been, and slightly displaced downwards and inwards; and that there was still no pain in the parts.

On the 12th, some purulent discharge escaped for the first time from the left ear; there was, however, no ear-ache or deafness. The temporal swelling was somewhat smaller. The protrusion of the eyeball had increased, and the swelling in its vicinity was larger, redder, and more distinctly fluctuating. A day or two afterwards the swelling was punctured with a fine trocar and cannula, but no fluid escaped.

On the 20th, I remarked that the swelling above the eye had become larger, but that the eye was somewhat less prominent; that pus had continued to escape from the left ear, and that the temporal swelling had almost disappeared; and that the child had for some days been able to move its legs freely, but that they were liable to become rigid and to tremble convulsively.

About this time, however, the child's temperature began to rise, attaining on one occasion an elevation of 103.4°; her appetite fell off, and her health began to fail. She complained at first of nausea, and soon was sick after everything she took, and rapidly lost flesh and strength. She still had no pain or tenderness in the back, and still retained the power of moving her legs voluntarily. She was now fed with nutrient enemata.

July 30th. She had a very restless night, calling and crying out constantly. She was apparently sensible, but spoke very indistinctly. Her pupils were dilated, equal. There was no paralysis of the face or arms. She had no discharge from the ear this morning. The swelling above the eye fluctuated. Temperature normal.

July 31st. She slept well and did not cry out all night. She had taken no food by mouth, and had been sick only once after medicine. She was drowsy. She put out her tongue when told; it was thickly furred. The left pupil was larger than the right. She had no pain in the head. Temperature normal. In the evening she was about the same. Pulse, 108; respirations, 24; temperature, subnormal. There was no pain in head, and no sickness nor discharge from the ear that day. There was no facial or ocular paralysis, but the tongue deviated distinctly to the left.

August 1st. She was much weaker. Her tongue was dry, protruded to the left. The pupils were equal. Pulse, 108; respirations, 36, attended with much rattling in the throat. Some hours later (at 1.30 P.M.) she had not spoken, but seemed sensible. The left pupil was more dilated than the right, and was unaffected by light. The tongue deviated distinctly to the left. The swelling above the eye fluctuated. There was no sickness, no fits. She waved her arms about, and picked at her nose; and had occasional twitchings of the muscles of the shoulder and back. The *tache cérébrale* was readily obtained. Pulse, 120; respirations, 30, attended with rattling in the throat. There was no sickness, nor discharge from the ear. She died shortly afterwards.

Post Mortem Examination.—The body was much emaciated. The left eyeball projected. There was ecchymosis of the corresponding upper eyelid. The left temporo-sphenoidal lobe of the brain was firmly adherent to the greater wing of the sphenoid bone and to the posterior border of the lesser wing. The arachnoid at the base of the brain was a good deal thickened, and of an opaque yellow colour. Surrounding the vessels of the base, and especially along the fissures of Sylvius and connected with the duplicatures of pia mater in the adjoining sulci, were numerous minute grey tubercles. There was great increase of sub-arachnoid fluid, but in all other respects the membranes were healthy. The ventricles were slightly distended with fluid. The substance of the left temporo-sphenoidal lobe was considerably softened, and was readily broken up by a stream of water. But there was no abscess; and the brain-substance, with this exception, was healthy. The nerves at the base were apparently healthy. In the left orbit, the upper and outer osseous boundary (including the orbital plate of the frontal, the greater wing of the sphenoid, and the orbital portion of the malar bone) was partly stripped of periosteum, carious, and bathed in a considerable accumulation of thick matter. There was also a collection of cheesy pus under the left temporal muscle, connected with denudation and caries of the portion of the sphenoid here situated. The bodies of the third, fourth, and fifth dorsal vertebrae were largely destroyed by caries; the pedicles of the same vertebrae were carious and brittle; and the laminae of the third and fourth were also involved. The bodies of the vertebrae were comprised in an abscess, extending from the second to the sixth vertebra, occupying the posterior mediastinum, but not affecting in any degree the adjoining pericardium and pleurae. The affected portions of the vertebrae bounding the spinal canal were also bathed in pus, which was chiefly accumulated in front between the bodies of the vertebrae and the dura mater of the spinal cord. The anterior and posterior common ligaments were partly destroyed. The accumulation had evidently caused some pres-

