REMARKS.

In these four houses the following diseases were apparently caused by exposure to sewer gas :

1. Pelvic cellulitis, 1 case.
2. Diphtheria (?), 1 case, not tested bacteriologically.
3. Follicular tonsillitis, 10 cases.
4. Otitis media, 5 cases.
5. Erysipelas, 1 case.
6. Pleuro-pneumonia, 1 case.
7. Lobar pneumonia, 1 case.
8. Poisoned thumb and septicæmia, 1 case.
9. Acute arthritis—rheumatism, 4 cases.
10. Acute nephritis, 1 case.
11. Gastro-enteritis, 1 case.
12. Abscess, 1 case.

1. *Pelvic cellulitis* is well known to arise from septic infection and every obstetrician knows the danger of confinements in badly drained houses.

2, 3. *Septic throats* are the commonest of all diseases due to sewer-gas. At one time I knew a boarding-house where follicular tonsillitis was constantly occurring in one of the dormitories, and most of the boys had chronic enlargement of the tonsils. An addition of 6 feet to a ventilating pipe near the window of this dormitory has entirely got rid of the occurrence of tonsillitis in this house.

4. *Otitis media* occurs as a sequela of tonsillitis and pharyngitis caused by sewer gas.

5. *Erysipelas* can be caused by the germs which are the septic agents in sewer gas, and in the case related these no doubt gained entrance through an abraded pimple.

6. *Pleuro-pneumonia*.—The case of pleuro-pneumonia appeared to be caused by the otorrhœa becoming septic from the introduction of sewer gas. In the absence of thrombosis of the lateral sinus it was thought that probably there was septic thrombosis of the petrosal sinuses. The scattered character of the pneumonia seemed to indicate an embolic origin.

8. *Septicæmia*.—This case was caused by the introduction of streptococci and staphylococci, which were obtained apparently from the case of erysipelas. It appears that the poison which in one person produces erysipelas, in another will produce septicæmia, and in another ordinary suppuration. This patient, G. H., for several days after infection seemed quite unable to produce pus; no pus formed until after the serum injections, and when the local abscesses did occur the dangerous symptoms subsided.

9. *Acute Arthritis or Rheumatism*.—Rheumatism appears to be a disease of doubtful origin. According to Fagge, the only well-recognised cause is getting wet or exposure to wet weather. The name has been applied to the cases of acute synovitis which follow scarlet fever, and also to those caused by the presence of the gonococcus in the joints. I have often thought that many of the cases of acute arthritis which go by the name of acute rheumatism are in reality cases of septic infection. It is possible that acute rheumatism is produced by the entrance of some germ into the body, which either gains entrance into the joints and there sets up a local inflammation, or which grows elsewhere—for example, in the tonsils and pharynx, and produces a toxin which causes the joint affection. The exposure to wet and cold may be merely the determining cause, as it so often is in an attack of influenza. One cannot help being struck by the similarity of the symptoms of acute rheumatism and septicæmia. In both we may get sore throat, fever, sweating, inflammation of joints, heart, veins, lungs, and serous membranes.

Dr. Newsholme, in his Milroy Lectures at the Royal College of Physicians in 1895,¹ on the Natural History and Affinities of Rheumatic Fever, stated that "Rheumatism is a specific febrile disease caused by the introduction from without and multiplication in the system of a pathogenic micro-organism." "With regard to the nature of the infecting micro-organism the evidence at present is incomplete and unsatisfactory." He stated that according to Dr. J. K. Fowler, "sore throat preceded 80 per cent. of the cases of rheumatic fever." If the infecting organism of rheumatism gains entrance through the tonsils and pharynx, it is exactly what happens in scarlet fever, which often is complicated with rheumatic symptoms.

As regards the incubation of acute rheumatism, Dr. Newsholme could not fix a period. The case of N. H., related above, may throw some light on this. The interval between the attacks of follicular tonsillitis and synovitis was 28 days. The onset of the synovitis, however, may have been deter-

mined by getting wet. Observations on the time of occurrence of rheumatism after the throat affection in scarlet fever may throw some light on this subject.

