

A case of intra-cranial injury with extensive destruction of brain substance about the rolandic area and loss of the so-called muscular sense / under care of J. Cooke ; report with observations and comments by G.L. Laycock.

Contributors

Cooke, J.
Laycock, G.L.
Mott, F. W. 1853-1926
King's College London

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*Secondary functions of
Rolandic Area*

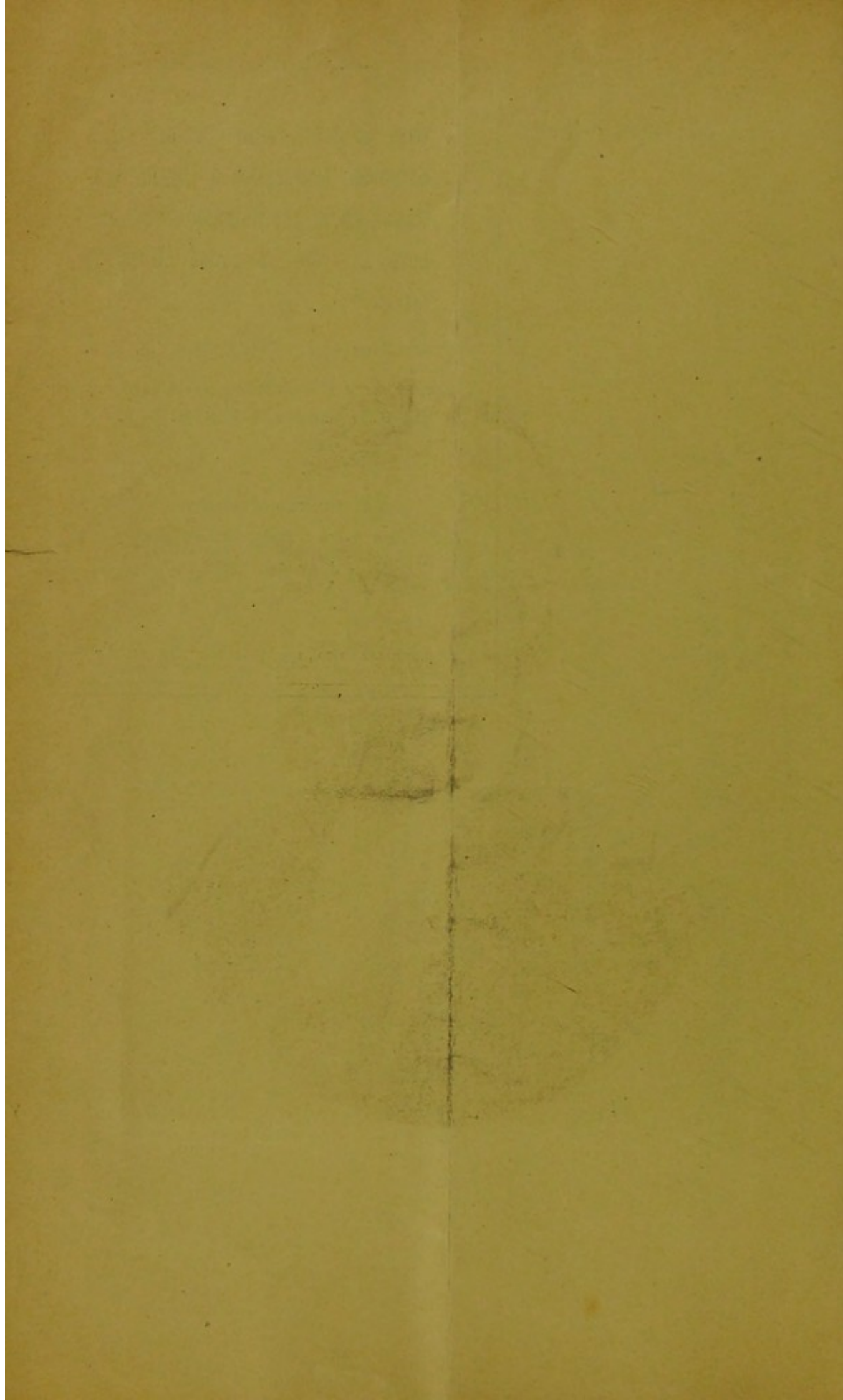
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A Case of Intra-Cranial Injury, with
Extensive Destruction of Brain Sub-
stance about the Rolandic Area, and
Loss of the So-called Muscular
Sense.