sure on the spinal cord. The dura mater was adherent at one point to the vertebrae; but the membranes were in the main healthy. The portion of cord corresponding to the diseased vertebrae was very pulpy. The rest of the cord appeared healthy. There was a little early inflammation at the base of the right lung; but no tubercles were discovered in the lungs or any other organ. The remaining thoracic and abdominal viscera, including the kidneys and bladder, were healthy. No disease of the temporal bone was discovered; nor was the communication (which doubtless existed), between the abscess under the temporal muscle and the external auditory meatus, traced.

REMARKS.—The facts which one or two of my cases seem to illustrate, and which I could have illustrated more fully had that been my sole, or even main, object, namely, that there is a period in the early progress of cerebral tuberculosis in which the presence of cerebral mischief is not revealed by symptoms; and that the symptoms which attend the presence of meningeal tubercles are, for the most part, due less to the tubercles themselves than to the inflammation which sooner or later accompanies them; suggest a question of no little importance, which I should have liked to discuss had I not already taken up fully as much of your time as, on the present occasion, I have any claim to do. The question is whether the progress of cerebral tuberculosis, like that of pulmonary tuberculosis, admits of being arrested; and whether, too, the cure of tubercular meningitis, that is, of tubercle with its inflammatory complication, is within the range of practical therapeutics. The first half of the question is, of course, exceedingly difficult to solve. It may be observed, however, in reference to it, that tubercular tumours are, judging from their clinical history, often very chronic in their progress, extending, it may be, over several years; and that occasionally the membranes of the brain seem, judging from *post mortem* examination, to be the only part of the body affected with tubercle. Both of these are facts comprising an element of hope as to the latter half of the question. I may say for myself that I have, on several occasions, had patients under my care, or have seen them in consultation, in whom the history and symptoms rendered it almost certain that they were suffering from tubercular meningitis, but in whom recovery took place. That the patients recovered from meningitis of the base was certain; but whether from meningitis the consequence or accompaniment of tubercle, I have never (fortunately or unfortunately, according to the point of view from which one regards it) had the opportunity of placing beyond doubt. At any rate, the belief that we may, even though very rarely, check the progress of cerebral tubercle, and cure the inflammation of tubercular meningitis, is calculated to encourage us in our dealings with such cases, and to justify us in persisting in reasonable treatment, and in hoping against hope.

THE DIAGNOSTIC VALUE OF THE DISCOVERY OF KOCH'S BACILLI IN SPUTUM.

Read in the Section of Medicine at the Annual Meeting of the British Medical Association, 1883.

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HAVING completed a series of observations on the sputa in 110 cases of diseases of the chest, with a view to ascertaining the presence of Koch's bacilli, I have thought it well to publish the results, not because the number is sufficient to justify any broad generalisations, but because practical contributions to the subject appear to be needed. My observations have been made almost exclusively at the Royal Chest Hospital, where I had abundant opportunities of obtaining specimens under favourable conditions, and of discovering the precise condition of the patient. In every instance, all important particulars of symptoms and physical signs were entered in a note-book at the time of examination, and the further history of the individual was added subsequently, when it could be ascertained; and, in a very large number of the cases (especially those in which the result was negative at first), the experiment was repeated several times.

