MEDICAL THESIS.

Subject: -

MEDICAL IONISATION.

Some Experimental Results and their Therapeutic Value.

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By medical ionisation is understood the passing into the body ions of drugs by the aid of electricity, in some cases the ions being positively charged and in others negatively.

The theories and proofs of medical ionisation are very simple.

It has been seen that Molecules are the smallest particles into which a substance can be divided without altering its chemical character. These Molecules may be further divided into atoms.

In dilute electrolytic solutions the Molecule of the solute is dissociated into two ions each acting as a Molecule in its osmotic cryoscopic and tonometric relations. When the molecule breaks up into ions each ion carries an equal and opposite electrical charge and by the laws of Static electricity we have those positive ions being carried to the — pole and — ions to positive pole.

Leduc proved that these ions bearing their charges and having reached their electrodes or poles throw off their charge positive or negative and enter the body.

By a classical experiment, taking two rabbits, placing them in series in the same galvanic circuit the electrodes being applied to the flanks which had previously been shaved.

The current was conducted to the first rabbit by an electrolytic solution containing 2% of sulphate of strychnine, it then passed out by a cathode of pure water, entered the second rabbit by the same cathode, and passed out by an electrolytic cathode of Cyanide of
Potassium.

A current was passed of 60 to 100 milliamperes and after a varying period of 1 to 20 seconds, it was observed that the reflexes of the first animal became greatly exaggerated. Tetanic convulsions and death speedily supervened, while the second rabbit suddenly became stiff, fell down senseless, and soon died. In the first case the symptoms were those of strychnine intoxication, and in the second they were those of hydrocyanic acid poisoning.

If the current was passed in the reverse direction the anodes being Cathodal neither animal was affected in the slightest degree.

Another proof is published by Leduc.

When a solution of permanganate of potash is used, as a cathode the anion, the permanganic acid radicle penetrates the skin and colours it, whereas no such result occurs where the permanganate solution occurs as an anode.

I have had personal proof of the following experiment of Leducs. Using the salycilic ion it is equally easy to see its penetration into the body by examining the urine.

The areas of penetration of the ions are shown to be the glandular orifices by the use of coloured ions.

The polar effects produced by the electrolytic solutions vary very much.

Anions Cl. Br. I. causing a sensation of heat, the cathions K. & Na. provoke a painful burning sensation.

Lithium only slight fomication.
The ions of Cl. (Leduc) are said only to produce slight burning and feeling of heat. I must say not always. In some cases the Cl. ions in my experience have blistered, producing somewhat deep sloughing areas, and in one case the ions of salycilate produced a marked dermatitis, which did not disappear until a month afterwards, and in a few cases there were some little blisters the size of a pin's head which were scattered over the area of application, disappearing in a few days. All the areas of application were reddened with the exception of those applications in which lithium was used, disappearing in a few hours.
The instrument which I have used for my experiments has been the Standard Ionic Medication Switch-board, working from the main, consisting of a white marble slab complete with volt regulator, enabling the operator to vary the current from 0 to 80 volts.

The milliampere meter, the most important and delicate instrument on the board, is a moving coil dead beat D'Arsonval instrument, quite independent of any outside electrical or magnetic influence. The instrument has three readings in one-tenths of milliamperes and going up to 500 milliamperes; along with the instrument there was supplied 1 flat carbon electrode, 3 copper electrodes, varying in size, 3 zinc electrodes, and a glass bulb electrode for experimental anaesthesia. There were also 1 flat zinc electrode, 8" long by 4" broad, and 1 chain electrode 6" long by 4" broad.

The instrument was joined to the main by the electric lamp attachment, and after the + and − poles were found by a very simple means wetting blue litmus paper and applying the two terminals of the wires from the main. The + pole turns the paper (blue) red and the − creates a more intense blue.

The electrodes for the application of the drug varied according to the application. The indifferent
electrode was always, where possible, placed in normal saline solution, and the electrode itself consisted of the large zinc disc, covered with lint. If the indifferent electrode could not be applied to the hand or foot, the electrode was rolled in layers of lint saturated in $\text{Na. Cl}_2$ normal saline – and bandaged firmly to the body on wherever part desired, when the current was switched on, it was gradually increased up to the strength which I deemed advisable to give. The length of the application varied in each case according to the nature of the lesion, and according to the amount of pain produced by the administration; as a rule wool was bandaged to the part after the application, in two cases where there were some small blisters, I put on some sterile gauze and boric powder. The cases which I have treated number 20, and the list includes:

(2) Injured backs.
(1) Angio neuritis.
(3) Stiff knee joints.
(3) Cases Chronic Synovitis.
(4) Cases Ulcer of Leg.
(1) Case pain in the back.
(2) Cases of Chronic Rhinitis.
(3) Cases Rodent Ulcer.
(1) Case Lymphadenoma.

The cases are somewhat varied, but I simply chose those which I thought most suitable as they were sent up to the wards having a definite aim in the treatment of each; first, the two injured backs. These were treated with Medical Ionisation for the relief of pain; Angio neuritis similar; Stiff joints for movement, and so on.
Each patient during the administration had the pulse and temperature taken, and the urine carefully examined before and afterwards for traces of any pathological constituents, and after the administration the patients, if they were in-patients, were put on 4 hrly. charts and in a large number of these charts some reaction will be seen from the effect of the ionisation, variations in the pulse rate being more evident in some cases than in others. In those cases where Salycilic ions were used, I examined the urine for any evidence of the administration and found Salycilic acid to be present.

Case 1. W.A., workman, admitted on December 2nd, 1911, age 32, fell from a ladder on Oct. 16th, hurting his back, and the muscles of his abdomen; ever since then he has been lying in bed complaining of pain especially in the back on the slightest exertion. On examination of the abdomen nothing abnormal can be seen, nor can any tender area be felt. In the back there were no evident signs of injury, but there was some tenderness at the lumbar spines, on the left side. He has had local and general treatment ever since his injury, but has not derived the slightest benefit. On November 4th I started treatment with Ionic Medication, using Sodium Salycilate, 2%, applying the — active electrode to the back, the electrode consisted of the chain 6" long and 4" broad. This was separated from the skin by 8 layers of lint, saturated with the solute; the electrode was now carefully bandaged to
the part, the + or indifferent electrode was firmly bandaged on the abdomen. The current was gradually increased up to 30 milliamperes, and allowed to flow for 20 minutes, patient complaining of a burning sensation especially in the back, and on removing the — electrode, I found the area of application red, and covered over with little blisters about the size of a pin's head. Boric powder, sterilized gauze and wool were applied, and everything was perfectly well in three days.

During the application there was slight rise in the pulse rate from 85 to 94, temperature remained normal. The urine specific gravity 10.23 after application. The urine before the application contained no abnormal constituents. The evening of the application there were traces of Salicylic Acid. The treatment was carried out on exactly similar lines on Dec. 7th, 10th, 20th, 28th, Jan.13th and the patient is perfectly free from pain. He had six applications, and after each one, he said he felt a distinct improvement. Patient was discharged Jan.16th.

Case II. Admitted Sept.12th.

J.S., labourer, aged 27, strained the muscles of his back by reaching over a table, having been a patient for over 12 months at home, and in the out-patient department. I determined in this case also to try 2% sodium salicylate. On examination of the back, nothing abnormal could be seen or felt, and there was absolutely no tenderness on or at either side of the spine, but he can't bend the back, nor can he sleep at night because
of the pain. Heart, lungs, and kidneys normal. The first application of Ionic Medication was given on the 17th Sept. 1910, the - or active terminal being the chain electrode separated from the skin by 8 layers of lint saturated with 2% sodii salycilate, as in Case I, + pole being the zinc electrode covered with lint, and bandaged to the abdomen. 30 milliamperes were given for 20 minutes, and during the administration severe pain was felt over the - electrode in the back. Patient also complained slightly of the abdomen. On removing the - electrode the area was red, and covered with little pinhead projections, but there was in one spot a large irregular blister, which was opened and dusted with boric powder, healing in a few days. The pulse and temperature remained normal, and the urine did not show any pathological changes after the application.