10. *Nephritis*.—In the BRITISH MEDICAL JOURNAL for 1888 Sir G. Johnson recorded several cases of albuminuria due to sewer gas poisoning.

11. *Gastro-enteritis* is often caused by streptococci, which appear to be the active agents in sewer gas.

REFERENCE.

¹ *Lancet*, vol. 1, pp. 589 and 657.

ON THE ACTION OF SOME ESSENTIAL OILS AND OTHER VOLATILE SUBSTANCES ON THE GROWTH OF THE BACILLUS TUBERCULOSIS AND IN THE TREATMENT OF PHTHISIS.*

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For some time past there has been a pretty general belief that certain essential oils when inhaled have the power of retarding the growth of the bacillus tuberculosis. The literature of the subject, although fairly copious, is inconclusive. As it seemed desirable to arrive at some definite result certain experiments were made, partly clinical and partly bacteriological. The two series were carried out simultaneously, and were spread over a period of about two years.

There are many essential oils, and two of them were selected as being typical of the group, the oil of cinnamon and the oil of peppermint.

All essential oils—from the high price they command—are liable to adulteration, but care was taken to obtain pure and reliable specimens. The services of an expert in this department were procured, and he selected two samples which he considered to be above suspicion.

The clinical observations were carried out on twenty patients suffering from phthisis, none of whom were confined to bed. Some were quite in an early stage, and some had cavities in either one or both lungs. In some cases the patients were made to inhale once or twice a day air impregnated with either oil of cinnamon or oil of peppermint, whilst in other cases the patient was given a supply of the material and instructed to inhale it almost constantly both night and day. A kind of "bib" was devised on which the oil was sprinkled, and this was worn suspended from the neck, so that the air taken into the lungs was constantly impregnated by the vapour. It would serve no useful purpose to give details of these cases, as the results were uniformly unfavourable, and after a trial extending over a period of six months the treatment had always to be abandoned in favour of some other method. The clinical results were undoubtedly a failure, and it was with some anxiety that the conclusions of the bacteriological investigations were awaited. These experiments were undertaken by Dr. Blaxall in the bacteriological laboratory of the Westminster Hospital Medical School, and the details of the method adopted will now be explained.

The apparatus used for these experiments was as follows :

A and G. Flasks containing 1 in 1,000 mercury perchloride. B and F. Flasks containing sterilised distilled water. C. Gas-washing bottle containing experimental fluid. D. Sterilised empty flask. E. Jar containing tubes inoculated with tubercle bacilli. The arrows indicate the direction of the current of air. H. Connection through wall of incubator with water pump.

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A flask A, containing a 1 in 1,000 solution of perchloride of mercury, was fitted like a wash bottle—that is, with two pieces of glass tubing bent at right angles. The longer limb, the lower part of which was immersed in the fluid, communicated with the outside air. The shorter limb connected the flask with flask B, containing sterilised distilled water, fitted in the same way and connected by its shorter limb with a small gas washing bottle C, which held the fluid to be experimented with. This gas bottle again communicated with an empty sterilised glass bottle D, and this again with a large sterilised glass jar E, covered with an air-tight disc perforated with two holes, through which the ingress (opening at the bottom) and egress (opening at the top of the jar) tubes passed. One egress tube passed thence to a wash bottle containing sterilised distilled water F, similar to B, and thence to a wash bottle containing a solution of 1 in 1,000 perchloride of mercury G. The whole of this apparatus was contained in an incubator kept at 37° C. constantly. The egress tube from flask G was connected through a perforator in the incubator with a water pump. The water pump being set in motion, air would enter flask A, and be freed of its organisms in passing through the mercury solution, thence pass to flask B, where any possible splashings of the mercury solution would be taken up, and thence to the gas bottle C. Here the air would become impregnated with the volatile oil or chemical experimented with, and, passing on to the empty flask D, would leave there its superfluous moisture, and enter the jar E. The current of air would then pass through the wash bottles F and G, and thence to the water pump. The two flasks F and G were intended to act as a check to the outgoing of the volatile oil in the impregnated air, and also to prevent any return current of air from the water pump. Any leakage in the apparatus could at once be seen by the cessation of bubbling in one or more of the flasks.