It may be well to state, by way of preface, that the value of these and all similar observations depends wholly upon a staining reaction. It is practically impossible for clinical observers to repeat the steps of Koch's well known experiments; and therefore, to identify the "pathogenic" organisms, we are obliged to content ourselves with certain staining methods by which, it is said, the "bacillus of tubercle" alone is coloured.¹ For I think it must be confessed that (except in their staining reaction) there is nothing obviously characteristic in the appearance of these bacilli. It is possible that a very wide experience

¹ Alone; that is, among organisms occurring in sputum.

might enable an observer to detect some distinctive features; but those who do not possess such experience, and yet are familiar with the great variety of rod-shaped bodies of all sizes which abound in decomposing albuminous matter, and which seem to be constantly present in the mouth and pharynx, will be slow to venture on any identification of species from a mere consideration of dimension or shape. The same bacteria seem to be capable of assuming various appearances under various conditions. Again, it is evident that a mere series of staining experiments upon sputa can throw no light whatever upon the important question, whether the presence of certain bacilli in the body is the true and only cause of a particular disease. But, though the scope of our inquiry is thus limited, it is clear that we may attain to important results in the course of extended observations. If, for instance, it should be proved that bacilli staining in a particular manner occur invariably in the sputa, etc., of one disease, and never occur elsewhere, we should have reason to be satisfied with our staining method² as a reliable means of diagnosis, although such experiments alone would not justify us in making any positive assertions as to the specific character of the organisms, or their precise relation to the disease in question.

In list A, which includes the sixty-five cases in which bacilli were found in the sputa, an extremely condensed report is given of the diagnosis of the disease by symptoms and physical signs; the progress or termination of the case is added; and, when a very unusual number of bacilli were observed, the fact is recorded. The cases are thrown together roughly in a certain order; thus the first fifteen are instances of the last stage of pulmonary phthisis; Nos. 16 to 46 are less advanced cases, in which, however, there could be no question as to the nature of the disease; and the remainder are either examples of incipient phthisis, or cases in which the diagnosis was very doubtful at the time of examination.

Since it is evidently of great importance to ascertain the truth of the statement that these bacilli do not occur in the sputa of other diseases besides phthisis, I have added in list B a list of the cases in which I have searched for them in vain. It will be readily understood that the two lists have not a precisely equal value. Of all the cases in the first list, the positive assertion can be made that bacilli were present, while of those in the second, I can only say that I did not find them. It is, of course, impossible to state absolutely that they did not exist in some part of the expectoration not examined. The cases in list B are so various, that no attempt at classification has been made. It is to be regretted that, many of the persons examined being out-patients who ceased attending at the hospital after a few weeks, it was impossible, in a large number of instances, to observe the progress of the case, or to ascertain its termination.

A.—Cases in which Bacilli were found in the Sputa.

1. Female, aged 20, advanced phthisis. Died soon afterwards; diagnosis confirmed *post mortem*.
2. Male, 38, acute phthisis; stated duration five weeks large vomicae. Died. Diagnosis confirmed *post mortem*.
3. Male, 27, empyema, chronic phthisis, vomicae. Diagnosis confirmed *post mortem*.
4. Female, 36, chronic phthisis, advancing excavation. Died three months afterwards. No *post mortem* examination.
5. Male, 22, phthisis far advanced; swarms of bacilli; died in a fortnight; no *post mortem*.
6. Female, 23, chronic phthisis, extensive excavation; bacilli very numerous. Died in a month; no *post mortem*.
7. Male, 32, chronic phthisis, vomicae at both apices. No longer under observation.
8. Male, 39, chronic phthisis, advanced; swarms of bacilli; died in ten days. *Post mortem*, very extensive excavation.
9. Male, 35, chronic phthisis, advanced; swarms of bacilli. Patient left hospital in a dying condition.
10. Female, 30, acute phthisis, vomica. Died a week afterwards; no *post mortem*.

² In these experiments, I have always used Ehrlich's method or Heneage Gibbs' modification. The possible sources of error in the examination of sputa are so evident that it is only necessary to refer to them briefly in a note. In dealing with the contents of the air-passages, it is impossible, for obvious reasons, to adopt the precautions which are usual in investigations about micro-organisms. If it be the case that the "tubercle-bacillus" exists in phthisical breath and in the atmosphere, it is clear that we cannot be absolutely certain that specimens occurring in sputum have not been accidentally introduced from without; they may have been inhaled by the patient, and subsequently expectorated, or they may have fallen on the sputum just after expectoration, or at any time before staining. So long as this is the case, we must avoid speaking too positively of our results. Practically, however, it is safe to assert that this mode of introduction must be rare, and that, when bacilli are found in at all large numbers in a particle of sputum, it is in the last degree improbable that they can be mere accidental intruders.

