The urine, in the course of a week, is generally found to be ammoniacal; and it is wonderful how men who have met with injuries to this portion of the spinal chord, live on, month after month, dying by inches, and, at last, slowly sinking, under sloughing bed-sores, and some low type of inflammation of the bladder.

If the seat of injury has been at the upper portion of the dorsal region, in addition to the symptoms already pointed out, there is added a train of symptoms indicative of paralysis of the expiratory muscles. Expiration is now altogether dependent on the elasticity of the walls of the chest; because the intercostal muscles have no longer the power of acting—and so sneezing, coughing, etc.—are no longer capable of being performed. It is hardly necessary to point out, that inspiration is carried on almost entirely by the diaphragm; and that, the blood not being arterialed, congestive pneumonia, in a very short period, terminates the life of the patient.

If the lower cervical region be the part injured, there is also, as the result of the injury, paralysis of the upper extremities, and the inspiration is altogether diaphragmatic.

Such is an *epitome* of the symptoms of injury to the different portions of the spinal chord which I have seen in my long experience. The student must not expect to find them exactly as described, in every case that may come before him. It is one thing to diagnose concussion, or any other present, remote, or possible result of spinal injury, to the satisfaction of the examiners at the London University, or the Royal Colleges of Physicians and Surgeons; and altogether another thing to do it at the bedside of a patient.

I quite agree with Dr. J. Ogden Fletcher, (whose work on *Railways in their Medical Aspects* has been described as pleading as eloquently in defence of railway companies, as does the work of Mr. Erichsen on the other side of the question), that, in every case where a claim is set up for compensation, we are bound to "*attach very considerable importance to moral evidence.*" Many years ago, I was employed in a case, where a young and highly educated physician had been deceived by a patient, who pretended that he was paralysed, in order to obtain compensation from an assurance company. This man played his part with no little skill; and suffered a pin to be run into his legs without moving, or betraying pain; and yet, in the end, he was proved, beyond doubt or question, to be feigning disease.

Again, every physician and surgeon must have seen cases of hysteria in the male. I had such a patient a few months ago, and I know he was attended by other physicians in Sheffield. He was a strong muscular man, aged 40, in whom the morbid nervous exaltation was such that he screamed on touching the spine or left side with a feather, although, when his attention was arrested, he could bear any amount of pressure on the same parts.

For many years past, medical writers have pointed out—and no one more ably, more fully, and more clearly than my old teacher, the late Sir B. C. Brodie—that, after a shock to the nervous system, symptoms *altogether subjective* are often present, similar to what we note in *real* affections of the nerve-centres. This state of things I have very frequently seen after railway accidents, and that, too, in ladies, and in those who have had no wish nor intention to deceive. The absence of *objective symptoms* in such cases will always enable us to form a correct diagnosis, and to decide between real and imaginary spinal disease.

It is quite impossible to shut our eyes, however, to the fact that persons, who have received very slight injuries, frequently greatly exaggerate their degree, or consequence, in order that they may induce a jury to give them a disproportionate compensation. When, therefore, I am called upon to examine for the purpose of legal investigation one of these doubtful cases of impaired function—said to have been the result of an accident—I feel it incumbent to collect all the information in my power respecting the person's moral and physical habits, and probable motives; and to inquire if the alleged causes of the disease are founded on fact, or probable. And more especially is it important to ascertain whether the pathognomonic symptoms of the supposed disease are present. This task, though difficult, is not altogether a hopeless one. The simulator of disease is apt to overact his part, to give a detail of incompatible symptoms, and greatly to exaggerate unimportant lesions.

