six ounces of deep straw-coloured fluid in pericardium. Liver, spleen, kidneys, intestines, and brain normal.”

The following clinical notes of Case 26 in the text (a case referred to as an instance of the ill-defined attacks so often apparently associated with unequivocal cases of anthrax) are supplied by Mr. Tordoff, of Bradford :—

“ John Hudson, æt. 36. Ten years ago had ague in America, otherwise healthy and good history. Had been working at the next sorting-board to J. W. S.” (Case 25, above recorded) “ until August 30th, after that at the board next to Stephen Ackroyd (page 26). “ He had, however, been complaining since the date above mentioned (August 30th). The symptoms from this time were dizziness, little headache, aching in back and limbs, chilliness and feeling of languor, and restless nights. On Sunday, the 12th of September, he felt much worse, and on Monday, the 13th, I saw him. Pulse 112, weak ; temperature little above normal ; complaining of weakness and little cough ; no particular physical signs. 14th : pulse 100 ; condition same. 15th : much better, got up and went out ; ate hearty dinner ; was worse at night, and very restless. 16th : in the afternoon he seemed much in the same condition as when I first saw him ; pulse 120 and weak. Sept. 17th, 10 a.m. (seen with Mr. Spear) : patient in bed, looking tired and listless ; very slight flush, and that dusky and diffused ; perspiring freely ; hands and face clammy ; distinct lividity about lips and fingers ; pulse 100, weak and compressible (signs, in fact, of incomplete filling of arteries) ; temp. 101° F. ; resp. 25 ; complains of restless nights, of coldness of extremities, and occasional oppression of breathing and cough ; no pain anywhere ; chest resonant on percussion ; heart sounds normal ; on deep inspiration, crepitant râles base of left lung posteriorly ; little white frothy expectoration ; tongue moist, and coated with thin white fur in centre ; no perceptible dulness over spleen ; no abdominal tenderness ; no diarrhœa ; no cutaneous eruption ; negative results on microscopical examination of the blood. 9 p.m. : pulse 88 ; temp. 101° F. ; respirations 25 ; has had a good day ; colour of lips and fingers better. Sept. 18 : has had a very good night ; pulse 80, feeble ; temp. 100°·2 ; breathing better ; tongue cleaner ; no albumen in urine ; little crepitation over right lung posteriorly. Sept. 19 : pulse 100 ; temp. 100°·2 ; resp. 21 ; feels much better ; tongue still furred ; cough not nearly so bad ; no particular expectoration ; the pulse feels much stronger, which I attribute to the port wine I ordered yesterday. Sept. 20 : has had a very restless night, and says his cough was much worse during the night ; pulse 120 ; temp. 103° ; resp. 24 ; no marked dulness, but crepitation all over left lung posteriorly ; tongue more furred, especially in centre ; bowels acted rather too freely this morning. Sept. 21 : pulse 84, temp. 100°, resp. 20 ; breathes much easier, has had a fairly good night, and cough not so troublesome ; fur on tongue just a little brown, bowels acting more regularly. Sept. 22 : had a good night, coughed more ; pulse 100 ; temp. 100°·9 ; slight crepitation over left lung, some dulness over right at back, and respiratory murmur scarcely audible (I think there is a little pleuritic effusion on this side) ; expectoration very slight. (Commenced to give quinine, and discontinued all food but meat broths.) Sept. 23 : has had a good night, less perspiration than usual ; pulse 96 ; temp. 101°·2 ; not so much dulness over right lung, and respiratory murmur can be heard distinctly ; tongue cleaner. Sept. 24th : feels much better ; pulse 96 ; temp. 100°·8 ; perspiration almost ceased. Sept. 25th : pulse 88 ; temp. 100° ; says he had a first-rate night ; no perspiration, very little cough, and breathing almost natural. Sept. 26th : pulse 88, temp. 99 ; feels almost well. Sept. 27th temp. 101°·2 ; pulse 106 ; had a somewhat restless night, but no perspiration. Sept. 28th : temp. 99°·4 ; pulse 100 ; had an extremely good night, good appetite, and feels much better ; no cough. Sept. 29th : temp. 99°·2 ; pulse 96 ; feels stronger, and sits up daily. (Discontinued quinine, to see if followed by any return of symptoms.) Sept. 30 : temp. 99° ; pulse 96 ; Oct. 1st : temp. 100°·4 ; pulse 102 ; had a good night (the rise in temperature and pulse I attribute to over-exertion ; has been up a long time and just returned to bed). Oct. 2nd : temp. 100°·2 ; pulse 96 ; had a good night ; feels fairly well. Oct. 4th : much better ; sitting up ; temp. 99° ; pulse 96. I gave him iron and digitalis to-day, and advised him to take the most nourishing food he could get. Oct. 11th : since last date he has progressed very well, and I have advised him to go for change of air.”

APPENDIX B.

TABLE 1.—Showing DEATHS amongst WOOLSORTERS in the BRADFORD and KEIGHLEY REGISTRATION DISTRICTS in TEN YEARS, 1870-79,* classified according to AGES and DISEASES (from returns supplied by the Superintendent Registrars).

At all Ages.	Ages.			Small-pox.	Scarlet Fever.	Diphtheria.	Fevers.			Diarrhoea.	Other Zymotics.†	Diseases of the Respiratory Organs.			Phthisis.	Heart Disease.	Other Diseases.
	18-25	25-60	60—				Typhus.	Typhoid.	Others.			Pneumonia.	Congestion of Lungs.	Bronchitis.			
455	39	277	139	1	—	—	3	8	2	8	21	53	14	60	94	36	155

* For certain sub-districts I have not yet received the returns quite up to date (owing to the registers from such districts not having come in). In other sub-districts returns a little beyond December 31st, 1879, have been supplied. The deficiency in the former case (a matter it is computed of 19 deaths only) has been made up from the excess in the latter.

† Sixteen of these were from "pyæmia," "woolsorters disease," "blood-poisoning."

In the following table the mortality from all causes, and from certain diseases, amongst the woolsorters living in the Bradford and Keighley registration districts is compared with the mortality amongst males of a corresponding age of the general population:—

TABLE 2.

—	Estimated Number living.	ANNUAL DEATH RATE PER 1,000.				
		From all Causes.	From seven principal Zymotic Diseases.	From other Zymotic Diseases.	From Diseases of the Respiratory Organs.	From Phthisis.
Woolsorters in Bradford and Keighley Registration Districts,* 10 years, 1870-79† - - - -	2,000*	22·6	1·1	1·05	6·35	4·7
Males above the age of 15 years in the Bradford and Keighley Registration Districts—10 years, 1861-70 - -	69,104	17·8	1·4	·34	3·3	3·7

* I have not the return from the Halifax Registration District.

† See foot-note to preceding table.

That the above table does not give, through an under-rating of the number of woolsorters living in these two districts, an unduly unfavourable account of the mortality, other combinations of figures go to show:—

The following table shows that the number of woolsorters living to advanced age is less than the corresponding proportion amongst the general population:—

TABLE 3.—PERCENTAGE OF DEATHS at 75 Years and upwards to TOTAL DEATHS above 15 Years of Age.

Amongst Woolsorters—10 years, 1870-79.	Amongst Males in Bradford and Keighley Registration Districts, 1861-70.	Ditto in England.
7·6*	11·6	16·7

* Notwithstanding that no deaths were registered under 18 years of age amongst woolsorters.

The annexed table gives the proportional number of deaths from certain causes to the total mortality—a computation, as is that in the last table, entirely independent of any estimate of population:

TABLE 4.—PROPORTIONAL NUMBER OF DEATHS from the UNDER-MENTIONED CAUSES to 100 DEATHS from ALL CAUSES, (1) amongst the WOOLSORTERS, (2) amongst MALES above the Age of 15 Years of the GENERAL POPULATION.*

	From inflammatory Lung Diseases.	From Phthisis.	From "other Zymotics."†
Woolsorters—Bradford and Keighley Registration Districts, 10 years, 1870-79 -	28·0	20·7	4·6
Males above 15 of general population, Bradford and Keighley, 10 years, 1861-70	18·4	20·9	1·8

* The influence of these diseases on the mortality must probably be judged of by the rates given rather in Table 2 than in this table, which latter is introduced principally for the purpose of showing the approximate accuracy of the first; for in this computation the "proportional number of deaths from certain diseases to deaths from all causes," the divisor, i.e. the total number of deaths from all causes, is an excessive number, and the quotient (i.e. the resulting proportional number) is consequently (and to this extent factitiously) reduced.

† i.e., from zymotic diseases other than the seven principal ones of this class.

In the subjoined table the mortality of the sorters employed in certain of the largest worsted factories of the district is given.

[This information has mostly been supplied me by the men themselves, and must to that extent be considered of an *ex parte* character. But the name, date of death, &c. of the deceased person was given me with this information, so that accuracy in this regard is probably assured. In estimating the average number of sorters, I have been guided as well by the masters as the men; and from one factory the numerical records of a club which comprised as its members all sorters there employed was placed at my disposal.]

TABLE 5.—MORTALITY amongst SORTERS employed in FACTORIES from which STATISTICS are obtainable.

Factories.	Years embraced by Statistics (inclusive).	No. of Years.	Estimated Average Number of Sorters employed during these Years.	Total Number of Deaths.	Average Annual Mortality per 1,000.
Saltaire* -	1871—Sept. 30, 1880	9·75	} 415	106	3·6
Queensbury† -	1864—Sept. 30, 1880	16·75			
Messrs. Mitchell Bros.‡ -	1874—Sept. 30, 1880	6·75			
Messrs. Mitchell & Shepherd's	1869—Sept. 30, 1880	11·75			

* About the year 1876 the ventilation of the sorting rooms at this factory was improved; they were no longer used to so large an extent as store rooms, and greater regard was paid to their cleanliness. Since then, it is said, the number of cases of "Woolsorters disease" have been comparatively few. The mortality averaged 26·6 from 1871-76, and 20·0 from 1877-80.

† I have the mortality returns from this factory since 1851, but have only included those since 1864, since before that date Van mohair was not used. Before this time the "Woolsorters disease" attacked occasionally, it is supposed, alpaca and average mohair sorters, but since the introduction of "Van" the cases, it is stated, have become more numerous. The death-rate during the years 1851-63 averaged 17·3 per 1,000, since then it has averaged 21·2. This factory is exceptionally well administered in regard to its hygienic conditions.

‡ Packers are included in the statistics of this factory. Previous to 1873 or 1874 inferior wools are stated to have been very little used here; since then large quantities have been dealt with. It is said that before that date the mortality was low (although I have not the statistics), from 1874 it has averaged 28·5 per 1,000 per annum.

NOTE.—It must be observed that the mortality given in the above table is probably to some extent understated. It must occasionally happen, for example, that a sorter leaves the employment through some chronic illness, or from old age, and dies some time afterwards, when his name has been removed from the lists kept by the employers and the men. The returns represent the mortality of persons actively engaged in the occupation.

APPENDIX C.

NOTE UPON CERTAIN PHENOMENA OBSERVED IN ATTACKS OF THE WOOLSORTERS' DISEASE.

THE nature of the contagious principle of anthrax, together with the histology of the disease, are subjects that will be dealt with by Dr. Greenfield, and I need only briefly advert to these matters. But certain questions have arisen in the course of this inquiry that cannot well be passed over, although, owing to the at present unavoidably indeterminate and provisional nature of the views their consideration suggests, I prefer to deal with them in an appended note rather than in the body of the Report.

It is scarcely necessary for me to premise that the discovery of Pollender, as subsequently interpreted by Davaine, is now all but universally accepted: the contagium of anthrax is a vegetable parasite, the *bacillus anthracis*, which gaining access, itself or more often by its spore or germ, to the blood of a sufferer, finds there a suitable medium for its development and multiplication; and so multiplies, until, as Davaine has shown, a single drop of blood may contain seven to ten millions of these organisms in different stages of development. They, as Pasteur, Cohn, and Hoffman have shown, cannot live without oxygen; they absorb it from the blood (may be their seeming affinity for the lungs is partly explicable from this need of theirs); they block up too as they increase in number the smaller capillaries; and thus produce series of effects in the infected organism of a double kind; the one due to a toxæmia, the other to the mechanical obstruction of the circulation.