11. Male, 38, chronic phthisis, advanced. Died in a month. *Post mortem*, extensive fibroid changes in upper lobes, small cavities; acute tubercular formations; lardaceous disease.
12. Male, 16, chronic phthisis; much excavation. Left hospital worse.
13. Male, 21, chronic phthisis, large vomicae in one lung; swarms of bacilli; becoming gradually worse.
14. Female, 14, chronic phthisis, with probable acute changes; vomicae. Died in a fortnight; no *post mortem* examination.
15. Female, 27, advanced phthisis of two years' duration; frequent hæmoptysis. Died in three months; *post mortem*, lungs riddled with cavities.
16. Female, 25, chronic phthisis; small vomicae in left lung. No change whilst under observation.
17. Male, 32, chronic phthisis, probable vomicae; very little fever; swarms of bacilli. Discharged better.
18. Female, 35, chronic phthisis. Improved.
19. Female, 9, consolidation of upper left lobe after empyema. No longer under observation.
20. Male, 29, chronic phthisis, probable small vomicae in left lung; bacilli numerous. No longer under observation.
21. Male, 38, chronic phthisis, bronchitis. Worse when last seen.
22. Male, 40, "senile" phthisis, extreme general degenerative changes, slow emaciation, no severe chest-symptoms, small crepitations at one apex, bacilli very numerous. Still under observation.
23. Male, 31, chronic phthisis. No marked change during several months.
24. Male, 36, phthisis; one year's duration; disorganisation at both apices, bacilli numerous. Died two months after leaving hospital.
25. Male, 15, phthisis, apparently acute, vomica in one lung, bacilli numerous. Severe symptoms subsided, and patient left hospital better.
26. Male, 21, phthisis, apparently acute. Only a short time under observation.
27. Male, 18, diabetes, signs of advancing lung-disorganisation. Becoming worse.
28. Female, 19, chronic phthisis, signs of vomica in one lung, but little fever. Improved.
29. Female, 32, acute phthisis. Still under observation.
30. Male, 36, chronic phthisis. Improved.
31. Male, 29, chronic phthisis, vomicae; bacilli very numerous. No longer under observation.
32. Male, 20, chronic phthisis, much pyrexia, other symptoms not severe. Improved.
33. Female, 33, chronic phthisis, bronchitis. Improved.
34. Female, 19, chronic phthisis, vomicae. Improved.
35. Female, 33, chronic phthisis. Improved.
36. Male, 18, signs of consolidation at left apex, no symptoms of severity. Still under observation.
37. Male, 36, chronic phthisis. Under observation for several years; old vomica.
38. Male, 28, acute phthisis. When last seen, becoming rapidly worse.
39. Male, 28, phthisis mainly laryngeal, dulness and fine crepitations at left apex. Still under observation.
40. Female, 23, chronic phthisis, signs of disorganisation limited to one apex. Improved.
41. Male, 28, chronic phthisis, small vomicae. No marked change.
42. Male, 49, chronic phthisis of very old standing; under observation for several years; retraction at apices, probable small cavity left side, emphysema. No fever, no loss of flesh during the last year. Swarms of bacilli. Still under observation.
43. Female, 24, chronic phthisis, symptoms for a year, but little fever, probable small cavity left apex. Bacilli very numerous. Improving.
44. Male, 31, chronic phthisis, symptoms for five years, much retraction of lungs. Still under observation.
45. Male, 35, chronic phthisis, small cavities. Still under observation.
46. Male, 46, phthisis probably acute; hectic; slightly impaired resonance and crepitations after coughing, at one apex. Bacilli very numerous. Still under observation.
47. Male, 19, phthisis apparently very early; ailing for some months; no symptoms of severity; signs of loss of elasticity at apex of right lung. Swarms of bacilli. Still under observation (three weeks after first examination), no marked change.
48. Male, 41, incipient phthisis. Still under observation.
49. Male, 50, "quite healthy" till two months ago; a good deal of

fever, anorexia, and emaciation; suspicious signs at apices. Improving somewhat under treatment.