The same dosage was given on 5 subsequent occasions, 24th Sept., 2nd, 10th, 15th and 23rd of Oct., and patient left here pain greatly improved.

Case III.

M.B. A girl aged 20, admitted Nov. 7th, 1911. In perfect health up to Oct. 3rd, when a trunk, about half a hundredweight, fell on her arm, and ever since she has had great pain. Nothing was noted at the time of the accident till the following Sunday, and then it was seen to be swollen, having a constant burning pain, sometimes shooting right down from the shoulder to the tip of the fingers. Patient had been in bed for 4
weeks at home, and had been with Sir Victor Horsley, who diagnosed Angio Neuritis. On examining the patient the general condition was very good, she was quite healthy, weighing 10 stones, and on examining the area (Nov. 7th) it was seen to be swollen from the elbow to the tips of the fingers, being held perfectly rigid. Patient would not move the arm. On moving it slightly myself, great pain was complained of. The arm was exceedingly tender, especially on the back and inner aspect, the slightest touch being felt as pain. On examination with X rays, nothing abnormal could be seen. On Nov. 10th I determined to try Ionic Medication, with 2% Sodium Salicylate, the positive or indifferent electrode being placed in saline and the right hand placed on the electrode, the active or negative chain electrode being separated from the arm by 8 layers of lint, saturated with Sodium Salicylate, and bandaged firmly on the part, from the elbow to the wrist, and the current gradually increased up to 20 milliamperes, and this was allowed to pass for 15 minutes. This occurred on Nov. 10th, and during the administration, she complained greatly of pain, the pulse and respirations increased from 76 to 100 and 20 to 28, and then became normal afterwards. Nothing abnormal was found in the urine, except a trace of Salicylate from the treatment. On removing the electrode, the area was slightly reddened, but showed no other change, and applications were given Dec. 14th, (2nd), Nov. 20th, (3rd), Nov. 28th, (4th), Dec. 3rd, (5th), Dec. 12th, and on Dec. 14th on examination of
the forearm the skin over the outer and back aspect was covered over with little septic pimples, and severe dermatitis, exuding a large amount of serum. Medical Ionisation was then stopped, and hot fomentations were applied every 4 hours, and the arm did splendidly, being perfectly healed on Dec.31st. The arm was painted with Glycerine and Ithylol paste, pain, swelling, and all pathological manifestations having cleared entirely away.

Patient is walking about and using her arm fairly well, and is not complaining of any pain or discomfort, and the arm is perfectly well.

The next case is one of a series of three stiff knee joints; in two of them the joints were rendered mobile; in the third case the knee was not improved after ten applications, and then treatment was deferred owing to a large sloughing ulcer which formed on the knee.

Case IV.

Harold Bridge, aged 35, admitted Sept.19th, 1911, suffering from T shaped fracture of the lower end of the Femur. The fracture was in fairly good position, the knee was slightly bent, but immobile. The knee was placed in a plaster case for three weeks; on inspection afterwards it was greatly swollen and stiff, no fluctuation could be detected, and the bony points not at all easily felt, the circumference was 2" larger than the normal knee. I determined to try Medical Ionisation.
On Oct. 10th I gave him aether, and tried by that means to bend the leg. The knee was held extremely rigid, and I was afraid of injuring the joint, and consequently I did not exert a great amount of force, and I could not break down the adhesions, and next day (Oct. 11th) I started the applications of Medical Ionisation, using Na. Cl₂ Sodium Chloride, 2%, as my active reagent with the — pole as the active electrode, the + indifferent electrode being placed on the sole of the foot; the current was gradually increased to 35 milliamperes, and passed for 30 minutes. At first the application was painful in the foot, gradually changing to the knee, and burning in character. On removing the negative — electrode the area was very red and tender, there was no change in pulse or respiration during the administration, nor any change in the urine afterwards. The temperature chart in this case shows slight rise in temperature but a more evident rise in the pulse rate. The application was repeated 12 times, each one exactly similar to the first.

(1) 10th Oct.
(2) 15th Oct.
(3) 21st Oct.
(4) 30th Oct.
(5) 10th Nov.
(6) 18th Nov.
(7) 26th Nov.
(8) 3rd Dec.
(9) 12th Dec.
(10) 20th Dec.
(11) 30th Dec.
(12) 6th Jan.

On examining the joint on Jan. 8th., the swelling was now gone, and the bony joints could be felt more distinctly, but the knee could not be bent, the muscles
being held rigid. On Jan. 10th, an anaesthetic was given, and the muscles relaxed. The knee was now very flacid, and was fully flexed and extended, the adhesions being very soft, requiring no force to move the joint. The knee was put on a splint, rested for 2 days, then passive movement was commenced. Patient left the hospital on 26th January, the knee joint being freely mobile.

Case V.

E.I., admitted Sept. 1st, suffering from stiff knee, due to gun shot wound, the bullet lodging in the knee joint.

On Sept. 21 the knee (left) was swollen and quite stiff, and on trying to flex the knee, great pain was experienced; consequently I determined to try Medical Ionisation to see if one could break down any adhesive bands which had formed. As before, Sodium Chloride, NaCl₂, 2%, was used on Oct. 2nd, with the chain electrode, the knee being wrapped in 8 layers of lint, saturated with the solute. The chain electrode attached to the negative terminal placed on the lint, covered with another layer and then bandaged firmly on the part, the positive electrode being placed on the sole of the foot. The current was gradually increased up to 30 milliamperes, but great burning pain was experienced, first in the heel, and then in the knee; consequently the current was reduced to 25 milliamperes, and allowed to pass for 20 minutes. On removing the electrode, the skin was very much reddened, and somewhat painful, the pulse, respiration and temperature remaining
normal. The urine after the application was not altered in any way, nor was it increased in quantity, 1st administration Sept. 22nd, and on 23rd temperature rose to 100.2 and pulse to 98, coming down again next morning. Applications, each one similar to the first, were given also on Oct. 12th, 20th; Nov. 1st, 12th, 22nd; Dec. 3rd, 13th, 24th; Jan. 2nd.

Patient was discharged on January 10th, the knee being perfectly well, movement being full flexion and extension.

Case VI.

J.J. Stiff knee joint, was admitted to the infirmary on the 9th Sept.

Patient had an operation on his knee for displaced semi lunar cartilage, the joint became septic, and has been stiff ever since. Ionic Medication was decided on, using Sodium Chloride, Na Cl₂, 2%, on Sept. 10th, as before. I saturated 8 layers of lint, rolling them completely round the knee, placing the chain electrode on the anterior aspect, and bandaging it firmly on, the positive electrode being placed on the sole of the foot. The current was gradually increased up to 40 milliamperes, and allowed to pass for 30 minutes. On removing the negative electrode, the area showed only slight redness. The urine showed no change after the administration. 10 administrations were given the knee massaged and moved as much as possible, but there was no result. After the 10th application on removing the negative electrode a slight blister was noted. Nothing much was thought of
this, but he came to see me two days afterwards, and on
the anterior aspect of the knee there was an irregular
sloughing ulcer with very unhealthy appearance, which is'
healing very slowly. Applications were exactly similar
to the first in every detail, and were given Sept. 10th,
16th, and 25th, Oct. 4th, 12th, 21st, 30th, Nov. 15th,
23rd, and Dec. 2nd. The knee has not shown the slightest
improvement, but I intend to resume the applications
again as soon as the ulcer heals.

Cases VII, VIII, & IX.

Three cases of Chronic Synovitis with very good re-
sults in each case.

A.B., admitted Nov. 10th, chronic pain in the ankle
joint for 8 months. Patient gave the ankle a sudden
wrench, being troubled with pain ever since, especially
on walking. When patient walks very much the ankle be-
comes slightly more swollen and somewhat tender. On ex-
amination the ankle measures $\frac{1}{2}$" larger in circumference
than the left.