The apparatus was used in this way: A dozen sterilised tubes, each of blood serum 6 per cent., glycerine agar-agar, and 6 per cent. glycerine beef broth were inoculated carefully from a recently-isolated culture on glycerine agar-agar of the *B. tuberculosis*. Two tubes each of these culture media thus inoculated were at once hermetically sealed with paraffin to serve as controls, and these tubes, with eight other tubes of each culture medium, were placed in the sterilised jar E. The remaining two tubes of each medium were capped with india-rubber caps and placed in a distant incubator, to serve as further controls. The aspirating apparatus was then started, the air bubbling through the liquid in the flasks and through the experimental fluid in the gas bottle D, so that through the jar E circulated a current of air permeated with the vapour of the experimental fluid. The jar E at this time contained eight tubes of each medium inoculated with a pure culture of tubercle bacillus, plugged only with their sterilised cotton-wool plugs, and two tubes of each medium similarly inoculated, but hermetically sealed with paraffin. After twenty-four hours the jar was disconnected, and under a sterilised cover the cotton-wool plugs from the eight tubes of each culture medium were expeditiously removed. The lid of the jar was then carefully resealed, the apparatus connected, and the aspiration restarted, so that now the eight tubes of each medium inoculated with tubercle bacilli were fully exposed to the influence of the experimental fluid. Forty-eight hours from this time the aspiration was stopped, the jar disconnected, and one tube of each culture medium carefully withdrawn under cover, plugged with sterilised cotton-wool, capped and placed in the distant incubator to await growth. The apparatus was then reconnected and the aspiration restarted, and after another 48 hours or 96 hours from the start, two tubes of each medium were withdrawn under the same conditions and placed in the distant incubator. The aspiration was then continued till the tenth day, when the apparatus was disconnected and all the tubes were withdrawn, plugged, and placed in the distant incubator, and with them those controls that had been hermetically sealed in the jar.

Here it may be stated that the hermetically sealed control tubes in the jar and the controls placed from the first in the distant incubator all grew well, so that no difference could be established between them either in vigour or in rapidity of growth. Hence hereafter it will be necessary only to speak of them jointly as the controls. The first experiment was made

with the essential oil of cinnamon, a specimen of known and reliable quality. One ounce of this pure oil was placed in the gas bottle D, so that the current of air bubbled through it. In this experiment five of the tubes exposed to the circulating air became contaminated with moulds, and were therefore discarded. A fortnight after the date of inoculation of the tubes the growth of the organism of the different culture media was compared with that on the controls, and no retardation or want of vigour was noticed. Again at three weeks the comparison was made, and at four weeks. At this period all the tubes controls and exposed tubes showed a vigorous growth, and no differences could be established between one and another. From the fluid cultures subcultures were made, and after a month had elapsed both control tubes and the exposed tubes had given equally vigorous growths. The apparatus was then re-sterilised, and a fresh batch of tubes of each medium inoculated, and the experiment with the cinnamon oil repeated exactly as before.

In this second experiment only one tube became contaminated (by a mould), and the results were precisely the same as in the first experiment. The vapour of oil of cinnamon exerted no retarding or inhibitive influence on the growth of the tubercle bacillus. Here it may be stated that the whole apparatus smelt most strongly of cinnamon, and the exposed tubes were redolent of the oil for months afterwards.

The third experiment was conducted in precisely the same way except that the pure oil of peppermint was used. In this experiment only one tube became contaminated. The results were the same as in the previous experiments, all the inoculations growing well, and showing no signs of retardation or enfeeblement. Subcultures from the fluid cultures gave in every case successful results.