50. Male, 42, acute pleurisy a month ago, ill defined signs of change at apex. Still under observation.

51. Male, 32, incipient phthisis; no noticeable change lately.

52. Male, 24, bronchial catarrh, suspicious signs at one apex. Since first examination, definite signs of phthisis have developed.

53. Male, 23, early phthisis? Signs doubtful: occasional slight hæmoptysis during the four months of his attendance at hospital; some loss of flesh. Bacilli not found till recently. (Diagnosis has become certain since.)

54. Male, 49, chronic change at one apex (impaired resonance and rough breathing), no fever or other important symptoms. No longer under observation.

55. Male, 39, chronic bronchitis and emphysema; change of old standing (possible cavity) at right apex. Bacilli very numerous. Improved.

56. Male, 30, subacute bronchitis; note flat at one apex; very little fever. No change whilst under observation.

57. Male, 40, empyema, doubtful signs of disease at apex of opposite lung. Gaining flesh since free opening of empyema. Temperature not normal.

58. Male, 35, acute pleurisy with effusion, suspected phthisis. Left hospital.

59. Male, 42, incipient phthisis. No longer under observation.

60. Female, 39, general bronchitis, obscure signs of change at right apex, emaciation. (A positive diagnosis of phthisis has since been given.)

61. Male, 48, chronic bronchitis and emphysema. Improved under treatment, but, when last seen, there were definite signs of phthisical mischief at the apices.

62. Male, 38, acute pneumonia of left base; ill for eight weeks before examination; imperfect resolution, continued pyrexia, night-sweats. Left hospital with signs of disease at base and apex.

63. Male, 26, early phthisis, distant breathing, and obscure crepitant sounds at right apex. Losing flesh recently.

64. Female, 19, cardiac disease congenital? Doubtful changes in lungs. Loss of flesh. Evening temperature elevated. Still under observation.

65. Female, 32, chronic bronchitis, early change at one apex.

b.—Cases in which no Bacilli were found in the Sputa.

1. Female, aged 12, emphysema, bronchial catarrh, cyanosis. Died suddenly; no *post mortem*.

2. Female, 66, pleural effusion (blood-stained), consolidation of apex of lung; frequent hæmoptysis; emaciation. *Post mortem*. Mediastinal cancer invading lung.

3. Female, 56, chronic bronchitis. Discharged relieved.

4. Male, 30, chronic disease of right lung, probably phthisical; examination soon after severe hæmoptysis. No longer under observation.

5. Female, 30, subacute bronchitis. Relieved.

6. Male, 39, a few days after severe hæmoptysis, physical signs of limited consolidation at left base; no fever. Discharged relieved.

7. Male, 39, acute pneumonia, left base. Recovered.

8. Male, 22, chronic pleural effusion; operation; high irregular temperature; death from pyæmia; no phthisical changes in lungs found after death.

9. Male, 13, pyrexia, catarrh, suspicion of tuberculosis. Recovered.

10. Male, 21, slight hæmoptysis, no definite signs of disease. No further symptoms developed.

11. Male, 5, empyema, bronchitis. Cured.

12. Male, 48, doubtful changes at apices; suspicion of early phthisis. No longer under observation.

13. Male, 33, acute pleurisy, bronchitis. Relieved.

14. Male, 30, chronic bronchial catarrh, signs of consolidation at apices? No change whilst under observation.

15. Male, 57, consolidation with retraction of right apex; no fever. No longer under observation.

16. Male, 33, early phthisis; sputum very scanty. Became worse. No longer under observation.

17. Male, 62, right pleurisy, suspicious sounds at apex; no fever. No marked change in condition.

18. Female, 28, mitral regurgitation, bronchial catarrh, emaciation. Improved.

19. Male, 41, chronic bronchitis. No change.

20. Female, 38, chronic interstitial pneumonia with great retraction, and displacement of organs. No longer under observation.