These latter are at least the two theories of the disease that have been advanced—principally by Bollinger and Toussaint. They are not altogether satisfactory as explaining the morbid phenomena observed, although, as the disease progresses, doubtless both the condition of carbonic acid poisoning, and the extensive occlusion of capillary vessels, come to play their part. But from the first, before so far as we have reason to believe either of these conditions are operating, a profound functional disturbance of certain nerve centres is apparent. And it is by this latter agency, however produced, that the varied phenomena of the disease—from the early prostration and cramps and accelerated respiration and cardiac movements, down to the peculiarities of convalescence, or the pathological conditions found in fatal attacks—are, it seems to me, most readily explicable. This subject may, however, be left for discussion elsewhere.

As to the more usual channel by which the parasite reaches the system observations hitherto are undecisive. Its entrance may be effected doubtless by various channels—by inoculation through wounds or minute abrasions of the skin; by inhalation, and the penetration of the mucous membrane of the nose, mouth, and air passages; by ingestion, and the penetration of the lining membrane of the digestive tract; or, lastly, by penetration through the cutaneous follicles, or the mucous membrane of the conjunctivæ. The poison may at its point of entrance produce a local lesion, or it may fatally infect the system and leave no trace at present recognizable of its way of entrance behind.

Klein, in a report recently presented to the Local Government Board, on the "Lymphatic System of the Skin and Mucous Membranes," shows the intimate connection that exists between the lymphatics surrounding the hair follicles and the epithelium constituting the outer root-sheath of the latter; and also between the superficial lymphatics of mucous membranes and the epithelium of the surface—a connection that, in each case, allows of the direct passage of injection material from the lymphatics into the interstitial or cement substance between the epithelial cells; and he claims to have given thereby the anatomical explanation of the efficacy of medicaments rubbed into the intact skin.

The frequent implication of the lungs in the disease processes has been said to indicate that the poison in such cases gains access to the system by inhalation. But, although this mode of infection is probably a frequent one, the deduction here referred to cannot, I take it, be granted. Human contagia in general exhibit this predilection each one for its special locality, and this independently of the point of introduction. In this disease the spleen is even more frequently than the lungs, and in the same class of cases, involved; and it is possible there may be something in the natural history of the contagium to render these organs favourite points for its collection; perhaps to render them, if I may be permitted the expression, favourite breeding grounds for it. I shall have presently to suggest a possible relation between the ingestion of certain articles of food and the development of the disease. Now in the spleen we have reason to believe an active metabolism associated with the digestion of these and other foods takes place; hence the richness of the spleen-pulp in various extractives. And if we could accept for a moment the theory that here, because of such possible favourable conditions, the contagium early collects and multiplies, its local action might suffice to explain the early and almost constant turgescence of the organ. The latter, according to M. Foster, is due in ordinary case to a vaso-motor dilation, accompanied by a relaxation of the muscular bands of the trabeculae. And a somewhat analogous local effect would seem actually to be induced by the poison of anthrax in the experimental inoculation of animals, as evidenced by the œdema around the point, and along the course, of the inoculation.

On its removal from the body that has given it shelter and nourishment, or on the death of that body, the bacillus itself usually dies (or it may, apparently, under favourable conditions, as for instance, in a moist soil, rich in vegetable matter, continue the process of development and reproduction outside the living body); but the spores, unless the medium in which they are contained undergo decomposition, may, in a dry state, retain their vitality for months or years (Koch and Greenfield, and as to persistency of poison, Davaine, Einike). It is in this form, and by this means, doubtless, that the fleeces and hides of diseased animals retain the contagium; and that the latter, gaining access to the blood or other fluids of a living animal, unfolds anew its full activity.

Now as in the case of other specific poisons, so in this one of anthrax, it is not all classes of animals that are equally susceptible to its influence; nor is the same animal at all times and under all circumstances capable of being infected. That the human race is one showing an inferior susceptibility to the infection is a conclusion I think fully justified. Doubtless many cases of anthrax in man occur, and pass unrecognised (the experience of Bradford shows it), and the certainty that it is so is a point worthy the attentive consideration of the medical profession generally; but having regard to the manifold ways in which the poison must be distributed over the country—ways numerous it seems beyond all previous conception even from this one manufacture, we can only explain its rare occurrence amongst the general population by acknowledging this inferior susceptibility. If, too, it were readily transmissible to man, we should, I certainly think, having regard to the nature of the occupation, expect the woolsorters

themselves to suffer more frequently; and, when they become infected, we might expect the disease to spread sometimes to others; for experiments on animals prove that the poison as it exists in the human body is actively infective. The behaviour of the disease itself, again, a study of what has preceded in the text of the Report will show, greatly favours this conclusion. There is considerable evidence, for example, that the morbid material may remain for a variable time latent in the body. In man it is at any rate much less sudden in its effects than in the more susceptible species of animals. I have no cases of so-called "lightning" or "apoplectic" attack to record. The disease in its stage of invasion differs widely too, not only from these cases amongst animals, but in different individuals. Thus this stage of invasion or prodromata is apparently of indeterminate course, it may sometimes be prolonged; the symptoms may even apparently be intermittent. The evidence, too, is almost conclusive that the disease often passes little or not at all beyond this stage; that, in fact, it aborts. Further, since the bacillus anthracis is rarely if ever found swarming in the blood of any animal until death is at least imminent, a superior power of resistance to the progress of the disease, such as the conditions above remarked upon indicate, is, we might conclude, dependent, not upon any exceptional individual tolerance of the presence of the contagion, but upon some actual restraining influence affecting the intrinsic power of development, and of diffusion, of the contagion itself. The whole picture of the infective process in many of these cases of anthrax in man is suggestive, then, in a peculiar degree, of a poison, at first and for a variable time, to use an expression of Darwin's, "barely able to prolong its existence"; but with the breaking down of unknown barriers, or with the advent to the blood or tissues of something favourable to its rapid multiplication, or perhaps in both these contingencies, there quickly and often most unexpectedly ensue the characteristic tumultuous course of the fully developed disease and swift and sudden termination.

Will our knowledge allow us to suggest an explanation of these peculiarly marked phenomena of individual susceptibility or immunity in anthrax? Their explanation is necessary to a due understanding of the pathology of the disease, or for its scientific treatment; and every circumstance that appears to bear upon the subject is worthy therefore of discussion.

It has long been known that whereas herbivorous animals frequently suffer from this disease in an epizootic form, and are most readily inoculated with the poison, omnivorous, and to a still greater degree carnivorous animals are with difficulty infected. The blood of the carnivorous race is perhaps deficient of something which is necessary for the free development of the poison; or contains something in greater degree inimical to its life. Experiments by M. Colin (quoted by Bollinger), go to show that the gastric juice of carnivorous animals is destructive to the poison. The observations of Professor Feser, of Munich, however, recently published, go further, and seem to promise a practical issue. He had observed that sometimes the rats he was experimenting upon exhibited a marked immunity from the effects of inoculation, and by a long series of experiments he assured himself that their susceptibility or immunity was determined by their alimentation. Those fed on flesh could not be inoculated; those fed on bread crumbs or grain were inoculated with ease.*

Here is one of his series of experiments:—

A female rat previously unsuccessfully inoculated, having been fed on flesh only, brought forth nine young ones. The family was fed on thirty grammes of anthrax meat, and again the same with bread steeped in anthrax blood. No harm ensued. But the mother's diet was changed to bread. She was then fed on the flesh of a rabbit that had suffered from anthrax for two days. She was found dead in her cage three days later. Of the nine young ones, three were placed with three of the progeny of another mother, and fed only on beef and horse flesh, while the remaining six were fed on bread. All of them were inoculated with the same quantity of anthrax blood from the heart of a rabbit; all those fed on bread died rapidly between the twenty-second and thirty-second hours; the six fed on flesh remained perfectly healthy.

From the first I was unable to dissociate these observations from a practical bearing upon the present inquiry; and I consequently set to work to ascertain minutely the alimentation of the sufferers from this disease. But before summarizing the results of this investigation, I may refer to a letter bearing upon the subject, that reaches me in the midst of my own inquiries, from a wholly independent and unexpected source from Constantinople (I publish the letter in extenso on a subsequent page). Anthrax in Constantinople appears to be well known, and it engages the special attention of a certain class of practitioners, called "Dallack Doctors," "dallack" being there the name given to the disease. One of these, a M. Diamanthi, enjoys a great reputation, "he only pretends to cure dallack," and his skill in this "has been handed down from father to son for several generations." The treatment he adopts (which appears to refer only to the malignant pustule, and to have nothing special in it) is described; and "the diet to be observed in caviare and bread and a little spirit, *vegetables and fruit being especially dangerous*."† Thus it would seem that the "dallack doctor" has arrived at a conclusion pointing distinctly in the same direction as that to which the scientific experiments above referred to lead. I, on the other hand, have to relate some very curious and suspicious circumstances that may admit of a similar interpretation; and which, perhaps, will be so interpreted when further opportunity for research has been made use of.

Early in the inquiry the fact attracted attention that in an extraordinarily large proportion of cases the initial or prodromal stage of the disease may be said to have terminated, and the acute often fatal one commenced, between the Saturday evening and the Monday morning. Thus of the 29 recent cases of acute constitutional infection that I have taken as affording more exact data, in 21 the sufferers practically left work for the last time at the completion of the week's labour on the Saturday afternoon. I say *practically*, for two of these 21 attempted, but unsuccessfully, to resume work on the Monday, and one, instead of going to his work on the Saturday, went for a long walk, thinking to throw off his feeling of malaise. Moreover, of the eight remaining cases, three left work or took to their beds during special holidays, viz., one on New Year's day, one on Good Friday, and one on

* *Wochenschrift f. Thierheilkunde und Viehzucht*, Nos. 24 and 25, 1879.

It may be mentioned, also, in connexion with this subject of the possible influence of food supply, that many observers have at different times actually attributed the disease in sheep and cattle to over-feeding—Deiafond, for example, and certain of our own veterinarians. In this, of course, they were wrong; still, the observations by which they supported their opinion may not be without significance.

† The italics are my own. Since writing the above a letter has been received from Dr. Patterson, of Constantinople, which refers to the same subject. *Vide postea*.

Whit-Tuesday. So that in more than 80 per cent. of these recent cases, the acute stage may be said to have commenced on a holiday. This coincidence is observed in a large proportion of the other more doubtful cases; and it is not, it seems, a new feature. It had been noticed in earlier attacks, so that I am told it was often said amongst the men, that if a sufferer got over the Sunday (that is the Sunday following the attack) he was all right.

I could not, on the most careful inquiry, attribute this incidence of the disease to any peculiarity of the occupation. There is no special work confined to any one day of the week. The work-rooms are usually swept out on the Saturday, so also are they in most factories on the Wednesday, and sometimes every day; and owing to a plentiful sprinkling of water there is certainly less dust at such times than when the bales are opened; the latter operation being, so far as time is concerned, indifferently performed. The explanation that of course next suggests itself is that the prodromal stage is long and indefinite, and that the men struggle on with their work to the week's end, thinking that the day and a half's rest they will then have (Saturday being a half holiday) will be a sufficient restorative. But in examination this explanation likewise does not appear to me satisfactory. There is very little evidence of this struggling on and gradual breaking down.

