alternate in arrangement with the other three, which contain respectively a red, a green, and a blue glass.

A standard candle is enclosed in a lantern having a circular aperture 25 mm. in diameter on the side nearest the screen, and this is filled with ground glass. The lantern can be moved to and fro along a horizontal scale graduated in centimetres from the screen backwards, and its position is indicated by a little pointer which projects from the base of the lantern. A small aperture in the side of the lantern just above this indicator allows the candlelight to illuminate the scale just where it is necessary to read it. During the examination daylight is to be so far excluded from the room "as to render recognition only possible at close quarters."

Donders gave the following formula:

$$K = \frac{1}{m^2} \cdot \frac{d^2}{D^2} \cdot \frac{a^2}{A^2}$$

It is only necessary to add to the explanation previously given that A = the distance of the candle behind the screen registered by the normal eye—that is, in practice the eye of the examining surgeon—in order to recognise the colour of the light coming through a 1 millimetre aperture at 5 metres distance; a = the distance of the candle behind the screen registered by the person who is being examined. This factor A is of great importance. It varies with different colours. Donders estimated that with the standard candle and ground glass employed by him:

A = 1.75 metres in the case of the plain ground glass.
A = 0.65 " " " red glass.
A = 0.25 " " " green glass.

Any lantern in which this factor cannot be calculated with precision is not satisfactory. It is equally important to measure carefully the subduing power of every piece of ground glass used in a lantern of this sort, while inequality in the combustion of the candle and the enormous influence of adaptation on the sensitiveness of the retina are disturbing elements in our calculations by this method.

From these considerations I pass to some practical remarks. I need scarcely point out that persons with quantitative defect for colours may have as great difficulty in recognising coloured signals at a distance as those who are truly colour blind. Holland is the only country whose railway regulations contain a definite proviso that a candidate must possess a certain quantitative standard of colour perception. A candidate for the post of engine driver or fireman must have, with both eyes open, a power of distinguishing colours of at least $\frac{1}{2}$; in each eye separately it must be not less than $\frac{1}{4}$; guards, porters, etc., must have $\frac{1}{2}$ with both eyes open, and at least $\frac{1}{4}$ with each separately. The examination is usually conducted with spots of coloured paper on a black background, arranged on a disc so that only one spot is exhibited at one time (apparatus shown). The degree of acuteness is measured by comparing the distance at which the candidate can see the colour of the spots with that at which the examiner sees them, each testing himself at the same moment. A grave responsibility evidently rests upon each examiner. It is essential that he should gauge as accurately as possible the relation between his own colour acuteness and the normal in order to apply this test with fairness. The data for this comparison can scarcely be said to be established. Professor Snellen, who is at the head of the controlling department, admits that a good test is still wanting.

The Committee appointed by the Council of the British Medical Association "to promote the efficient control of railway servants' eyesight" have made no specific recommendation on this subject in the report which they have issued this year; and as the mission has been commented upon in the BRITISH MEDICAL JOURNAL of July 23rd by Dr. McGillivray, of Dundee, I may state that the Committee are quite aware of it.

My chief purpose this day has been to lay before you some of the considerations which have induced its members to delay making any definite recommendation on this point to the railway authorities until the whole subject has been more fully investigated. In Holland the eyesight of railway servants is under the complete surveillance of ophthalmic surgeons. I fear that in this country some time will elapse before the examination of the eyesight of mariners and railway men is entrusted to persons properly qualified, and willing to apply a quantitative test with the accuracy which is essential if it is to be of any real value.

REVOLVER WOUND OF THE BRAIN; LODGMET OF THE BULLET; RECOVERY.

By P. BLAICKIE SMITH, M.D.,

Physician and Lecturer on Clinical Medicine, Aberdeen Royal Infirmary.

It does not often fall to the lot of the civil practitioner to treat bullet wounds of the brain. Injuries of this description, if not immediately fatal, generally soon destroy life, but their prognosis is not invariably hopeless. Recovery occasionally takes place—oftener, indeed, than is usually imagined—and whenever such a favourable result ensues the attendant circumstances are always worthy of being placed on record.