21. Male, 23, endocarditis, high irregular temperature, suspected

change at one apex. *Post mortem*, acute endocarditis, pleural adhesions.

22. Female, 28, chronic bronchitis. Improved.

23. Female, 17, slight morning hæmoptysis, source uncertain; some bronchial catarrh. Symptoms disappeared.

24. Female, 53, anasarca, dilated heart, cyanosis, patches of consolidation in lungs. *Post mortem*, granular kidneys, endocarditis, acute lobular pneumonia.

25. Male, 39, subacute bronchitis. Discharged cured.

26. Male, 25, slight hæmoptysis. Still under observation: no signs of disease.

27. Female, 53, chronic bronchitis and emphysema. Still under observation.

28. Male, 67, emphysema, probably dilated bronchi, consolidation at one apex (old damage? history of hæmoptysis 14 years ago). Still under observation, improving.

29. Female, 37, emphysema, retraction of one apex; cough for many years. Still under observation.

30. Male, 22, slight hæmoptysis, bronchial catarrh. Symptoms disappeared.

31. Male, 43, acute pleurisy, bronchitis. Relieved.

32. Male, 34, acute pleurisy, bronchitis. Relieved.

33. Female, 33, old change at one apex, no symptoms of gravity. Still under observation.

34. Male, 20, chronic bronchial catarrh with very copious secretion. Still under observation.

35. Male, 6, broncho-pneumonia right base. Still under observation, recovering.

36. Male, 37, emphysema, probable fibroid changes in lungs. Discharged relieved.

37. Female, 38, chronic bronchitis, extreme emphysema, old change (fibroid) at one apex. Still under observation.

38. Male, 26, diabetes, bronchial catarrh; no evidence of pulmonary disease. Still under observation.

39. Male, 45, emphysema, some condensation and signs of possible cavity in right lung (bronchiectatic?). Attending hospital for several months, improving in all respects. No fever.

40. Female, 41, thoracic aneurysm, some bronchial catarrh.

41. Male, 45, dilated heart, tricuspid regurgitation, emphysema.

42. Female, 50, mitral stenosis, pulmonary congestion.

43. Female, 66, chronic bronchitis.

44. Male, 18, acute bronchitis. Recovering.

45. Male, 29, acute pleurisy with effusion; high fever, subsiding.

It is, I should think, almost impossible for anyone to carry out a methodical series of examinations such as those detailed, without becoming convinced that the presence of Koch's bacilli in the sputa has an intimate connection with that morbid condition (or those conditions) known as pulmonary phthisis. What the nature of the connection may be, whether the bacilli are the cause or products of the disease, is (as already stated) altogether beyond the scope of this inquiry, which deals only with the diagnostic value of the discovery of the organisms. The broad result of the above experiments is this: the great majority of specimens of bacilli-containing sputa were from undoubtedly phthisical patients, and the remainder from persons who, in all probability, suffered from the disease; while the specimens of sputa free from bacilli were, as a rule, from cases where the lungs were either healthy or affected by some totally distinct morbid process. The few exceptions to this latter assertion, and the instances in which the bacilli were repeatedly sought for in vain, and at length found at some later period, lead me to the conclusion that, while the presence of these organisms is, in all probability, positive evidence of phthisis, their absence under certain circumstances does not negative the existence of the disease. The question of the precise nature of the phthisical change in the different cases in List A has been purposely avoided, since no useful object would seem to be gained by assigning disputed titles, such as "bronchopneumonic," "fibroid," and "tubercular." For the present purpose, at all events, pulmonary phthisis may be considered as one disease—the disease which, with great variations in its mode of onset, and the acuteness of its course, tends to attack both lungs, commences with localised consolidation, passes on to softening and excavation, is attended by the train of symptoms known as "consumption," and presents certain common appearances after death.