UNDER CARE OF J. COOKE, M.R.C.S. ENG.
REPORT, WITH OBSERVATIONS AND COMMENTS,
BY G. L. LAYCOCK, M.B., C.M. EDIN.

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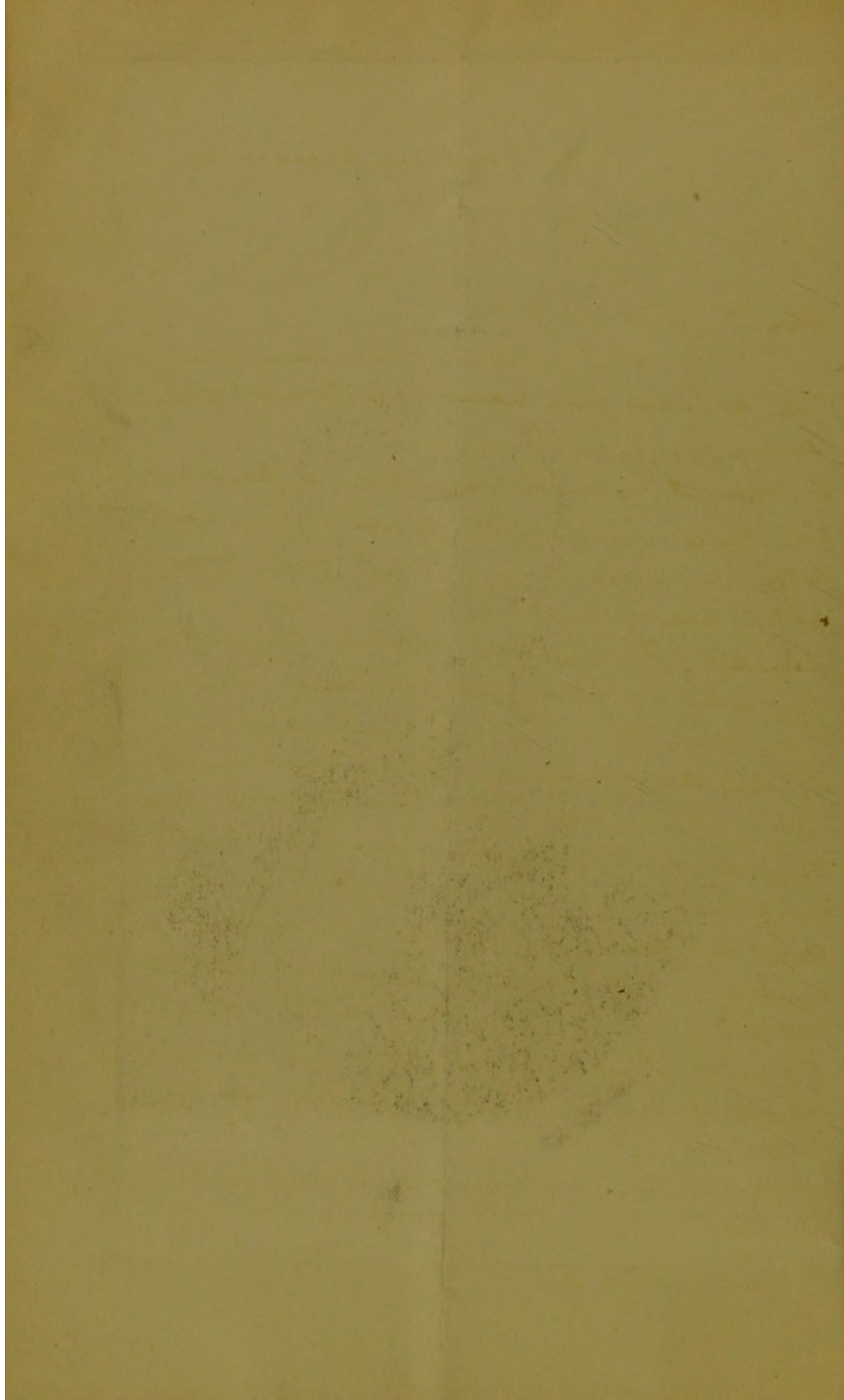


