tion to remove almost, if not quite, the whole of the diseased portions of bone.

Two other cases were unsuccessful, being only temporarily and partly benefited by operative interference.

CASE III.—W. S., aged 16, had very extensive disease of the dorsal spine, from which he had suffered for a long time. He had had marked paraplegia for six months, and when operated on this was complete. The spinal canal was exposed on three separate occasions within a period of fourteen or fifteen months, and large quantities of tuberculous material and carious bone were removed. On the third occasion large pieces of dead bone, as large as the end of the finger, were taken out of the cavity below the cord. Some benefit was derived from each operation, but the steady and comparatively rapid progress of the disease soon obliterated the advantage gained. He died later from pneumonia, probably complicating influenza, with which his paralysed condition rendered him quite unable to cope successfully.

CASE IV.—J. M., a lad, aged 17, gave only a month's history of progressive paraplegia. At the operation the posterior surface of the bodies of three or four dorsal vertebrae were found to be deeply infiltrated by tuberculous material, a quantity of caseous material compressing the cord. He improved after the first operation, but as a relapse of his original symptoms took place, another and a more extensive operation was performed. An abscess was then found in the right side of the chest, and the bodies of the vertebrae were found to be more deeply involved than was suspected at the first exploration. He improved but slightly on this occasion, and soon relapsed. He refused any further active interference, and though the treatment by recumbency was continued he did not improve. I have been unable to find him, as his parents have changed their address, so cannot report as to his present condition.

CASE V.—H. S., a boy, who gave eleven months' history of paraplegia, with more or less incontinence of urine and faeces, was apparently sinking rapidly from pulmonary complications, was operated on in February, 1890. He rapidly lost his paraplegic symptoms and gained in health and strength, his cough also disappearing. He now leads a very active life, having had no recurrence of his paraplegic or spinal symptoms, the tuberculous disease being apparently cured.

CASE VI.—H. M., aged 32, gave about three weeks' history of progressive paraplegia, which, while he was treated by recumbency alone, rapidly became almost, if not quite, complete. He was operated on in May, 1890; an abscess was opened, and much tuberculous material removed. He gained complete power over his legs, and since the operation has had no return of paraplegic symptoms. The spinal disease is apparently cured. He says that it is only after he has walked a considerable distance that he feels any weakness in his back.

CASE VII.—K. B., aged 21, gave more than nine months' history of paraplegia, which had been complete for some considerable time before her admission. She had also a disorganised knee-joint. She was extremely feeble physically. On November 5th, 1890, she was operated on, and in a remarkably short space of time all symptoms of paraplegia had disappeared. The knee was excised on November 30th. Five months after the first operation complete paraplegia and cystitis developed very rapidly, and a second operation was performed. On this occasion a considerable quantity of pus and caseous material was evacuated, when she recovered as rapidly as she had done before. The excised knee did well. I heard from Dr. Bernard Scott, whose patient she was, that she died of influenza about eight months after she left the hospital, and that she had had no recurrence of the paraplegic symptoms, nor had she any trouble in her back or knee.

CASE VIII.—A. T., aged 7, gave six weeks' history of rapidly progressive paraplegia, which became almost complete, sensation being much impaired. He was operated on on February 10th, 1891, a large abscess which compressed the cord anteriorly being opened, cleansed and filled with iodoform. He recovered rapidly and completely, and now leads as active a life as a boy with so marked a deformity can. The angular curve is now apparently firmly ankylosed, and free from disease.

CASE IX.—T. J., aged 23, a very delicate man, had paraplegia five years before admission, and recovered after fifteen months' recumbency. Three months before admission paraplegia steadily returned. He was operated on in July, 1891, when a large abscess extending well into the chest, the walls being formed by bone, was exposed and evacuated. It was obvious that this abscess had existed since the first attack of paraplegia. He has now regained control over his legs, and can walk about, though not for very long distances. He is troubled by a slight purulent discharge from an abscess which formed in the loin, the spinal trouble being in the mid dorsal region. This discomfort will, I hope, be removed during the next few months. He has gained in strength, but has a suspicious condition of the apex of one lung.