I may observe, in passing, that List A certainly comprises cases which would be considered examples of different diseases by those who hold the view that more than one affection is included in the clinical term phthisis. If it should be demonstrated that the bacilli are the essential elements of tubercle, and stand in a causal relation to the change, then, of course, these and similar experiments would go a long way towards proving the unity of the disease.

It has been just observed that, under certain circumstances, bacilli are not found in phthisical sputa. So far as my experiments entitle me to give an opinion, these circumstances are mainly as follows. 1. If a patient be directed to cough and expectorate, very commonly the result of the examination will be negative. It would seem that such purely voluntary expulsive efforts may merely dislodge the secretion of the larynx and neighbouring parts, and may fail to bring to light bacilli existing in the deeper air-passages. In all cases, it is well to wait for natural expectoration, that is, to wait till the natural upward movement of the contents of the tubes has caused such an accumulation as to excite the reflex action of coughing. It is needless to say that this is sometimes quite hopeless; in certain cases, there is no natural expectoration, the cough is "dry." I lately made a *post mortem* examination on a patient who died of acute pulmonary tuberculosis, who never expectorated during her illness; in the secretion of the bronchi there were many bacilli; during life, the disease could never have been diagnosed by their means. 2. There is reason to believe that, at a certain stage of phthisis—a very early stage—bacilli are not present in the sputum. My impression is that they do not appear till there is some actual breaking-down in the lung, but I cannot prove this.³ 3. The existence of general bronchial catarrh in a severe form may render it difficult to find the organisms. On several occasions, I have failed to discover them in patients with advanced phthisis whilst suffering from this complication. Provisionally, we may accept the explanation that the bacilli are so widely separated by the abundant bronchial secretion, that one may examine a good deal of the sputum without happening to light upon a specimen.

Some writers have gone so far as to assert that it is possible to ascertain the amount of lung-damage, and even to venture on a prognosis, by observing the number of bacilli present in the expectoration. I can scarcely think that our present methods are exact enough to warrant such deductions. It should be remembered that the thin layer of sputum on a slide is a quite infinitesimal portion of the whole expectorated; and unless the organisms were equally distributed throughout the mass (and they certainly are not), it would be obviously rash to attempt to judge of the quantity in a patient's lungs or secretions by examining three or four, or even thirty or forty such samples. The particles of sputum selected might be comparatively free from bacilli, while neighbouring particles might swarm with them. On the whole, it must be acknowledged that there are very many sources of error and uncertainty in the test. Nevertheless, it seems to me to be true that the bacilli are seldom, if ever, found in such large numbers in the sputa of early phthisis as they are after the formation of vomica. I have only once seen what I call "swarms" in the table, where there was no reason to suspect actual excavation; and in that case (No. 47) I should be slow to deny the possibility that the disease may have advanced so far.

On the other hand, I have examined many cases of extensive excavation, and discovered only very few bacilli. Moreover, the finding of "swarms" seems to me to reveal nothing about the extent of the morbid process or its acuteness. Cases 17, 22, 42, 43, and 55 show that immense numbers may exist in instances where there is limited excavation, little constitutional disturbance, and, on the whole, a good prognosis. The grouping of the bacilli in densely aggregated masses, which has been lately described as a matter of consequence, seems to me to be of equally uncertain significance. The observations of Balmer and Fräntzel about the prognostic importance of the degree of development (size, segmentation, spore-formation) of the bacilli require confirmation; and I must add that there is reason to believe that some apparent differences in form may be due to slight differences in the method of preparation.

What value, then, are we to attach to the discovery of these organisms as a means of diagnosis? Probably the majority of phthisical patients, when they come under observation, present such characteristic signs and symptoms, that testing of the sputum is practically unnecessary. But there are certain chest-diseases which simulate phthisis, and in which the signs and symptoms may mislead a practised observer; and there are forms of phthisis in which the diagnosis must be always doubtful. I need only refer to the difficulties met with in malignant disease of the lung, chronic pleurisy, chronic pneumonia, bronchiectasis, incipient phthisis, phthisis, with extensive bronchitis masking the physical signs, and phthisis, with deep-seated changes obscured by surrounding emphysema. If we find bacilli in the sputum, we may venture on the diagnosis of phthisis. If we do not find them, we cannot.