The fourth experiment was a repetition of this. In this case three tubes became contaminated with moulds, but in every other respect the results were the same as in the previous experiment. The essential oil of peppermint showed no deleterious influence on the growth of the tubercle bacillus. In this case also the smell of the oil was most intense, and clung to the exposed tubes for a very long period.

The essential oils having proved useless experiments were made in other directions, and after many failures formaldehyde, or formic aldehyde CH_2O , obtained by the oxidation of methyl alcohol, was adopted. A 40 per cent. aqueous solution was used, and it was found that the majority of patients could inhale a 1 in 16 spray of this solution without inconvenience. Bacteriological investigations were undertaken with a 6 per cent. solution of formaldehyde, and the results proved most satisfactory as regards its action on the bacillus tuberculosis.

A 6 per cent. solution was made up with sterilised distilled water, and an ounce of the solution placed in the gas bottle, so that the air bubbled freely through it. The experiment was conducted in precisely the same manner as the foregoing ones, with the exception that some of the tubes were inverted in the jar. The results were:

(a) That no contaminations occurred in any of the tubes.

(b) That all the controls grew well except in one agar-agar tube sealed with paraffin in the jar; in this case the plug had been forced out and loosened and no growth occurred.

(c) That neither the tubes kept under the influence of formaldehyde vapour for forty hours, for ninety-six hours, or for ten days showed any growth whatever.

(d) Subcultures were made from several tubes of the solid media and from all the tubes of fluid media; all of these failed with the exception of one glycerine beef-broth tube exposed for forty-eight hours, which, reinoculated on to blood serum, commenced after three weeks to grow feebly. This growth, however, did not progress, and subcultures made six weeks afterwards entirely failed.

After re-sterilisation of the apparatus, the next experiment was proceeded with, being a repetition of the previous one. In this instance no contaminations occurred in the tubes. An alteration was made in this experiment. Tubes were removed from the jar after two days' exposure to the formaldehydised air, after four days, after six days, and after ten days. None of these tubes showed any growth up to six weeks from the date of inoculation, but after that date two tubes of 6 per cent. glycerine agar exposed for two days (or forty-eight hours)

commenced to grow; one developed a very meagre growth, the other a fairly vigorous growth, and both were subcultured with success. None of the other tubes showed any signs of development, and subcultures from them all failed with the exception of a 6 per cent. glycerine beef-broth tube, which, after exposure for forty-eight hours, was carried on successfully.

From these experiments it is seen that even a weak solution of formic aldehyde, such as 6 per cent., exerts a very marked retarding and inhibitive influence on the growth of tubercle bacilli inoculated on to favourable culture media, and that this influence prolonged over forty-eight hours entirely prevents the growth and future development of the bacilli.

In these experiments no attempt was made to estimate the amount of the volatile vapour in any given quantity of the circulating air at any given time. In the case of the formic aldehyde experiments, the irritating odour of formic aldehyde was most marked in the earlier stages of the aspiration, and diminished as the experiment neared conclusion. The possibility that the formaldehysed air might condense on the under surface of the disc of the jar, and fall into the open test tubes, was obviated by inverting some of the tubes.

The clinical results of the formic-aldehyde treatment are quite in accord with the results of the bacteriological observations. A 6 per cent. solution was as a rule employed, but this was increased or decreased according to the idiosyncrasy of the patient. In most cases the drug was inhaled either once or twice a day, compressed air by a simple mechanical arrangement being made to bubble through the solution. This gave the best results. In other cases, in hospital practice especially, the "bib" method was employed.