[Rae Bros., Phototype.]

[Elizabeth Street, Melb.]

A CASE OF INTRA-CRANIAL INJURY.

ILLUSTRATING DR. LAYCOCK'S PAPER.



15 Trinity Square E
7th Ave 94

Dear Dr. Mott.

The following case may interest
you, as I have just received the Journal of Phy-
siology containing your paper.

On Aug 8th a middle aged man, a German
Cat River was admitted under my care with
extensive lacerations of the scalp caused by being
fallen head foremost on the revolving wheel
of his cart. The bone was laid bare chiefly over
the vertex but not apparently injured. The wounds
were cleaned out and dressed antiseptically.
In three days temp. was about 102° and there
was a little suppuration. Then the temp. became
normal, and suppuration ceased. On the 18th
temp. rose to 104° Scalp was apparently all
right & I could find nothing to account for
the temp. but at last the man said that his
left hand was freezing, that he did not seem
to feel it. I tried the grasping power of both
hands: it was equal & powerful. He could
move his left upper extremity quite freely
but he had no conscious sense of any touching
his hand. On the 19th paroxysms of motion

Remained but that evening he was ill as his wife taking him home
was obliged to his sweetest disposition towards her. I thought
myself better than but the summer the wind has been been
a the last report on the 12th the news that he was much the same.
It was quite true to me that emotion & emotion could cause and return
to my independence of each other from critical trouble.

Yours truly
Remond's last letter

Seems to feel the left hand. 22nd much the same, but has had
some more fits. An interval of shorter duration than before operation
this week but repeated his statement of peculiar sensation when
he worked right hand. 23rd no more fits. Slight numbness in left
hand, no swelling. 24th Sensibility greater but localization imperfect.
No sensation in terminal phalanges. No swelling. 26th improvement
Sensibility, in slight swelling proximal. Inflammation in terminal phalanges.
29th much greater swelling proximal. Great left hand & catch knots of
both before one has been. ~~There is~~ ^{There is} much the same. 31st no
well. Considerable swelling. Scarth flap shrinking at the part, a little
suppuration, on left hand flap. a little, each of these knots has been
slightly raised, with white spots but covered by very fine scales. ~~Present~~
31st more swelling. Swelling has unfortunately become very deepening
of the. Thought that seems to be a swelling upon lower & anterior
to the same more suppuration. 31st 2 1/2