If called to a man, then, who has been in a railway collision, and who tells me that he received a blow on the spine, or a jar, or a twist, or a sprain, or concussion; that he is now quite unable to move his legs, or even to turn himself in bed—and, especially, if there had been no immediate symptoms following the injury of impaired or altered function of the nerve-centre, but some weeks or months after the accident, and when it was almost forgotten, these symptoms indicative of serious disease are said to have appeared; when this goes on week after week—the man still remaining, apparently, without the power of moving in his bed—his lower extremities stated to be without sensation or motion—with a healthy looking countenance—no marked lesion of nutrition—no

difference of temperature between the parts said to be paralysed and the rest of the body—perfect command over the bladder and rectum—pulse natural—no bed-sores—no flattening of the nates or calves of the legs—and I am drawing no imaginary picture here—I say, emphatically, there is a total absence of the objective symptoms which I have seen during the last thirty years, in all the numerous cases of serious spinal injuries that I have attended. In all cases, therefore, where the pathognomonic symptoms of the alleged injury are absent, who will venture to say they ought not to be submitted to the most searching, careful, and fearless investigation?

I have used the terms *objective* and *subjective*. By *objective*, I mean whatever is exterior to the mind—outward, external; something that we can see. To this, the term *subjective* is altogether opposed. In the former case, I depend on the evidence cognisable to my senses; in the latter, there is nothing to depend upon, save the statement of the patient.

The result of my experience has been this: that I have never yet seen a case of injury, the result of a collision on a railway, where the symptoms have been subjective only, in which the favourable verdict of a jury, and the payment of the damages awarded, has not been followed (generally very rapidly), sooner or later, by complete restoration to health and strength.

I must reserve to the next number, a series of most interesting cases, illustrative of railway accidents and their results.

ON THE USE OF THE SPECTROSCOPE AND MICROSCOPIC TOSCOPE IN THE DISCOVERY OF BLOOD- STAINS AND DISSOLVED BLOOD.†

By W. BIRD HERAPATH, M.D., F.R.S., Bristol.

THE spectroscope which has been mounted on this stand is so perfect in its action, that it readily exhibits Fraunhofer's lines in solar or in lunar light, and it divides the bright yellow sodium line D into two when properly adjusted. It therefore gives great accuracy of observation; and the stronger dark lines of the solar spectrum become so many fixed points for the comparison of the position of the dark absorption bands of various coloured solutions when they are observed by daylight. One disadvantage attendant upon the employment of this form of spectroscopy is the quantity of material necessary to be employed. Several drops of blood must be at the disposal of the operator, to get a sufficiently coloured solution to fill the little test-tube used in the optical examination.

By modifying the instrument and introducing a longer tube for containing the liquid to be examined, say a column six or eight inches in length, it would be possible to discover one drop of scarlet cruorine in a pint of distilled water without much difficulty—a quantity so minute that no perceptible colour would be visible to the unaided eye, and no other method of analysis would be capable of detecting it.

Quantities like these are not always to be had; and a recent well-known case, in which I had the opportunity of first using the micro-spectroscope in a medico-legal inquiry, would have failed altogether if I had depended alone upon this "fluid spectroscope," as nearly all traces of blood-stains had disappeared from the weapon employed by the murderer, in consequence of the hatchet having been left exposed in the woods near Mountain Ash for several weeks after the deed was accomplished. (Case—Reg. v. Robert Coe; Swansea Assizes, 1866.)

It was only on the removal of the head of the hatchet that any appearances of blood were to be obtained from the surface of the handle, which had been protected by the iron ring; and, on carefully making thin sections of these stained portions of wood, and treating them with distilled water, a few drops only of a brownish coloured fluid were obtained, which coagulated and became discoloured on boiling; also another drop, when placed in a very minute tube about half an inch long, and the one-eighth of an inch diameter, the total contents of which tube were one grain and one-third of distilled water, gave the optical absorption bands due to old blood. This little drop of bloody-coloured fluid was placed on the stage of the microscope, and examined with an inch Ross's objective, illuminated by an achromatic condenser; and the microspectroscope was inserted into one of the tubes of a binocular microscope, as an ocular lens would be employed. This form of instrument is that known as the Sorby-Browning Spectroscope, and it admits of great precision, as it has a lateral spectro-

* Read before the Bath and Bristol Branch, January, 1867. [Concluded from page 190 of last number.]

scope, as well as a terminal one. These two spectra appear side by side in the field of view, and, being perfectly parallel, admit of examining substances by two sources of light at the same time; or enable us to make comparisons between two different or similar substances at the same time by the same kind of illumination, the two spectra being both visible with the same eye.