CASE X.—E. R., aged 8, a feeble, deformed child, rapidly developed paraplegia which appeared three weeks before the operation, and became almost complete. The spinal canal was opened on May 2nd, 1891, when extensive caries and necrosis of the bodies of two or more vertebrae was found. He soon recovered power over his legs, and led as active a life as his deformity permitted. Recently a sinus has formed in the vicinity of the cicatrix, and some pus discharges daily from it. It improves rapidly under treatment, and will, I have no doubt, close shortly. He has had no return of the paraplegic symptoms.

CASE XI.—W. H. W., a very delicate deformed boy, 7 years of age, gave five weeks' history of paraplegia, which developed more or less suddenly, and was accompanied by imperfect control over the sphincters. He was operated on in April, 1891, when extensive disease of the bodies of two or three vertebrae was found. He recovered rapidly. He now leads an active life, has had no return of the paraplegic symptoms, and the spinal disease is apparently cured.

In the paper which I read before the Clinical Society I urged very strongly the advisability of operating on these cases as early as possible, if a short period of recumbency was not followed by definite improvement. The subsequent career of these cases confirms me still more strongly in this opinion.

I would point out that operative interference is accompanied by slight risk, for out of the eleven cases operated on, in only one was death consequent in any way upon the operation, and considering that these patients were all greatly enfeebled and often very much deformed, their respiratory functions being very much impaired by the angular curvature, frequently also by paralysis of the abdominal and lower intercostal muscles, and occasionally by bronchitis and cystitis, and by other tuberculous lesions, this mortality can hardly be regarded as other than small.

In the large majority of cases the operation not only relieves the patient permanently of the paraplegic symptoms, but it enables the surgeon to remove the large quantity of caseous material, and such carious and necrosed bone as is not uncommonly present. In all but one of my cases a quantity of caseous material with carious bone existed. The surgeon is enabled to treat the scraped bone by suitable antiseptic reagents. By this means the diseased vertebrae are put in a condition most favourable for their recovery and ankylosis. I do not believe for one moment that the spinal disease would have subsided in some of my cases without operative treatment quite apart from the paraplegia resulting from its presence. The pulmonary and vesical symptoms are rapidly relieved by the removal of the paralytic condition, and the general health of the patient is correspondingly improved.

The operation in no way interferes with the treatment by recumbency, the latter being a necessary consequence of the former in order that the spine may ankylose firmly. If a case does not recover with operative treatment and recumbency, it obviously will not recover if treated by recumbency alone. I would point out that one of the cases had, after fifteen months' recumbency, been cured of his paraplegia; but I found on operating on him for a relapse of his symptoms five years afterwards, that the relief of the cord from pressure was due to an extension of the abscess forwards into the chest where it acquired a more or less perfect bony wall and remained latent for five years. The tension within the abscess then increased for some reason or another and paraplegia again developed. On this occasion the abscess cavity which was as large as a tangerine orange was readily and effectually cleared of its contents.

NOTES

ON

CARBOLIC ACID: ITS PHYSIOLOGICAL ACTION AND THERAPEUTIC USE IN TYPHOID FEVER.

By M. CHARTERIS, M.D.,

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WHEN the research on salicylic acid, natural and artificial, had been completed I was induced to test the physiological action of the three forms of carbolic acid which can now be purchased, namely, ordinary carbolic acid of the *British Pharmacopœia*, pure carbolic acid, and synthetic carbolic acid. The physical characters of these acids will now be noted:

1. Ordinary carbolic acid. In colourless acicular crystals of a peculiar tarry odour. Melting point 33° C.
2. Pure carbolic acid. Rhomboidal, not needle-shaped crystals; free and detached. Melting point 40° C.
3. Synthetic carbolic acid. Well defined separate crystals; little odour. Melting point 42° C.

PHYSIOLOGICAL ACTION.

The physiological action of these acids was tried upon rabbits weighing in each case 3½ lbs. The mode of procedure was to dissolve the acid in water and to inject it into the cellular tissue of the abdomen.

EXPERIMENTS.