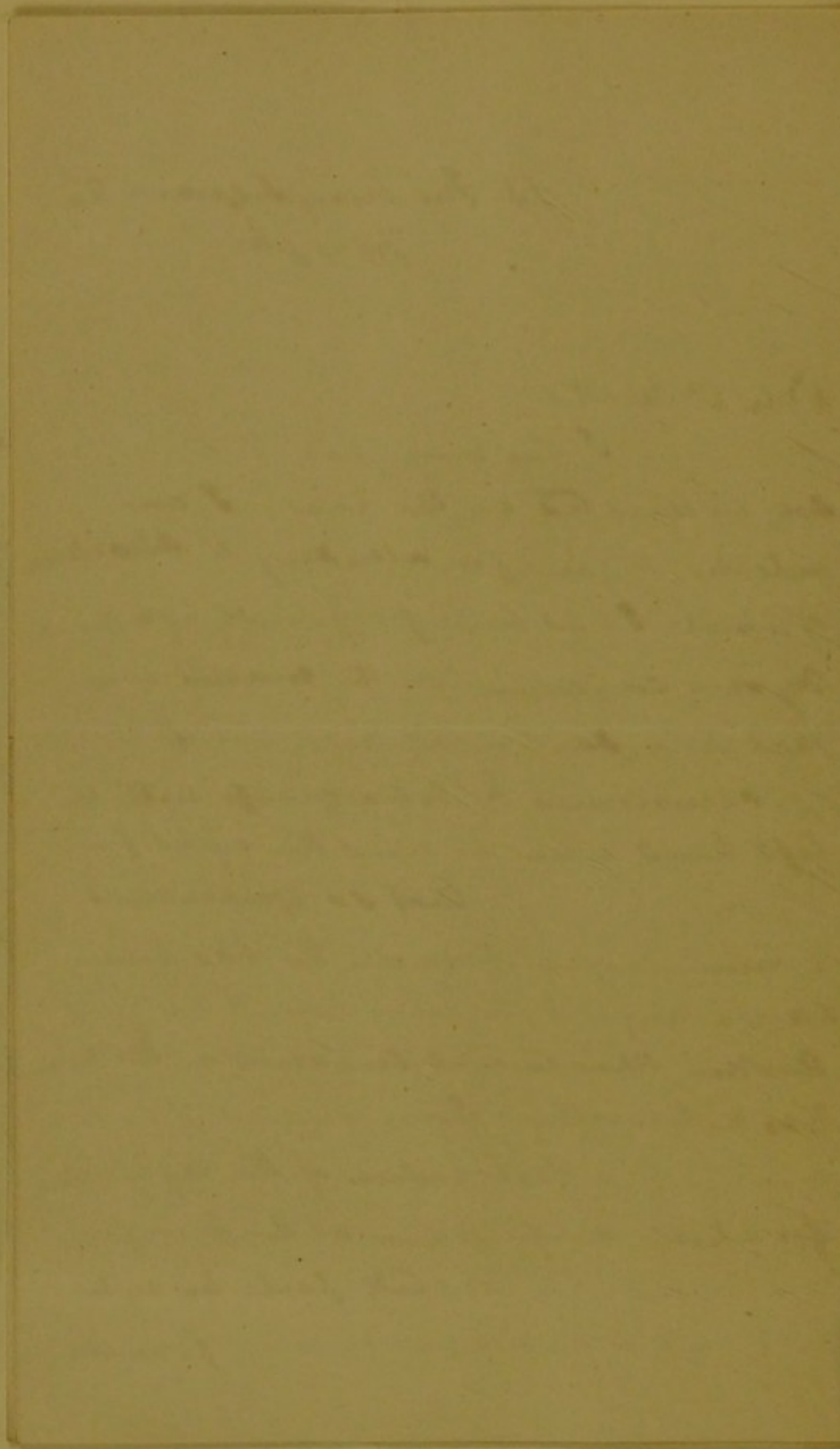
appeared. on the 20th Complete paralysis of
left upper limb & many "fits" commencing
left arm & so all over body. I saw him
8 of pm. He was quite rational, very intelligent.
Eyes normal. headache, pulse quick. Temp
104°. I trephined for left arm center. Scrup
vascular coordination. Prolapsed very vascular
When trephine pin had penetrated outer table
very free bleeding. so that when trephine
was removed the blood spouted in a stream
Stream for about 4 inches through center
puncture. Dura mater normal as per
Sutton. When Dura was incised, a little
pus escaped, & when dural flap was turned
down a flake of purulent lymph came
away. Pia mater very congested opaque
leathery no pulsation. Brain very
elastic. but puncture to depth of about
3/4" gave nothing. Dural flap turned
down. Excised bone replaced. pins turned
down. drainage tube. Scabs dusted
of corium all antiseptic.

21st Temp normal. no more "fits" still
Complete paraplegia. but he said that he
worked the fingers of the right hand

15 Trinity Square E.
7th Feb.

Dear Dr. Hott.

