THE DARRAN EXPLOSION FROM THE MEDICAL STANDPOINT.

By T. LISTER LLEWELLYN, M.D., B.S.LOND.,
MEDICAL OFFICER TO THE RHYMNEY IRON AND THE POWELL DUFFRYN COMPANIES.

An explosion took place in the Darran Colliery at 4.30 a.m. October 29th, 1909. Of the forty-five men who were in the pit at the time twenty escaped through a communication between the Darran and Gilfach pits, four men were brought up alive, and twenty-one were killed. One of the rescued died subsequently, and five rescuers lost their lives. The total casualties were twenty-seven.

THE EXPLOSION AND ITS IMMEDIATE EFFECTS.

The explosion, in the opinion of the mining experts who gave evidence at the inquest, arose from shot-firing at the stone marked in the plan. This shot-firing ignited coal dust, and produced the explosion.*

The zone of explosion extended from about 100 yards inbye of the stone to the pit mouth.

The air-bridge carrying the return air across the intake was destroyed, and all the doors between the intake and return air-ways from this point to the shafts were broken down. The ventilation of the pit was thus short-circuited, and the fan, which remained undamaged, at first simply drew the air from one shaft to the other. The downcast shaft was damaged and not repaired until 11.30 a.m.

The positions in which the bodies were found are shown in the plan. An attempt will be made to ascertain as far as possible the exact position of each of the men at the time of the explosion and to trace their subsequent movements.

Nos. 1 and 2, who were brought up alive, say they were sitting down a few yards from the downcast shaft, when they were hurled into the shaft, and Jones (No. 2) was pinned under the cage.

Tovey (1) was found in a dazed condition, unable to move or speak. (I was able later on to diagnose fracture of the base of the skull.) His right hand was badly crushed—three metacarpals were broken. The left side of his face was scorched, and his hair was singed. Fine coal dust had been driven into his face and head.

Jones (2). General bruising and simple fracture of both bones of the right leg. He remained conscious throughout.

Both these men had a good supply of air and showed no symptoms of carbon monoxide poisoning.

Wm. Cleavy (3). This man was stooping down fifteen yards from the shaft when the "blast" came. "I was knocked down, but was able to get up and go to the bottom of the shaft. I could not help the two men there, so went back to look for more help. I got lost in one of the passages between intake and return, and decided to stop where I was." He was found here by the first rescue party. His face and hair were slightly scorched, but he sustained no other injury.

Bodies 4-9 were found in a recess in which it was the usual custom of men to wait before going out. The men were all colliers and dressed. In all probability these six men were sitting down waiting to go out. The bodies all lay with their heads towards the return, and presented more signs of violence than any of the others. All the exposed parts—face and hands—were scorched.

W. Brown (4) was found lying under a fall. The top of his head was completely crushed. The face was covered with fine coal dust driven in; when this dust was removed all the signs of carbon monoxide poisoning were seen. The face and hands were scorched.

Brown could not have breathed after the stone had fallen on to his head. He showed as well-marked signs of carbon monoxide poisoning as any of the other bodies. The fall must, then, have been delayed for some time after the explosion.

I visited the place afterwards with Mr. W. N. Atkinson, H.M. Inspector, and he was able to say, from the clean surface of the fracture left by the fall, that the stone had come down some time after the explosion.

James Weeks (5). Left side of face crushed; malar and inferior maxilla bones fractured; face and hands scorched; well-marked signs of carbon monoxide poisoning, from the effects of which he died.

* For details see the report by Messrs. W. N. Atkinson and F. A. Gray, His Majesty's Inspectors of Mines.¹

top of the drift, for the following reasons. The explosion probably reached its maximum there, as shown by evidence of greater injury to the bodies and presence of a large fall. More after-damp would be formed here then. The top of the drift would act as a chimney, and the heated air and after-damp would tend to remain at the highest point. (There is a well-marked fall in level from the top of the drift to the stone.) The evidence that men were able to go beyond the stone proves there was not much after-damp there at first. As the heated gases cooled, and with partial return of the natural ventilation, the after-damp moved gradually down the drift, clearing away almost entirely from the main road.

Possibility of Rescue.