1. Ordinary carbolic acid. Eight grains of this injected caused immediate convulsions, and death occurred in thirty minutes. This experiment repeated three times gave in each case a similar result. Four grains injected caused, in the course of a few minutes, convulsions, which continued with diminishing severity for twenty-four hours. The

animal died after the expiry of two days. This experiment repeated twice gave the same result.

2. Pure carbolic acid. Eight grains of this caused no convulsions and no bad results in three cases in which it was injected. In a fourth case disturbances but not death ensued.

3. Synthetic carbolic acid.¹ Eight grains of this occasioned, after the expiry of four minutes, severe convulsions, which lasted for two hours. At the end of this time they became less marked, but the animal remained weak, listless, unable to eat, and death ensued after eight hours. The same quantity tried three times had a similar effect. Four grains injected on different days into two rabbits occasioned slight convulsions, but the animals recovered.

Summary.—The results of these experiments thus showed that an 8-grain injection of pure carbolic acid was innocuous; that an 8-grain injection of synthetic carbolic acid caused death, while a 4-grain injection caused disturbance, but not death; that an 8- and 4-grain injection of ordinary carbolic acid always proved fatal. In all the fatal cases it was observed that convulsions occurred, not continuous, but separated by intervals more or less short, according to the strength of the acid employed. In human beings who have been poisoned by carbolic acid, convulsions do not ensue; those poisoned by large doses sink into a comatose condition, with abolition of sensory and reflex movements, stertorous breathing, and suppression of the urine. If the poisoning be due to absorption of the acid from external applications, the urine is not suppressed, but what is passed has a dark colour, and, on being allowed to stand, becomes black. This colour is due to the presence of hydrochinon, a derivative of phenol. When carbolic acid is purified, this derivative, and doubtless other impurities, are taken away, and in this way may be explained the difference of the physiological action of the pure and impure acid, but it is difficult to explain why synthetic carbolic acid, presumably more pure from its higher melting point, should have more injurious properties than pure carbolic acid.

ACTION ON DIFFERENT MICRO-ORGANISMS.

Having now ascertained the physiological action of these different forms of carbolic acid, a further inquiry was obviously essential—namely, to determine whether or not the freedom from impurities altered or minimised the antiseptic properties of the pure acid.

In order to obtain a definite, accurate, and impartial verdict upon this crucial point, I requested my friend, Dr. John MacIntyre, Glasgow, to institute a series of experiments with regard to the action of the three forms of carbolic acid on different micro-organisms. In due time he gave me the following report:—

On September 28th, 1890, Professor Charteris sent me three specimens of carbolic acid marked 33° C., 40° C., and 42° C., to test their comparative antiseptic properties. The organisms found in suppurative processes, typhoid, tubercle (Koch's spirillum) were selected for experiments. Two solutions of the strength used in surgical practice were prepared from each of these, and control experiments in every case were made in suitable media for the cultivation of the specific organisms. In the first set of experiments inoculation was made into tubes. In the second, sterilised threads were soaked for different periods in the fluids containing these organisms, and passed into solutions containing the antiseptics, and subsequently placed upon cultivation plates. In every instance the control experiments succeeded proving the vitality of the germ life. The results were such that no difference could be found between the antiseptic properties of the ordinary carbolic acid and the new specimens. In all about 150 experiments were made extending over a period of four months. Weaker solutions were afterwards tried with the same result as in the above mentioned experiments, namely, that the carbolic acid melting at higher temperatures seemed as efficacious as that usually employed in surgery.

PREPARATION OF A PILL OF PURE CARBOLIC ACID, COATED WITH KERATIN.

Dr. MacIntyre's carefully conducted experiments conclusively showed that the purity of carbolic acid in no way impaired its antiseptic action on specific micro-organisms, and the question now to be considered was: Could any benefit be derived from this in the treatment of disease? His laboratory experiments showed that it had controlled the development of the bacillus of typhoid fever, and the literature of this fever evinces the desire of many well known physicians to give an antiseptic remedy, even before its specific micro-organism had been definitely determined. Thus, Liebermeister recommended calomel in the early stage

with a view of destroying putrefaction products and so rendering the disease milder and shorter. With a similar object, arsenic, naphthol, hydro-naphthol, sulphides, and free chlorine have been administered. Dr. Gramshaw used with success carbolic acid in a mixture of tincture of iodine, tincture of orange and syrup. The objection to giving carbolic acid in this or any mixture is that it causes vomiting, and I had personal experience of this objection at the Royal Infirmary of Glasgow, when I administered it with glycerine.² Theoretically carbolic acid was an excellent remedy, but practically its use was inadvisable, whether on account of its mode of administration, or the impurities it contained, I cannot say.