Ten of the 21 were not known to have complained of sickness before the Saturday of their leaving work; others seem to have felt no worse on that day than on preceding ones: and, with one exception, they all appear to have gone after dinner for their usual Saturday afternoon's walk or other recreation. Still ten of them (the evidence was doubtful in one case) had complained more or less before, and some few had very probably to make an effort to complete the week's work. But granting that they have in this way the termination of the prodromal stage, as indicated by the cessation of work, to an extent in their own hands, so to speak, it does not follow that this would determine the accession of the stage of full development; and yet, at some time after leaving work on Saturday afternoon and before the Monday morning, this stage with urgent symptoms, had set in. This peculiar feature of the attacks may be expressed as follows:—

Of the 21 men giving up active employment on the Saturday, two were seriously ill the same night, 18 others were similarly placed by the Sunday night, so that on the evening of the last-named day, of these 20 men one and all were confined to bed through sickness, although, as before stated, two attempted to resume work on the following day. In the case of the single remaining sufferer the attack was a little longer delayed; he had left work apparently quite well on the Saturday, had gone on a holiday excursion to Kidderminster, and was brought home in a partial state of collapse on the Tuesday night. The day of termination will show, again, how swift in these cases was the progress of the disease after the Sunday. Of the 21 cases five recovered; all but one of the remaining 16 had terminated fatally by the following Friday night.

The suggestion is forced upon the mind by an attentive study of these histories, that between the hour of leaving work on the Saturday afternoon and the Sunday night something must occur to awaken as it were the slumbering disease germs, or to give an enormous impetus to the disease.

There is one marked difference between the mode of living of the large majority of these workers on the Saturday and Sunday, and on the other days of the week. They all, it seems, on the work days make more or less hurried meals; a large number, indeed (in some factories two-thirds of the men), take their meals to their work. It follows that on Saturday, when they dine at home, but more especially on Sunday (on this point testimony is unanimous), a much larger amount of vegetable food is eaten than on other days; as much often, I am told, as on all the other days combined. Further, during what is afterwards assumed to be the initial stage of the disease, a man usually thinks he is suffering from a cold; and it is a very common practice indeed for him to lay up on the Saturday evening and Sunday, when he would not on other days, and doctor himself. With this latter object, for the purpose of "sweating himself," he drinks copious draughts of various herb decoctions (yarrow, camomile, balm, mint, and hore-hound teas, &c. &c.). In 22 recent cases of the disease, where special inquiry was made on this point (attention was not directed to it at the early stages of the inquiry), the practice of drinking such infusions had been carried out, during the stage of indefinite initial symptoms, which in many cases seem to prolong themselves or to disappear spontaneously, in no less than 15, (these were cases, 4, 9, 14, 15, 16, 18, 20, 24, 25, 28, 30, 31, 32, 38, and 40, in "Histories of Recent Attacks"); and whether there exist a causal relation or not, it was not very long after this imbibition that the violent symptoms of the disease in these cases manifested themselves. In nearly every case where satisfactory information was obtainable, and it was obtained in the large majority, the development of these violent symptoms was found to be co-incident with the ingestion of an apparently unusual quantity of vegetable food in some form or other (onions, lettuce, cabbage, fruit, or herb decoctions). In the progress of certain of the cases, again, after remission of the symptoms, a relapse or exacerbation appeared to follow the ingestion of vegetable food or fruit. (This was specially observed in cases 21, 39, and 40; the patients were much better and thought to be recovering, and were downstairs *eating fruit*, and in case 21 *cabbage* also, 24 hours before the fatal termination of their illnesses.) At the same time I must guard against an appearance of laying undue stress upon this coincidence. I am fully alive to the danger of drawing deductions from the mere concurrence of two circumstances, when one of them is so common a one as the eating of vegetable food and fruit. But in the light of our knowledge of the natural history of the contagium, by which it might appear that a causative relation between one and the other of these circumstances is not so improbable as at first sight it may seem, and in view also of the immensely important issues that are involved if this relation really obtain, I have considered the subject worthy of careful attention.

The possible influence of "catching cold" cannot altogether be discarded. In some few cases there would seem to be a history of cold with exposure to wet, preceding the appearance of the disease; and in malarial affections it is believed the lighting up of the disease (the germs being presumably present in the system) may be brought about by such an influence. The sorters' occupation is an in-door one. So, perhaps, there may be more exposure to weather on the Saturday and Sunday than on other days. But, on the other hand, these men often live long distances from their work, and then the opposite condition would obtain. On the whole I was obliged to consider that such a cause could not, in the majority of cases, have influenced the result.

Since the incidence of the disease referred to is on the Saturday night and Sunday, question as to the "drinking habits" of the sufferers will no doubt be suggested. Alcohol, judging even from the histories, could rarely have had any influence; a large proportion of the recent sufferers were most abstemious men, two or three of them indeed being "total

abstainers." But beer, the usual alcoholic drink of the sorter, may of course be regarded as a vegetable decoction; and it is a curious fact that in one case, offering a striking exception to the incidence in question, the sufferer, who was stated to have undergone during 17 years five distinct attacks of this disease (good histories being given, and the nature of the last attack at least being recognised by the medical attendant), had been remarked by his comrades to have been "on the beer" immediately preceding each of the several occasions.

The following is the letter from Constantinople referred to on page 48, it is addressed to Messrs. Crabtree, of Bradford, by their agent, Mr. Gatherall:—

"Since writing you some months ago I have been making further inquiries into the nature of the disease from which I lost one man a few years ago, and from which my men suffered last year, but from which they all (five of them) recovered. This disease, the men say, may be contracted from sorting other mohair, but it generally results from Van sorting. The men do not fear to sort Van mohair, and the bulk of the sorters are always ready to accept work on this class. The cases which have come under my own observation, and of which I have heard as proving fatal, have presented different symptoms to those occurring in Bradford, and the sorters say that no man need die of the disease if he has it looked to in time. The disease here is called 'Dallack,' which means 'Spleen.' There are practitioners here whose sole business is to cure dallack. I suppose they would be called quacks in England; but they have a large practice, and the sorters have confidence in them, while they have none in the treatment of regular practitioners. I have seen one of those dallack doctors, who is the most esteemed, and to whom the mohair sorters invariably apply. His name is 'Diamanthi,' and the following information was obtained by me from him. The disease is called spleen, because it is that organ which is diseased in the animal from which the infection comes. There are various kinds of this disease; there is a disease which can be contracted from a sick goat, or sheep, or cow, or buffalo. Most commonly the disease is contracted in Constantinople from sheep and sometimes from goats. The men who mostly suffer are shepherds, butchers, and wool and mohair sorters. The disease in the animal shows itself by boils, and the infection may take place by touching or rubbing the animal, or by handling the skin or wool. The meat may be eaten with impunity after cooking, but the steam off the pot may give the infection. The disease shows itself in man by a carbuncle, which breaks out on the face, neck, or hands; some constitutions being more liable than others. It is very like plague in its symptoms, only much milder; always curable if taken in time, and not communicable from one man to another. The dallack doctor only guarantees a cure if applied to ere 12 days have elapsed, and his treatment lasts about 25 days. If more than 12 days have elapsed cure is very doubtful. The first symptom is a great itchiness of the affected part; on scratching this water exudes, and then the boil grows and hardens. The skill of the doctor lies in determining the right moment to apply a poultice of herbs, and the right time to lance the boil. After lancing the parts are burned with caustic. The diet to be observed is caviare and bread, and a little spirits. Vegetables and fruit being especially dangerous. The skill of M. Diamanthi has been handed down from father to son for several generations, and he only pretends to cure this one disease.

"The foregoing may contain some nonsense, but there must be some ground for the confidence which our men have in the doctor. It is from such boils that men have died in this city, and from which many have recovered, the infection being attributed to Van mohair."

(Received from Messrs. Crabtree, August 26, 1880.)

Since the above was in type a letter has been received through Dr. Dickson, of the British Embassy, from Dr. Patterson, Physician to the English Hospital in Constantinople, which substantiates earlier information from that city. Dr. Patterson speaks of the frequent occurrence of boils among sorters, especially sorters of Van Mohair; their boils sometimes assuming the appearance, but not always, of typical malignant pustule. He speaks also of rumours of rapidly fatal attacks of the constitutional infection, and saw himself on one occasion, at the master's request, several sorters employed at one factory who showed "incipient symptoms of blood poisoning," after sorting a particular lot of Van mohair; none of them had any pimple or pustule, and all recovered. Unfortunately Dr. Patterson has had no opportunity of studying a case completely; for, he says, the natives will only be treated by the Dallakjis, or "Dallack doctors," in whom they have entire confidence. These native practitioners excise, or cauterize (with the red-hot iron), the local pustule, and "then prescribe an absolute diet of caviare and mastic, or raki."

L O N D O N :

Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.

For Her Majesty's Stationery Office.

[6260.—100.—7/81.]

Dr. H. F. Parsons's Report on the prevalence of Scarlet Fever and Enteric Fever in the Castleford Registration Sub-District, and on the General Sanitary Condition of the Castleford, Whitwood, and Methley Urban Sanitary Districts included in that Sub-District.

GEORGE BUCHANAN,
 Medical Department,
 May 24th, 1880.

The present inspection, which was made in February and March 1880, was called for on account of the continued prevalence of Scarlet Fever and "Fever" in the Castleford Registration Sub-District, as shown by the Registrar General's returns.

The Castleford Registration Sub-District is included in the Pontefract Registration District, of which it forms the north-western portion. It includes the three urban sanitary districts of Castleford, Whitwood, and Methley, which are conterminous with the townships of the same name, and also the township of Glass Houghton, which for sanitary purposes is included in the district of the Pontefract Rural Sanitary Authority. The area and population of these townships are given in the census returns for 1871 as follows:—

Township.	Area in Acres.	Inhabited Houses.		Population.	
		1861.	1871.	1861.	1871.
Castleford - - - -	564	813	1,271	3,876	6,268
Whitwood - - - -	1,082	324	639	1,723	3,342
Methley - - - -	3,492	501	691	2,472	3,277
Glass Houghton - - -	1,079	113	187	489	881
Sub-district - - - -	6,217	1,751	2,788	8,560	13,768

The large increase of population between 1861 and 1871 was attributed by the Registrar to the establishment of new glassworks and to the opening of several new collieries; it amounted to 60 per cent. in the 10 years, or 4·8 per cent. annually. If the same rate of increase had prevailed since 1871 the present population of the sub-district would be upwards of 21,000, but it is probable that the augmentation of the population has been checked or arrested by the depression in trade which has prevailed during the last year or two. Few houses are now building, and many are empty.

The sub-district is situated in the broad open valleys of the Aire and the Calder at the point where these rivers join. The geological formation is the Coal Measures, which are covered up in the lower grounds with alluvium and river gravel. There are several large collieries employing in prosperous times a large number of men. There are also extensive glassworks giving employment to a large number of hands, male and female; the other industries being chemical works, earthenware potteries, and agriculture.

The table on p. 2, compiled from the Registrar General's quarterly reports, gives the vital statistics of the Castleford Sub-District during the nine years 1871-79.

This table shows that the birth-rate in the sub-district is excessively high, indicating that a comparatively large proportion of the population consists of young married adults.

The death-rate is also high, both among infants and at all ages. The deaths from small-pox, scarlet-fever, "fever" (chiefly enteric), and especially diarrhœa, are above the average.

Year.	Estimated Population.	Births.		Deaths.		Deaths under one year old.		Deaths from							
		Number.	Rate per 1,000 population.	Number.	Rate per 1,000 population.	Number.	Per 100 Births.	Small-pox.	Measles.	Scarlet Fever.	Diphtheria.	Whooping Cough.	Fever.	Diarrhoea.	Violence.
1871	13,768	703	51.2	305	22.1	110	15.6	11	—	11	1	11	15	26	8
1872	14,438	681	47.2	400	27.7	120	17.6	82	16	1	3	7	10	29	15
1873	15,141	855	56.5	392	25.9	151	17.7	10	4	15	5	5	17	25	9
1874	15,878	911	57.4	401	25.2	156	17.1	1	6	45	2	9	8	32	7
1875	16,650	892	53.5	472	28.3	173	19.4	—	8	22	—	21	14	38	26
1876	17,461	918	52.6	424	24.3	150	16.3	—	2	25	—	5	12	33	12
1877	18,311	986	53.9	315	17.2	108	10.9	—	3	4	—	1	12	22	14
1878	19,202	935	48.6	421	21.9	173	18.5	—	10	4	—	20	5	49	11
1879	19,202	934	48.6	409	21.3	129	13.8	—	3	59	—	3	12	27	19
Average	16,672	868	52.2	371	23.8	141	16.3	0.69	0.35	1.25	0.07	0.55	0.70	1.87	0.81
England and Wales.	—	—	35.7	—	21.6	—	14.8	0.27	0.37	0.73	0.12	0.51	0.51	0.87	0.74

Rates per 1,000 population per annum.