The drug in many cases caused irritation at the back of the throat, and sometimes induced violent paroxysms of cough. Twenty cases of phthisis were treated by formic aldehyde, and in six of them the results were inconclusive, either because the patient was lost sight of or because other methods were resorted to in addition. For example, in 3 cases injections of Tuberculin R were given, and these had to be discarded. In the remaining 14 cases nothing but the formic aldehyde was administered, with the exception of an occasional pill of $\frac{1}{2}$ grain of picrotoxin to check the night-sweating. Of the 14 cases, 12 were much benefited, whilst 2 only slightly improved. Both the unsuccessful cases were men, and both presented the physical signs of cavities or of extensive breaking down on both sides. Of the 12 successful cases, all of which were much improved, 5 were men and 7 were women. Of the 5 men 3 had cavities at both apices, and the other 2 had marked signs of consolidation at the left apex. Of the 7 women 3 had breaking down of both lungs, and 4 had consolidation of one lung only. One man and one woman had, in addition to the lung symptoms, tuberculous ulceration of the larynx. Some of these patients had previously had inhalations of oil of cinnamon or oil of peppermint without benefit. It is impossible to record all these cases in detail, but a brief outline is given of a few typical instances.

CASE I.—Mr. M., aged 46, was first seen on November 25th, 1896. His family history was a bad one. He had had a cough with expectoration for some months, was rapidly losing flesh, and had profuse night sweats. His evening temperature ranged from 100.5° to 102°. At the left apex in front was bronchial breathing with abundant moist rales. Specimens of the expectoration were submitted to Dr. Blaxall, who reported: "Both specimens contain tubercle bacilli. The bacilli are very slender and in clumps and fairly numerous. I should consider it to be an early case rather fiercely attacked, and should imagine that the prognosis was very unfavourable." The patient was placed on the formic-aldehyde treatment and had an inhalation almost daily until the end of February. The expectoration was examined twice a week, but the bacilli, although fewer in number, were always present. The patient's condition speedily improved, the night sweating ceased; he gained in weight, and in March, 1897, was free from cough and expectoration. A corresponding improvement took place in the physical signs in the chest. He has been seen from time to time during the last eighteen months and carefully examined. The whole condition is now perfectly quiescent and he is apparently in perfect health and is able to do his work and enjoy life. He lives in England and has not found it necessary to winter abroad. The notable point about the case is that as long as there was any expectoration it contained bacilli.

CASE II.—L. B., aged 25, married, came to the hospital on January 25th, 1898. She had had a cough for six months. The expectoration was thick and yellow, and was found by Mr. W. J. Quicke to contain the bacillus of tubercle in abundance. She had had no hæmoptysis, but had been losing flesh rapidly, and weighed only 6st. 13lbs. At the left apex there was deficient movement, with well-marked dullness, bronchial breathing, and moist sounds. She was placed on general treatment, with cod-liver oil, but continued to lose flesh. On July 8th she was given a 10 per cent. solution of formic aldehyde, and told to inhale it freely from a piece of lint both night and day. On this she rapidly improved, and on August 30th the strength of the formic-aldehyde solution was doubled. During a

portion of this time she was still taking the cod-liver oil. On September 13th the physical signs were dullness at the left apex, with bronchial breathing, and few moist sounds. The expectoration, which was slight, still contained bacilli, but in much smaller numbers. The patient's general condition had, however, markedly improved, and she had gained 7lbs. in weight. On November 22nd she was seen again, and was found to have still further improved. This is a less striking case than the last, but there was no doubt that the patient derived considerable benefit from the treatment.