³ How far the case may be altered in tubercular laryngitis, I cannot say; I have had no opportunity of examining the sputum in this disease, except when there were well marked pulmonary changes. By "actual breaking-down in the lung," I do not mean that such coarse lesions are necessary as give rise to obvious signs of disorganisation; probably very minute foci of liquefaction are sufficient.

not absolutely deny the existence of the disease. But if we do not find them, after repeated searches under favourable conditions, in a case where there are definite signs of lung-damage, or in a case where the disease has lasted so long that, if it were phthisis, we might reasonably expect disorganisation somewhere, then we are justified in suspecting that some other process is at work, or that the phthisical process has been arrested.

The conclusions that may be drawn from the experiments above recorded may be thus summarised.

1. Koch's bacilli occur in the sputa of pulmonary phthisis, acute and chronic, in all its forms.
2. They do not occur in the sputa of other common diseases of the chest.
3. They may probably be found in every case of phthisis which has advanced to the stage of breaking down of tissue.
4. The discovery of very few bacilli in the sputum conveys no certain information as to the gravity of the case. Their occurrence in enormous swarms in all probability denotes excavation.

FOOD AND RICKETS.

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THE part which artificial food plays in the production of rickets has always been insisted upon, and by most authors it is regarded as the primary and chief, not to say sole factor, in the production of this now widely spread affection.

The writer of this present paper, while fully conceding the importance of a suitable diet for young infants and children, cannot but feel that the constitutional factors are a little too much left out of consideration, and that a sufficient value is not placed on the growing influence of heredity in the production of rickets; he believes, until these circumstances are more fully recognised and acted upon, that infantile rickets will develop in increasing proportions, and that, as a consequence, our improved sanitation and hygienic institutions notwithstanding, infantile mortality will become even greater than it is at present; and this, too, from causes which must be classed as preventable.

Rickets occurs very widely, and under very different social conditions; about the only point which can be said to affect all children alike is the matter of nursing, using the word, of course, in its widest sense, and including under it not merely suckling, but maternal care generally. Nature clearly intended that the food of an infant should be its mother's breast-milk. Do all children get it? Do those children who do get it escape rickets? On the other hand, do those children who do not get breast-milk always show signs of rickets? In the first place, it will be well to define what is here meant by rickets. Is it to be considered and classed as a disease; and if a disease, is it local or general? Are there degrees of severity? Is any part of the process physiological; and, if so, where is the normal line to be drawn? Or is it only a condition incidental to childhood, like dentition, through which, more or less, all must pass?

On referring to authors, rickets will be found described among the cachexiae of early life, and attention is particularly drawn to the fact that it is a general disease, affecting not the osseous system only, but the nervous, the digestive, and respiratory systems likewise. When this is the case, doubtless the sum-total is disease. On the other hand, are these various systems implicated—that is to say, appreciably so—in all cases? and if not, what shall such cases be called? Shall we agree upon some name to be given to the cases in which bone-lesions are the only manifest ones; and upon another for the cases in which the nerve-lesions predominate; and upon yet another for the cases where the abdominal signs are alone appreciable; although the local pathological anatomy in each of the three cases would prove identical with what we now call rickets, when all the conditions are found together in the same subject?

The following may be regarded as a typical case, and would be accepted by most authorities. A child about 2 years of age, unable to stand, with a large belly and offensive stools "on and off;" with a large square-shaped head, with unclosed fontanelle; often covered, and especially when asleep, with a profuse perspiration; said to be the subject of "catching of the breath" (laryngismus stridulus), and to "twitchings and convulsions;" with a chest compressed at the sides and prominent sternum, and with the junctions between the cartilages and ribs enlarged and "beaded," the epiphyses of the bones large, especially those at the lower end of the radii, giving the child the appearance of being "double-jointed."