On commencing the inspection it was ascertained that the epidemic of scarlet-fever, which was the more immediate occasion of its being made, had up to that time been confined to the urban districts of Castleford, Whitwood, and Methley; the investigation was therefore limited to those districts.

Scarlet-Fever.—From the table given above it appears that the sub-district is rarely, if ever, entirely free from scarlet-fever, deaths from that disease having occurred in every year since 1871. It was prevalent in 1874–76, but in 1877 and 1878 it was comparatively quiescent, only four deaths having occurred in each of those years. During those two years many children were born or grew from infancy into childhood, reaching the period of life when the liability to scarlet-fever is greatest, unprotected against the disease by a previous attack.

Methley was the first place in the sub-district to feel the force of the present epidemic, but there had been a few previous cases in Castleford in the latter part of 1878. In January 1879 there was a large family gathering at a funeral in Methley; some of the friends of the deceased, who came from Castleford and brought a child with them, had scarlet-fever in their house at the time. A child living in Methley, who was at the funeral, was taken ill with scarlet-fever three days afterwards, and died on January 12th after two days' illness. This is believed by the Medical Officer of Health to have been the first case that occurred in Methley. The second case, also a child, lived half a mile from the first, but the fathers of the two children worked at the same pit, and had occasion sometimes to go to each other's houses. From this time the fever soon spread. Several of the families attacked in the earlier part of the outbreak were related to each other, and the children used to visit at each others' houses. Into an outlying part of the Methley district scarlet-fever was introduced from the neighbouring township of Rothwell; the patient was a child who had been taken there to a festival and dressed in a house in which scarlet-fever existed: it was taken ill two or three days afterwards. In many of the cases in Methley the source could be traced to intercourse with households in which the disease previously existed. The epidemic at Methley had, it was hoped, subsided at the time of inspection.

In Castleford the disease did not become prevalent till the autumn of 1879, and it was increasing at the time of inspection, 15 deaths having occurred in February 1880. The genealogy of the cases was not traced so readily as at Methley, but there can be no doubt that personal intercourse was the chief means by which the disease was spread. At Whitwood also the disease was on the increase at the time of inspection. Some of the cases appeared to have contracted the infection in Castleford; others from their neighbours in Whitwood.

Much carelessness and indifference appears to prevail among the labouring class with respect to the propagation of infection. It was stated that a few years ago the body of a child who had died of scarlet-fever was brought from Leeds to Methley to be buried. On arriving at Methley it was taken into a public-house, where the coffin lid was unscrewed, and a number of children were

brought to kiss the corpse. Children are commonly taken to funerals, even to houses where infectious disease exists, and mourning clothes are frequently let out on hire, or lent, for such occasions.

The following Table gives the number of deaths from scarlet-fever in the Castleford Registration Sub-District, from 1878 to 1880:—

	Castleford.	Whitwood.	Methley.
1878.			
March - - - -	—	1	—
October - - - -	—	1	—
November - - - -	1	—	—
December - - - -	1	—	—
1879.			
January - - - -	1	—	2
February - - - -	—	—	3
March - - - -	—	1	1
April - - - -	1	—	12
May - - - -	1	—	5
June - - - -	—	—	6
July - - - -	—	—	1
August - - - -	2	—	1
September - - - -	2	3	—
October - - - -	3	—	1
November - - - -	4	—	2
December - - - -	2	1	4
1880.			
January - - - -	7	2	1
February - - - -	15	3	—

Enteric Fever.—It will appear from the description which will be given of the districts over which this inspection extended that the local conditions favouring the propagation of enteric fever, viz., bad drainage, polluted drinking-water, and nuisances from excremental filth, are abundantly present in all of them. It is not surprising, therefore, that in all three districts the death-rate from "fever," chiefly enteric, is above the average, being for Castleford, 0·61; for Methley, 0·66; and for Whitwood, 1·00 per 1,000 per annum on an average of nine years; that for England and Wales having been 0·51.

Enteric fever has been especially prevalent in Driver's Row, Castleford. Cases have occurred there from time to time for years back, and in 1879, in the 12 houses of the row, 12 cases of enteric fever occurred, four of which were fatal. Suspicion fell upon the well-water used by the inmates of the whole row; but it was analysed on two different occasions, and each time was pronounced free from contamination, and on the well being cleaned only light-coloured clay was got out. It is said however that a drain-pipe runs close alongside the well, and the inspector was not sure that there might not be some leakage from it into the well. The drains, of which the inlets are close to the houses, were blocked up last year, and very offensive.

Diarrhœa Mortality.—The probable causes of the invariably high mortality from diarrhœa in the sub-district call for some notice. In addition to the general prevalence of filth and filth-effluvia in the neighbourhood of the houses, and to the frequent contamination of the water used for drinking and the preparation of food, other circumstances, less under the control of sanitary authorities, appear to be operative in producing it.

Neglect and mismanagement of children seem only too common. Early marriages are frequent, and many women who are employed from girlhood in the manufactories can have little time or opportunity to learn or practise lessons of domestic economy. The interiors of many of the cottages visited presented a scene of dirt and disorder, very unlike the neatness and cleanliness which mark a well-regulated cottage home. While the mothers are out, the younger children are often left in charge of others little older and unable to take proper care of them. The following are illustrations of some of the casualties to which children are exposed, the cause of death in each case being given on the verdict of a coroner's jury:—

Age, 10 weeks.—"Syncope, caused by chronic diarrhœa, kept up by improper feeding."

Age, 12 weeks.—"Accidentally burned."

Age, 7 months.—“ Suffocated by swallowing a penny.”

Age, 6 weeks.—“ Suffocated in bed with parents.”

Age, 16 weeks.—“ Diarrhœa, aggravated by want of attention and nourishment.”

Age, 1 year and 9 months.—“ Accidentally drowned while playing alone.”

Age, 11 weeks.—“ Diarrhœa, and want of proper food, and attention.”

Another Child.—“ Diarrhœa, aggravated by want of medical treatment and proper attention.”

It was stated by several persons likely to be well informed that the practice, common in the neighbourhood, of insuring the lives of children had an injurious tendency in diminishing the care which their parents took of them.

Milk is said to be very scarce and difficult to obtain in some of the places visited, and is hence rarely used for feeding children.

A circumstance which cannot fail to have a prejudicial effect, is the frequent absence of a proper pantry for keeping food. Few of the cottages visited had a properly constructed larder, with free ventilation into the open air. The usual place for storing food is on shelves above the steps leading down to the coal-cellar, the cellar itself being frequently invaded by foul water from the surface or subsoil, or by sewer air from an untrapped drain. In other houses food is kept in a cupboard without external ventilation; it may be next the fireplace, or against the chimney-back of the adjoining house. In such situations, especially in hot weather, food soon taints and passes into a condition in which it is very liable to derange the organs of nutrition, causing diarrhœa and other disorders.

The following portions of this report relate to the sanitary condition of the several districts inspected.

CASTLEFORD URBAN DISTRICT.

Castleford stands on the south bank of the river Aire, just below its junction with the Calder. The town is situated mostly on sloping ground, and is irregular in ground-plan. The population has increased very rapidly until within the last year or two, but is now stationary or declining, many houses being empty. The staple industry is the manufacture of glass bottles; pottery ware is also made, and many of the inhabitants work in collieries, of which there are several in the neighbourhood, although none are actually within the Castleford district.

Castleford has been twice previously inspected. In 1850 the General Board of Health caused an inquiry into the sanitary condition of the township to be made by Mr. Benjamin Herschel Babbage. The principal conclusions at which that gentleman arrived were as follows:—

1. The township was very unhealthy. This was proved by the returns of mortality for the 10 years 1840-9. These showed a mean annual death-rate of 27·9 in each 1,000 of the population, and a proportion of deaths from zymotic diseases to the total deaths from all causes of not less than 27·7 per cent.

2. Little drainage had been carried out in the village, and the little which had been done was very defective.

3. The method of excrement disposal by privies and open cesspools was bad in principle, and in execution a source of the gravest nuisance and injury to health.

4. The water-supply derived from the river, from shallow wells, and from the storage of rain-water, was defective in quantity, and as a rule of very impure quality.

5. There was much nuisance in some places from the careless mode of disposing of the blood and offal of slaughtered animals; the highways were badly repaired, and the churchyard was very much overcrowded with graves, and a proposed addition to it quite inadequate to the wants of the population.

Mr. Babbage recommended:—

1. That the Public Health Act, 1848, should be applied to the township of Castleford.

2. That a complete system of sewerage should be laid down with outfalls at such levels as would enable the greater portion of the sewage to be used for the irrigation of the land.

3. That a supply of water should be obtained from the rising grounds about Castleford by a system of deep subsoil drainage, the water being stored in a reservoir and distributed by mains to the different houses.

4. That all cesspools be abolished; that the privies be converted into waterclosets, and that additional closets be built where wanted.

5. That a public slaughter-house be erected.

6. That a public cemetery be established.

An inspection of the township was made in 1871 by Mr. Netten Radcliffe, on behalf of the Medical Department of the Privy Council Office, on account of the

Registrar General's tables showing an unduly high mortality from "fever." In the interval between this and the previous inspection the Public Health Act, 1848, had been adopted (1851), a Medical Officer of Health appointed (1853), and a code of byelaws framed and approved (1864).

The following summary of the 20 years' sanitary work done by the Local Board is given by Mr. Radcliffe:—

Sewerage.—The main thoroughfares had been sewered, but the sewers had not been extended proportionately to the growth of the place. No plans of the sewers existed. The branch drains were ill-constructed.

Surface Drainage.—This was very generally defective, and from its imperfection much nuisance arose.

Water-Supply.—The arrangements for a public supply were then being completed, and the inhabitants had not as yet access to the water.

Excrement Disposal and Abatement of Nuisances.—The arrangements for excrement disposal and the nuisance arising therefrom, remained practically the same as in 1850; much nuisance existed from over-full middensteads, from filthy surface drains, and from collections of manure. The nuisance from slaughtering animals had not been altogether abated; that from an overcrowded burial ground had alone been effectually remedied.

Cottage Construction.—The erection of back-to-back houses was not permitted by the Local Board; all recently erected cottages had through ventilation.

"The results here described fall far short of Mr. Babbage's recommendations in 1850, and in all essential respects the excremental and other nuisances which those recommendations were mainly designed to remove remain unabated at the present time. It is not surprising, therefore, to learn from the returns of deaths that there has been no manifest improvement in the health of the population during the past 20 years. The sewerage, as far as it has been carried out, has chiefly aided in securing greater surface cleanliness, but even this very imperfectly in many localities. The population has yet to benefit from the improved water-supply. The conditions which give rise to excremental nuisance are essential to the method of excrement disposal by the common privy with middenstead; and so long as this method of disposal is persisted in, any abatement of this form of nuisance which would sensibly affect the health of the inhabitants, is impracticable."

Mr. Radcliffe recommended that the advice of a skilled engineer should be obtained as to the sufficiency of the existing sewers, and as to the extension of the sewerage; that measures for the improvement of the surface drainage should at once be systematically proceeded with; that water from the new waterworks should be supplied to houses without delay, and that in place of privies with middensteads, if the water-supply proved insufficient to allow of the general adoption of waterclosets, there should be substituted either (a) earth closets; (b) pail closets; or (c) midden closets modified so as to avoid the evils attaching to the common privy with middenstead.

The following description of the present sanitary condition of Castleford will show how far these recommendations have been acted upon. It will be seen that though various extensive and costly works have been undertaken, much still remains to be done before the full benefit of them can be derived, and that up to the present time the amelioration of the sanitary condition of the town actually effected has been but small.