I resolved, however, to have a pill of pure carbolic acid prepared, and then to coat this with keratin, so that its emetic action would be minimised because solution would not take place until it had passed from the stomach. The preparation of a pill from this acid is very difficult, and consequently those first used at Belvidere Hospital, Glasgow, were not perfect, for they were not stable; but now I am glad to say Mr. Macmillan, of Glasgow, has succeeded in preparing a pill which satisfies all requirements as regards form, stability, non-solubility in a peptic and ready solubility in a pancreatic solution. Each pill contains 2½ grains of pure acid made up with some innocuous powder and covered with keratin. The nature of the pill and the results of the experimental research were made known to Dr. Allan, of Belvidere, and he consented to try them in suitable cases of enteric fever, and on June 15th, 1891, I received the following reports:—

TREATMENT OF TYPHOID FEVER AT BELVIDERE HOSPITAL BY CARBOLIC ACID PILLS.

Dr. Davidson reports: "I have employed them three times daily in cases where the motions were very offensive in odour. In one case I found that after their use the motions became much less offensive, and (what is to my mind more important) much less frequent. This was the more gratifying as the patient suffered from old-standing bronchitis, with much expectoration, and I scrupled to employ opium more than I could help. I had grave fears for her life, but fortunately she is now up and convalescent. I never found the pills to affect the urine to any appreciable extent, nor yet to cause vomiting. In another case there was, on admission, tympanites, a little ascites, and some vomiting; green vomited matter and green motions followed the use of the pills, but not in greater frequency than before their use. Here, again, without the aid of opium at all, I am pleased to record a diminution in the severity of the diarrhoea."

Dr. Tindal reports: "I had three typical cases—two of these were amongst the most severe of my enteric cases. They each had a pill thrice daily. No nausea followed after the exhibition of the pills. One of these cases was a girl, aged 18. She had frequent offensive "chopped vegetable" motions. After the use of the pills, it seemed to the nurse and myself that the motions were not so offensive nor quite so frequent."

The next communication I had from Belvidere was not so satisfactory. The pills were tried by Dr. Love in four cases, and he states, "the pills had no favourable influence on the disease, its course was not shortened, the temperatures were in no way modified."

The statements in this report, contradictory of those obtained in the previous reports, were explained by the fact that the pills used in the first cases had in each 2½ grains of carbolic acid, while in the latter, for convenience in preparing them, the pharmacist had subsequently made them to contain only 1½ grain. This difference had unfortunately not been notified when they were delivered at the hospital. In subsequent cases they were ordered to be given four times instead of thrice daily, and Dr. McNaught—a distinguished graduate of the University of Glasgow, and now a surgeon in the Army Medical Service—undertook the treatment of cases on which they were tried. He fulfilled the task with great

¹ In the following experiments Robert Graesser's pure carbolic acid, which has a guaranteed melting point of 40° C., was used. The pills subsequently referred to were made from the same acid.

² Dr. Kirk, of Glasgow, in 1887, speaks favourably of the acid in typhoid fever, and in other conditions connected with pyrexia, and in an able and suggestive address at the meeting of the British Medical Association in Glasgow, 1888, Professor Cash spoke as to its antipyretic action, but because "of the dangerous character of the body," he considered its employment inexpedient.

care, gave charts of the temperature in each case, and a daily record of their progress to recovery. I regret that pressure on the space of the BRITISH MEDICAL JOURNAL prevents me publishing all the cases in full or inserting the charts. In all he treated successfully eight cases, and of three of these I shall now give his report.

