also been laid in with a *backward* fall; and, in fact, it became necessary to dismiss the builder and send for the engineer.

After discovering the stoppage and its cause, and after removing some cart-loads of ordure out of the extra large-sized pipes, I began to re-arrange the whole, as shown upon plan (Fig. 3). I dug out the drain-pipes on the dotted line between the points E and N, and transferred the servants' closet from the middle of the house to E E, in the corner of a new coal-cellar, which I built at O. I also carried the drain from the foot of the upstairs water-closets, through the open area P on to the sewer in the road, and moved the scullery-sink from F to the site F F, which was more convenient to the servants. I next dug up the old stable-cesspool at S, and led the wastes of the cistern and butler's pantry to an open disconnecting chamber seen at Z, and on to the main-drain, easing the bends as I went on. I also laid in a new drain round the garden-path from the rain-water stack-pipe in the conservatory C, and so made sure of an occasional good flushing for the new drain. Ventilation for the drain I provided by erecting a shaft at V up the high gable of the new stable building B, and upon the top of it I fixed a foul air withdrawing cowl. Very little remains to be done, except to ventilate the soil-pipes and relay the basement-floor; first searching for the cesspools, and concreting the surface over. An open area round the building would also prove a blessing.

An example of a large-sized mansion, which was partly drained into cesspools and partly otherwise, is given on the plan (Fig. 4). The

Fig. 4.

drainage was at first collected, as shown by the black lines, and ran down to a lake where the drain was trapped, the sewage falling through a valved grating into the water. The outlet being thus hydraulically sealed, and there being no ventilation in the march of the drain, the gas generated in the drains (which, by the way, were all brick-barrel ones) found it way into nearly every room of the house.

The collection from one side of the house commenced with an old rotten brick drain under the housekeeper's room at H, and the state in which it was found sufficiently accounted for certain smells prevalent thereabouts, for dampness, and for the presence of slugs. The rain-water flowing down this drain led to the beer-cellars I I, and then ran in an open channel (see faint dotted line) as far as the passage, when it entered the store-room, and here, at C, was put a catch-trap, which was relied upon to shut out the air of the drains from the house. It then ran on to the main-drain. The smells in this part of the basement were intensified, owing to the beer-droppings in the open channelling. The collection from the other side of the house led on from J through the scullery S, a separate pipe being led on from the sink. The water-closets throughout the establishment were eighteen in number, and of these ten drained direct into the drain, and so on to the lake; five into a cesspool in the quadrant-shaped yard, and only the overflow into the drain, and the other three drained into deep cesspools at A and D, excavated in the chalk. And I might here note, as a curious thing, that, upon opening a cesspool cut in the chalk, it will be found that the soil disappears there with an unaccountable rapidity. But, when once the cesspool is emptied, and the porosity of the sides interfered with, it holds water like a common brick cesspool, and becomes a receptacle where disease-germs multiply.

Whatever gas was generated in the main-drain or tributaries, or in the large cesspool in the quadrant yard, had, therefore, no escape, save into the house. The cure, therefore, lay in the abolition of this cesspool, the diversion of the drain which led into the catch-pit C outside the house altogether, the ventilating to the roof of the heretofore unventilated soil-pipes, the disconnection of the house-sinks from the drains, and the taking up of the retardative brick drains, and substitution of earthenware pipes. The large cesspool A was also filled up after having been emptied, and the closets which formerly discharged there were drained by way of the dotted line into the main sewer.

The plan (Fig. 5) illustrates the ground-floor of a large house of

Fig. 5.

which I was both architect and engineer; and I exhibit it merely to demonstrate how easy it is to arrange so as to have the whole of the wastes delivering immediately outside the house. The water-closets A, B, and C, and others above these, the lavatories D and E, and the sinks G and H, have only the exterior wall between them and the drain. Hence none of these drains which convey the soil and other effete matters pass under the house. When it was found advisable to drain the basement—and here I found it so along the dotted double lines—I disconnected it from the main drain by interposing over the junction a ventilating shaft at X. The sinks and lavatories also deliver in the open air. To assist in flushing, some rain-water pipes, for instance, R and W, might, under certain circumstances, be led into the soil-drains. But, as a rule, it will be found wise to collect the rain-water as I did, by the dotted single line of drain-pipes to the tank T, for use in the laundry and green-houses. The main walls of the house were also built hollow, and protected from rising damp by a damp-proof course.