I shall therefore now proceed to the narrative of a case where a considerable part of the brain was traversed by a bullet, and the patient made a complete recovery, notwithstanding the grave injury which he had received.

Early in the forenoon of May 29th, 1891, a young gentleman, previously in the best of health and spirits, accidentally shot himself with his revolver. Subsequent investigation showed that he had entered his bedroom, where the accident took place, with the intention either of cleaning the weapon or of extracting some cartridges that remained in it, and that in the course of his manipulations he had touched the trigger and fired the shot, which wounded him in the manner afterwards to be described. The revolver was a small one, shooting with so little noise that the accident was not discovered for some time after its occurrence. When I saw him, about an hour later, he was lying on the floor immediately in front of a table on which lay the revolver along with one or two cartridges. Blood and cerebral matter issued slowly from a wound in his forehead, a pool of blood, also mixed with brain tissue, stained the carpet behind his head, and cerebral fragments were visible on the furniture adjacent. Evidence of vomiting was also apparent, and the contents of the bladder and rectum had been evacuated.

Upon examination after he had been put to bed, the following was discovered to be his condition. A small round aperture, slowly discharging blood and brain matter, existed over the right eyebrow immediately to the outside of the supra-orbital foramen and slightly above its level. The opening scarcely admitted the tip of the little finger, its edges were infiltrated with blood, and led down to a corresponding, though smaller, aperture in the bone beneath. On inserting a director into the wound, it at once entered the cavity of the cranium through what appeared to be a small clean-punched opening in the frontal bone. After ascertaining the condition of this orifice, the instrument was next slowly and carefully passed onwards for its whole length into the brain. During its introduction it gradually assumed an upward direction, and when completely within the cranium the distal end apparently occupied a situation not far from the upper extremity of the fissure of Rolando. No resistance to the progress of the director was experienced, and no trace of the bullet could be discovered upon careful searching, but it was clear, from the ease with which the instrument passed along, that it marked out the track of the missile backwards and upwards towards the vault of the cranium. No other serious wound existed; a few grains of gunpowder were embedded under the skin of the face; one or two were scattered on the sclerotics and corneæ of both eyes, and the right upper eyelid was considerably ecchymosed. The pupils were equal and reacted normally. There was no paralysis of the ocular muscles.

In spite of the formidable nature of the injury, the patient was not unconscious. He looked like one half asleep, and was really in a drowsy condition. When addressed he either paid no attention or else he answered after an interval slowly and in monosyllables without opening his eyes or manifesting any interest in his surroundings. Occasionally, however, he complained of headache. There was very slight paralysis of the left side of the face, chiefly in the vicinity of the mouth. The condition of the tongue could not be ascertained, as he declined to protrude it. He swallowed with difficulty. The left arm and leg were completely paralysed, and at times presented jerking movements. The arm and leg on the right side were unaffected by paralysis, but they were frequently moved about in a restless manner. Sensation was nowhere

involved. The superficial reflexes on the left side were all diminished; the left knee-jerk was excessive, but there was neither rectus nor ankle-clonus. The pulse was slow, the respirations sighing, and the temperature subnormal.

For four days subsequent to the accident (May 30th to June 2nd) there was on the whole a slight improvement. The paralysis of the left side of the face disappeared, and its subsidence was followed by a copious eruption of herpes, which affected that part of the face previously most paralysed. The arm and leg remained in the same state as before, and the reflexes were still abnormal. Consciousness was, however, distinctly less interfered with. Though he always lay as if he were asleep—and, indeed, did sleep a great deal—yet he could easily be roused, and, when he spoke, his articulation was faster and his replies more prompt than before. He recognised those who were around him by their voices, not caring to open his eyes, though he could do so when he chose, and on several occasions he inquired about the pursuits of his brothers, and showed an interest in lawn tennis. He had frequent sighing, but no hic-cough or vomiting. The temperature was slightly raised. Next day (June 3rd), though pulse and temperature were still febrile, and the cerebral state was unaltered, it was plain that the arm was not so paralysed as before, for he could now slightly move his fingers.