CASE I.—A. McW., aged 15, admitted January 2nd, 1892. History: Illness began 14 days ago with headache, shivering, and diarrhoea, no abdominal pain. He had been confined to bed for 8 days. Temperature on admission 102.8° F. Notes on admission: Patient was quite intelligent and did not complain of any pain, abdomen somewhat distended, no tenderness over the right iliac region, but slight pain caused by palpating the spleen. Some rose spots observed on abdomen and back. The spleen did not project below the costal arch. The area of dullness extended from the seventh to the eleventh ribs and increased forwards; a sense of resistance was felt on palpating underneath the ribs. Tongue was dry, glazed, and slightly brown in the centre. Heart sounds pure but weak. Urine showed a faint trace of albumen. Carbolic acid pill (1½ grain) four times a day.

January 5th. Bowels have moved twice since admission, motions not characteristic. He had some difficulty in swallowing carbolic pills and to-day was inclined to be sick after taking one. Temperature remits well in morning.

January 8th. Doing well. Morning temperature is now 99° F., but evening temperature is still keeping up. Tongue bare and glazed. No abdominal pain or distension. Bowels are now inclined to be loose. Two motions in the last 24 hours. Pulse 84. Urine very slightly albuminous. He now took the pills more easily.

January 12th. Temperature normal for two evenings.

February 21st. Dismissed well.

CASE II.—W. H., aged 14. Admitted January 12th, 1892. History: Illness began eight days ago with headache and shivering and pain in the abdomen. He was constipated until three days ago when castor oil was given and his bowels have been loose since. He has been confined to bed for four days. Temperature on admission 103.4° F. Notes on admission: Patient was quite intelligent. The abdomen was considerably distended but was neither painful or tender. There were several rose spots on the abdomen, chest, and back. The spleen could be felt projecting slightly beneath the costal arch. He had two motions since admission, one "pea-soupy" in character. Tongue moist with slight white fur. Heart sounds pure. Pulse 108, full, soft, and regular. Some sibilant râles are heard at the base of both lungs, but especially over the right one. Urine slightly albuminous. Carbolic pills (1½ grain) four times a day.

January 15th. Some fresh rose spots noted to-day. Has had characteristic loose motions since admission; tongue remains moist; sleeps well without hypnotics; takes carbolic pills easily.

January 18th. This boy continues to do well. The abdominal tenderness, which was very marked on admission, is now very much less. He has two or three loose motions in the twenty-four hours; at first they were "pea soupy," latterly they have been of a more healthy type. He has no pain, no delusions, and sleeps well. Some fresh spots noticed to-day.

January 23rd. Temperature normal for four mornings.

March 5th. Dismissed well.

CASE III.—M. G., aged 13, admitted December 25th, 1891. History: Illness began four days ago with shivering, headache, sickness, vomiting, and pain in the chest. Bowels were constipated until she had a dose of castor oil, after which they became loose. Temperature on admission 101.2°. Notes on admission: Her face is flushed, eyes clear, abdomen is not distended or painful, spleen cannot be felt, tongue is dry and brown in the centre and at the tip; at the sides it is coated with sordes. Pulse 108.

December 27th. No abdominal tenderness, spleen markedly enlarged, but not below the ribs. She had a loose, enteric-like motion to-day.

December 29th. There is a rose spot noticed in the left umbilical region. She is passing on the average two "pea soupy" stools in the twenty-four hours; tongue brown and dry, thickly furred; pulse 108, small and weak; urine free from albumen; temperature shows distinct morning remissions; to have carbolic pills 1½ grain four times a day.

December 30th. Had a good night, and is progressing favourably. There is a fresh rose spot noticed in the epigastrium to-day, and two fresh ones in the back.

January 1st. Tongue becoming moist; three fresh rose spots; abdomen slightly distended; two loose yellow motions in twenty-four hours.

January 2nd. Two fresh rose spots.

January 6th. Fresh rose spot noticed; temperature normal in morning, 100° in the evening; tongue moist; pulse 96.

January 8th. Evening temperature normal.

January 15th. Pills stopped.

February 10th. Dismissed well.

TREATMENT OF TYPHOID FEVER IN PRIVATE PRACTICE BY CARBOLIC ACID PILLS.

