ARSENICAL POISONING

IN

BEER DRINKERS.

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TABLE OF CONTENTS.

Preface page 1.

Chapter 1. A short history of the so-called epidemic followed by a brief account of the methods of investigation. page 3.

Chapter 2. A detailed account of the cases. page 5.

Chapter 3. A consideration of the most noteworthy features which were seen in the cases, differential diagnosis and treatment. page 41.

Chapter 4. The Chemistry of the subject. page 58.

Chapter 5. The conclusions which were drawn from the whole of the investigations. page 68.

LIST OF ILLUSTRATIONS.

Plate 1. Oedema and pigmentation of face (case 1). page 5.

Plate 2. Arsenical pigmentation (case 7). page 17.

Plate 3. Arsenical pigmentation (case 7). page 17.

PREFACE.

In the issue of the British Medical Journal for November 24th, 1900, there appears a remarkable paper by Dr. Reynolds of Manchester, drawing attention to the unusual prevalence of Peripheral Neuritis in Manchester at that time, and pointing out the presence of Arsenic in the beer drunk by the patients, as the probable cause thereof. For some time previous to this in my own practice, which is situated in a town largely supplied by Manchester beer, I had been puzzled by a series of cases of apparently inexplicable Peripheral Neuritis, and at once saw the most likely solution of the difficulty in the cause assigned by Dr. Reynolds.

From that time I determined to carefully study and closely investigate all such cases which might present themselves to me, and owing to the large and interesting number of cases I have been privelaged to see, I have been led to adopt this as the subject of the following thesis.

Although the publication of Dr. Reynolds' paper caused great excitement and consternation amongst the beer drinking section of the public, yet there are on record accounts of similar epidemics. Barthélemy reports an epidemic of arsenical poisoning at Hyères caused by a wine merchant who poured a solution of arsenic into his wine casks in mistake. The same observer thinks that the outbreak in 1828-29, on the banks of the Seine causing the loss of 40,000 lives was also due to the wine having been contaminated with Arsenic.

Again Nielsen records some previous outbreaks of arsenical poisoning.

CHAPTER 1.

SHORT HISTORY OF THE EPIDEMIC AND METHODS OF INVESTIGATION.

Short History of the Epidemic.

During the autumn of last year an unusual number of patients shewing signs of Peripheral Neuritis attended at the hospitals of Manchester and district. Associated with the Peripheral Neuritis were other symptoms which could not be attributed to alcohol. All the patients so suffering were beer drinkers, and the conclusion was arrived at, that the "epidemic" was due to some toxic agent in the beer. Mr. Reynolds first drew the attention of the profession to the fact that the toxic agent was arsenic. He obtained samples of the beer which his patients had been in the habit of drinking, and found on analysis, distinct evidence of the presence of arsenic. He at once reported this fact to the Medical Officers of Health for Manchester and Salford, who got many samples of beer, most of which contained arsenic in more or less quantities. Since then, many hundreds of cases of patients suffering from arsenical poisoning have been reported, the great majority of which have been limited to Lancashire and Cheshire.

The arsenicated beers were the cheap varieties, viz., the "Fourpenny" and "Sixpenny" ales, and the public houses retailing these ales were supplied by certain brewers. These brewers were communicated with, and all the substances used in the preparation of this beer were tested, with the

result, that arsenic was found in the saccharine matter. This saccharine matter had been supplied to these breweries by one firm of sugar makers, who used sulphuric acid in its preparation. The sulphuric acid was proved to contain arsenic, having been made from arsenical pyrites.

[illegible]

The following mode was adopted in the examination, etc., of the cases:-

1. History of present illness, including special enquiries as to amount of beer consumed daily, and as to the source of such beer.

2. Present condition, including examination of patients.

3. Progress of the cases.

4. The obtaining of a sample of the beer, if possible, usually consumed by the patients, and a subsequent analysis of the same.

5. In two cases, one in which the pigmentation of the skin was very marked, and another shewing distinct oedema of the face, I took photographs.