From June 4th to June 8th the symptoms showed a still further improvement. During this period the arm regained power so rapidly that on the latter date he was able to raise his hand as far as his face. The temperature, too, had fallen to some extent, the previous sleepy state was less pronounced, the condition of the wound was satisfactory, and he made no complaint except of headache, and then only when his head was moved for the purpose of dressing the wound. He could now swallow with much greater ease, he protruded his tongue readily, and without lateral deviation; he frequently opened his eyes, and recognised those who were in his room.

Between June 8th and 12th the paralysis of the arm again diminished, and now the leg gave evidence of returning power. He could flex the thigh and move the toes slightly. Speech was more natural, and he was disposed to converse; cerebration became more active, he was inclined to be dictatorial and to resent being kept in bed. By this time the pulse and temperature had resumed their normal conditions.

During the next week (June 12th to 19th) his progress continued to be most satisfactory. Headache was no longer complained of, the mental powers were steadily recovering, the paralysed limbs were regaining strength, and the bladder and rectum once more came under voluntary control. The wound, however, exhibited slight signs of hernia cerebri for a few days, and the patient suffered considerable annoyance from what appeared to be a grain of powder deeply embedded in the substance of the right cornea. With the view of relieving his discomfort, he was anaesthetised, and the foreign body removed. Subsequent examination proved it to be a small fragment of lead, which had doubtless been torn from the bullet as it passed through the barrel of the revolver. With the removal of the lead, the eye symptoms completely disappeared.

At this date it seemed that all immediate danger was at an end; but on June 20th the temperature rose suddenly to 104° F., headache came on, vomiting made its appearance, and the pulse became somewhat irregular. Next day the pyrexia decreased to a slight extent, and the vomiting and irregularity of the pulse subsided, but the headache persisted, and was the source of considerable suffering. The pain was chiefly occipital, and over the right vertex, and both these situations were distinctly tender on percussion. Fortunately these alarming signs were of short duration. For a few days pyrexia was present; then the temperature began to fall, becoming normal on July 5th, while the headache and skull tenderness gradually abated, and finally took their departure about the end of the month. During this slight attack of meningitis—for such I regarded it—the case in other respects continued to make favourable progress. The mind was quite clear, conversation natural and free; the demeanour, previously somewhat peremptory and impatient, returned to its normal condition, and the paralysed limbs, notably the arm, steadily regained power. The alteration in the state of the reflexes remained as before.

Throughout August the paralysis rapidly decreased, and the

walking powers correspondingly improved. The early days of the month found him just able to be removed upon a couch to the verandah: towards the middle of the month he was strong enough to walk indoors, supported on either side, and before it was ended he could step about in the open, practically without assistance. His progression was slow and typically hemiplegic; the paralysed limbs were somewhat rigid, and they, as well as the body generally, were much wasted. By this time the wound had healed.

In the month of September he continued to regain power; he was in the open air all day, and he rapidly put on flesh. The dynamometer in the right hand registered 70 K.; in the left 35 K.

In the middle of October the following was his condition: Paralysis was greatly diminished and rigidity less evident; grasp of right hand 80 K.; of left 50 K. Reflexes: Superficial on the left side still impaired, and knee-jerk as exaggerated as ever. He could walk for an hour continuously, and was quite free from headache and skull tenderness. Towards the end of the month I cross-examined him as to his recollection of what took place on the day of the accident, and I found that his mind was in this respect a perfect blank. He remembered distinctly events that had occurred previous to May 29th, but the circumstances of that morning, even before the accident happened, were completely lost. When it was suggested to him that he had been shot with his revolver he was at first rather incredulous, but, after realising the fact, he said that he supposed that he must have been firing at a tree, and that the bullet had rebounded and struck him on the head. So far as I could discover, his memory had remained in abeyance up to about the middle of June; after that date it was slowly and steadily restored, and now presented nothing abnormal. His other faculties seemed unaffected. His perception was good, his reasoning powers and imagination were unimpaired, his conversation was easy and natural; in a word, there was nothing in his demeanour (using the expression in its widest significance) to indicate that he had been the subject of a serious cerebral injury.