Nos. 1, 2, and 3 were exposed for so short a time to the after-damp that their lives were not endangered; 4 to 9, 11, 12, 13, 14, 15 probably lived a very short time, and it is very doubtful if they could have been saved; 10 (D. Edwards) should have escaped through Gilfach; 16, 21, and 22 could not save themselves, and it was in trying to save them that 20, 23, 24, 25, 26, and 27 (and possibly 10) lost their lives.

Why should Anthony have lived? Barker in almost the same position died. Anthony may have been less susceptible to carbon monoxide than Barker. Both were young, and Barker was a very well-built man. Barker was sitting propped up against the side with his head, say, 2½ ft. above the ground; Anthony was lying on the ground. Possibly a stream of air entered along the ground and brought the necessary amount of oxygen to Anthony, while, Barker, who was above this stream, breathed air containing more carbon monoxide.

THE RESCUE OPERATIONS.
From the Darran End.
The pit carpenter, W. Evans, went down the ladder in the upcast shaft immediately after the explosion. He was followed by E. Davies and T. Matthews. They first attended to Jones (1) and Tovey (2), and after some trouble succeeded in getting Jones free. David Lewis then came down, and with Ed. Davies and T. Matthews proceeded down the main road. Wm. Cleavy (3) got up from the ground and called to them. They took him along with the intention of taking him out through Gilfach.

Fig. 2.—To show supposed positions of men five to ten minutes after the explosion.

They went below the air-bridge, when Cleavy became affected by the after-damp. (He had probably already absorbed a good deal of CO before starting.) The party retired, and met E. Owen and Ned Jones.

Davies, who had been down since 5 a.m., was also overcome; he was sent back to the pit mouth with Cleavy.

Lewis, Owen, and Jones then proceeded down the drift; they found the bodies 10, 11, 12, 13, 14, 15, 16, in the positions shown.

They could hear someone breathing, and eventually found Anthony in the manhole. His breathing was so noisy that they heard him 20 yards off. They tried to do artificial respiration, but desisted as the skin (epidermis) was coming off his arms. He was quite unconscious.

Ned Jones was sent back to fetch Dr. Turner (8 a.m.); Lewis and Owen then went on by themselves as far as

Shenkin's level. The air here was very thick, and Owen was unable to go any further. They retired, and met Dr. Turner, Ned Jones, E. Richards, and W. Edwards.

Dr. Turner sent Owen back to the pit mouth with Richards, and gave orders that Anthony was to be taken to the pit mouth. This was done by E. Davies, who had returned the second time with fresh help. Owen, on return to the bottom of shaft, revived, and was able to superintend repairs to the doors.

Dr. Turner, Edwards, Lewis, and Ned Jones then went down the drift. Jones, who had been down some hours, was obliged to return; he was able to go out by himself. The others then went down the drift as far as Shenkin's level, when Dr. Turner, who was leading, noticed that he had no reply from Lewis; he turned back, and saw Lewis slide slowly into a sitting position. He shouted to him, and tried to rouse him, but obtained no reply. Edwards also gradually subsided, but remained conscious. Dr. Turner asked him for the jack of beef tea which he was carrying; Edwards did not speak, but let the jack fall. They both became unconscious, and Dr. Turner was unable to rouse either.

Dr. Turner had no symptoms until he exerted himself in trying to rouse the other two. He then felt tired, wanted to lie down, but struggled on as far as he could, falling several times, and finally losing consciousness.

Ned Jones for the third time, with Wm. Thomas (under-manager), Meredith and C. Edwards, went down the drift at 9 a.m. They found Dr. Turner unconscious, but breathing. Edwards was told to carry Dr. Turner out, and Thomas proceeded a short way down the drift. He found no one, and catching up the others, found that Edwards could not carry Dr. Turner. Thomas himself then took Dr. Turner on his back and carried him for about 30 yards. He was then obliged to drop Dr. Turner and struggle on himself.

Ned Jones relates how he saw Thomas drop on his knees, crawl forward, and finally stop—he himself was just able to crawl beyond Thomas. Evan Owen had by this time returned with E. Davies and others to the air-bridge. He saw a light below and shouted; receiving no answer he proceeded down the drift and found the four men all unconscious in the roadway. Ned Jones was in front with his lamp in his teeth, and with his chin resting on it. The lamp was thus kept vertical and alight. The four unconscious men were brought to the pit side of the air-bridge, when Owen again collapsed.