I am very glad that you
are interested in the case. I am
indebted to you for alluding to Allochiria
of which I had been profoundly ignorant.
My own conjecture on the matter was
that as a Baume & Mercier he would be
so accustomed to extra grasp with the
left hand when he used the right for
whipping purpose that so peculiar
communication between the two hemi-
spheres might have been trained to action.
Another Phantasmal sensation in the knee
was noteworthy. Some years ago he had
a compound dislocation of the right tibia
for which amputation at the knee joint
was performed. He still feels his right
foot, and at the normal distance from the





think. So vivid too is his perception that
he with considerable humor described
how when excited in conversation with
friends he would start up & stand on
his right foot & so tumble over -
The last report about him is that he is
improving.

Please send love to Anna & this

Yours truly
Levin W. Burdett

A CASE OF INTRA-CRANIAL INJURY, WITH
EXTENSIVE DESTRUCTION OF BRAIN SUB-
STANCE ABOUT THE ROLANDIC AREA, AND
LOSS OF THE SO-CALLED MUSCULAR SENSE.

[With Phototype.]

Under the care of J. COOKE, M.R.C.S. Eng.

Hon. Surgeon to the Alfred Hospital.

Report, with Observations and Comments, by G. L. LAYCOCK,
M.B., C.M. Edin.

Hon. Medical Electrician to the Alfred Hospital.

Hon. Medical Officer to the Out-patients' Department, Children's Hospital,
Melbourne.

A. A., 29, single, above the average in strength and robustness, with a history of perfect health, except an attack of influenza and two accidents to the leg and ankle respectively, was admitted to the Alfred Hospital suffering from a compound comminuted fracture of the skull.

The history, for the surgical aspects of which I am indebted to Dr. F. S. Crowther, Resident Surgeon, is as follows:—On 24th February last, while the patient was cutting down a tall gum tree, a branch about the thickness of a man's arm fell from the height of about 100 ft. on his head. The patient was standing firmly in position for swinging his axe, and the falling branch meeting what was practically a rigid body, simply crushed in the skull, just behind the right parieto-frontal suture. The patient was admitted to the hospital next day, and was placed under the care of Mr. J. Cooke, Honorary Surgeon. He was then unconscious, with great restlessness and delirium. The right eye was contused, the pupils were equal, and there were left hemiplegic symptoms. The vertex was extensively fractured, and in the wound there were pieces of bone and brain substance. Mr. Cooke cut down over the wound and removed ten pieces of bone, the gap in the cranium being an irregular oval measuring four by three inches. He explored the

wound with his finger, and found the base of the skull fractured just behind the orbits, there being a fissure about a quarter of an inch wide. The right frontal bone could be easily moved, and in fact the skull had been practically split in two in the line of the blow. A good deal of lacerated and contused brain substance was removed, the edges of the dura mater brought together as far as possible, and the wound closed.

After the operation, the patient was very restless, extremely noisy in his delirium, and was continually throwing his right arm about. The nurse reported that he moved his arm in a circular direction, and that if anybody was speaking within earshot of him, he would catch up the last two or three words and repeat them several times. The hemiplegic symptoms were well marked. There was scarcely any rise of temperature.

On the sixth day after the accident, consciousness began to return, and he could recognise people about him. At this time there was noticed right facial paralysis; this, however, passed off in about four weeks. From this time he gradually became more rational, though very restless and excitable. On the tenth day a hernia cerebri began to threaten, but this soon passed off. The improvement continued, and in about a month the hemiplegic symptoms began to disappear.