No pain was complained of when the ankle was at
rest, but the joint was a little tender in front; there
were no signs of tuberculosis or rheumatism, and I dia-
gnosed simple synovitis of the ankle joint. Patient had
been an out-patient of this infirmary and had been at
home in bed for 4 weeks under treatment before she came
as an in-patient, so I determined to try Medical Ionis-
ation, Lithium Sulphate being used 2% solution.
On Nov. 12th the ankle was wrapped up in 8 layers of lint, saturated with the solute, and the chain electrode placed on the anterior aspect of the joint and bandaged firmly on; the — electrode was firmly bandaged to the calf of the leg, and the current gradually increased up to 20 milliamperes, and allowed to flow for 25 minutes, — the patient complaining of very little pain during the application, and pulse and temperature never showed the slightest rise nor was there any redness of the skin on removing the electrode.

The temperature never rose afterwards, nor was there any change in the urine. Application was repeated on the following dates:

1. Nov. 15th, 2. Nov. 24th, 3. Nov. 29th, 4. Dec. 5th, each the same as No. 1, and on Dec. 20th patient said ankle felt much better, and she was walking about on Dec. 25th, suffering no inconvenience nor any pain.

Case VIII.

D.W. aged 17, admitted Nov. 29th, suffering from synovitis of the right knee. About 2 years ago patient slipped and fell on the knee, and ever since has been troubled with pain, especially on walking.

Since the accident patient has been attended by several doctors, but without any benefit, and on examination of the knee the right was swollen $1\frac{1}{2}$" larger in circumference than the left, fluctuation definite in the joint, Pain not felt unless on extreme flexion or extension, but on walking some little distance pain is
experienced, and the joint becomes more swollen and tender. I determined to try Medical Ionisation, using Lithium Sulphate 2% as before, and on Dec.1st the knee was rolled in 8 layers of lint, saturated with the solute, and the chain electrode firmly bandaged over the lint on the front part of the knee. The electrode being placed in saline at the sole of the foot, the current was gradually increased to 30 milliamperes, and continued for 30 minutes. The patient during the application did not complain of any pain or discomfort, nor was there any increase in the pulse, respiration or temperature during the administration or afterwards. When the electrode was removed, the knee presented no abnormal appearance. On the 6th day after the administration the knee was measured, and it was found to be only ½" greater than the normal knee, and fluctuation very difficult to determine. Dec.10th, 20th, 28th treatment again given, and the knee on examination Dec. 26th showed no swelling, nor pain, even on extreme flexion, and patient left the hospital quite recovered on Jan.2nd.

Case IX.

F.T. admitted Nov.5th, and complained of pain in the knee, on the slightest movement. About a week before admission he was playing football, and wrenched his knee.

On examining the knee it was greatly swollen, measuring about 17", being 2" more in circumference than the right, tender and fluctuating. I determined to
try Ionisation with Lithium Sulphate 2% and on Nov. 7th the + chain electrode was bandaged to the knee over 8 layers of lint, saturated with the solute, the negative electrode being placed on the sole of the foot, the current passed and gradually increased to 25 milliamperes, and allowed to pass for 20 minutes. On removing the electrode the knee was not inflamed; no pulse or temperature was marked, and in 4 days the knee was very much less tender than formerly; swelling had subsided 1", and one more application was given on Nov. 14th, similar to the first, and on Nov. 22nd he was discharged, the knee being perfectly well.

Cases X, XI, XII, XIII are a series of chronic ulcers on which I used Copper Sulphate 2%, 3 layers of lint as near as possible to the size of the ulcer were saturated with the solute and a flat copper electrode of similar size held firmly on the lint, the electrode being attached to the + terminal.

This method was adopted in all the cases.

Case X.

M.R. admitted Sept. 20th, suffering from an ulcer about the size of 5/- on the outer surface of the ankle which had been present now for three years. On examination the floor of the ulcer is unhealthy, and exuding a putrid discharge. Edges well defined, sharp and irregular, the ulcer presenting a punched out appearance, the skin around about greatly discoloured. Patient has been under treatment now since she first had the ulcer, and with no benefit, so on Sept. 21st.
I determined to try Medical Ionisation, using as before stated 2% Copper Sulphate Cu. \( \text{SO}_4 \) the + terminal being the active electrode, and the foot placed on the negative or indifferent electrode in saline solution, the current was gradually increased up to 20 milliamperes, and allowed to pass for 15 minutes, patient complaining of pain, especially in the ulcer during the application, the pulse and temperature remained normal. There was slight increase in the pulse rate the next morning, rising from 78 to 90.

On removing the electrode from the ulcer the base was seen to be coloured intensely with the copper ions. A simple dressing of green protective and dry gauze was applied and patient was sent to bed. The ulcer on the 22nd was very tender, and slightly inflamed; on Sept. 30th the inflammation was very much less, the granulations were becoming more healthy and not so irregular, the edges were not so punched out.

Oct.1st, same application given with same results.

Oct.6th, on examination of ulcer the edges have grown in exceedingly, and the ulcer is now about half its original size, the granulations were very healthy, with very little discharge, and on the 15th Oct. the ulcer was perfectly healed.

Case XI.

T.K, aged 22, admitted Sept.10th, suffering from a large sinus in the hand extending from a point midway between the head of the fifth meta carpal and the
pisiform bone and slightly to the radial side. The sinus, which extends backwards to the wrist, is wide, allowing a pair of sinus forceps to be passed along for 2 inches. At the opening there is an ulcer, irregular in shape, and covered with unhealthy granulations, having a very putrid discharge.

Patient in April last got a needle into the hand which was removed, but the sinus would not heal, and on September 10th he was admitted, the ulcer dressed with Boric fomentations and gauze drains, but on Oct.3rd no improvement had taken place, so I determined to try ionisation, and for the purpose of getting into the sinus, I took a copper sound and wrapped the end round with strips of lint saturated in the solute, and passed it into the sinus. Lint saturated with the solute was spread over the ulcer and round the copper electrode, the indifferent electrode being placed on the other hand in normal saline. The current was passed and gradually increased to 30 milliamperes, and allowed to flow for 20 minutes. Boric fomentations being applied on Oct.6th the hand was greatly swollen, and hot lysol baths were given, on Oct.10th all inflammation subsided. On Oct.11th I gave the second administration exactly similar to No.1 and on examination afterwards, the floor of the ulcer and sinus were seen to be cauterised and blueish in colour. On Oct.16th the sinus was examined and was shorter by about \( \frac{1}{2} \)", becoming narrower and the discharge much less. The ulcer was also healing, and the granulations were more healthy. Another application was given. First of all
I gave the sinus 10 minutes at 20 milliamperes, and with the flat copper electrode the ulcer was cauterised for 10 minutes.

On Oct. 20th the sinus was again treated for 10 minutes, the ulcer doing beautifully, and on Nov. 3rd the sinus was perfectly healed and the ulcer was only the size of a threepenny bit, and the application was repeated for 10 minutes at 20 milliamperes, and on Nov. 8th the ulcer was healed, leaving a firm cicatrix.

**Case XII.**

W.C., admitted Nov. 17th, suffering from ulcer on the inner side of the heel. He had an accident on Nov. 15th with a motor bike. He was admitted here on Nov. 17th, and on the inner surface of the heel there was an irregular ulcer with unhealthy granulation tissue exuding pus. The edges were thin and irregular. On Nov. 25th the ulcer showed no sign of improvement, and I determined to try Medical Ionisation, using Copper Sulphate, 2%, with the + electrode, and the ulcer was thoroughly cauterised when the electrode was removed, and on Dec. 1st the ulcer was healing beautifully, and the granulations bright red with the skin edges gradually creeping over the granulating surface. On Dec. 9th the ulcer was perfectly healed.

**Case XIII.**

M.B., 56 years of age, admitted Nov. 11th for ulcer of the leg, which she has had for 4 years.

Patient has been attended during this time by
various doctors, but the ulcer has never shown the slightest improvement. I determined to try Medical Ionisation, using Copper Sulphate, Cu. $\text{SO}_4$, 2%, the positive pole as the active terminal and the negative pole being placed in saline on the sole of the foot.