All, except E. Davies, were overcome, but a fresh party of rescuers was able to bring all the men out.

Subsequent operations were all directed to the recovery of Dr. Turner. He was soon found, but the tales are so conflicting that I am unable to make out a definite account. He was treated on the pit side of the air-bridge with oxygen and artificial respiration and was only brought out about 2.30 p.m.

W. Edwards and D. Lewis were both dead when found. Mr. Grey, Inspector of Mines, then gave orders that no one was to go beyond the air-bridge until it had been repaired (3.30 p.m.).

From Gilfach.

The first rescue party, consisting of Mr. Bowen, manager (30), G. Griffiths, overman (29), D. Morgan, fireman (28),

Dr. Jones, collier, J. McCarthy, collier, went forward about 5.45 a.m. They walked very quickly to the door communicating with Darran Pit, so quickly that Mr. Bowen felt tired when he arrived there. The door between the two pits was shut.

Entering the Darran Pit they passed a horse feeding in Week's level. Proceeding carefully they noticed a distinct smell of "powder" (H_2S ?). Mr. Bowen sat down and asked the others how they felt. Morgan said he was a little dazed. Mr. Bowen asked for a drink of tea, and then said, "What about going a little further, boys?"

"We started, and had only gone about ten yards when Morgan, who was second, fell. Mr. Bowen went on a yard or so; we shouted, and he dropped his stick and came back. I carried Morgan's head; Jones and Mr. Bowen took one leg each. We went back as quickly as possible, Gomer Griffiths leading with the light. We had only gone back about forty yards when Mr. Bowen said, 'Put him down.' Mr. Bowen and Griffiths then dropped almost together. Jones and I ran back for help" (McCarthy). Mr. Bowen's stick was found forty yards beyond the three bodies (28, 29, 30), which were all together.

A second rescue party say they heard Jones and McCarthy shouting for help, and saw them fall unconscious near Boot's level. They carried the two men back.

A third rescue party then went forward about 7 a.m. Several men were partly overcome and had to be helped back. One member, Ned Rees, was left behind unconscious. The party was not able to advance very far into the Darran Pit.

The last rescue party was led by Mr. Watkins, manager of Bargoed Colliery, about 8 a.m. He was not allowed at first to enter the Darran Colliery, but when he was told that Ned Rees was left behind he blocked up the Gilfach return airway and went forward (8.45 a.m.), taking the Gilfach air with him. Ned Rees was found unconscious, breathing very noisily and with his tongue out. He was carried back. Proceeding, they found a horse in Week's level (see above), unconscious and breathing very heavily. Mr. Watkins examined all the double partings and felt dazed every time he entered one. They worked their way up to Boot's parting taking most of the air with them. Here they found a dead horse. There was no indication of a cap in the lamp. A resinous smell resembling that of burning timber was noticed. The men were continually questioned as to how they felt, and in one case, after a satisfactory reply ten yards before, one man fell without warning. "One more man fell and then I fell myself. A few yards before this I had taken rest and felt quite well. My legs became weak and the man behind noticed I was walking unsteadily" (Watkins).

The party then retired, Mr. Watkins on a stretcher; he soon recovered and returned, sending on a fresh party of seven men, followed shortly afterwards by a second party of seven. The first party recovered the three bodies and brought them back. Phil Williams and Parry then went on further, and had to be assisted back by the second party.

All retired, and passing Week's level they found that the horse had been revived by the fresh air. The horse was on his feet, and just able to stand up.

All rescue operations from Gilfach were then suspended.

Of the first rescue party three died and two escaped. They were all under similar conditions.

The three men who died were officials, the others colliers. Mr. Bowen had had nothing to eat since the previous evening, Griffiths had been working all night, and Morgan had had a long walk to the pit. McCarthy and Jones were fresh, and had just had a good breakfast; being colliers they were also more accustomed to physical exertion.

SYMPTOMS OF AFTER-DAMP POISONING.

The following accounts were given by the men:

J. McCarthy: No symptom until he tried to carry back Morgan; he then felt his breathing becoming deep and laboured. When he ran back for help he felt his legs weak and heavy, and had feeling of weight on his back. Felt very sick. When he came round, he felt very cold, had marked shiverings, and a bad headache.