In all [illegible]1 cases were investigated, an account of which I will now give.

CHAPTER 2.

DETAILED ACCOUNT OF THE CASES.

CASE 1. F. Q., aged [illegible], male, labourer, consulted me on November [illegible]th, complaining of numbness and pain in the feet and hands.

History of present illness. In June he noticed that his feet were tender and were sweating excessively. One month later his fingers and hands began to tingle, and he suffered from the feeling of "pins and needles" and numbness in the feet. This numbness gradually extended up the legs to the knees. At times he experienced shooting pains in the calves. He also noticed that he was unable to pick up small things with his fingers or to do such operations as buttoning his clothes etc. Towards the end of September his eyes began to "run" - also his nose. He says that at this time " he caught a cold in his head" which has lasted until now. The painful condition of his feet gradually got worse till he was unable to follow his employment. For some weeks past his skin has assumed a darkish colour which has gradually deepened. He has not suffered from any gastric disturbance beyond slight nausea and loss of appetite. In July he weighed 1[illegible] stones 1[illegible] lbs. He was a beer drinker - never touching spirits - consuming [illegible] or 1[illegible] pints a day and generally more at the week ends. His favourite drink is "Fourpenny ale".

Present condition. The patient walked into the room as if his feet were sore and his gait was

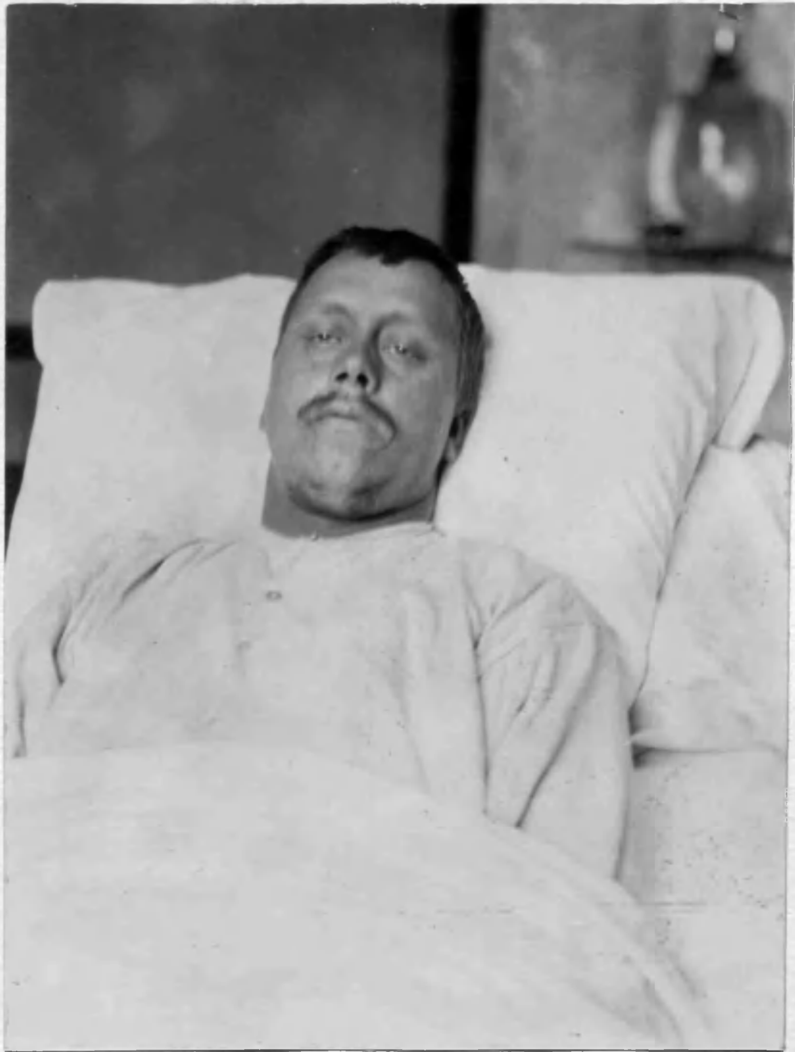


Plate I (Case I). showing puffiness of the eyes and slight pigmentation of the skin.