On examination of the leg, the skin round the ulcer was hard and brawny.

The ulcer is irregular in shape, measuring $2\frac{1}{2}''$ in length, and $1\frac{1}{2}''$ broad, the edges are very thick and present a punched out appearance. The base of the ulcer is very irregular, the granulations being large, unhealthy and exuding very thick pus which on examination shows staphlococci in large numbers.

I put Boric fomentations on the ulcer, when patient came in, and on 13th I gave my first application, the ulcer being covered with three layers of lint saturated in 2% Cu. $\text{SO}_4$ the current was gradually increased to 20 milliamperes, and allowed to flow for 25 minutes, patient complaining of pain in the ulcer. On removing the electrode the ulcer was thoroughly cauterised and the copper ions had penetrated into the granulations. Boric fomentations were applied for 4 days, then simple sterile gauze and green protective. On Nov. 21st the ulcer presented the appearance of a healing ulcer. Nov. 22nd second application was repeated, lasting 15 minutes, the ulcer presenting the same cauterised appearance afterwards.

Nov. 28th, third application, 20 milliamperes for 15 minutes.

Dec. 3rd, on examining the leg the ulcer is now practically healed.
Dec.8th., ulcer healed, perfect eschar, soft, firm and no pain.

Dec.16th left the hospital.

The next case is one of pain in the back.

Case 14.

N.Barrett, aged 30, admitted Nov.20th for pain in the back, which she has had for 5 years; there is no history of accident; on examination of the patient there was nothing abnormal in the heart and lungs or the abdomen, the uterus was slightly enlarged but not tender; there was nothing to be felt per rectum. There was no deformity of the back, — no tenderness. Pain, this was located over the third lumbar spine, slightly to the left side. A constant dull ache for which I could see no cause. The patient was X rayed, but nothing abnormal was seen. Dr.B. had been attending her at home for three months, rest in bed, and other treatment had been given but with no result, so I determined to try Sodium Salicylate 2% by Ionic Medication, the — active electrode consisting of the chain electrode — 3 layers of lint saturated in the solute — were bandaged firmly to the part, the + electrode consisting of the zinc plate covered with lint bandaged firmly to the abdomen. The current was passed and gradually increased to 25 milliamperes, and continued for 30 minutes, patient complaining of severe pain in the back. Pulse was accelerated during the application from 80 to 92 temperature or respiration not changed.
Urine no change, but on careful examination one can find a trace of Salicylic acid.

The application was repeated on the following dated: - (II) Dec. 2nd, (III) Dec. 11th, (IV) Dec. 16th, (V) Dec. 23rd.

On examination of the patient on Dec. 27th, there was no change whatever in the patient's condition, pain the same, and she asked me not to give any more applications as she was receiving no benefit.

The next two cases are a series of chronic ulcerative rhinitis.

Case XV.

A.J., admitted Oct. 2nd, suffering from ulcerating rhinitis, affecting both nostrils. Patient has been ill for nearly three years with pain and discharge. On examining the nostrils the condition of both was the same. At the opening of the anterior nares there were ulcerating areas covered over with thick hard pus, these ulcers extending on the septum of the nose upwards and backwards, discharging pus. Patient complains of great pain, especially in the back of the head.

During all this time patient has been attending different doctors, each one trying something different. None seemed to give her any benefit, so I determined to try Copper Sulphate, Cu. So₄, 2%, by Medical Ionisation for the − electrode, using the zinc plate covered with lint in saline, and the active + electrode a copper rode rolled in lint, saturated with the solute. On Oct. 3rd the + electrode was introduced
into the nose. Left nostril first, and brought into direct contact with the ulcerating surface, and the current gradually increased up to 15 milliamperes, passed for x minutes; the right nostril was treated in a similar manner. The application was very painful, patient complaining greatly of burning pain in the nose.

Temperature or pulse never varied, but on the morning of the 4th there was an increase of the pulse rate from 84 to 100, and temperature from 93.4 to 101.4 which returned to normal 10 p.m. same evening. The application was repeated on Oct.9th, Oct.17th., and on examination Oct.20th the nose looked ever so much better. There was much less discharge; and crusts were not so evident. Applications were repeated again on Oct.27th, Nov.6th, 12th, 19th, and on examining the nose on the 26th one could see a very great improvement. The ulcers had now almost entirely healed with the exception of a small area above the vestibule of the nose in the right nostril, and an ulcer on the septum of the left nostril, about the size of a threepenny bit. These ulcers were again cauterised on the 26th, each ulcer receiving 20 milliamperes for 10 minutes. On examining the nose on Dec.4th, ulcers were perfectly healed, no discharge nor pain or any description.

On Jan.30th patient came to see me, nostrils in perfect condition.

Case XVI.

Emma Cooke, 27, admitted Nov.8th. Patient is a strong, healthy girl, complaining of great pain in the
nose, which she has had for 8 years, and on examination the right nostril was extensively ulcerated, especially on the septum, and in the middle of the septum the ulcer had extended through to the left nostril - the ulcer was very septic, and giving rise to a very foul discharge, left nostril presented a similar appearance. Patient had been treated here as a medical out-patient for some considerable time, but with no improvement. There was no specific history, and the lesion did not clear up under specific treatment.

I determined to try Medical Ionisation, using copper sulphate \( \text{Cu SO}_4 \), 2%. On Nov.11th using the same electrodes as in Case XV I gave 15 milliamperes to each nostril for 10 minutes. There was no reaction, pulse and temperature not increasing. The application was repeated on Nov.15th, 22nd, 29th; Dec.4th, giving 15 milliamperes for 10 minutes to each. On examination of the nose on Dec.5th, there was no improvement, the discharge seemed to be slightly less. Applications were repeated on Dec.7th, 13th, 20th, and 27th, and on examination again no improvement could be seen. Patient went home and came up on two days a week, 2nd, 6th, 9th, 16th, 20th, Tuesday and Saturday.

On examination on Saturday, 20th January, there was not the slightest change in the condition of the nose, the aperture in the septum had not diminished nor the ulcers assumed a more healthy appearance, so I determined to stop the applications, seeing no
benefit result.

The next is a series of three cases of Rodent Ulcer, and the technique of the application was as follows. 4 layers of lint the size of the ulcer were saturated in 2% Zn. Cl₂, the + electrode was a zinc plate ¼" thick, and as near as possible the same size. The negative electrode was the zinc plate, 3" by 4", covered by lint in saline solution, the left hand placed on the electrode. The applications lasted as a rule 10 minutes, and the strength of the current about 10 milliamperes.

Case XVII.

A.S., male, aged 40, admitted here Dec. 6th, suffering from a Rodent Ulcer on the left cheek just at the outer margin of the eye. About 2 years ago this ulcer started with a little pimple, and has been gradually getting larger.

The ulcer is the size of a shilling, with heaped up edges, irregular, and exuding very slight discharge. The edge, which is posterior, is more shallow than the anterior; there is no pain, but slight itchiness. I gave my first application on Dec. 7th, passing the current for 10 minutes at 10 milliamperes, patient complaining of a burning pain in the eye. On Dec. 9th the ulcer was slightly inflamed, discharging pus. On Dec. 10 resumed its normal appearance, so on Dec. 14th I repeated the application, also Dec. 19th, 24th, Jan. 2nd, 8th, 13th, and on examination of the ulcer there was nothing to be seen except a small raw area just at the anterior edge to which I gave another application
on Jan. 23rd, and on Feb. 4th the ulcer quite healed with firm eschar.

Case XVIII.

A.G., an out-patient, I saw him first last July, 1911, and I started treating him with Co₂ Snow; on August and September the ulcer received 6 applications of X rays without any benefit. On examination the ulcer was situated on the left side of the nose, the size of a two shilling piece, with irregular heaped up edges, showing signs of healing on the inner aspect, but gradually extending to the cheek. I commenced Medical Ionisation with Zinc Chloride 2% on Oct. 2nd, the application lasting for XII minutes at 15 milliamperes. There was no reaction from the application, which was repeated on Oct. 9th, 15th, 24th, Nov. 1st. On examination of the ulcer there was no sign of improvement; the base of the ulcer not becoming more healthy nor the edges growing in over the surface, and he asked me not to continue with the applications on account of the pain which it produced.