Thomas McCarthy: Slightly affected only. Giddy. Air thick and difficult to breathe.

Mr. Watkins (Manager): Felt dazed after going into double partings. Became tired; his legs gave way; marked palpitation. He was walking unsteadily before he fell. "A few yards before

I fell I had taken rest and felt quite well. My urine was very thick afterwards."

Ed. Owen (Under-manager): Noticed the air was very thick. Pain in back of head; weakness of legs, so that they felt very heavy. Unsteadiness. He was better after return to fresh air, but again collapsed when he went down the drift again. "Quite done up." Marked nausea, with headache and giddiness when he reached the pit top a second time; he rapidly became worse, and fell outside the offices.

W. Thomas (Under-manager): None until I carried Dr. Turner. I felt him very heavy, and my knees became very weak. I had to breathe very deeply, and had headache. I was obliged to drop Dr. Turner, and was able to struggle on with great difficulty. I thought I had gone 20 yards, but was only just beyond Dr. Turner.

Ned Jones: This man went down the drift on three occasions; he was obliged to retire twice, but returned after he had been in fresh air for some time. "Quite done up; no power in my legs; quite unable to help to carry Dr. Turner. I felt my legs going and my head swelling. When I came round I was shivering, and felt very cold for a long time. I was very weak next day."

Ed. Davies (first rescue party): "Eyes burning, throat parched, legs weak. I was obliged to return, and improved in fresh air. After helping to bring Mr. Thomas back, I was again done up, but was able to walk out."

J. Evans (in pit when explosion occurred): "Beyond the stone the air was full of smoke and dust, and very hot. My lamp nearly went out. Great heat across my forehead. Felt my legs very weak; each step was like ten."

Syd. Edwards (in pit): "Tried to go forward, but air was so thick and breathing so difficult that I had to return. On my way back I felt very weak and was unable to keep up with the others. I was quite done up until I met the fresh air."

Mr. Hannah (General Manager, Ferndale)—Evidence at inquest: "Mr. Trump and I went to within 6 yards of Shenkin's level. We found it difficult to breathe; had palpitation and pungent feeling of the eyes and nose; worse coming back."

Dr. Turner: No symptoms until he exerted himself to rouse the others. "I felt tired, wanted to lie down, had weakness of the legs, and fell several times."

SUMMARY OF SYMPTOMS.

It is most important to realize that symptoms may be entirely absent and the man fall without warning.

Once symptoms appeared they always increased in severity unless a return to fresh air was made at once.

It follows that as soon as symptoms appear the man should at once retire.

Symptoms are always increased and in many cases only brought out by exertion.

A man who had been down before collapsed before a fresh man.

Symptoms sometimes increased when fresh air was reached.

Objective Symptoms.—The man would be silent, not answering when spoken to; his gait would be unsteady, slow, and rolling from side to side. Then he would fall and become unconscious, with stertorous breathing.

Subjective Symptoms.—Tired feeling, weakness in knees and legs, giddiness, palpitation, and difficulty in breathing. All movement becomes difficult, the legs feel heavy, and there is sense of weight on the back. Time sense delayed. "Every step like ten." Then would come complete helplessness, followed by unconsciousness.

Physical Signs (of Carbon Monoxide Poisoning).

Severe.—Unconsciousness, with stertorous breathing, which at times becomes very irregular and jerky. The pulse is small, very irregular, and intermittent. The body is convulsed with severe shivering attacks. Recovery is shown by regularity of breathing with steady pulse, and, after a variable time, return of consciousness.

Mild.—These men appear stupid, are unable to walk without assistance, and look something like "an incapable." They are often sick, feel cold and miserable, but soon recover with warmth. Some cases showed excitement, but I believe this was due to the brandy they received.

TREATMENT OF AFTER-DAMP POISONING.

Preventive.

No one should advance into the zone of explosion until the ventilation has been, at any rate partly, restored. The air should be taken with the party.

It is very important to impress on the men:

The very great danger of the after-damp.

The fact that carbon monoxide gives no indication of its presence either by a cap in the lamp or by smell. Also, that the lamp burns well in a poisonous percentage of the gas.