TWO CASES OF PUNCTURED FRACTURE OF THE FRONTAL BONE TREATED BY TREPHINING;

AND RESULTING ONE IN TOTAL THE OTHER
IN PARTIAL LOSS OF VISION.

By KELBURNE KING, M.D., F.R.C.S.,
Surgeon to the General Infirmary, Hull.

THE following cases seem to me to possess sufficient interest, both in a surgical and a physiological point of view, to warrant me in bringing them before the notice of this section. Though differing greatly in the extent of injury, they have this in common: that in each the most formidable symptoms depended upon extensive fracture and displacement of the internal osseous plate of the skull, of which but little evidence was procured by means of external examination; and in both the ultimate result of the accident was loss of vision: of both eyes in the first, of one eye in the second; although in both the seat of the accident was far removed from the origin or course of the optic nerves.

CASE I.—G. A., aged 17, was kicked by a horse on the left side of

* Read before the Surgical Section at the Annual Meeting of the British Medical Association in Edinburgh, August 1875.

his forehead, on January 3rd, 1874. Though considerably injured—for he had two front teeth knocked out, and lost a good deal of blood from the wound—he rode a distance of two miles to the residence of Mr. Morley, of Barton, who dressed the wound, and observed that the lad was perfectly self-possessed, and showed no symptom of disturbance in the functions of the brain or the organs of sense. He was cautioned to keep quiet; but, two days after, again rode over to have the wound dressed. After this, the forehead and nose became swollen; sickness, slowness of pulse, headache, and suppuration of the wound supervened. On January 12th, the sickness and headache had subsided. There was much less suppuration, but rough bone was felt at the bottom of the sinus. The pulse was 44. His memory was not impaired, nor were his faculties affected; except that he was sluggish, disinclined to exertion, and uninterested in what was going on around him. I saw him on February 5th, about a month after the receipt of the accident. He was then confined to bed; had lately suffered much from sickness and headache, though these symptoms were again relieved. His pulse was 40, and full. He answered questions slowly and hesitatingly. His pupils responded to light but slowly; his vision was not affected. His mental condition was clouded; his faculties were not effaced, but they acted slowly. He had a general feeling of distress and depression, and was quite anxious to have anything done for his relief.

On examining the forehead, there was found a fistulous opening just above, and a little external to, the left supraciliary ridge. A probe led to bare bone, and then could be passed on indefinitely. On examining with the finger, a punctured depression was felt in the bone, not larger than a split pea. Pressure in this situation caused him to wince. From these conditions, Mr. Morley and myself concluded that the injury to the internal plate of the skull was much greater than that to the external. The wound was enlarged, and a circular piece of bone removed with the trephine. On raising it up, the internal plate was found divided into three parts, and driven inwards, forming a kind of cone, the apex of which was opposite the small punctured depression of the external plate. Here the dura mater was ulcerated and sloughing.

A fortnight after, on the 19th February, Mr. Morley informed me that the lad was steadily progressing towards recovery; there was no hernia cerebri. Mr. Morley added: "The only bad symptom he has is diplopia; and he tells me that he sees double, even when I close his right eye." After this, however, protrusion took place; and an abscess formed, which burst on March 13th. On the 17th March, Mr. Morley sent me the following report. "He has not been sick for a week. Pus is still flowing, the bulging is gradually diminishing, and cicatrization advancing. Pulse 70. He does not see double with the left eye, as before; but he does with the right, the left being closed." The purulent discharge continued to the beginning of May; his general condition improved so much, that, with this exception, he might be considered as well. In the early part of May, the discharge ceased, and the wound cicatrised. He then noticed a failure of vision: first, in the left; afterwards, also in the right eye. The blindness increased; and he came under my care in the Hull Infirmary on the 26th of May. He could then distinguish light from darkness, and but little more. Both eyes were equally affected. There was a pulsating tumour, about the size of a walnut, over the seat of the operation, which could be reduced by pressure, without pain or inconvenience, but immediately returned. The pupils were dilated and sluggish, but responded distinctly to the stimulus of light. There was no paralysis, except of the optic nerve. As blindness supervened on the cessation of purulent discharge, I thought it possible that there might be deep-seated matter, and passed a fine trocar deep into the substance of the brain. No pus was discharged, and no effect was produced. He eventually left the hospital perfectly well in health, but practically quite blind. The ophthalmoscope showed white atrophy of the retina; and his condition is, I suppose, incurable.

In this case, there are two points to which I would call special attention.