Sewerage.—A system of main sewers has been carried out under the direction of Mr. Paterson, C.E., and has been completed about a year. The sewers consist partly of oval brick culverts, partly of glazed earthenware pipes. The trunk main leading to the pumping station is a large culvert which is intended to act as a reservoir for the sewage in the intervals of pumping. The sewage is raised to a plot of ground containing 12 acres, situated at Wheldale, just outside the border of the district, where it is disposed of by intermittent downward filtration. At the present time about two hours' pumping each day is sufficient to empty the sewers. Ventilation is provided for by man-holes and shafts in the crown of the road. The sewers are designed to convey foul liquids only, it being intended to utilize the old sewers as outlets for storm water.

At the present time, however, it is estimated that only about a tenth part of the houses in the town are drained into the new sewers. The private streets

in which a great proportion of the houses are situated are with few exceptions still unsewered, or drained only into the old sewers or into watercourses. In the undrained parts of the town house-slops are commonly thrown into the middensteads, or into gutters dug in the bare earthen surface of the back-yards, down which they flow into the back street, or, it may be, into an adjacent piece of waste ground, to find some hollow spot where they may stagnate in a filthy pool. The nuisances arising from want of proper sewerage are especially obvious in two new parts of the town, built since the date of Mr. Radcliffe's visit, one a low-lying part on the north-east called Wheldale Lane, the other called Eleven Acres on higher ground to the south, separated from the older part of the town by the North Eastern Railway. In Wellington Street, Wheldale Lane, the private sewer down the back street at the time of inspection was stopped up in its lower part, the sewage thrown into the upper inlets welling up through those lower down, and flooding the back-yards far and wide with pools of foul water reaching even to the doors of the houses, which, however, were fortunately mostly unoccupied. Half Acres, mentioned by Mr. Radcliffe as unsewered in 1871, is so still; scarlet-fever has been very prevalent there.

On some of the older properties the drains are square, roughly made of stones; in some cases they run under the houses. The newer drains are of glazed pipes, but appear often inefficiently constructed, and many of them were found stopped up with sediment. As an example of the carelessness shown in the laying of drains, it may be mentioned that I saw a siphon bend, the object of which was to prevent sewer-air coming up the house-drain, which was laid horizontally on its side so that it could hold no trapping water.

The branch drains are usually ill-constructed. On the older properties the inlets are mostly large untrapped brick gullies of the kind to which the term "cesspool" is applied in some parts of Yorkshire, containing a large quantity of putrefying sediment, and giving off effluvia in some cases in the neighbourhood of the doors and windows of the houses; the yard surface around them was not unfrequently unpaved, or laid with rough stones or brickwork, the interstices of which were sodden with foul liquid. The inlets were, as a rule, outside the houses, but one case was observed in which the pipe of a newly-constructed scullery sink went direct into the drain, no attempt having been made, even by trapping, to prevent the sewer-air from entering the house.

The houses in Castleford have many of them cellars for the storage of coals and food; these are frequently ill-drained, and in some instances, as in Bridge Street, contaminated with sewer-air, or in times of flood even with sewage from openings in the floor. In Lower Oxford Street, which is on sloping ground, the cellars of a long row of houses are drained by openings in the party walls into those of the lower houses of the row, in some of which at the time of inspection water stood as high as the second step. The smell from this stagnant water was much complained of, and meat kept in these cellars was stated soon to become tainted and turn green. In one of the lowest houses two cases of enteric fever, one fatal, occurred in 1878.

The "Willow Beck," a watercourse used as a sewer, mentioned by Mr. Babbage as forming an extended open cesspool, has been arched over and converted into a flat-bottomed sewer, over which houses have been built. The emanations from it coming up untrapped drains are still a source of nuisance, and it still in wet weather floods the cellars of neighbouring houses.

Streets and Dwellings.—The private streets in Castleford, of which there are many, especially in the new neighbourhoods of Eleven Acres and Wheldale Lane, are many of them in a deplorable condition, owing to the want of drainage, to the surface never having been levelled or laid with proper materials, and to their being made receptacles for filth and refuse, solid and liquid. Notices under section 150 of the Public Health Act, 1875, have been served by the Sanitary Authority for putting into repair and sewerage some of these private streets, and have expired, but the Authority are unable for financial reasons to carry out the work themselves.

The common court-yards and private back-yards are also almost always unpaved and ill-drained, and often in a dirty condition.

The older houses, as some of those in the yards in the neighbourhood of Bridge Street, are situated in low-lying and confined positions, and are damp and ill-ventilated. There are a good many back-to-back houses in the older parts of the town, but the erection of houses of this class is now forbidden by the byelaws, and all newly-built houses have through ventilation.

Water-Supply.—Castleford is furnished with a public water-supply which is in the hands of the Sanitary Authority. The water is obtained from a well in the coal-measures at the lower part of the district, at some distance from any house; the well is about 30 feet deep, and is fed by a horizontal driving. The water is pumped into settling tanks, and thence into an open reservoir on Red Hill, an eminence about 200 feet above the town. The water when first pumped up is clear with a strong chalybeate taste, which it loses to a great extent on standing, throwing down at the same time a rusty sediment of oxide of iron, which accumulates in the settling tanks and is flushed out every week into the river. The Rivers Pollution Commissioners, 1868 (Sixth Report, page 329), thus speak of the quality of the water of the Castleford Waterworks: "The water is somewhat chalybeate, and becomes slightly turbid on exposure to the air from the deposition of oxide of iron. It also contains a remarkably large proportion of common salt. Its chalybeate character would be entirely destroyed by the addition of lime to it in the proportion of 1 lb. to each 1,000 gallons. Allowed afterwards to repose for 12 hours in a reservoir, the water would become perfectly clear, a considerable proportion of the organic matter which it contains would be removed, and the hardness would be materially reduced."

The samples referred to in the Report of the Commissioners were taken from a now disused well at the pumping station, about 100 yards from the present well; the water of both wells is, however, of a similar quality. The appended report by Mr. Fairley, borough analyst of Leeds, shows the character of that now in use. The quantity of water daily supplied is estimated at 139,000 gallons; the yield of the well is stated to be barely sufficient for the requirements of the district. The water is supplied by a constant service. There was a good deal of waste at the time of inspection from water pipes burst by the frost, especially on unoccupied premises, some of which were flooded in consequence.

The town's water is estimated to be used by about two thirds of the inhabitants, the remainder drawing their supply from private sources, as shallow wells and rain-water cisterns.

The water of the River Aire is used occasionally for domestic purposes, and a spring, called Spring Well, on the foreshore, said to issue from an old colliery working, is a good deal resorted to; the water of the latter is reported by the analyst to be, though hard, such as may be safely used for drinking.

The shallow wells and underground cisterns are many of them polluted, from foul matters finding their way into them from the surface or subsoil. The Sanitary Authority are gradually getting such wells and cisterns disused, and requiring a supply of water from the mains to be substituted.

The disused wells and cisterns are in some cases not only, from their unguarded state, pit-falls dangerous to life and limb, but also a source of nuisance from the foul matters which find their way into them, being in fact unintentionally converted into cesspools. One such cistern of large size and full of black sewage is partially under a house in Castle Street, the cellar of which is occasionally flooded by it; the opening, covered only with loose stones and broken boards, is close to the door of another house in a very confined situation, the inmates of which complain of the bad smell from it, and suffer frequent ill-health, especially diarrhoea.

Excrement Disposal.—There are few waterclosets in Castleford, and those almost all in houses of the better class. One case, however, was observed in which a watercloset had been substituted for a midden-privy in a very confined position; it was flushed direct from the pipes by means of a screw-down tap below the seat.

The Rochdale pail-system was in part adopted in Castleford some years ago, but has fallen into disfavour, and is being gradually given up. There are two streets in Wheldale Lane in which it was stated that there were formerly 200 pail-closets which have now been converted into privies with open middensteads of a kind to be hereafter described. There are at present about 136 pail-closets remaining. The objections alleged to me against the pail-closet system, with the exception of that of the greater expense entailed by the more frequent scavenging which it necessitates, were such as should have been brought, not against the system itself, but against the unintelligent and slovenly manner in which it has been worked.

Thus (1st) it was objected that the frequent removal caused great inconvenience to householders. That this is so, is due solely to the faulty plan on which the privies are constructed. Although in the newer parts of the town, in which alone the pail-system is in use, the houses are generally provided with approaches at the back for scavenging purposes, the pails are not accessible from the back streets for removal, but it is necessary for the scavengers to enter the back-yard, lift up the riser of the seat, and carry out the pail. The occupiers frequently omit to leave their back-yard doors unlocked, and object to being aroused in the night to admit the scavengers. If a small door were provided at the end of the privy, by which the pail might be drawn out into the back street without the necessity of entering the yard, the inconvenience complained of would cease to exist.

2nd. Another objection was that the pans, which are of galvanised iron, are apt to become leaky through corrosion or rough usage, and thus cause a nuisance. This might be obviated by using stronger vessels; wooden pails are usually found to answer better.

3rd. It was also objected that the pails when recently emptied gave forth a greater stench even than when full. This is due to the method of collection; the contents of the pail are tipped into a sludge cart, and the pail, smeared on its inner surface with fæcal matter, is replaced there and then. If after each emptying the pails were cleansed and disinfected, as is done in places where the pail-system is in successful operation, this objection would be overcome.

With these exceptions, privies with open middensteads are in general use in Castleford, as at the time of the previous inspections. The middensteads are usually very large, and deeply dug out; indeed, one of the byelaws of the Local Board of Health requires that every ashpit, (*i.e.*, middenstead), shall be of sufficient size to contain at least 80 cubic feet of ashes below the sill of the door! The walls of many of the older middensteads are low, and of some, dilapidated: they are often full in view of the houses and within a few yards of them; the privy roofs almost invariably drip into them, and in many parts of the town they are the common receptacle for house-slops. The privy and ashpit are usually so situated in relation to each other that the daily covering up of the excreta with ashes is impossible. Little or no attempt seems to be made to improve upon this plan, which would almost appear to be considered the most perfect that human ingenuity can devise. The open middensteads which have been substituted for the pail-closets before-mentioned, are 5 feet square; the walls are of brick only $4\frac{1}{2}$ inches thick, not cemented, and already show frequent cracks; the space under the privy seat communicates with the middenstead only by a small hole so that the excreta lodge under the seat instead of flowing into the middenstead. The bottom, however, is level with the ground, and the walls are 6 feet high instead of only 3 feet as is usually the case in the older middensteads. Another new middenstead is covered in, but not ventilated; it measures inside 6 feet by 5, the bottom being 2 feet below the ground level; it is so situated, access to it being obtained only through a narrow passage and up a flight of steps, that the contents have to be three times deposited on the ground and shovelled up before they reach the scavenger's cart.

The number of privies is in some cases hardly sufficient. One of the byelaws requires that "there shall be constructed one privy or watercloset to every four houses at the least." This allowance is scarcely ample enough, and cleanliness is apt to be neglected when the responsibility is divided among so many households.

The removal of excrement is performed by the Sanitary Authority at a cost last year of 1,096*l.*, from which has to be deducted 267*l.* realised by the sale of manure. No difficulty is met with in the disposal of the refuse; much of the surrounding land being heavy clay on which ashes form a good manure. An uncleanly practice was observed of filling up a hollow place in the ground at the waterworks with rubbish, such as broken crockery and hardware picked out from the contents of the middens, and smeared with excrement and ashes; there did not appear to be any risk of contamination of the water by soakage therefrom, but it seemed likely enough that in high winds particles of the dried ashes might be blown into the open settling tanks.

Slaughter-Houses.—These are said to be registered and inspected. One near the Castle Hotel is unventilated; it has a rough floor of decayed porous bricks with wide interstices in which blood lodges. Similar defects were observed in others.

Common Lodging-Houses.—These are registered and inspected; those visited were in fairly good condition.