Never to go in small parties; there should be six or seven in each party.

The rescue party should be under a good leader, and should be followed by a reserve party. They should be all fresh and have had a meal recently.

A canary or tame mouse should be taken with the party, and the movements of the animal carefully watched. The party should return on signs of collapse of the animal.² They should immediately return if one of their number is affected in any way. The alternative is the use of one of the rescue appliances.

Curative.

1. *The man should be removed to fresh air without delay.* This should mean the pit top. It is useless to attempt treatment in an atmosphere which contains carbon monoxide.

2. *The patient should be kept warm.* This is of the greatest importance. Several cases collapsed more than once after coming round, and were quickly revived by warmth.

3. *Oxygen should be administered in large quantities.* Oxygen should be given warm. One oxygen cylinder may be made to serve several patients at once by filling football bladders with the gas; the bladders could then be warmed in front of a fire and continually refilled.

4. *Artificial respiration, if necessary.* This should only be done in a pure atmosphere or the patient will be made worse. Schäfer's method is the best. This method was found very useful in men who collapsed after coming round.

5. *Injection of strychnine and adrenalin.*

6. *No exertion should be allowed.* The men should be carried home when they have recovered.

POST-MORTEM SIGNS OF CARBON MONOXIDE POISONING.

I was unable to make any internal examination. The bodies were all well preserved eighty hours after death,

and rigor mortis was still well marked. In case of the rescuers one glance was sufficient to determine cause of death.³ The face was of a bright pink colour, ears and mucous membranes of lips of the same tint. The *post-mortem* stains were also pink. The man almost looked alive. I saw no evidence of venous engorgement. I tried to obtain blood from the heart of one body by a syringe, but was only able to draw off pink serum.

In all the other cases the pink colour could be seen either inside the mouth or by rubbing off the superficial layer of skin, which was in many cases loose as the result of burns.

CHARACTER OF THE BURNS.

Fifteen men were burnt more or less severely. The burns were severe, according to amount of body exposed. Anthony (17) and John (21), who were in their shirts, had face, hands, arms, neck, and chest affected. The men (4-9, 11-15) were dressed, and only had hands and face burnt. Tovey (1) at pit bottom was burnt by hot coal dust. In all cases the superficial layer of the skin was separated and was curled up into small areas. In John's case the burns were more extensive and the finger-nails were loose. Possibly in his case the injuries were due to the action of force. The hair in many cases was singed.

Two men were injured on top of the pit.

A.—*Skyrme*: This man was stepping into the cage when the explosion occurred. He was thrown against the side of the cage, but received no definite injury. He suffered afterwards from great nervous depression, had marked tremor of face and hands, was tired easily, and did not return to work for two months. He has now apparently recovered.

B.—*T. Williams*: Acting as banksman. Cut eyelid and small scalp wound. This man also was very nervous afterwards; he started whenever spoken to, had marked tremor, and was idle six weeks.

Table Showing Cause of Death.

A. RESCUERS.		Burns.	Injuries.	Cause of Death.
No.	Name.			
18	Wm. Edwards ...	<i>Nil</i>	<i>Nil</i>	Carbon monoxide.
19	D. Lewis ...	"	"	" "
28	D. Morgan ...	"	"	" "
29	G. Griffiths* ...	"	"	" "
30	Wm. Bowen* ...	"	"	" "
B. MEN IN MINE AT TIME OF EXPLOSION.				
10	D. Edwards ...	<i>Nil</i>	<i>Nil</i>	Carbon monoxide.
20	J. Morgan ...	"	"	" "
24	Chas. Vaughan ...	"	"	" "
25	Ed. Cleavy ...	"	"	" "
23	D. Jenkins* ...	"	"	" "
27	J. Baragweneth ...	"	"	" "
26	W. Davies ...	"	"	" "
9	H. Edwards ...	Face and hands scorched ; hair singed	"	" "
11	D. McCarthy ...	" " "	"	" "
12	E. Roberts ...	" " "	"	" "
13	Lewis Morgan ...	" " "	"	" "
14	Ambrose Jones ...	" " "	"	" "
15	M. Coombes ...	" " "	"	" "
16	H. Barker ...	" " "	"	" "
21	J. John ...	Face and hands badly burnt	Nose full of pieces of coal, etc. ; nails coming off	" "
22	E. Prosser ...	Hands and arms	<i>Nil</i>	" "
5	J. Weeks ...	Face and hands scorched	Left side of face crushed	" "
7	John Tovey ...	" "	Right cheek split open	" "
4	W. Brown ...	" "	Top of head crushed by fall (after death)	" "
17	S. Anthony ...	Face, hands, arms, neck, front of chest and head	—	Died 5 days afterwards ; septic infection and bronchopneumonia.
8	Jas. Vincent* ...	Face and hands	Fracture right elbow-joint	? Carbon monoxide ; ? violence.