Consideration of the reports from Belvidere justified me in concluding that greater and more decisive benefit might be obtained from their employment in private practice when cases of enteric fever can be treated at an earlier stage of its development than when patients are admitted to a fever hospital, and the disease has taken a complete hold of the system. On my advice Dr. Sloan, of Galashiels, decided to try them in his practice, as he had opportunities for doing this, since typhoid fever in spring and autumn is not uncommon in the district where his lot is cast. At the end of last July he reported that he had treated seven cases successfully, and from these he selected one as evidencing the influence which car-

bolic acid has in reducing the temperature and in curtailing the progress of the fever.

M. L., female, aged 26. Illness began six days ago with shivering, headache; and on the seventh day of her illness when I saw her I detected some rose-coloured spots on the abdomen, and tenderness was evinced on pressure over the right iliac region. The temperature was 102.5° F. in the morning, and 104.5° in the evening. There was slight diarrhoea. The following day (June 24th) I found the symptoms in no way different, and I ordered her carbolic pills (2½ grains in each) thrice daily.

June 26th. She takes the pills easily, and the evening temperature is now 101° F.

June 27th. Temperature in the morning normal; in the evening 100° F.

June 28th. Temperature normal morning and evening. The pills were continued for two days, and on July 1st were stopped. She continued to do well until July 10th, when owing to an indiscretion in her diet, the temperature rose to 101° F. and diarrhoea reappeared. The pills were again ordered thrice daily, and in the course of two days the temperature was normal. Yet I considered it advisable to continue their employment for four days afterwards. There was no further increase of the temperature, and she made a satisfactory recovery.

GENERAL CONCLUSIONS.

I am perfectly aware that the record of cases of typhoid fever treated by carbolic acid is not conclusive, yet I think it has sufficiently proved that no danger attends this method of treatment in the doses mentioned, and even the dosage might, if necessary, without peril be increased.

Wisely and timely undertaken, I believe benefit will be derived from its adoption by medical men in general practice, who see the fever at its onset, and consider it inadvisable or impossible to remove the patient to a fever hospital. At the same time the reports from Belvidere Hospital show that in suitable cases, even where the disease is advanced, it will moderate the diarrhoea, sweeten by its antiseptic action the intestinal tract, and check the fœtor of the stools.

There are other internal uses of carbolic acid, and I have elsewhere recommended its employment in cholera as a prophylactic and therapeutic agent, and also stated that it might be tried in diphtheria with advantage and safety in doses of two grains every two hours to control the development of the pathogenetic organism on which this disease depends. Others have advocated its use in flatulency with great distension accompanied by pain. But to enter into details on these points would be extraneous to the scope of this article.

I conclude by saying that this research clearly shows that the pure acid should supplant the objectionable and impure acid at present sanctioned by the *British Pharmacopœia*. Our official melting point is below the standard of any other civilised nation, and doubtless this glaring defect will be altered when another edition of the *Pharmacopœia* is issued. Meanwhile it is the obvious duty of surgeons to see that the pure acid is alone employed in hospital and private practice, and if this be attended to I have little doubt that the untoward results accruing from its use, emphasised by Billroth in 1889, would no longer be observed, and that it would resume its position of unquestioned superiority over other antiseptic agents.

ON PERFORATION OF THE MASTOID PROCESS IN CASES OF ACUTE OTITIS MEDIA DUE TO INFLUENZA.

By ADAM POLITZER, M.D.

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PURULENT inflammation of the middle ear appears to occur with exceptional frequency in connection with influenza, and I am inclined to attribute this fact to direct infection by the passage of pathogenic organisms into the middle ear from the pharynx. The affection is in many cases limited to the lower part of the Eustachian tube, without reaching the cavity of the tympanum. In other instances, however, a catarrhal or suppurative inflammation of the middle ear is observed, which is apt to prove much more dangerous than ordinary cases of acute otitis media.

During the last two epidemics in Vienna the complication of acute middle ear inflammation with the formation of mastoid abscesses was remarkably common, and in a considerable number of these cases perforation of the mastoid process became unavoidable.