CASE III.—Mrs. B., aged 26, a housekeeper, was first seen on May 24th, 1898. She had had a bad cough with expectoration for six months, and had been rapidly losing flesh. For one month her voice had been very husky, and towards the end of the day she was practically inaudible. Her expectoration contained bacilli in large numbers. She had cavernous breathing at the left apex with large bubbling rhonchus, and there was also crepitation scattered all over the right back. My colleague, Mr. P. de Santi, examined her larynx, and reported that the left vocal cord was stationary, probably due to infiltration of tuberculous matter. Active treatment was not commenced at once, but on May 31st she was given a 40 per cent. solution of formic aldehyde, and told to place 5 drops on lint every four hours and inhale it. This quantity after the first week was increased, and by the use of the "bib" the treatment was kept up practically night and day. On June 21st the moist sounds at the apex had almost disappeared, and Mr. de Santi reported that the cords were less infiltrated and much more movable. Her voice and general condition had much improved, and she had gained 3 pounds in weight. The treatment was kept up steadily until September 13th, when Mr. W. J. Quicke examined her chest, and reported that there was no crepitation at the left apex, but just an occasional rale at the right posteriorly. "but doubtful and not with every respiration." Mr. de Santi's report on the same day was as follows: "Swelling of epiglottis, which at last examination was infiltrated and thickened, entirely gone. Cords quite free; only a slight hyperæmia; before uniform redness. Swelling over arytenoids entirely disappeared. Pallor of palate much less. Phonation good." The patient had increased in weight, she looked well, and was able to do a good day's work. A week later she was seen by Dr. Lemare Bunch, the British Medical Association Research Scholar, who considered that she was a good example of a case of arrested phthisis. On November 17th she reported that she had gained another 4 pounds in weight, and was practically free from cough. She still continues well, and is able to do a full day's work.

CASE IV.—The next case is that of an English physician long resident in the south of Europe. For obvious reasons it is not desirable to disclose his identity or his exact place of abode. He came to see me first on June 27th, 1898, and gave the following history. He had resided out of England for twenty years, and had not been home for fifteen years. He had malaria in February, 1884, and had suffered from it more or less at intervals ever since. He had an attack of influenza in March, 1892, and this left a chronic cough, but there were no definite lung symptoms until November last. Since then the cough had increased in severity and had come on in paroxysms, especially on exertion such as going upstairs or walking uphill. It was attended with much mucopurulent expectoration. The other symptoms were progressive loss of flesh and profuse night sweating. There was almost complete anorexia, and the patient stated that he loathed the sight of food. When first seen he was obviously very ill; he could hardly walk; he was panting for breath, and his voice was little more than a whisper. On examining the chest it was found that there was scattered crepitation all over both lungs, heard back and front, slight but perfectly distinct. There was very little dullness, and there were no indications of a cavity. The expectoration was examined by Dr. Blaxall, who found pus cells and tubercle bacilli in abundance. Mr. de Santi examined the larynx and reported that the cords were congested, but that there was no ulceration. The epiglottis and interarytenoid space were free, and there was some swelling of the mucosa over the arytenoids. The patient was placed on daily inhalations of formaldehyde, and in three weeks had greatly improved both as regards cough and general condition. On July 25th the crepitation was less and the sputum was less viscid and contained fewer bacilli.

At the end of July he went to Cornwall, taking a supply of the formic aldehyde with him. There he made rapid progress and put on flesh. His appetite was restored and the cough ceased to trouble him at night. His dyspnoea was much less, and he was able to walk a couple of miles or more on the level without feeling tired. On September 14th he was seen again, and Mr. de Santi made the following report: "Cords almost uniformly white, otherwise no difference. Voice much stronger; can now produce his usual singing notes, except the highest range." The crepitation had now entirely disappeared. On September 23rd Dr. Blaxall found a few tubercle bacilli, less than formerly. On October 9th the patient wrote: "The chief points of improvement are (1) a gain of weight of 22 lbs. and (2) a great diminution of cough and expectoration. I can now mount stairs with comparative comfort and ease." He has since returned home and has resumed active practice.

My belief is that the best way of treating tuberculous phthisis is to obtain the bacilli from the expectoration, cultivate them, pass over them various volatile substances until one is found which will arrest their growth, and then administer it by inhalation to the patient. This by no means precludes the use of fatty foods and other substances, such as cod-liver oil.

THE SALE OF COCAINE IN THE UNITED STATES.—Ordinances have recently been made in Austin, Texas, and in New Orleans, Louisiana, prohibiting the sale or the giving of cocaine to any person, except by a duly authorised physician, or upon a physician's order; provision is also made for a fine of from 10 dols. to 100 dols. for infringement of the law in Austin, and for a similar fine or imprisonment, or both, in New Orleans.