* Seen by Dr. Thomas only, to whom I am indebted for the notes in Cases 29, 30, 23, and 8.

Progress of Cases 1, 2, and 3.

1. *Eli Tovey*: Hand much deformed, and at present useless. The left tympanic membrane was ruptured, and he is still deaf on that side. He had no symptoms of nervous depression.

2. *Evan Jones*: Fractured leg. No nervous symptoms.

3. *Wm. Cleavy*: No definite injury, but complained of weakness after any slight exertion. Marked tremor of hands. Well-marked nystagmus also set in immediately after accident, although he had had no trouble from his eyes before. Is only able to do light work still.

It is interesting to note that, of these five cases, 1 and 2 had marked physical injuries, but no nervous symptoms, while the others had marked nervous symptoms but trivial injuries.

AFTER-RESULTS OF THE EXPLOSION.

All the cases who suffered from after-damp recovered very quickly, with one exception: J. McCarthy, of the first rescue party, was unable to work for six weeks. He suffered from great nervous depression, inability to perform any physical exertion, and loss of appetite. He showed marked weakness of grip, with tremor of hands.

A. Thomas, who was in charge of a pump underground on the night of the explosion, and who escaped through Gilfach, is also at present unable to work. He suffered from great nervousness, loss of appetite, sleeplessness, and weakness. The other men were all able to resume work when the pit started.

REFERENCES.

- ¹ Report to the Home Secretary on the Darran Explosion. By Messrs. W. N. Atkinson and F. A. Gray, H.M. Inspectors of Mines. 1910.
² Haldane and Douglas, *Transactions, Institution of Mining Engineers*, vol. xxxviii, p. 267, 1910. ³ Haldane, *Report to the Home Secretary on the Causes of Death in Colliery Explosions and Fires*, 1896.

TRIGEMINAL NEURALGIA AND ITS TREATMENT BY ALCOHOL INJECTION.

BY

WILFRED HARRIS, M.D., F.R.C.P.,

PHYSICIAN TO ST. MARY'S HOSPITAL AND TO THE HOSPITAL FOR EPILEPSY AND PARALYSIS, MAIDA VALE.

OWING to the frequency of dental caries, or other causes connected with the teeth, neuralgic pain in the area of distribution of the fifth cranial or trigeminal nerve is one of the commonest disorders calling for treatment. Excluding dental neuralgia due to caries, erupting or impacted teeth, periostitis, etc., errors of refraction and other ocular and nasal troubles, antral and other sinus disease, there yet remain a number of cases of intractable neuralgia affecting one or more of the divisions of the fifth nerve, whose cause is either irremovable or else cannot be discovered. Prominent amongst these are the cases of true tic douloureux, often spoken of as trigeminal neuralgia. It has been a matter of general agreement that true tic douloureux, once acquired, persists indefinitely until either death or removal of the Gasserian ganglion has brought relief. Cases of so-called cure following cataphoresis or other electric treatments, or the use of various drugs, have probably been either not instances of the disease at all, or else the relief was transient, and recurrence of the pain soon takes place. The only treatment besides extirpation of the Gasserian ganglion that gave any real relief was resection of the nerve trunks, and this often failed, as in the cases of neuralgia of the second division. When the pain affected the upper jaw as well as the skin of the nose, lip and cheek, unless the superior maxillary nerve was resected intracranially no improvement resulted, as peripheral resection of the infraorbital nerve alone would not influence the pain in the upper jaw, owing to the dental nerves being given off from the trunk of the nerve some distance behind the point of resection at the infraorbital foramen. Pain referred to the lower jaw alone, or to the supraorbital nerve, was often relieved for one or two years by division of the inferior dental nerve at the angle of the lower jaw, or of the supraorbital nerve at the notch respectively. In neuralgia of the third division, however, if the pain was referred to the tongue and auriculo-temporal nerves in addition to the lower jaw, peripheral resection became more difficult. The real reason, however, of the failure of the treatment by peripheral resection of the nerves, was the impossibility of repeating the operations when the pain recurred, due to regeneration of the nerve, which invariably occurred in from one to two or three years. Thus, extirpation of the