Case XIX.

N.B., admitted here Dec. 10th, suffering from Rodent ulcer just below the right eye. The ulcer has been present for two years, and is now about the size of a sixpence, slightly elongated, deep with heaped up edges and growing in towards the eye. No pain whatever. I gave my first application on Dec. 20, 1911, the current flowing for 10 minutes at 10 milliamperes.
The ulcer was thoroughly cauterised; there was no rise of pulse or temperature, simple dressing was applied on Dec. 22nd; ulcer showed signs of inflammation and irritation, settling down again in a few days. On Dec. 30th and Jan. 3rd application was repeated, and on examination on Jan. 10th, the ulcer was perfectly healed.

**Case XX.**

R.S., male, admitted 6th Oct., 1911, suffering from Lymphadenoma glands in the neck groin and axilla being very much enlarged. The patient has been ill now for nearly 12 months, complaining principally of pain in the cervical swelling. On examining the neck, there were two distinct swellings, one in front of and one behind the sternomastoid, each about the size of a tangerine orange, freely mobile, slightly tender, and painful, the neck measuring 15", glands in axilla about the size of a large orange, in the groin about the size of a pigeon's egg.

When patient was admitted he had been having large doses of arsenic for 6 months without any special benefit. He was losing weight, had great pain in the neck, and his temperature was 101.2 as a general rule in the evening. I determined to try Arrhenalor Di-Sodic-mono-Methyl-arsenate, using the negative pole with chain electrode, and 8 layers of lint saturated in the solute, placing the indifferent electrode in saline on the palm of the hand.

Pain being very marked in the neck on Nov. 7th I det-
ermined to try the effect; the negative electrode was firmly bandaged round the neck, and the current gradually increased to 15 milliamperes, and passed for 10 minutes; patient complained of burning pain, the pulse increased from 90 to 120 during the application, and on removal of the electrode the skin of the neck was very red and tender.

Urine did not in any way change its normal characteristics.

The temperature the same evening was normal, and remained so until Nov. 11th when temperature rose again.

Pain had entirely left the neck, not returning again until Nov. 13th, when I gave another application with similar results, patient remaining free from pain until Nov. 23rd, temperature remaining normal until Nov. 20th. Applications were given Nov. 23rd, Dec. 3rd, 10th and 15th, patient not complaining of pain during all that time, and temperature remaining normal.

Patient had been losing weight during the last three months, and during his first week in hospital lost 3½ lbs., 2nd week, 2½, 3rd week, 4, 4th week, 3 lbs.

Since the commencement of Medical Ionisation he has not lost weight, in fact gaining two lbs.

The neck measuring 15" when patient was admitted now measures 14½".

On Dec. 16th patient was feeling better than he had for some time, but on Dec. 17th pulse and temperature rose from 90 to 127, from 98.2 to 101.4. Pain had returned and he felt very ill. I gave another
application, but with no very marked effect. I also gave one on Dec. 21st, with very little effect, and the temperature did not react. The patient lost 4 lbs. in weight during that same week, and he was discharged on Dec. 24th. I saw patient on January 10th, the neck measuring 14 1/2", the pain very severe, and the patient is losing weight very rapidly.

On reviewing the results of Ionic Medication, in the first two cases the results were very good, especially No. 1, the only other treatment given was rest in bed, hot baths, massage, and a tonic; there was no other medicine given, and six applications in Case I completely relieved the pain; in Case II the result was not quite so good, but there was definite improvement, the patient being able to move and bend much more freely than before the applications were commenced.

In these cases, judging from other injured backs which one has had to attend, the illness would in all probability have been prolonged for a considerable period; the only ill effect which one had from the application was a sloughing ulcer about 1/2" round, produced on the back, requiring considerable time to heal.

In Case III, which is very peculiar, I think there is no doubt the applications cured the pain.

In Cases No. 4, 5, 6, we have two in which the treatment was very successful, the other case I have not despaired of, as I intend to begin the applications as soon as possible. The treatment which was given to these cases was simply massage with general treatment
by tonics, etc.

In Case 4 the adhesions in the knee joint were broken down after 12 applications with the greatest of ease, whereas one was not able to bend the limb with safety at the first anaesthesia. These two cases prove the benefit which Medical Ionisation is to joints which are stiff on account of adhesions.

Cases 7, 8, & 9, in these cases we have three which have done exceedingly well, - the first case receiving five applications, second, four, and the third case, two. There was no pain nor any reaction whatever from the application, and I think the results show the value of Ionic Medication in Synovitis, Acute or Chronic. The patients received no treatment except keeping the joint at perfect rest, and wool firmly bandaged to the joint.

Patients were not allowed up until all the pain had gone. They were allowed full diet, and no medicine internally.

Cases, IO, 11, 12, 13, are ulcers which have been healed by the application and there is no doubt that it alone healed the ulcers. The applications were very painful, causing a burning sensation in the ulcer. The ulcer was thoroughly cauterised by the application and gradually changed from the unhealthy surface which it presented to a bright red granulating area, the edges growing in over the surface. The ulcers in the intervals between the applications were simply covered over with green protective and sterile gauze, being dressed twice daily, and at each dressing bathed with Boric
lotion, and sprayed with Hydrogen per oxide.

In Cases 10, 11, the local reaction was very marked, the ulcer being tender and inflamed, but dying down again in less than a week. The discharge was much greater during the few days following the inflammation, but very soon the ulcer assumed the characteristics of the healing ulcer.

On examining the leg after the ulcer healed it was interesting to compare the eschar which one had in these cases with that of ulcers which healed with other treatment. The eschar was firm, soft, and showed no signs of breaking down. Patients were kept in bed during the treatment.

Medical Ionisation is extremely useful in these cases, as shown by the above, causing the ulcer to heal more rapidly and forming a much stronger eschar.

Case 14, here there is no positive diagnosis, and I have examined patient very carefully, but I cannot find the reason for the pain. The urine shows nothing abnormal, the bowels are quite free, the uterus not displaced or enlarged. There was nothing to be seen by X rays. Medical Ionisation gave no result, the pain not showing the slightest improvement, and patient asked me to discontinue the treatment. Patient complained of great pain during the applications, but there was no sign of blistering or other irritations on removing the electrode.

Cases 15 and 16, are two which have been attending the S.O.P.D. for some time. Case 15 the treatment was
very successful; in Case 16 the nose seemed to improve after the 1st two applications the discharge getting slightly less, but this was only temporary, and during the 14 applications which I gave her, the nose was examined frequently, but no improvement could be seen. Case 1 did extremely well, the ulcerated surfaces healing up, and the nose being quite cured before she left here on Dec. 6th.

There was definite reaction shown to the treatment by the variation in the pulse and temperature.

Cases 17, 18, 19, cases of Rodent Ulcer, in which I used Ionic Medication with splendid results in 17 and 19, and 18 the result was not at all satisfactory. I gave him 5 applications, but the ulcer showed no signs of healing. I tried increasing the dosage both in time and milliamperes, but patient could not bear the pain, and consequently I decreased the dosage to the usual amount; in Cases 17 & 19 the ulcer showed signs of reaction after the 1st application, the ulcer becoming inflamed and red, and discharging thick pus very freely.

The ulcers assumed the raw healthy granulating appearance which is typical of the healing ulcer, the heaped up edge disappearing; the eschar which was formed was depressed, firm and soft, with no hard nodule to be felt.