Firstly, we had abscess of the left anterior lobe of the brain producing blindness of the left, then also of the right, eye. Secondly, we had the extraordinary symptoms noted by Mr. Morley, of double vision: first of the left eye, when the right was closed; then of the right eye, the left being closed.

CASE II.—The next case was that of J. F., aged 25, a sailor, who, on the 14th October, 1874, fell from the yard-arm of a ship into the empty hold—a height of upwards of thirty feet—was taken up insensible, and conveyed to the Hull Infirmary. On admission, his whole head and face were very much swollen, so that it was impossible to examine his pupils. There was a slight abrasion of the skin over the right eyebrow; and above the left supraciliary ridge, an indentation of the bone was perceptible, sharp and deep, but not wider than a split-pea. Pressure here caused him to shrink, though he was otherwise

unconscious, incapable of being roused, all voluntary action being suspended, and only the reflex functions being carried on. In this state, he continued till the 19th—five days—when consciousness began to return, though the excretions were still passed involuntarily, and the swollen condition of the head and face prevented examination of the pupils. On the 27th, the œdema had so far subsided, that this examination could be made; when the left pupil was found to be natural, but the right was dilated and insensible to light. There was ptosis of the right eyelid; and the right eye, though capable of distinguishing light from darkness, could not discern objects with any distinctness. After this, the pulse became rapid and hard; and he suffered from severe headache, with hot skin, restlessness, and general fever. The pain was especially severe over the left supraciliary ridge, where the depression was felt, and pressure there greatly increased the pain. It was evident that inflammatory fever was being set up as the symptoms of concussion subsided; and was probably occasioned by displacement of the inner table of the skull at this point. Accordingly, on the 4th November, the trephine was applied over the punctured bone. A portion of the outer table being thus removed, the internal was found broken up extensively, and forced inwards upon the brain. One jagged spicula, an inch and a half in length, and half an inch in breadth, was forced through the membranes right into the substance of the anterior lobe. On removing it, broken down portions of brain came away through the ulcerated aperture. At first, he seemed relieved after the operation; but, three days after, on the 7th, the part became swollen and painful; and, though pus and broken down brain-structure came away freely from the wound, he again became feverish, with great restlessness, so that he could only with difficulty be kept in bed. On the 10th, erysipelas set in in the face and scalp, affecting principally the right side; the feverish symptoms increased, and he became quite delirious. In the course of a week, the erysipelas disappeared, and the fever diminished. He became more tractable, but was very weak, and had very little muscular control. The right eye was quite blind, and the power of moving the eyeball was lost. His speech was very indistinct; the left ear was almost incapable of hearing; and the left side of the body was partially paralysed, especially the left arm. A new feature now began to present itself (November 17th). He complained of great pain in the back, legs, and feet, increased by pressure, and he dreaded even the weight of the bedclothes. In the latter part of November, and during the whole of December, his condition seemed to be desperate. There was almost complete loss of power in both legs and in the left arm, the right arm being the only limb over which he had any control. His legs were bent and drawn up, and in such a state of hyperæsthesia that the slightest touch elicited cries of pain. He was quite blind in both eyes; could hear only very loud sounds with the right ear, the left being quite deaf. His speech was not quite lost, but consisted of little more than inarticulate ejaculations. The excretions were passed involuntarily. Nevertheless, about the beginning of January, he began to improve. The œdema of the head had so far subsided that a fissured fracture—the inferior lip of which was slightly depressed—was perceived extending from the trephined part to near the left parietal protuberance. On January 13th, I made the following entry: "His general condition is much improved. Hyperæsthesia is much diminished, but still present in the legs. Muscular power is returning in the left arm, and also, though more slowly, in the legs. He has more power of moving the right eyeball, but there is still complete loss of vision in both eyes. The ophthalmoscope shows extravasation of blood in the retina of both eyes; but, on the right side, the optic nerve is becoming cupped and atrophied." From this time, his symptoms gradually improved. On April 7th, he had quite recovered control over the sphincters. The vision of the left eye was restored, but the right was quite blind. The ophthalmoscope showed that the blood patches on both retinae were absorbed, but the atrophy of the right optic disc increased. Hearing had returned: first on the right, afterwards also on the left, side. There was occasional stammering; but the power of speech was greatly improved. The paralysis and hyperæsthesia of the limbs had disappeared. His memory, though imperfect, was daily increasing in strength. There remained some numbness of the right side of the face. When he laughed or whistled, the right side was still slightly paralysed. The movements of the right eyeball were imperfect, but he could completely close the eyelids. He had gained greatly in flesh, and his general health was good.