Gasserian ganglion was the only real remedy, and that had the advantage of producing a permanent cure, some cases having now been free from pain for more than fifteen years since that operation. It is, however, an operation of considerable severity, and many patients have refused to undergo it, and preferred to submit to the pain, rather than undertake the risk, which the latest statistics show to be about 7 per cent., even in skilled hands.

In 1903, Schlösser,⁴ a Munich ophthalmologist, published his method of injection of strong alcohol into the main branches of the fifth nerve at their points of exit from the skull at the deep foramina. The action of the alcohol instantly paralyses the nerve, destroying the nerve fibres at the point of injection, if the needle has properly punctured the nerve sheath. The immediate result is anaesthesia to all forms of sensation on the skin and mucous membrane supplied by the nerve below the point of injection, and, if the third division of the nerve is injected at the foramen ovale, there will also be motor paralysis of the masseter, pterygoids, and temporal muscle. Experimental work by Finkelnburg¹ has shown that degeneration of the nerve fibres of the ordinary type follows injection of a nerve trunk with strong alcohol, so that this method practically amounts to a chemical resection of the nerve. The advantage of this method over resection by the ordinary method of incision is that the needle leaves practically no scar, and it is possible to repeat the operation indefinitely, whenever pain returns after regeneration of the nerve. Schlösser² states that alcohol injection is less successful in those cases in which resection of the nerves has previously been done. This has not been my experience in three cases in which the inferior dental, infraorbital and lingual nerves had been divided. In each case the relief of pain after injection was complete.

During the last twenty months, between October, 1908, and May, 1910, I have treated with alcohol injections 50 cases of neuralgia of one or more branches of the trigeminal nerve. In this period I have had sent to me 38 cases of true tic douloureux, 23 in private practice and 15 in hospital. Of these 38 cases I have treated 33 with injections of strong alcohol into the affected nerve trunks at their foramina of exit from the skull. Two of my cases have been unsuccessful, owing to my failing to hit off the nerve, and the pain remained uninfluenced. One case died suddenly of angina whilst awaiting the injection treatment to be begun; two refused all suggestion of any form of operative treatment, and one is considering the question. Another, a woman with bilateral spasmodic neuralgia of the second and third divisions, which has continued off and on for over thirty years, ever since she was 17 years old, improved somewhat under butyl chloral hydrate, and injection treatment was consequently postponed. The remaining 31 cases were all completely relieved of the pain in the affected nerve, as the result of the injections, for periods varying from two months to eleven months and more. Nine of my cases have had recurrences of the pain after intervals of complete freedom varying from two to nine months. Five of these cases have been re-injected, causing much deeper anaesthesia than before, and their next interval of relief will almost certainly be much longer. The short interval of two months' freedom occurred in case 35, a woman with tic of the right third division mostly, with some reflected pain in the upper jaw, of six years' duration. Injection of the foramen ovale on March 5th, 1910, must have been perineuritic, not into the nerve, as no anaesthesia at all was produced, but her pain was instantly relieved, and did not recur until May 13th, and then in the lower jaw only. On May 14th I again injected the foramen ovale, producing complete anaesthesia of the inferior dental and lingual nerves, though only slight anaesthesia of the auriculo-temporal, and no paresis at all of the motor branch. She has been perfectly free from pain since. Three cases injected in June, 1909, are still quite free from pain, over eleven months, and the remaining 19 cases, which were injected between the end of August, 1909, and May 14th, 1910, have so far had no recurrence.

Another common type of trigeminal pain, though quite distinct from tic douloureux, and yet equally curable by alcohol injection, is supraorbital neuralgia, or brow ache. Of these I have injected eight cases with alcohol at the supraorbital notch, with the best possible results, the pain disappearing generally at once, as though by magic,