Sanitary Administration.—The Local Board of Health of Castleford have undertaken many public works since their formation, but at present are beset with financial difficulties which prevent them from undertaking any further expenditure. They have borrowed the following sums for permanent works, viz.:—

For Sewerage	-	-	-	-	£25,000
„ Paving	-	-	-	-	2,000
„ Water-supply	-	-	-	-	14,800
„ New streets	-	-	-	-	3,300
„ Market site and offices	-	-	-	-	2,400
„ New Market Hall	-	-	-	-	10,500
					Total - 58,000

The Authority have applied for the following further loans for the completion of the work which they have on hand, viz.:—

For Paving, flagging, and channelling	-	-	-	-	£1,100
„ Sewerage	-	-	-	-	2,500
„ Construction of a new street	-	-	-	-	2,800

but are unable at present to obtain them without exceeding their borrowing powers.

Mr. E. Horner is appointed Medical Officer of Health at a salary of 25*l.* He has not been under the Local Government Board's order. He visits any places to which his attention may be specially called, but does not make systematic inspections of his district. He is supplied with lists of deaths monthly by the registrar.

The Inspector of Nuisances is not under the Local Government Board's order. Little appears to be done in the way of the abatement of nuisances; little indeed can be done in the way of permanent improvement until effectual drainage is provided for every part of the district, and until a better system of excrement disposal is adopted.

There is no accommodation provided for the isolation of cases of infectious disease nor for the disinfection by heat of clothing and bedding. Carbolic powder is furnished to the inmates of houses in which infectious disease has occurred, and they are directed to sprinkle it about, but the houses are not fumigated, nor are the wall papers removed, nor the walls lime-washed.

From the foregoing account of the present sanitary condition of Castleford, it will be seen that the administration of the town in matters relating to the public health is still very far from satisfactory. The shortcomings of the Sanitary Authority are to be ascribed, not to parsimony, but to their failure to apprehend and apply the ascertained principles of sanitary science to the suppression in details of the particular nuisances which have characterised the district from the time of Mr. Babbage's inquiry in 1850 to the present time. The financial embarrassments of the Authority can hardly be considered an excuse. Granting these, and without raising the question as to the past expenditure on permanent work the important part of public health administration already referred to, viz., the suppression of nuisances, excremental and other, and the enforcing of private improvement works to that end, which does not demand the expenditure of public money, would appear, judging from the state of the town, to be almost entirely ignored.

Vital Statistics.—The present population of Castleford is locally estimated at 10,000, but it is difficult to form an accurate estimate after the lapse of nine years from the last census, as in manufacturing and mining communities the population fluctuates greatly and rapidly with the prosperity or depression of trade. Many of the owners of cottages in Castleford compound for the rates, paying rates whether their houses be occupied or not; so that it is not possible to obtain from the rate book the number of houses actually inhabited. The death-rates in the following table must therefore be taken with

some reservation on account of the uncertainty with regard to the number of the population:—

Year.	Estimated Population.	Deaths.		Deaths from						
		Number.	Rate per 1,000 Population.	Small-pox.	Measles.	Scarlet-Fever.	Diphtheria.	Whooping Cough.	Fever.	Diarrhœa.
1871 - - -	6,268	136	21·7	2	—	—	—	8	5	10
1872 - - -	6,722	208	30·9	39	10	—	3	3	2	12
1873 - - -	7,210	208	28·9	6	1	12	2	3	3	12
1874 - - -	7,645	194	25·1	1	1	20	1	6	4	11
1875 - - -	8,294	249	30·0	—	6	10	—	9	5	20
1876 - - -	8,896	222	25·0	—	2	6	—	1	10	18
1877 - - -	9,541	154	16·2	—	—	1	—	—	8	12
1878 - - -	10,000	233	23·3	—	—	2	—	17	3	27
1879 - - -	10,000	212	21·2	—	4	17	—	1	6	19
Average - -	8,286	202	24·7	0·64	0·32	0·91	0·08	0·64	·61	1·89
England and Wales	—	—	21·6	0·27	0·37	0·73	0·12	0·55	0·51	0·87
Castleford, 1840-49	1,685	45	26·7	—	—	—	—	—	0·04	2·67
Castleford, 1861-70	4,972	132	26·5	—	—	1·56	—	—	1·91	1·99
Rates per 1,000 population per annum.										

Debiting the township with its proportion of deaths in the Pontefract Union Workhouse, the average death-rate for the nine years is 25·1.

It will be seen from the above table that the death-rate in Castleford has fallen 2 per 1,000 from what it was in 1840-49, although the town has increased in size and density in the meanwhile. The death rates from scarlet-fever, from "fever," and from diarrhœa, though still above the average, especially the latter, have diminished since the last inspection. The public works carried out by the Sanitary Authority have apparently not been devoid of good results, but the sewerage must be completed, a better system of disposal of excrement adopted, and the general sanitary administration carried out in a very different fashion before Castleford can expect to be a healthy town.

WHITWOOD URBAN DISTRICT.

The population of this district, which is now estimated at 4,500, is principally grouped in three centres, Whitwood proper, Whitwood Mere, and Hightown. The two latter adjoin Castleford, forming with it in appearance parts of the same town. Hightown lies on higher ground than Whitwood Mere, and is separated from it by the North Eastern Railway. Whitwood proper is situated about a mile to the south-west, a tract of open country intervening.

The town is of a similar character to Castleford; there are at Whitwood Mere glassworks, potteries, and chemical works; at Whitwood there are large collieries belonging to the firm of Messrs. Briggs, Son, & Co., Limited; the inhabitants are employed in these industries and in agriculture.

The vapours given off by the chemical works are very destructive to vegetation in this and the adjoining Castleford district.

The town being of modern date there are not many old confined cottages.

Some of the private streets are not in good repair, and the back-yards are almost invariably unpaved or paved only with rough bricks badly laid.

Sewerage.—A system of sewerage, designed by Mr. J. Richardson, C.E., is now in progress of construction. It is in three sections; the sewage of Whitwood proper is to be conveyed by gravitation to a piece of irrigation ground near the River Calder; that of Hightown will also flow by gravitation to an irrigation ground at Cutsyke, near the Lancashire and Yorkshire Railway Station; that of Whitwood Mere will be raised by pumping to the same point. The sewers are provided with ventilators in the crown of the roads, and can be flushed in part at least from watercourses. They are intended to convey sewage only, surface water being excluded. At the present time few house connexions with the new sewers have been made, only the Hightown section being completed. At the present time a portion of the sewage of Whitwood

Mere and Hightown flows into the sewers of the Castleford Local Board under an agreement which expires in May of the present year.

Heretofore in the absence of sewerage, house-slops have been disposed of by throwing them into the middensteads, or into watercourses, which when they have thereby become nuisances have been covered up and converted into rude sewers. Some old pipe sewers which were seen uncovered were in very bad condition and choked with sediment. It is intended that no direct communication shall exist between the sewers and the interiors of houses, but that all sink pipes shall discharge in the open air.

Certain branch drains connected with the sewers had inlets raised above the level of the yards in which they were situated. The object of this arrangement, which is not unfrequent in parts of Yorkshire, is that only the house-slops shall enter the drain, the rain water, with the mud and grit washed by it off the unpaved yard surface, being excluded. The arrangement is, however, open to several objections. Unless the soil and configuration of the surface, be such as to afford natural drainage, means ought to be provided for conveying away the storm water, which, otherwise stagnating upon the surface, will cause an unwholesome dampness. Moreover, unless the occupants of the premises be cleanly to an unusual degree, the surface water from the back-yards will be contaminated more or less with foul matters. Indeed in pouring away slop water portions may not improbably be spilled or splashed about, which if the inlet be above the level of the yard cannot run away, but will stagnate upon the surface or sodden the ground around it.

Water-Supply.—There is no public water service by pipes. Water is obtained for drinking and domestic purposes from the following sources:—

(1.) Rain water, caught from the roofs and stored in tubs and underground cisterns, is largely used. The cisterns are frequently ill-made, so that the subsoil water finds its way into them, as proved by the hardness of their contents. The habit frequent among colliers of keeping pigeons, which perch on the roofs and drop their dung there, is much complained of as contaminating the rain water. The Sanitary Authority were endeavouring to put a stop to this practice, and proceedings were pending against certain owners of pigeons under the clause of the Public Health Act, 1875, which forbids the keeping of any animal in such a state as to be a nuisance or injurious to health.

(2.) Some of the inhabitants of Whitwood Mere dip water out of the "old river." This is a bend of the Calder, cut off when the navigation was straightened; it communicates with the river below, but it forms a *cul de sac*, in which the blank inky waters are somewhat purified by subsidence.

(3.) Shallow wells are also in use. As the water which they yield is derived only from the few feet of surface soil and sand which rest upon the retentive clays and shales of the coal measures, and which receive the soakings from defective drains and open middensteads, it is not to be supposed that it can be a safe or desirable supply. The wells in the lower part of Whitwood Mere are fed from the Calder by percolation through the porous sand-bed which intervenes; the level of the water in them rises and falls with that of the river. This water is said to be soft, and of good quality, and that yielded by a well so situated at a brewery is distributed by the Sanitary Authority in watercarts, and sold at the rate of a halfpenny a bucketful.

(4.) Whitwood proper is mostly supplied with water from the pumpings of the collieries, which flow into a small dirty pond dignified by the name of "the reservoir." The water from this pond is dipped out by the inhabitants of the neighbouring houses, and pumped into carts, which carry it to those more distant. It is turbid with floating organic particles, and has an unpleasant taste, and must, in all probability, be polluted by the excreta of the horses and men employed in the pits.

The Sanitary Authority are in treaty with the Leeds Corporation for a supply of water from their mains, which at present extend to Rothwell, about eight miles distant.

Excrement Disposal.—Privies with open middensteads, similar to those at Castleford, are in general use in the district. It was stated, however, that newly-erected middensteads were now required to be covered in. Some ranges of new privies have been erected by Messrs. Briggs & Co., at the Square, Whitwood, on an improved plan, the middensteads being roofed in and ventilated by means of a brick shaft; they are long and narrow, each serving for nine privies. The space at the bottom is very narrow, being

reduced to a mere trough, on one side of which are the privies, on the other, the openings for throwing in ashes. The spaces under the privy seats are made entirely open at the back, and are floored with flags, with a good slope towards the middensteads. There are, however, in each middenstead, only three openings for throwing in ashes; it would have been better if the openings had been equally numerous with the privies, so that the excreta from each privy might be covered with ashes. The numbers of the houses entitled to use the privies are painted on the doors; a useful plan, serving to prevent disputes, and fix the responsibility for cleanliness.

The removal of privy refuse is performed by the Local Board's labourers, under arrangement with the neighbouring farmers to receive the manure. When a middenstead is full an arrangement is made with a farmer to send a cart thither; the contents are got out by the scavengers, and led away at once on to the land. This system is said to work satisfactorily, as regards the facility of getting refuse removed.

Sanitary Administration.—The Local Government Act was adopted in Whitwood in 1858. The Local Board meet fortnightly. In 1868, a code of byelaws was passed, with respect to the matters usually regulated by Urban Sanitary Authorities. The byelaws with respect to the structure of walls of new buildings do not include provisions for purposes of health; the minimum size of ashpits is fixed at 80 cubic feet, as in the Castleford byelaws, which seem to have been adopted at Whitwood with few alterations; a privy or watercloset is, however, required to be provided for each house.

The Medical Officer of Health, Mr. W. S. Simpson of Pontefract, receives 15*l.* salary; he was not appointed under the Local Government Board's order of November 11th, 1872, but being a Poor Law Medical Officer, he is required by the terms of the Board's sanction to his appointment to furnish to them copies of his annual reports. He makes inspections of the district, and receives monthly returns of deaths from the Registrar. The Inspector of Nuisances holds also the offices of Surveyor and collector of rates, at a salary for the three offices of 100*l.*, of which no part is repaid from the Treasury grant. He keeps no books relating to the inspection of nuisances.

No action whatever appears to have been taken to prevent the spread of infectious disease, except that when small-pox was prevalent in the district in 1871-73, infected bedding was in some cases burnt by order of the Sanitary Authority. It appeared that until the letter announcing the present inspection was received, no notice whatever had been taken of the presence of scarlet fever in the district, although five deaths occurred from it in 1879, and the same number in January and February of the present year.