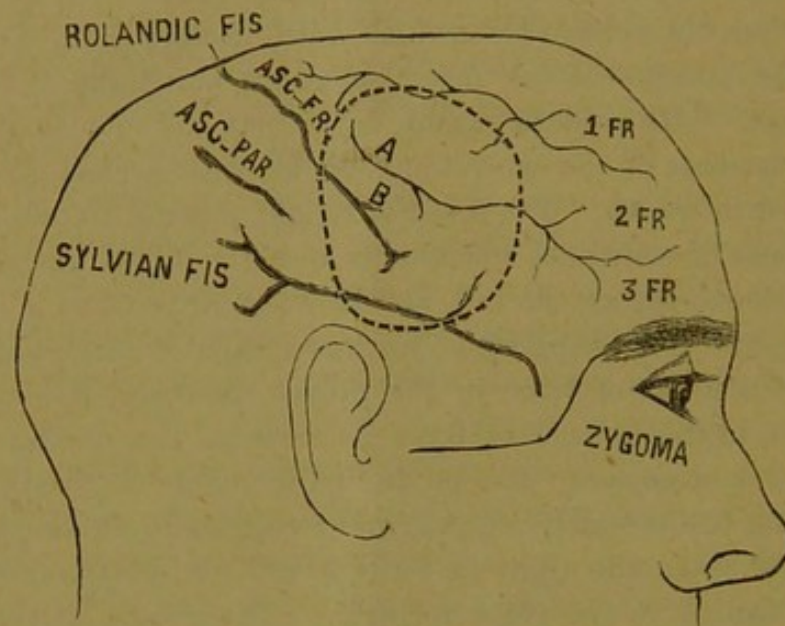
During his illness he complained from time to time of a cramping sensation in the flexors of the right forearm and a slight pain in the part, but there was no rigidity or tenderness of any kind. He continued very emotional, but in every other respect the progress was continuous, and on the 4th of May, just ten weeks after the accident, he got up. I think Mr. Cooke is greatly to be congratulated on the masterly way in which he managed the case, the patient being in a well nigh hopeless condition on admission.

At this stage I saw him for the first time, and his condition was as follows:—He could walk with assistance, but in a very uncertain manner, his gait being distinctly hemiplegic. He had good average power of grasp in the left hand, and the muscular power in the left leg seemed unimpaired. Voluntary movements were performed with the left limbs in an extremely awkward manner. He had complete loss of sense of position in the leg, and incomplete in the arm. If his leg were moved when his eyes

were shut, he could not tell where it had been moved to. Under similar circumstances he could tell the position of his arm, but with considerable uncertainty. He could recall in idea a series of positions, the change being made with his eyes shut. He could move the muscles of his face, but could not make a specified movement. He said he could do it, but did not know how. The movements of the eyeball and eyelids were perfect, also those concerned in speech. The sense of weight was not tested, but the allied sense of resistance was almost absent. When his hand was pressed down, say on the bed, and he was told to move it towards his face, his eyes being shut, he was incapable of bringing the requisite amount of force in the proper direction, and made no difference in the amount of force he used on the pressure being increased or decreased; also he was quite unable to disengage his hand from one pressing it down, and struggled in an aimless kind of manner. On the right side there was no symptom, except a crampy feeling in the right forearm. There was, however, no spasm or motor disturbance, and no loss of strength at that time. The right leg was quite unaffected. The knee-jerks and plantar reflexes were absent on both sides.

As regards sensation. On the affected side he had sensation of a very rudimentary description, there being only tactile and painful sensibility. When he was touched he felt he was touched, but did not know what kind of thing had touched, or where the point was in the limb. He told me that soon after he regained consciousness he felt a fly walking over the back of his hand, but he did not know that it was a fly, or where it was without looking for it. If his arm were touched, his eyes being shut, he marked the spot two or three inches below the point. If his arm were slightly pinched, say on the outside of the elbow, he felt the pinch in the fingers, or as he described it, between the ring and forefingers. If on the inner side of the elbow, the sensation was between the little and ring fingers. If the arm were strongly pinched, the pain shot all over it, without being localised in any way. In the skin of the face there seemed to be a delay between the contact and the mental conception. The same result could be got from the arms, but not so marked. He could not distinguish heat from cold, but if the heat of the water were excessive, pain was caused which spread all over the arm. In the

leg, the sensory disturbances seemed to run in the same lines, but the symptoms could not be so clearly brought out.