Soon after this date he left Aberdeen, and I did not see him for six months. When he again appeared before me he was perfectly well. He had been absolutely free from headache, he could read with comfort and with profit, he never suffered from vertigo, his eyesight was unaffected, the ophthalmoscopic appearances were normal, the two arms were of equal power, and he walked with freedom and naturally. In fact, the only indications of his recent injury that now existed were the scar on his forehead and the exaggerated condition of his left knee-jerk. Nothing approaching to an epileptiform seizure had ever been observed, and everything pointed to youthful health and vigour.

The treatment of the case consisted chiefly of rest, quiet, good nursing, and suitable diet. On the day of the accident the wound on the forehead was enlarged by Professor Ogston (Dr. Edmond, of Aberdeen, assisting), with the view of facilitating free drainage, and to this precaution I ascribe in part the happy termination of the case. Subsequently I had the privilege of consulting with Professor Macewen, of Glasgow, with reference to the advisability of undertaking operative proceedings for the removal of the bullet, and at a later stage Dr. Mackenzie Davidson, of Aberdeen, extracted from the cornea the small piece of lead to which I have already referred. During the attack of meningitis, much benefit was derived from the administration of mercury, along with the application of ice to the head, while the pain was materially controlled by repeated doses of antipyrin. Throughout the progress of the case considerable trouble was frequently experienced from constipation, and on several occasions the bowels were so obstinately confined as to require the administration of croton oil. The incontinence of urine was of the reflex variety, and called for no special treatment. The secretion when tested was always normal.

The foregoing case suggests many points of interest. One of the first that presents itself has reference to the course and situation of the bullet and the symptoms arising therefrom. It seems clear from the position of the opening in the skull that the missile penetrated the brain about the lower part of the right first frontal convolution. Continuing its course obliquely upward through this convolution, it apparently next entered the motor area of the brain, producing as

direct results paralysis of the arm and leg on the opposite side of the body.

On the assumption that this was the course actually taken by the bullet—an assumption sustained by the direction and extent of the sinus discovered by the probe—the explanation of the symptoms is not a very difficult matter. To the laceration and loss of brain substance, with the attendant hæmorrhage and subsequent inflammatory conditions, is to be ascribed the hemiplegia which was such a marked feature in the case. The very slight facial paralysis and its brief duration was a manifest indication that the centre for the face had not been injured, and it must, therefore, be regarded as a distant or indirect result of the lesion to the adjacent cerebral substance. The complete paralysis of the arm and its gradual and absolute recovery, commencing before the leg showed any signs of improvement, indicated that the arm centre itself had not been involved, and that probably the loss of power resulted from injury to the arm fibres on their way down to the internal capsule, while the equally complete and more prolonged paralysis of the leg with the still present excessive knee-jerk would seem to point to the existence of a lesion, either more cortical in its situation or more destructive in its results than that which had brought about the affection of the arm. In all probability the bullet has become arrested either in the leg centre or in its immediate vicinity. The exact situation is open to doubt; possibly the future may determine its position with greater accuracy than can be done at present. The occurrence of the herpetic eruption affecting the paralysed side of the face is an interesting symptom for which I can offer no very satisfactory explanation.

Diagram of supposed track of bullet. A, bullet track; B, fissure of Rolando. Weight of bullet, 80 grains.