Vital Statistics.—The following Table shows that the death-rate in Whitwood on an average of the past 10 years has been 23·2, a high mortality, especially when it is considered that the population is not a densely aggregated one (there being on an average only four persons to an acre), and that from its rapidly growing character it must of necessity contain a relatively large proportion of young persons, and of adults in the prime of life, *i.e.*, persons of the ages at which the mortality is lowest.

Year.	Estimated Population.	Deaths.		Deaths from						
		Num-ber.	Rate per 1,000 Popula-tion.	Small-pox.	Measles.	Scarlet Fever.	Diph-theria.	Whoop-ing Cough.	Fever.	Diarrhoea.
1871 - - -	3,342	89	26·6	9	—	9	1	2	8	10
1872 - - -	3,505	105	29·9	23	7	1	—	3	1	6
1873 - - -	3,675	79	21·5	4	—	—	1	—	10	4
1874 - - -	3,854	101	26·2	—	4	9	—	3	1	12
1875 - - -	4,042	110	27·2	—	2	5	—	4	4	12
1876 - - -	4,238	90	21·2	—	—	3	—	—	2	11
1877 - - -	4,445	68	15·3	—	—	—	—	—	3	7
1878 - - -	4,500	105	23·3	—	8	2	—	1	2	15
1879 - - -	4,500	79	17·5	—	—	5	—	2	5	7
Average - -	4,011	92	23·2	1·00	0·58	0·94	0·5	0·41	1·00	2·33
England and Wales	—	—	21·6	0·27	0·37	0·73	0·12	0·51	0·51	0·87

Rates per 1,000 population per annum.

Adding the deaths in the Pontefract Union Workhouse of persons admitted from Whitwood, the average death-rate will be nearly 23·6.

METHLEY URBAN DISTRICT.

This district, rural rather than urban in character, is situated in the angle between the Aire and the Calder; the surface is for the most part flat and lies low. The soil consists of alluvial sand and gravel, with a thin band of clay in places, under all being the shales of the coal measures. There are several extensive collieries in the district. Where the coal has been removed swampy hollows result from the sinking of the surface. The only industries are coal mining and agriculture, the collieries employing about 900 men. Nearly the whole of the land in the township belongs to the Earl of Mexborough, whose seat is at Methley Park. The principal place in the district is Mickletown; there are also several long rows of pitmen's houses at Methley Junction; in the remainder of the district there are only small hamlets or scattered houses.

Mickletown consists of a single long winding street with a few yards and alleys leading out of it, in which, and along the sides of the main street, the houses are irregularly grouped. It occupies the brow of a low gravelly terrace, and on the north of the street, on which side most of the houses are situated, the ground has a slight slope down to a level tract of marshy ground called the "Carrs," which intervenes between the village and the Aire. These meadows are intersected by wide and deep dykes, the water in which is stagnant or nearly so; the bottoms of the dykes being below the outlet. The outlet is by two artificial watercourses, which discharge into the River Aire by "cloughs" or tidal valves. The Aire is not tidal at this point, but is subject, after heavy falls of rain in the hilly country in which it rises, to sudden freshets, which pen back the drainage from the low-lying lands bordering the lower part of its course.

Streets and Buildings.—Although the houses are not as a rule densely crowded together, yet some of them are ill-provided with means of ventilation. At Methley Junction there are several long rows of houses united together at their eastern ends by another row at right angles, the interspaces, in shape long parallelograms open at one end, are in considerable part occupied by privies with huge open middensteads. One of the rows consists of back-to-back houses. The yards are unpaved, and the surface is drained through openings into the middensteads.

Denison's Fold, Mickletown, is a hollow square of 26 houses, the two angles adjacent to one side of the square being built up. In the centre of the square is an isolated block containing two other houses. Some of the houses are without through ventilation. The surface of the common yard is unpaved; the drain inlets are situated on the summits of mounds raised above the level of the yard.

Sewerage.—There is hardly any structure in the district to which the term "sewer" could be applied; the nearest approach to it is at Methley Junction, where a culvert has been constructed by Messrs. Briggs & Co., to convey the sewage of the colliery cottages upon a neighbouring field. There are also some old drains at Mickletown constructed by the highway surveyors before the Local Board was formed, which cross the main street at right angles and carry the surface water from it into the Carr dykes, and which have been made to serve also the purpose of conveying sewage. One of these, a culvert 2 feet wide with a flat earthen bottom, was locally considered a good and efficient drain. Elsewhere the mode of disposal of house-slops is to throw them into the middensteads, or run them by a few pipes into the nearest watercourse. Even at Methley Junction the house-slops are not poured direct into the drains, but are thrown into the middensteads, from which the liquid when it reaches a certain level runs off into the drain. There are indeed slopstones in the houses, the pipes from which run direct into the drains with the intervention only of small bell-traps, but the occupants do not use them, having a notion that if they do not pour any slops down them no bad smell will come up. On inquiring in what state the drains were, I was assured that there was no fault to be found with them, for the pipes were taken up and cleaned out every few weeks. Nevertheless, the occupiers

complained that their cellars were flooded with filthy water, leaking into them from the drains.

The houses in Mickletown are drained into the Carr dykes; each property having usually its own drain. These ditches are in consequence soon filled with accumulations of black stinking sediment; some of them were in this condition at the time of inspection; others had recently been cleansed out—a not very frequent occurrence, as it was stated—the sludge being deposited on their banks. The effluvia arising from them must in hot weather be a very great nuisance. The house drains, where such exist, are in some instances rough square stone drains, in others, of common field pipes, or of socket pipes ill laid; they are frequently choked with sediment. The inlets in the back yards are mostly “cesspools,” untrapped, and of the roughest construction, and in some cases are near the houses. There are sinks in many of the cottages; in some of these the waste pipe is continuous with the drains directly or with the intervention only of a bell-trap; in others a rude kind of disconnexion is practised in the following manner:—The water from the sink passes through an opening in the wall, and trickles down the side of the wall in a triangular space enclosed between it and two long narrow upright strips of flag meeting at an angle in front, into an untrapped inlet below. The triangular enclosed space, although open above to the air, reaches as high as the opening from the sink; the drain air ascending by it must therefore be liable to be drawn into the house, though perhaps somewhat diluted with the external air.

Water-Supply.—The water of the River Aire is used for drinking and domestic purposes by the inmates of the houses in its vicinity; although it need hardly be said that it is utterly unsuited for such use. The quality of the water however is stated to have improved since means have been taken to purify the sewage of Leeds, which enters the river a few miles higher up. The water of the Carr Beck, one of the outfalls for the drainage of Mickletown, is said to be used by some persons in preference to that of the Aire. Methley Hall is supplied by a spring. With these exceptions the water-supply is entirely derived from shallow wells, and is both scanty and bad. In Mickletown most of the wells are obviously and admittedly polluted, and for drinking purposes most of the inhabitants resort to two or three pumps which have a good reputation; the children, however, are said to be in the habit of drinking from the polluted pumps. At Methley Junction there are only two pumps for about 100 houses; only one of these is resorted to for drinking, and the water of that is turbid and yellowish, with an unpleasant taste. In seasons of drought, water from the condensers of the steam engines is sent to these houses in a cart by the colliery owners. A well was pointed out to me at Silver Row, Mickletown, which had been condemned as polluted by the Medical Officer of Health; the water was as black as ink and horribly foetid, and one would hardly have thought it necessary to prohibit people from using it. Some of the members of the Sanitary Authority were of opinion that good water might be obtained by means of wells, if care were taken to puddle them down to the band of clay, which exists in some parts of the district at a depth of about 13 feet from the surface, so as to exclude the top spring water. Whether this be so or not, it is certain that few of the existing wells yield good water; scarcely any were met with during the inspection of which the water appeared even tolerably good to the unaided senses. The water of the wells is in some cases chalybeate from the decomposition of pyrites contained in the strata from which it is derived. No steps have been taken by the Sanitary Authority towards providing a public supply of water. The Local Board of the adjacent township of Whitwood propose to procure water for their district from the waterworks of the Leeds Corporation. If this were done, the mains would pass through the Methley district, which might probably be supplied from the same source.

Disposal of Excrement.—This is effected by privies with open middensteads, similar to those at Castleford and Whitwood. The custom of throwing house-slops into the middensteads adds greatly to the offensiveness inseparable from this form of privy. Two examples of privy arrangements may be given. In Denison's Fold the middenstead is in connexion with seven privies, the roofs of which drip into it: it is of the shape of the letter L, the long

limb being 13 feet in length, the short limb 8 feet, and there is only one opening for ashes, situated at the angle between the two limbs. At Methley Junction the privies, with their accompanying middensteads, are in groups of four, the privies being in the middle, the middensteads at the corners. The middensteads, which have low walls, are 15 feet from the houses, in the space between the rows. They measure 9 feet by 7 feet, and are of great depth. They receive not only the rain water from the privy roofs, but also that from the surface of the yard and the house-slops. They are furnished with drains, which, however, do not reach to the bottom of the middensteads, so that the latter always contain a quantity of water. They are never completely emptied; the saturated ashes indeed are got out, but the excrement, mixed up with water into a thick fluid, remains behind. The middenstead in connexion with some houses erected since the byelaws came into operation was of smaller size, and roofed in; the bottom was not below the ground level.

There are no public arrangements for the removal of the contents of middensteads. Those at the colliery rows at Methley Junction are emptied by Messrs. Briggs & Co.; in other places the occupiers have to arrange with farmers for the removal of midden stuff. There is said to be no difficulty in getting the work done. It is stated that the midden contents are thrown direct into carts, not deposited on the ground. The removal is required by the byelaws to be effected only between the hours of 5 p.m. and 9 a.m., but in practice it is carried out at any hour of the day.

The privies were in many cases found to be very filthy. The want of any opening for light and ventilation is a common defect in their construction.

Sanitary Administration.—Until 1875 Methley was under the jurisdiction in sanitary matters of the Pontefract Rural Sanitary Authority. Strong reports as to the unwholesome condition of the township were made to the Rural Sanitary Authority by their Medical Officer of Health, and the Rural Authority had under consideration the question of providing a system of sewers.

On July 29th, 1875, a resolution adopting the Local Government Acts was passed by the owners and ratepayers of the parish of Methley, to which after a local inquiry held on November 2nd, 1875, by Major Hector Tulloch, the assent of the Local Government Board was given in an order which came into operation on January 15th, 1876. The Local Board, which held its first meeting on February 23rd, 1876, consists of 12 members, who meet once a month.

Although at the inquiry held by Major Tulloch the necessity of improving the sanitary condition of the township was one of the principal reasons brought forward to show the expediency of constituting it an urban sanitary district, yet the Local Board since its formation appears to have done little or nothing towards effecting such improvement. No public sanitary works have been carried out, nor have any private structural works for the prevention of the recurrence of nuisances been enforced, steps for the removal of nuisances being limited to such temporary measures as the cleansing of ditches and the emptying of overfull middensteads. No rate for sanitary purposes has been made during the past year.

The Medical Officer of Health, Mr. Taylor, was not appointed under the Local Government Board's order of November 11th, 1872, but as district medical officer, he is required to furnish the Board with copies of his annual report. He makes inspections of his district and visits houses in which outbreaks of infectious disease have occurred. He is furnished with returns of deaths in his district, but only at monthly intervals.

The Inspector of Nuisances, who is also Surveyor, receives a salary for the two offices of 30*l.*, no part of which is repaid from the Parliamentary grant. He holds other parochial offices, and is in business. He makes occasional visits of inspection, but keeps no books relating to his office as Inspector, and seldom reports any nuisance to the Sanitary Authority, as he states that he generally finds a verbal notice sufficient. His duties as officer to the Sanitary Authority chiefly relate to the repair of roads. The Sanitary Authority have adopted a code of byelaws, which received the sanction of the Local Government Board on March 4th, 1879.

Disinfectants are furnished to the occupiers of houses in which infectious diseases have occurred, and at the termination of the illness cleansing and

lime-washing are enforced. Occasionally houses are fumigated with burning sulphur.