The dotted line shows the extent of the injury to the bone, the letters A and B are placed over the deepest part.

The depression on the head forms an irregularly-shaped oval, 9 cm. by 7 cm., its deepest points A and B in the diagram being 3.7 cm. and 3.5 cm. respectively, measured from the perpendicular plane to the external meatus. The posterior wall slopes abruptly to the deepest part, and is very well seen in the phototype, which enables its whole extent to be made out. The slope of the anterior is more gradual. The upper margin is 5.5 cm. from the middle line at a point 17 cm. from the nasion, and the lower margin is a similar distance from the zygomatic line. (I give, for purposes of comparison, the dimensions of the patient's head. In the middle line, from the root of the nose to the occipital protuberance, 36.2 cm. Laterally, between these two points, 28.75 cm. Between the external meatus 15.5 cm., from the external meatus to the middle line at the vertex 18.5 cm., cutting the middle line 17.5 cm. and the lateral line at 14.7 cm. from the nasion).

The following parts of the cerebrum would appear to be involved:—The lower half of the ascending frontal convolution, and the greater part of the sigmoid flexure, the posterior third

of the lower and middle frontal convolutions, and the base of the posterior end of the upper one; also the base of the corresponding part of the falciform lobe. The destruction being deep at the part the nerve fibres radiate from the anterior half of the internal capsule, these fibres must have been affected close to their emergence. Thus it will be seen that the motor centre for the arm would be the one principally involved. Those of the leg and trunk and of the face would be affected to a less degree.

As regards his other senses—hearing, taste, and smell are quite unaffected. Speech also, and the promptitude with which he answers questions, forms a marked contrast to the slow and apparently stupid manner in which he performs movements with his affected arm. As regards the sight, Dr. Inglis Taylor, Hon. Oculist to the Alfred Hospital, noted the following.—Fundus rather pale; veins enlarged; arteries small; muscles of the eye, both external and internal, normal; vision, as far as it was tested, was quite normal. His temper seemed quite unaffected, and his memory and intelligence were perfect. He is rather emotional, and inclined to laugh or cry. The rest of the body is sound and healthy, without the slightest indication of any disease.

As soon as the wound had completely healed up, and the patient was able to bear it, I endeavoured to get some localising indications from electrical stimulus. The indifferent pole, a flat-electrode, 5 x 8 cm., was placed on the back of the neck, the other pole, with a small olive-shaped point, was placed on various parts of the depression. No result was obtained from the faradic current, the patient being able to bear only a very mild degree of strength. With the galvanic current of 5 to 10 milliamperes, I got the following results:—With the anode in the inferior part of the posterior margin—the face centre—on each interruption of the current there was a sensation in the neck on the opposite side. With the kathode, the sensation was more localised, and went through both sides of the neck just above the level of the angle of the jaw. With the anode in the middle of the posterior margin—the arm centre—there was a sensation in the shoulder and upper part of the arm. With the kathode, the sensation extended down the arm in a slow crawling manner (to use the patient's expression), and when it

got to the fingers there was a tingling as if the hand had been numb with cold, and had been brought to a fire. The patient was able to follow the sensation downward with his finger. On the current being increased to 12 or 13 milliamperes, both sides were affected; the right, however, not so much as the left, the sensation downwards being of much greater rapidity. On the anode being placed on the upper part of the posterior margin—the centre for the trunk and thigh—there was a sensation just at the angle of the neck and shoulder. With the kathode the sensation was in the same region, but somewhat deeper from the surface. In none of these observations was any muscular action obtained. The sensations were not painful, being only of a tingling character, and it should be noted that the upward current gave far more definite results than the downward.

As regards the subsequent history, the patient has improved steadily in the condition of his left arm and foot, and performs movements with them much more expertly. The right arm, however, is showing signs of weakness. When I last saw him, the crampy sensation in the flexors of the hand and wrist was still there, and it was accompanied by a burning pain at the same region. There was no tenderness or swelling, and no headache of any kind. The pain was best relieved by simple rubbing.