Another point of interest in connection with this case is the fact that the accident was not fatal. Not only did the patient survive the injury, but he recovered with retention of the bullet in his brain, and without presenting any of those signs which are so apt to supervene when foreign bodies become lodged within the cranium. In the *Medical and Surgical History of the War of the Rebellion, 1861-65*, edited by Surgeon-General Barnes, United States Army, there are recorded nineteen cases of recovery from gunshot wounds of the cranium, with lodgment of the bullet in the brain. In four of these cases, just as in the present instance, the bullet penetrated immediately above the right eyebrow, travelling backwards and producing various symptoms. Of these four cases, one developed epilepsy two years after the wound in the head had healed, the second had to be discharged the service, owing to persistent headache, and "hallucinations," the third was

pensioned four years after the reception of the wound, on account of vertigo upon exertion, while the fourth (the report of this case is very meagre) returned to his regiment after a stay in hospital of almost two months. Out of the whole nineteen cases, I observe that vertigo is mentioned as a sequela in seven instances, and that epilepsy is noted only twice, while headache, impaired vision, and various paralytic symptoms, such as paresis of limbs, deafness, etc., complete the remaining causes of disability. The whole of the patients, however, did not develop sequelæ, for some were apparently in the enjoyment of perfect health at the date of the publication of the *History* from which I have quoted (1870).

Another case of bullet wound of the brain, wonderfully like that of my patient, has recently been reported in an American lay paper. The patient, a boy of 15 years, accidentally shot himself with a small rifle when he was on a hunting expedition early in June, 1891. The bullet entered the skull immediately above the right supra-orbital foramen, and a little to its outer side. Subsequent examination indicated that it had split in two against the hard bone, one fragment passing horizontally backward, and the other taking an upward and backward course for about six inches. The two fragments could be detected by a probe, but it was not deemed advisable to attempt their removal, as the case was considered hopeless. Towards the end of the month he came under the care of Dr. Fr. Heuel, jun., of New York. He was then rapidly losing strength. He ate little or nothing, and there were severe pains in his head. The wound had almost healed. Recognising the serious condition of the patient, Dr. Heuel trephined on both sides of the bullet opening, removed a number of bony spicula and pieces of lead, and also opened a circumscribed abscess beneath the dura mater, containing about a thimbleful of pus. Under appropriate treatment, all alarming symptoms gradually disappeared, and the patient steadily progressed towards recovery. In a letter to me, dated May 4th, 1892, Dr. Heuel gives the following additional particulars of his interesting case:—

"Since then (recovery from operation) he has been in the best of mental and physical conditions, with the exception of a partial paralysis—which promises to be permanent—of the extensors of the toes of the left foot. This does not interfere with locomotion, and cannot be noticed except by an expert eye. Sensation is perfect. He uses neither crutch nor cane, and is very fond and expert in riding his bicycle. He is brighter and more cheerful than before the accident, has gained in weight, and is growing rapidly." I am glad to learn from Dr. Heuel that he is to publish the case in the near future, and it will be both interesting and instructive to follow the career of the two patients whose cases are so much akin.

MEMORANDA:

MEDICAL, SURGICAL, OBSTETRICAL, THERAPEUTICAL, PATHOLOGICAL, Etc.

A CASE OF MILKY ASCITIC FLUID.

IN the *BRITISH MEDICAL JOURNAL* of July 16th, an interesting case of the above is reported by Drs. Nieuwoudt and Rozenzweig, of Cape Town, and having had a similar case quite recently, I think the following notes may be of some interest.

N. G., aged 10 years, a pale, strumous looking child, was first seen by me in consultation on May 24th, 1892. She was suffering from increasing abdominal fluid distension, with rapid wasting and persistently high temperature, 103° to 104° each night. She had been gradually getting worse for two months past. I had no difficulty in confirming the diagnosis of her medical attendant, that it was a case of tuberculous peritonitis, and it was decided to treat it by abdominal section, which was accordingly done. Fully a gallon of fluid of the colour and consistency of rich creamy milk came away. This fluid coagulated spontaneously, was rendered almost transparent by the addition of ether, and otherwise agreed physically with chyle. The mesenteric glands were found enlarged to the size of a cricket ball, and firmly fixed to the lumbar spine; the iliac and lumbar glands were also greatly enlarged, and resembled a number of walnuts strung on a