There is no hospital for the isolation of cases of infectious sickness. At the time of the last epidemic of small-pox, a cottage was set apart by Messrs. Briggs & Co., for the use of any of their employés who might be affected with the disease; it was subsequently used for a time as a cottage hospital in cases of accident, and then fell into disuse. When the advisability of providing hospital accommodation for the district was pressed upon the Sanitary Authority by the Local Government Board last year, the Authority proposed to take this cottage for that object, but it was said that they did not consider it altogether suitable, and it is now let for another purpose.

Vital Statistics.—These are given in the following table:—

Year.	Estimated Population.	Deaths.		Deaths from						
		Number.	Rate per 1,000 Population.	Small-pox.	Measles.	Scarlet-Fever.	Diphtheria.	Whooping Cough.	Fever.	Diarrhoea.
1871 - - -	3,277	58	17·7	1	—	1	—	—	1	4
1872 - - -	3,371	68	20·2	16	—	—	—	—	7	8
1873 - - -	3,467	86	24·8	—	3	3	1	1	4	5
1874 - - -	3,566	77	21·6	—	1	6	1	—	4	7
1875 - - -	3,668	93	25·4	—	—	4	—	7	4	7
1876 - - -	3,773	94	24·9	—	—	16	—	4	1	5
1877 - - -	3,881	77	19·8	—	3	3	—	1	—	3
1878 - - -	4,000	61	15·2	—	2	—	—	1	—	3
1879 - - -	4,000	100	25·0	—	—	37	—	—	1	1
Average, nine years - -	3,644	79	21·6	0·51	0·27	3·13	0·06	0·42	0·66	1·30
England and Wales	—	—	21·6	0·27	0·37	0·73	0·12	0·55	0·51	0·87

Rates per 1,000 population per annum.

Corrected for workhouse deaths, the average death-rate for the past nine years is 21·9. This, though scarcely above the average rate for the whole of England and Wales, is considerably higher than the death-rate should be in a district which, though urban in name, is practically rural, with on an average nearly an acre of land to each person. The death-rates from small-pox, fever, diarrhoea, and especially scarlet-fever—diseases all more or less preventable—are above the average, showing that there is need for the vigorous exercise on the part of the Sanitary Authority of the powers with which the Legislature has invested it for the protection of the public health.

Summary.—The following are the main facts brought out by the investigation:—

(1.) Scarlet fever, a disease endemic in, or rarely absent from, the sub-district, prevailed as an epidemic in 1879–80, the development of the outbreak probably depending upon the accumulation of susceptible subjects during the two previous years of comparative quiescence. The propagation of the disease was effected by personal intercourse, favoured by the carelessness and indifference with regard to infection which prevail among the labouring class.

(2.) "Fever," chiefly enteric, is unduly prevalent in the sub-district, the local conditions favouring its occurrence, viz., defective drainage, contaminated drinking water, and offensive accumulations of excremental filth, being generally present throughout the places visited.

(3.) The mortality in the sub-district from diarrhoea, which occurs especially among infants, is excessively high, the death-rate from this disease being more than double that for England and Wales. This high mortality appears to be due to two classes of causes, viz.:—

(a.) The pervading presence of filth in the neighbourhood of the houses, contaminating the air and drinking water.

(b.) The frequent neglect and mismanagement of children, especially in the matter of improper and unwholesome food.

(4.) In all the three urban districts included within the Castleford sub-district, the sanitary condition was found gravely defective, more especially as regards the following matters:—

(a.) *Sewerage*.—Methley is entirely unsewered. Castleford has been provided with main sewers, and at Whitwood sewers are in course of construction, but few of the houses in either district are connected with the sewers. Nuisances from defective drainage were common in all three districts.

(b.) *Surface Cleanliness*.—In all three districts this is very defective, the surface of private streets and yards not having been levelled, coated with proper materials, and provided with means for the removal of surface water.

(c.) *Water Supply*.—Castleford has a public supply, but it is not laid on to all the houses. About a third of the inhabitants of Castleford and the whole of those of Whitwood and Methley derive their water supply from shallow wells and other sources liable to contamination.

(d.) *Excrement Disposal*.—Except in Castleford, where an abortive pail-system is in partial use, this is effected solely by midden privies of a very offensive description.

(e.) *Abatement of Nuisances*.—In all the districts, but especially in Methley, the action of the Sanitary Authorities in this respect is very insufficient.

(f.) *Infectious Diseases*.—In none of the districts are these dealt with in an efficient manner.

H. FRANKLIN PARSONS.

Recommendations.

CASTLEFORD URBAN DISTRICT.

1. As soon as circumstances permit, the system of sewers should be completed so as to afford efficient sewerage to all parts of the town.
All house premises should be drained into the sewers by properly constructed drains. All cellars in which water lodges should be effectually drained, care being taken that the drains are so constructed as to prevent the entrance of foul air into the cellar.
2. So soon as practicable, the Sanitary Authority should cause all private streets within their district which are in bad condition to be sewered, levelled, paved, metalled, and made good.
The surface of courts and yards should be paved with proper materials, laid at a suitable inclination to a drain so as to run dry.
3. The public water-supply of the town should continue to receive the care and attention of the Authority with the view of maintaining and, if deemed necessary or expedient, improving the quantity and quality of the supply. Practices which may endanger the purity of the water should not be permitted.
4. All houses in the district which are without a sufficient and wholesome supply of water should be provided with one. All wells and cisterns of doubtful purity should be examined, and if found to be polluted, should be closed in such a manner as to prevent them from becoming a source of nuisance.
5. The Sanitary Authority should consider whether some system of excrement disposal, free from the objections attaching to the use of midden privies, could not be found which should be applicable to the circumstances of Castleford. Instead of abandoning the pail system, they would do well to endeavour rather to improve it by obviating those objections which attach, not to the principle of the system, but to the defective way in which it has hitherto been worked.

They will find it useful to consult the Local Government Board's report "On certain Means of preventing Excrement Nuisances in

- Towns and Villages," and also to visit places in which improved systems of excrement disposal are in successful operation.
6. The abatement of nuisances, excremental and other, should be carried on with vigour, and where these are of a kind to require structural works for the prevention of their recurrence, the Authority should take steps to cause such structural works to be carried out.
 7. The condition of the slaughter-houses should receive attention, and such structural alterations should be enforced as may be required for the prevention of nuisance.
 8. The Medical Officer of Health should receive immediate notice of all deaths from infectious disease.
 9. The Authority should have in readiness some accommodation for the lodgment and isolation of cases of infectious disease.
 10. Houses in which infectious sickness has occurred should on the termination of such sickness be disinfected with burning brimstone or other effectual method; the wall papers should be removed, and the walls lime-washed.
An apparatus should be provided for the effectual disinfection by heat of infected clothing and bedding, with means for the transmission of such articles thereto without risk to the public.
 11. The byelaws should be revised on the lines of the Model Byelaws issued by the Local Government Board.

WHITWOOD URBAN DISTRICT.

1. As soon as the system of sewers is completed, all houses in the district which are within the prescribed distance should be connected with it by properly-constructed branch drains.
2. The surface of courts and back-yards, whether appertaining to one house or more, should be properly laid with suitable materials, and they should be provided with means for carrying away the surface water.
3. The Authority should secure for the district without delay a supply of wholesome water laid on in pipes at a constant pressure.
All houses within the district which are without a sufficient and wholesome supply of water should be provided with one. All wells and other sources of water which are of doubtful purity should be examined, and if found to be polluted should be closed, or their use for dietetic purposes prohibited.
4. The Authority should consider what system of excrement disposal will be best suited to the requirements of the district in place of the present noisome midden-privies, in which matter they should consult the Local Government Board's Report "On certain Means of preventing Excrement Nuisances in Towns and Villages."
When an improved system has been decided on, it should be required to be adopted for all new privies, and all old midden-privies that are in such a state as to be a nuisance should be required to be altered in conformity with it.
Privy-middens, if allowed to exist, should be reduced to the smallest practicable size, and should be so constructed as to be watertight and exclude extraneous moisture, and to allow of the daily covering of excreta with ashes. Arrangements should be made for the frequent removal of privy refuse.
5. The byelaws should be revised; in doing this the Authority should study the Model Byelaws issued for the guidance of Local Authorities by the Local Government Board.
6. The Medical Officer of Health should be furnished with immediate notice of all deaths registered as caused by infectious diseases.
7. Houses in which infectious disease has occurred should be visited by the Medical Officer of Health, and the occupiers should be advised what measures to take to prevent the disease from spreading.

When the sickness is over the house should be effectually disinfected. An apparatus should be provided for the disinfection by heat of articles of bedding and clothing.

8. Provision should be made for the isolation of cases of infectious disease in accordance with the principles set forth in the Departmental "Memorandum on Hospital Accommodation to be given by Local Authorities."

METHLEY URBAN DISTRICT.

1. The Sanitary Authority should without delay take steps to provide their district with efficient sewerage; and in this matter they will do well to take the advice of a competent engineer. When sewers have been provided, the owners of all houses situated within the prescribed distance should be compelled to drain their premises into them by proper branch drains of such construction as not to contaminate with foul air the atmosphere in and around the houses.
 2. Measures should be taken for the improvement of the surface drainage, especially of common yards and back premises.
 3. The Authority should without delay take steps to procure for their district a supply of wholesome water laid on under constant pressure. They should cause all wells which there may be reason to suspect to be contaminated to be examined, and if found polluted, to be made safe against contamination or to be closed.
If the Urban Sanitary Authority on due consideration are of opinion that it would be advantageous to them to be invested with the powers with respect to water-supply conferred on Rural Sanitary Authorities by the Public Health (Water) Act, 1878, they should make application to the Local Government Board to that effect.
 4. The present highly objectionable midden-privies should be abolished, and some better system substituted. The question as to what system will be best suited to the requirements of the district should receive the careful consideration of the Authority, and in coming to a decision they will do well to consult the Local Government Board's Report "On certain Means of preventing Excrement Nuisances in Towns and Villages."
Privy middens, if allowed to exist, should be reduced to the smallest practicable size and should be so constructed as to exclude extraneous water, and to allow of the daily covering of excrement with ashes. No connexion between the middens and the drains should be allowed.
 5. The Sanitary Authority should give their earnest attention to the abatement of the many grave nuisances existing within the district, and to this end should cause diligent inspection of it to be made, and should enforce the abatement of all nuisances injurious to health which may be discovered within it.
Where nuisances are caused or aggravated by the want or bad construction of structural appliances, or are of a kind likely to recur, the Authority should not be content with the mere abatement of them for the time being, but should require, and if necessary seek for magistrates' order to enforce, the execution of such works as may be necessary to prevent the recurrence of the nuisance.
 6. The Medical Officer of Health should be furnished with immediate notice of all deaths from infectious disorders.
 7. All houses in which infectious sickness has occurred should be disinfected by sulphur fumigation or other effectual method. Means should be provided for the effectual disinfection by heat of clothing and bedding which have been exposed to infection.
 8. The Sanitary Authority should, either alone or in conjunction with other Authorities, have in readiness some accommodation for the isolation of persons suffering from infectious disease. The permanent accommodation need not be of a costly nature; and for the principles which should guide them in deciding on its nature the Authority should consult the Board's memorandum on the subject.
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APPENDIX.

The following is a copy of an analysis of the Castleford town water made by Mr. Fairley, F.C.S., Borough Analyst of Leeds.

REPORT ON ANALYSIS OF WATER received from the CASTLEFORD LOCAL BOARD,
March 13th, 1879.

The water contains in grains, per gallon:—

Chloride of sodium	-	-	-	-	-	10·25
Nitrates of lime, &c.	-	-	-	-	-	None
Salts of lime and magnesia, volatile and organic matter	-	-	-	-	-	35·25

Total solid matter - 45·50

(1) Containing ammonia	-	-	-	-	-	·0084
" also organic ammonia	-	-	-	-	-	·0033
Corresponding to nitrogenous organic matter, about	-	-	-	-	-	·033

The chlorides and total solids in this water are large, but the proportion of organic matter shows that in its present state the water may be safely used for drinking.

16, East Parade, Leeds,
March 21st, 1879.

THOMAS FAIRLEY.

LONDON:

Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

[13889.—260.—5/80.]