Case 20, in this case of Lymphadenoma I determined to try if Sodium Mono Methyl Arsenate commonly known as Arrhenal would have any effect soluble
l to 2 of water, a 2 per cent solution of the drug was used, there was definite benefit — though only temporary — received from the applications, which numbered 8, 15 milliamperes passing for 10 minutes at each. The patient previous to coming to the infirmary had been under treatment with arsenic. Patient has been running a temperature generally about 101.2 from the first application until Dec.17th, the temperature never rose, keeping normal all that time with one exception, and then another dose brought it normal again immediately. Patient complained a great deal of pain, which was relieved from the first application until Dec.17th.

Tenderness which was also relieved.

Patient had been losing weight steadily ever since he came in, but during the period of applications he gained two lbs.

The swelling became slightly smaller, the circumference of the neck when patient came in was 15", and after 5 applications 14½", and the patient felt better in every way until Dec.16th, when he seemed very much duller; on Dec.17th temperature rose again to 102.1 and pain had returned. Two applications had no beneficial effect, and they were discontinued, the patient gradually becoming worse.

I thought of trying a more concentrated solution of the drug, but not having any efficient guide as to the amount of drug used, I was afraid; patient was kept in bed during this time, given fluid diet, with regular aperients, the neck wrapped in wool and bandaged.
Medical ionisation acts in my opinion in three ways,

1st, the drug being carried into the tissues.

2nd, counter irritation at the active electrode producing local reaction.

3rd, the mental or suggestive effect of the actual application.

I have had no very bad effects from Medical Ionisation, no patient complaining of feeling ill, but locally there were various lesions produced.

In Case II there was a small blister, which left a small ulcerating area.

In Case III the most serious lesion of all was produced, a dermatitis over the whole forearm under the electrode taking a long time to heal. In Cases IV & V after the first application the knee was covered over with little blisters about the size of a pin-head, not painful; they simply dusted with Boric Powder, wool was applied, and they disappeared.

In Case VI there was a sloughing ulcer produced on the anterior aspect of the knee which is very difficult to heal, and which is preventing any further applications at present.

In Cases VII, VIII & IX, treated with Lithium sulphate, there was no pain or lesion of any sort produced.

The reaction in the ulcers was a local inflammation.

The treatment of disease by Medical Ionisation is now an established fact, and on reviewing the 20
cases which I have had, one cannot but say that its use is extremely varied.

There were three cases which would not yield to treatment.

1 case pain in the back, 1 case of rodent ulcer, and 1 case of Ulcerative Rhinitis.

In these the results were extremely unsatisfactory, and in one case the treatment had to be abandoned owing to the ulcer which was produced by the active terminal.

In the other 16 cases Medical Ionisation was very successful, and when one remembers the fact that they were cases which had been under treatment for some considerable time with other remedies, and that Medical Ionisation was only tried as a last resort. The treatment is very simple to carry out, finding the terminals positive and negative and carefully regulating the amount of current being the only trouble in connection with the actual administration. The great objection which one has to the treatment is that there is no means, at present, of accurately determining the amount of drug given.

The pain of the application is in some cases very severe, often acting as a deterrent to the strength of the current, but the results are so good that the disadvantages of Medical Ionisation is a minor consideration.
The second part of the Thesis deals with the production of local anaesthesia by medical ions. In the little synopsis of Ionic Medication published by the Cavendish Electrical Company, 1911, page 31, there is a slight account of cocaine ions for Local Anaesthesia, using 10% solution connected to the + electrode and a current of 20 milliamperes. I determined to try Beta-Eucaïne Lactate 10 per cent using the same switch board—standard Ionic Medication—as used for treatment getting the current from the main, the only addition to the outfit being the inverted tumbler with a parchment membrane on the open surface and an opening on the opposite surface with a metal ring stuck into this end allowing the copper electrode to be screwed in. On this metal electrode there is a carbon pencil projecting down into the tumbler, and a wooden handle on the other end, allowing the operator to hold the active terminal firmly against the skin.

I had a series of four cases which I tried with the Beta-Eucaïne Lactate, 10 per cent.

1st case.
A.M., aged 17.
Admitted into the Stockport Infirmary on Nov.17th, at 6.30, and it was seen he had a gun shot wound in the abdomen just below the ninth right costal cartilage.

I decided to open up the wound and drain, and for this purpose local anaesthesia by Ionic Medication was tried. The patient being on the table, the negative electrode was placed on the small of the back, and the
positive electrode, the glass bulb filled with 10% Beta-Eucaine Lactate, placed over the wound, which was covered with a layer of lint, moistened with Na Cl₂ (normal).

The current was switched on and gradually increased up to 25 milliamperes, being passed for 5 mins. On removing the electrode and examining the area, there was absolutely no anaesthesia, the electrode was re-applied and the current passed for another 10 mins, and on removal of the electrode there was now slight anaesthesia. A needle prick was not felt, so we decided to pass a probe and open up, but on passing the probe pain was complained of and much more so on opening up with the knife, and on the application of Fr.Iodine needle pricks could now be felt distinctly after 4 mins. of the anaesthesia. The area of anaesthesia was not at any time so large as the electrode. One could distinctly mark out the size of the electrode by the pale anaemic area which it covered.

This my first case with Ionic Medication was unsuccessful. The anaesthesia was very superficial, very transient, and during the administration the pain complained of made one very doubtful of its value.
Case II.

Patient admitted Nov. 30th suffering from a ganglion on the back of the wrist. The ganglion had been there for two years, about the size of a pigeon's egg, freely mobile from side to side and slightly from above downwards.

I determined to try Medical Eucainisation, using the same switch board and inverted cup for the experiment, the + terminal connected to the cup and the cup placed directly on the part to be Eucainised, the indifferent electrode being just above the elbow.

The current was switched on and gradually increased up to 25 milliamperes allowing this to pass for 10 mins, the patient complaining of acute pain in the hand all the time, and on examination there was practically no anaesthesia. Another 5 mins. was given at 25 milliamperes, and the result was slightly better, but nothing like what one would have liked, pin pricks felt very slightly, skin not sensitive to touch. I tried to open the superficial tissues with the knife, but it was impossible, so I had to inject Eudrenine 1% into the parts and go on with that anaesthesia. Here was absolute failure. I took every precaution, and instead of 3 minutes I gave 15 minutes with the most meagre results, and giving a great lot of trouble besides causing the patient considerable pain which should if possible be avoided. Patient was very nervous, so the expectation of feeling it might have made the sense of pain more acute, but on inserting the needle for the Eudrenine, nothing to denote this was experienced.
Case III.

S.G., admitted to the Infirmary Dec.10th suffering from Lipoma on the inner surface of the forearm; a small fatty tumour about the size of a hen's egg, not painful or tender, but wanted it removed. Patient was a strong healthy woman of the masculine type, and not in any way hysterical or nervous, so I determined to try excision of the tumour with Medical Ionisation, 10% Beta-Eucaine Lactate being the preparation as used before, the indifferent electrode being placed at the hand; the glass bulb attached to the positive terminal was placed over the tumour, the current switched on and gradually increased up to 30 milliamperes, passed for 12 mins. On removal of the + pole the area covered was found to be insensitive to touch and needle pricks were felt only very faintly, so I gave another 25 milliamperes for 5 minutes, with very little better result, and the moment I touched the skin with the knife, the patient felt distinct pain. I tried another 10 minutes with 25 milliamperes, but no better result, and I again had to start and inject Eudrenine; after trying 27 minutes with the Beta-Eucaine the result was extremely disappointing. I got anaesthesia but not enough for making a very small incision into the skin nor for doing the simplest operation.

Case III was therefore also disappointing in many ways, indeed the trouble and time, besides the original expense of the instrument and the expense of the electricity seemed, from a practical point of view, to have been useless.
Case IV.