On the 14th of April, 1875, he left the Infirmary, cured, with the exception of complete blindness of the right eye.

The nervous symptoms in this case are difficult to explain. The optic and motor nerves of the right eyeball and portio dura suffered most, while the left auditory nerve and the left side of the body generally were more affected than the right. In a case of such severe in-

jury, it would not be right to attribute all the results to the injury caused by the splinter of bone driven through the membranes into the brain, and removed by the operation of trephining. But, in the first case related, the injury was clearly restricted to that caused by the punctured fracture; and, as it resulted in atrophy of both optic nerves, it affords proof that injury and irritation of the anterior lobe of the brain may result in loss of vision of either or both eyes.

The practical deduction is that, in cases of punctured fracture, the greatest care and caution ought to be observed; and, on the appearance of head-symptoms, the trephine ought to be applied without delay, so as to remove all offending spiculæ of bone from the membranes and substance of the brain.

Percival Pott declared that "perforation is absolutely necessary in seven cases out of ten of simple undepressed fracture of the skull", a doctrine which subsequent experience has disproved; but it is not impossible that, in punctured fracture, some such proportion of cases may demand the operation; and in all such it must be of vital importance that its performance should be as early as possible, and before serious changes have been set up in the substance of the brain.

A CASE OF POISONING BY THE INHALATION OF COAL-GAS.*

By STEWART LOCKIE, M.D.,
Physician to the Cumberland Infirmary.

I FEEL justified in drawing attention to the details of the following case, as accounts of the symptoms and *post mortem* appearances in cases of poisoning by the inhalation of coal-gas are of comparative rarity; and yet it might happen to any one of us practising in towns to be summoned to a similar case.

I was called between eight and nine o'clock in the morning of 26th April to see W. J. B., aged about 18, "assistant boots" at one of the hotels in this city, who was stated to have been found in bed in an unconscious condition, and incapable of being roused. He slept in a cupboard bed in the smoking-room of the hotel. There was no fireplace in the room. He had retired to rest about half-past twelve. At twenty minutes past eight, the "boots" knocked at his door, but, receiving no reply, entered the apartment. There was a strong smell of gas in the room, so strong that the "boots" could not at first remain; the sliding gaselier was drawn down as far as possible, and one of the two jets was burning with the cock turned full. The "boots" tried to arouse him; but, failing to do so, came for me.

I arrived at 8.50 A.M. I found him lying on the right side in the semiprone position. There was a little staining of the pillow with a brownish coloured fluid near the position of the mouth. He was completely comatose, breathing irregularly, now rapidly, now more slowly, moaning much. The face was livid; the pupils were equal, neither abnormally contracted nor dilated, and sensible to light.

I had him immediately removed to a larger room, laid him on a mattress on the floor, and established a current of fresh air through the apartment. Then it was further observed that the pulse was feeble and excessively rapid (150), and that the temperature in the axilla was 102.8 deg. The eyeballs were observed to roll about in a peculiar fashion. The eyes were turned slowly to the extreme left, as if the patient were looking to his left, they then slowly returned to the median line, then back to the left, and so on. The motion was almost rhythmical, and nearly constant. It took place whether the eyelids were opened or closed. The breath smelt of coal-gas.

Dr. Maclaren was kind enough to render me his assistance and advice in the treatment of the case, as also did subsequently Dr. Coldstream and Mr. George Murphy. The subsequent notes were made by one or other of us—by whomever it was that happened to be present.

10.55 A.M. Temperature 102.2 deg. Respirations 52. Pulse 160. The conjunctivæ and corneæ were quite insensible to touch.

11.40 A.M. There was slight reflex action of the lids on touching the conjunctivæ.

It had been determined to try the effects of the administration of oxygen gas; and at 12 noon, an apparatus having been obtained, this was commenced in a modified form by setting free oxygen and conducting it by means of a tube near the mouth of the patient. This was continued with a few short intervals until 1.45 P.M., when it was discontinued. No perceptible improvement occurred during the administration.

1.45 P.M. A catheter was passed, and about a pint of clear pale

amber urine was withdrawn. A considerable portion of this had to be pressed out of the bladder with the hand, showing some degree of paralysis of the organ. Shortly afterwards, an involuntary fecal evacuation occurred. One ounce of brandy and six ounces of beef-tea were administered as an enema.