This form of instrument is very sensitive to small quantities of blood, and it would be perfectly easy to detect and ocularly examine the blood contained in the stomach of a flea, and even dilute it with a table-spoonful of water without losing its properties, especially if he had made anything like a successful forage upon some sanguineous individual. But to shew how small a quantity of blood is really necessary for recognition with this instrument, Mr. Sorby has distinctly obtained the absorptive bands in a single half-corpuscle of dried blood; and in order to obtain this result the object was illuminated by a powerful achromatic condenser, and one of Smith and Beck's new one-twenty-fifth objectives was employed.

However, without having gone as far as this, my own observations have proved that it is possible to obtain very evident results from less than one-thousandth of a grain of dried blood, the colouring matter of which had been dissolved out by a drop and a half of distilled water.

In fact, comparative experiments proved that, in the Mountain Ash case, the quantity of blood actually experimented upon, and productive of conclusive results, did not exceed one-thousandth part of a grain. The justice of the sentence was afterwards proved to the satisfaction of all parties by the confession of the prisoner previously to his execution.

However, this optical or micro-spectroscopic result was, in that case, also confirmed by the microscopic examination and detection of the blood-corpuscles, as well as by the chemical testing of the solution of hæmating, or rather red hæmating, for it had not passed to the extreme state of change visible in old dried blood.

Other forms of spectroscopes have been adapted to the microscope by different opticians or inventors. One great objection to the other forms consists in the greater complexity of the arrangements, and the variety of adaptations to be made, rendering the observations both difficult and troublesome, involving great loss of time, and of course multiplying the chances of failure.

It is somewhat remarkable that, though various other bodies have to the eye all the appearances and colour of blood, yet none of those usually met with have any spectra to be mistaken for those of the various forms of blood-colouring matter herein described. The generality of soluble red colouring matters absorb *continuously* more or less of the violet, blue, green, or yellow, even orange rays of the spectrum. Some wholly absorb the spectrum with the exception of the red ray, which they transmit; a chart will be exhibited to demonstrate these various appearances. The well-known sulphocyanide of iron, often used by conjurors and chemists, and called artificial blood, is strikingly wanting in those optical absorptive powers or bands so indicative of crurine or hæmating in their various forms.

Spectrum-analysis is capable of rendering great service in chemical and pathological inquiries, as, by means of the optical spectra, blood may be easily recognised in urine and detected in some forms of albuminuria, even if the urine be also charged with the colouring matter of bile. Highly jaundiced urine absorbs all the blue end of the spectrum; but, as the green, orange, and red rays are unaltered, the two bands of scarlet crurine are readily seen. The recent menstrual fluid, when dissolved and properly diluted, gives the spectrum of scarlet crurine; so does urine mixed with menstrual fluid, even if highly bilious.

Two substances only have been found comparable in their optical effects to those of hæmating—a dilute ammoniacal solution of carmine, and a similar solution of cochineal in ammonia; these colouring matters are very unstable and fade quickly. In both these liquids the same colouring matter exists, as carmine is produced from cochineal. The two absorption bands are much broader and more diffuse than any of the optical appearances due to the colouring matter of blood, though most like that of brown hæmating, and only a novice in spectrum-analysis could possibly mistake the one for the other, whilst the least attempt at chemical investigation would pronounce them different, the action of heat alone being sufficient to coagulate the colouring matter of blood, whilst the cochineal and carmine would remain unchanged. Reducing agents would also settle the question definitely. Acids immediately change the colour of cochineal solutions to a reddish-orange, deficient in absorptive power; and even a spontaneous discolouration will take place in the ammoniacal solution of cochineal. Solutions of carmine are more permanent. Acetic acid produces no change at first, but eventually the colouring matter is precipitated. Sulphide of ammonium does not alter it in the least, nor does the alkaline solution of protochloride of tin. On adding protochloride of iron and ammonia to any solution of carmine, the colouring matter is immediately precipitated in

combination with the oxide of iron as a brown or maroon-coloured compound.