J.B., aged 40, admitted to the Infirmary Jan. 3rd, suffering from a sebaceous cyst just underneath the angle of the jaw. Here I determined also to try Beta-Eucaine Lactate by Ionic Medication, using a current of 25 milliamperes for 15 minutes, the patient complaining of great pain during the administration. On removing the + or active electrode from the cyst the area covered by the electrode was pale anaemic and patient could not feel pin pricks nor touch, consequently the incision was made about 1" long over the cyst, patient complaining slightly of pain. I started dissecting the cyst out from the tissues, pain was experienced very much, and it was with the greatest difficulty I could go on and finish the operation without another anaesthetic, but being very small, I succeeded in shelling it out. There was considerable oozing, and I caught (with a pair of artery forceps) a little spurting point down in the floor of the cavity, and patient cried out with pain, showing the penetration of the ions to be very superficial. The operation lasted about 7 to 10 minutes, and when I came to stitch up all anaesthesia of the skin and sup. structures had gone, and the patient felt the needles going through the skin, as if no attempt at anaesthesia had ever been made. This was what some might call a successful case, but anaesthesia was in no sense of the word complete, and had the man not had the strongest will power, I should have had to use Eudrenine in order to finish the operation.

The indifferent electrode was placed at the nape of the neck, and the usual one was used.
My experiments in the use of Ionic Medication for local anaesthesia have been very disappointing. There are only 4 cases, but still they gave me the idea that its use was not satisfactory; in the four cases which I tried, there was not one in which one could say there was anaesthesia that would enable one to do even the smallest operation with that comparative comfort which one has, for both operator and patient, in the use of Eudrenine by the infiltration method. In strong men or women who are less sensitive than others, one could use it, but not in a nervous girl. Seeing the results of the above, I tried the anaesthesia on 12 people who were quite healthy to see the effect of the anaesthetic in the healthy and physiological condition. The solution I determined to try was the same as I had used for my other applications, 10% Sol. of Beta-Eucaine Lactate, and the patients, 6 men and 6 women, the strength of the current varying as I thought they could bear it. The areas I determined to try were very different, (I) the abdomen, (II) The thighs, (III), Arms and Breasts.

The Beta-Eucaine was not at fault in any of the previous results, because I tried it by the infiltration method, and found it to be perfectly active, producing a perfect anaesthesia for the amputation of a finger, and for the extraction of teeth 1% solution being used, patients feeling absolutely no pain whatever. The anaesthesia in the case of the finger being good one hour after operation.
Case I. Patient was a strong healthy man, aged 40, who had been in Sydney, and was now here for fractured patella which was quite united.

I determined to try the upper arm in his case, and consequently chose the outer surface just at the swelling of the outer head of the triceps having the indifferent electrode on the palmer surface of the hand. The active electrode was separated from the skin by a layer of lint saturated in salt solution, 2%, the current was switched on, and gradually increased up to 30 milliamperes, and passed for 10 minutes. On removal of the electrode from the surface of the skin, the area was tested for the following sensations, (I) touch by cotton wool felt distinctly all over the surface, (II) heat and cold sensation normal, (III) pain not in any way decreased. The electrode was again applied, and the current was passed up to 25 milliamperes - not going up to 30 as he complained of pain - passed for another x minutes; on removing the electrode now the sense of touch was lost. Heat and cold were also lost as tested by the test tubes with hot and cold water, the sensation of pain was very different in the area, and I mapped out the phenomena as best I could. At first on pricking the patient with the needle I found he was sensitive, but on further examination a very peculiar circumstance presented itself.

Over the area of application the sensation varied, in some places the needle prick was not felt, in others only slightly, in other words the anaesthesia was very varied and the areas of variation are portrayed above, and in
these anaesthetic areas the centre of each seemed to be the least sensitive.

It may here be noted that patient felt the pain of the administration getting less as the anaesthesia proceeded.

Case II.

A young girl aged 13 who was admitted to the hospital for synovitis of the knee joint. I determined to try the effects of medical ions, but she was not hypersensitive, nor in any way nervous. I tried in her case the front of the thigh, having the — or indifferent electrode at the sole of the foot. The active electrode was placed in front of the thigh, and slightly to the inner aspect separated from it only by a layer of lint saturated with Na. Cl₂ 2%. The application — 20 milliamperes — lasted for 15 minutes, after which the part was examined. There was very little anaesthesia, the needle pricks being felt quite distinctly but slightly less than on the normal skin. The application was repeated for 10 minutes at 20 milliamperes, and the result noted. Area presented a dull anaemic appearance, quite distinct from any other part of the thigh, the sensibility to touch, heat, and cold was lost. Over the whole area there was just the slightest pain during the pin prick. Pin prick felt for 10 minutes, so that one may say here was fairly successful anaesthesia, but only lasting for a very few moments however, as in 10 minutes the sensation of pain had returned to normal.

Case III.

A man, admitted to the Stockport Infirmary, suffering
from injured back, and I determined to try in this case the anterior wall of the abdomen, the active positive electrode being placed on the right side of the abdomen, the — or indifferent electrode being placed at the back, just over the lumbar vertebrae. The current was gradually increased up to 25 milliamperes, and allowed to pass for 15 minutes. On removing the electrode practically no anaesthesia to pain was found, but touch as tested by cotton wool, was absent. Heat and cold not able to be distinguished. Further application of 10 minutes to the same area produced slight anaesthesia to pain which would not suffice for the simplest operation, needle pricks being distinctly felt, but not so acutely as on the other surfaces of the body, nor did another 10 minutes at 30 milliamperes give any further improvement.

In this case there was also some slight difference in the degree of anaesthesia over the area. In some parts the needle prick being felt more distinctly than in others, and the slight amount of anaesthesia there was, had gone in 15 minutes.

Case IV.

A strong healthy man, admitted to the Infirmary with fracture of the patella in the left leg, and in his case I selected the fore-arm. I put the negative or indifferent electrode on the palm of the hand, and, placing the positive electrode directly over the inner and front aspect of the fore-arm, the current was switched on, gradually increased up to 30 milliamperes, and this current was passed for 15 minutes. During the administration he complained of pain in the hand, gradually changing up
to the $+$ pole and then there was a feeling of numbness which was directly under the active electrode. On removing the $+$ electrode the area was pale and anaemic. The sense of touch was lost, and it certainly had the appearance which one gets in anaesthetised areas by the infiltration method, but on examination of the area for pain there was very slight alteration, the needle prick being only slightly diminished. The application was repeated for 10 minutes, with the result that all the senses except pain were destroyed and pain partially over the whole area. Here again after applications lasting 25 minutes and a current of 25 milliamperes the result was very unsatisfactory, and in no way comparable with the anaesthesia by infiltration.

Case V.

A male admitted for strangulated femoral hernia, convalescent from the operation. I took the upper arm on the outer surface at the external head of the biceps, having the $-$ electrode placed in the palm of the hand. The $+$ electrode was placed directly on to the surface of the arm, and a current of 25 milliamperes passed for 15 minutes, and the part then examined. Heat, cold and pain not in any way diminished. The only thing to notice was the sense of touch, which was somewhat diminished. Another application lasting 10 minutes was given, and the area again examined. It was found now to be definitely anaesthetic, and needles could be put into the skin with only the slightest feeling. The sense of touch, heat, and cold were all lost, the
anaesthesia lasted for 15 minutes. Here was the best result which I have had with the Beta-Eucaine Lactate, and there is no doubt that a small operation could have been done here with comparative comfort to patient and operator.

Case VI.

A male aged 16 admitted here for tonsils and adenoids. I tried the thigh in his case, using a current of 12 milliamperes for 10 minutes. He complained greatly of the pain in the foot where the indifferent electrode was placed. On examination of the part anaesthetised there was absolutely no result, no sense either (I) touch (II) pain, heat or cold being in any way diminished. I persuaded him to allow another 5 minutes, which he did, and I gradually increased the current up to 15 milliamperes, with absolutely no result.

Case VII.

A girl admitted here for varicose veins, but before the operation, which was a very small one, I tried the effect of medical ionisation, negative pole placed on the sole of the foot and the + electrode over the varicose vein.

The current was gradually increased up to 20 milliamperes, and passed for 10 minutes, with no result. I then repeated the application for another 5 minutes, with the current at 25 milliamperes. The result was very unsatisfactory — sense of touch being lost. Heat and cold in some places lost, and in others not quite definite pain, needle pricks felt with varying degrees
of sensitiveness over the area in some spots I found that the anaesthesia was very indefinite and not in equal proportion over the whole area. Here there was slight anaesthesia which from a surgeon's point of view was useless, and lasting for only 15 minutes.