During the afternoon, our efforts were directed to obtaining a larger supply of oxygen, with a view to its administration in a pure state. An apparatus for the production of the gas was obtained, and, through the kind courtesy of Mr. Hele, a bag capable of containing twenty-six gallons with tube and mouthpiece for its administration. After considerable delay, we succeeded in obtaining the bag full of gas; and, at 6.30 P.M., commenced its administration. The whole twenty-six gallons were inhaled with two short intervals. Except that respiration was increased in frequency and the distress aggravated, no effect was observed.

By 10 P.M., we had obtained another bagful of oxygen. It was agreed to try a different method of administration, viz., to give three or four inhalations every five minutes. This was continued for an hour and a half, during which the whole twenty-six gallons were again inhaled. As before, it only seemed temporarily to increase the distressing symptoms.

At 11 P.M., the temperature had risen to 105 deg. Four ounces of urine had been withdrawn; an enema of beef-tea and gin was administered. At 11.30 P.M., the practice of cold affusion to the head was commenced. This seemed, at first, to have a good effect, the respiration becoming deeper and easier, and the temperature lower. At 12 midnight, the thermometer in the axilla registered 102.6 deg. (a fall of 2.4 deg.) Respirations 48. Pulse 150. The cold affusions were continued at short intervals until 1 A.M. (April 27th), always with apparent though temporary relief to the symptoms. After this, they were practised at longer intervals.

At 5 A.M., it was noted: "There is passive rigidity constantly present in both upper and lower limbs, and about every half minute the muscles become more rigid for a few seconds, and the patient moans. Pupils dilated, and nearly insensible to light; conjunctivæ much injected; about four ounces of urine removed. Pulse 148. Respirations 52. Temperature 103.6 deg." At 5.20 A.M., cold affusion to head; two chamber ewers full. At 5.30 A.M., temperature 102.4 deg.; pupils sensible to light; cold affusion again for eight minutes. At 5.45 A.M., temperature 102.5 deg.; no fall, but rather the reverse after this affusion. It was again practised for eight minutes. At 5.55 A.M., the temperature was 102.8 deg.

At 8.5 A.M., cold affusion was commenced again for ten minutes; before affusion, pulse 144, respirations 48, temperature 103.2 deg.; after affusion, pulse 140, respirations 48, temperature 103.4 deg. 9.5 A.M. Cold affusion had been continued, at intervals, for thirty minutes; before affusion, respirations 57, pulse 140; afterwards, respirations 42, pulse 144, temperature 103 deg.; the conjunctivæ were less injected; the pupils were sensible to light; there was spasmodic rigidity of arms now nearly constant. 10.15 A.M. Cold affusion was applied for ten minutes. The temperature had been gradually rising, and was now 104 deg. 10.45 A.M. Cold affusion was applied for fifteen minutes. Temperature 103.8 deg. Three ounces of urine were withdrawn. 11.40 A.M. Temperature 104.6 deg., pulse 140, respirations 51. 12 noon. Cold affusion was applied. The temperature afterwards was 102.8 deg. Between noon and 3.40 P.M., affusion was practised four times, but it seemed to have lost the effect of reducing the temperature, and was, therefore, abandoned at this time. The nutritive enemata had been given about every four hours. During the afternoon, it was observed that the rolling of the eyeballs had ceased. 7 P.M. Pulse 160. Respirations 65. Temperature 105.4 deg. 8.45 P.M. About six ounces of urine were withdrawn. A trace of albumen was found in this specimen. At 11.30 P.M., we commenced to feed the patient by means of the stomach-pump. One of the enemata had not been retained, and we indulged the hope that, as the struggle was so protracted, if the patient were adequately supported, he might possibly rally. Upwards of a pint of a mixture of coffee and milk, with two ounces of gin, was administered. Soon afterwards, the pulse was observed rather stronger.

April 28th, 3.30 A.M. He was in profuse perspiration. Respirations 66. Pulse decidedly stronger, but 180 at least. Temperature 105.8 degs. He was again fed by the stomach-pump with a similar mixture. Six ounces of urine were withdrawn. 8 A.M. Pulse 180 at least, more feeble. Respirations 64. Temperature 105 degs. There was no spasmodic rigidity. 8.15 A.M. Upwards of a pint of a mixture of beef-tea, milk, and gin was administered. 12 noon. Pulse very feeble, could not be counted. Respirations 62. Temperature 105.5 degs. Eight ounces of urine were withdrawn. He was fed again by the means of the pump. At this point of the case, it was agreed to try

* Read at the Spring Meeting of the Border Counties Branch, held at Carlisle.