But one great safeguard in medico-legal inquiries will be the absence of cochineal or carmine from those positions in which blood may by any possibility be found, some cloth-fabrics alone being dyed by a mordanted cochineal. Some scarlet cloths are of this character; and the carmine colour, being fixed by alumina, would be insoluble in cold water; whereas the crurine or hæmating would dissolve with more or less facility according to its age. It is evident, therefore, that all these considerations render the detection of blood-stains by spectrum-analysis a matter of little doubt or difficulty, even when in minute quantities. In conclusion, although spectrum-analysis does not go one step farther than we were before in our powers of discriminating human blood from that of other mammalian or red-blooded creatures, yet it gives us greater facilities of demonstrating the presence of the colouring matter of blood, even in inconceivably minute and almost invisible proportions; whilst the facility with which the observations are made is a great, if not the greatest, recommendation to the employment of this method whenever practicable.

ABSTRACT OF A CASE OF FIBROID PHTHISIS.*

By ANDREW CLARK, M.D., F.R.C.P.,

Physician and Lecturer on Medicine at the London Hospital.

General Summary.—A woman, aged 28, four years married, childless, sprung from healthy parents, said to have been temperate, and to have enjoyed good health till three years before, when she had ascites, from which she recovered in eleven months, began in July, 1867, to suffer from vomiting, prostration, cough, occasional hæmoptysis, mucopurulent expectoration containing lung-tissue, œdema of the extremities, and intermittent diarrhoea. She became rapidly worse, and died comatose on the 5th of December of the same year. *Post mortem* examination revealed, as had been predicted during life, fibroid disease of the left lung, with dilated bronchi, cheesy deposits, and cavities arising from their disintegration; enlargement (and waxy degeneration) of the liver; granular contraction (and some waxy change) of the kidneys; ulceration of the bowels; enlargement of the mesenteric glands; and fibroid degeneration of, or deposit in, other organs and tissues.

State on Admission.—The patient was greatly emaciated, reclined on her back, and took little notice. The pupils were dilated and sluggish. She was drowsy, but sleepless. She answered questions with difficulty, but, as it seemed, correctly. The skin was dusky, yellowish, dry, rough, with white patches here and there. The hair was dark, scanty, coarse. The fingers were clubbed. The temperature in the axilla was 97.4. The teeth were decayed, yellow; with sordes. The tongue was dry, red, and cracked; she had thirst, vomiting, flatulence, and diarrhoea, preceded by griping pains. The hepatic dulness was greatly increased downwards and to the left. There was no increase of the splenic dulness. She menstruated two months before admission. There was slight leucorrhœa. The urine was deficient in quantity, pale, acid, of a density of 1012, and containing a tenth of its bulk of albumen. There was a scanty deposit, exhibiting granular matter and small hyaline casts. On account of the weakness of the patient, the front and lateral parts of the chest were alone examined. The respirations were twenty per minute, and chiefly abdominal.

On the *left side* the front was depressed, and the movement slight. In the supraclavicular region, percussion was tympanitic; the breath sounds were blowing; the resonance bronchophonic, with echo. From the second to the fifth ribs, and from near the sternum to the posterior part of the axillary region, there was hard resistant dulness, with considerable retraction of the chest-wall. In front of this region inspiration was bronchial, and accompanied by moist subcrepitant râles; expiration was dry, and not sensibly prolonged. In the axillary region, the breath-sounds were tubular, and partly masked by coarse crepitation; the vocal resonance was bronchophonic. At two spots the breathing was cavernous and the voice pectoriloquous; here a metallic click was heard, coincident with the heart's contractions. Along the posterior axillary line an occasional creaking leather-sound was heard, and vocal fremitus and vocal resonance were notably diminished. Over the lower part of the lung the inspiratory murmur was harsh; and the expiratory murmur, which in its first half was blowing, terminated only after apparent cessation of the movements of the thoracic walls by a few gentle puffs. A fine dry crepitation was developed by forced inspiration. Ultimately in this region there were uniform dulness, tubular breathing, and bronchophony. On the *right side*, percussion over the anterior third was tympanitic;

* Read at the Clinical Society of London, February 28th, 1868.