**Case VIII.**

Thigh of a girl. I tried in this case the anterior and inner surface of the thigh, with the negative electrode at the sole of the foot. The current was gradually increased up to 20 milliamperes, and passed for 14 minutes, pain in the foot being complained of. On examination of the area the sense of touch was lost, heat and cold slightly changed. Pain was very slightly decreased and the decrease varied somewhat over the area. Another 5 minutes was given, the current at 25 milliamperes. On examination afterwards the sense of pain was more diminished than previously, needle pricks not being felt nearly so acutely as around the area, but not in any way like the anaesthesia produced by the infiltration method, and lasting only 12 minutes.

**Case IX.**

A man admitted into the Stockport Infirmary for lacerated wound on the head, and I determined to try the effect of the anaesthetic on him. I tried his thigh, using the same solution and placing the electrode on the sole of the foot.

In his case I gave 30 milliamperes for 10 minutes, and then tried the area which was anaesthetised, On
examination for touch, no sensation; heat and cold partially gone. There was absolutely no diminution of the pain.

The electrode was re-applied and the current passed for another 10 minutes, with the result that the area was fairly insensitive to pain, the pin pricks being only very slightly felt, but there was the same variation of sense of pain which I noticed in other cases - not an even distribution of the anaesthetic over the area in question.

**Case X.**

A girl admitted to the Infirmary for adenoma of the breast. Here I tried medical ionisation, not to do the operation, but to see if it would produce anaesthesia. Placing the negative electrode at the back of the chest, the current was very gradually increased up to 20 milliamperes, and allowed to pass for 12 minutes. On removing the + electrode there was no result whatever, nor was there any change in the sense of touch. I again gave 15 milliamperes for 5 minutes, and examined the part anaesthetised. Patient said it felt slightly numb, but the sense of touch was only very slightly altered, and the sense of pain not in any way diminished.

**Case XI.**

Woman admitted to Infirmary with Rheumatoid Arthritis in the knee. She allowed me to try Medical Ionisation on the right breast, the - pole being placed at the back on the left side, and the positive electrode on the upper part of the right breast. The cup
was placed directly in contact with the skin, and the current gradually increased up to 20 milliamperes, and allowed to pass for 15 minutes. On removing the electrode there was slight diminution in the sense of pain, and exhibiting the same phenomena as before in some parts the sense being more acute than in others. I re-applied the electrode for another 5 minutes, and again gave 20 milliamperes, and on removing the electrode the area was slightly more insensitive, and the insensitive areas were rather more diffuse than previously, but the anaesthesia was in no way complete.

Case XII.

A woman admitted here for exostosis of the leg. I tried the upper arm just on the outer surface, the — electrode being at the hand, and the + electrode applied directly to the surface of the arm. The current was passed for 15 minutes, being gradually increased up to 20 milliamperes. On the application proceeding, the patient felt the area covered by the + pole to be growing numb, and on removal of the electrode the area was found to be quite insensitive to touch, heat and cold. Pain here we had the same localisation of the anaesthesia, because in some places we had the needle prick hardly felt, in others the needle was felt in very much the same way as on the normal skin around the area of application.

The anaesthesia here was in no way comparable to Eudrenine infiltration.
In reviewing the results of anaesthesia by medical ionisation, I shall commence by stating the technique was in every way similar to that used in the 1st part of the Thesis, except that after Case II in the list of operative cases the surface of the skin was freed from fat by the application of ether. With regard to the + electrode it was simply held firm over the surface on which we were experimenting. At first I separated the + electrode from the skin by means of a layer of lint, saturated in 2% saline, but finding it made absolutely no difference to the patient's feelings, nor to the results of the experiment, I discarded it, and simply placed the electrode in direct apposition to the skin. The — electrode was simply saturated in salt solution and bandaged carefully to the part or where the part was the hand or foot the — electrode was placed in salt solution.

In the experiments which I have done, my aim has been to see if this method of producing anaesthesia (local) possesses any advantage over the other methods, and whether the anaesthesia produced was so successful. The method which I employed before using the Medical Ionisation was the infiltration method, surrounding the part with the anaesthetic. A record glass syringe with 1 per cent Eudrenine which produces a perfect anaesthesia for all small operations which I have done, and on comparing the two methods in the 1st place with regard to expense to have local anaesthesia by medical ions is somewhat expensive, the initial outlay of the
switch board is £7.10. 0. and we have the electricity. Then is we take into consideration the convenience, I think it possesses great disadvantages over the infiltration method. In the first place, if one looks at the trouble there is in fixing up the apparatus and then in the application which is somewhat difficult to perform unless one has a skilled assistant to gradually increase the current and gradually decreasing the current on removal of the + electrode from the area of application. The time which the application takes, over 20 minutes at the very least, which is an important consideration; then we have the pain of the administration, which, in one or two cases, kept me from increasing the current on account of the discomfort which was produced.

The Results of the 16 cases, little though they are, can give one some idea of the value of this form of anaesthesia. I have already given some of the disadvantages of the actual application, and now if we take the results - 1st of all, none was absolutely satisfactory, and in the four operative cases in which I tried the anaesthesia, there was very little effect, and only in one case was there anything like anaesthesia, and that was the case of the cyst, and even there one would not feel justified in repeating the experiment on account of the pain and discomfiture which occurred, and not only the pain of the operation, but the pain of the actual application, and then, when partial anaesthesia occurred, here its effect was only very transient. If
we take the other three cases -

Case I.

In which with the injection of eudrenine there would have been no pain, he felt the incision and the probing of the wound quite distinctly, giving him considerable pain, but why give him such unnecessary pain, when, by giving eudrenine or Beta-Eucaine Lactate by infiltration method, all pain is abolished.

Case II.

The boy with the ganglion, here again the anaesthesia was quite insufficient, and without the aid of eudrenine one never could have gone on with the operation.

Case III.

Exactly similar with an even less amount of anaesthesia than in the previous cases. Whenever one is going to operate, even an operation ever so small, one would like an anaesthesia which was simple to administer, and very easy to control, whereas in Medical Ionisation we have one which is not only very difficult to manage, but to control.

If we take the 12 cases in which I tried the anaesthesia there was only two cases in which one could say the anaesthesia was fairly good. In all the others the anaesthesia was only very slight, and in some cases, none at all, each application taking over 20 minutes, and if one had gone on, perhaps for an hour, there might have been anaesthesia sufficient for a slight operation, but I did not feel justified in go-
ing on so long giving them pain nor is any anaesthetic which takes an hour to administer going to be any use for the medical practitioner.

Another point which is of importance is the uneven distribution of the anaesthetised parts, as I have pointed out; over the area to which the electrode was applied there were certain parts in which the anaesthesia was only very slight, and in some parts actually none at all. Here one has a difficulty which may be got over by a method which I am going to try if possible: If one took 4 layers of lint saturated in the solute with a flat carbon disc used as the electrode. Then again we have a tumbler inverted, passing through that there is a current which as Leduc has shown the ions of the solute enter the body, one has no very convenient control over the amount of Beta-Eucaaine which is administered, except by first of all making a scale of graduated ratios, and how one would make this scale is by first of all having 10% solution, apply the solute to the body, knowing the amount of eucaine in solution before and after the application, the time application lasted, and the strength of the current. In my opinion, Medical Ionisation for anaesthesia will never be used until one has a more convenient method, and in my case I still use and will continue to use the Infiltration Method with 1% Eudrenaline, seeing as I have done the unsatisfactory anaesthesia, and the time which the anaesthesia has taken to produce. There has been no ill effects from any ap-
plication which I have given.

Conclusions:

(I) The anaesthesia is not satisfactory.

(II) The amount actually administered is difficult to determine.

(III) The pain of the administration is a great inconvenience.

(IV) The inconvenience of the administration in my opinion prohibits the use of Medical Ions in anaesthesia at the present stage of development.