On reviewing the history, there are one or two points of interest. From the nature of the injury, a zone of brain substance just in front of the fissure of Rolando would bear the brunt of the blow, and its left half would, at least, be severely concussed. This left half would include Broca's convolution (the centre for speech), and the anterior end of the temporal lobe (one of the auditory centres). It will be remembered that it was noted that, for two or three days after the accident, the patient was very noisy, and if anyone were talking in his presence, he would catch up the last two or three words of the sentence and repeat them several times, he being unconscious at the time. This would signify that the auditory and speech centres were in a state of extreme excitability, and that the stimulation by the vibration of the sound of a word would set automatically into action the whole chain of centres, the result being the spoken words. The zone of brain substance would also include the centre for the right arm. During the first two or three days he threw about this arm a great deal, chiefly in

a revolving manner, which showed its cortical centre to be in a highly irritable state. The symptoms of cramp and burning pain, and the weakness which has come on more recently, have certainly a causal connection with this, and it seems to me to be rather ominous, and shows that there is some mischief, probably of an inflammatory character, going on in the left frontal lobe.

The cerebral injury presents a problem of the greatest complexity. With the exception of a small part of the base of the falciform lobe, which is considered to be sensory, the bulk of the part destroyed is in the area which is generally regarded as motor. Nevertheless, the sensory and motor functions of, say the arm, as it is the part most completely involved, seem to be affected in a relatively equal degree, and both of these functions seem to have been cut down to a very rudimentary level.

On the sensory, or to be more exact, the afferent side, there is simple tactile sensibility, but there is an absence or deficiency of the higher conceptions of sensation, which are evolved from the lower and simpler levels, such as the position of the limb, the qualities and position of foreign bodies touching the part, their weight, resistance, &c. Similarly on the motor or efferent side, there is the power of making simple movements, but there is an absence or deficiency of the power of making the more complicated ones, which must necessarily be on a higher developmental level.

As both these afferent and efferent functional disturbances are the result of one and the same injury, it follows that the part destroyed, that is part of the Rolandic area, is sensori-motor. What, however, the comparative importance of each of these factors is, and where their functions end and begin, are the most difficult problems in neurology. These afferent impressions make up the complex which forms the so-called muscular sense, and as they are severely affected, especially in the arm in the case under discussion, the symptom of loss of this sense are very well seen. In the group of impressions and sensations which form this sense, I am inclined to regard the sense of position as of the greatest importance, and the awkwardness of movement in this case depends more upon this than upon anything else. The nicety of muscular movement, and the quantity of force used, entirely depend on a knowledge of the point from which the

muscular force has to commence action, and of the successive changes of position or relations which the movement causes.

These estimations of position are always present in the normal body, as anyone can ascertain for himself, and it leads me to the belief that they are not of the nature of ordinary sensory impressions such as pain or heat and cold, but that there must be some arrangement by which a circuit of nerve force is continually in equilibrium. In the cerebral part of this circuit, there will be some sort of centre like a galvanometer in an electric circuit, which will keep the cortical centres informed, so to speak, of the state of the peripheral parts, not only when they are at rest, but when they are in action, action being indicated by change from one state of equilibrium to that of another. In our case, injury to the cortical loop of such a circuit could explain many of the symptoms.

As regards the sensory disturbance, here again the sense of position takes an important place. Common or cutaneous sensation, with pain or some variety of pain, has its nervous tract in the posterior end of the hindmost limb of the internal capsule. This has escaped injury in our case evidently, for common sensation seems to be actually increased. The sense of tactile localisation is almost lost, and I think we may infer that this faculty is in a different nervous tract from common sensation. In the diagrams of the internal capsule, the anterior half of the anterior limb is left blank. From the experience gained by this case, I think it may be fairly filled up by the tracts of the so-called muscular sense, or, as I prefer to call it, the sense of local relation.