somewhat jerky suggesting slight ataxia. The face is that of an alcoholic, with eyes very puffy and watery (Vide plate 1.) - so watery that tears drop on his cheeks. The conjunctival mucous membrane is injected. Pigmentation. The arsenical pigmentation is most marked, more or less all over his body, with the exceptions of the soles of his feet and the palms of his hands. It is a dusky brownish colouring of the skin - a bronzing. A very noteworthy feature of the pigmentation is the presence of numerous small rounded white unpigmented patches varying in size from 1/16 to 1/8 of an inch. These white patches are seen best in places where the surrounding colouring is deepest, by reason of the contrast. The pigmentation varies in intensity, being more marked in places which are liable to pressure. The face is slightly coloured. On the neck, over the shoulders (where the braces would press), inside the arms, in the axillary regions, over the loins, in the groins and round the genitals, the pigmentation is deepest in tint. The nipples and the areolae are very dark, and on looking closely into places covered with hair it is seen that round the hair follicles are dark spots. No pigmentation is observed on any mucous membrane, though the soft palate and post pharynx have a red congested appearance. Besides this general bronzing of the skin there are here and there large papules and pustules. He complains of great irritation of the skin, which is worst in the deeply pigmented areas. The skin of the palmar and plantar surfaces is

very thick and horny (Keratosis) and is peeling off. The desquamation is very noticeable in the grooves of the fingers. The fingers present a swollen appearance, because not only is the skin of the palmar surfaces thickened but also that of the dorsal, especially round the joints. The hands, feet and legs are bathed in perspiration which gives to the skin a glistening appearance. The perspiration has a very foul smell. He says he does not feel the hard resistanse of the ground, but imagines he is walking on something soft. There is complete anoesthesia below the knees, and the sensation of touch is defective above the knees but gradually improves towards the groins where the sensation is normal. He experiences great pain on deep pressure over the calf and anterior antibial muscles (Myalgia). He complains of neuralgic pains in his legs, more especially behind the internal malleoli and says his legs get easily tired. There is a tendency to "foot-drop" and the knee jerks are present though feeble. The sensation at the tips of the fingers is much diminished and likewise that of the palms. It is noticed that he is continually rubbing the tips of the fingers with the thumb. He is unable to pick up small articles, and with difficulty holds a cup. Muscular power is lessened, the grasp being somewhat feeble. The slightest exertion produces muscular tremor. In this case there is not seen much muscular wasting, though the muscular power is impaired as shown by the tendency to "foot-drop" and the feeble hand grasp.

The heart is not enlarged; the sounds are weakened but pure. The pulse is 68 per minute and is soft and regular.

The tonsils, uvula and pharynx are injected. He speaks rather huskily but says his throat is not "sore."

The tongue is coated with a silvery fur and the digestive organs are good.

The urine is scanty amounting to about [illegible] ounces in the [illegible] hours. There is no albumen or sugar. This urine was tested for arsenic by Reinsch's test but no trace could be found.

He weighs 11 stones [illegible] lbs. (Nov. [illegible]th).

Two pints of beer obtained for his consumption were given to me and I got distinct evidence of the presence of arsenic. This patient became an inmate of Crewe Cottage Hospital on November [illegible], and during his stay there was no rise of temperature.

Progress. December [illegible]th. The patient steadily improves. He has been kept in bed since admission. The face still retains the swollen appearance though to a less extent. The eyes do not weep. The sensation of touch is gradually returning to his legs. A branny desquamation is peeling off his whole body, the skin of the hands and of the feet coming off in large shreds. An intensely irritable papular eruption appeared on the back of the hands which disappeared after three days by a scaly desquamation. The nurse reports that during his sleep he frequently starts up with a frightened expression and when asked the reason, he replied,

"that he had had a bad dream." This occurred during several nights after his admission.

January 22nd. Steady improvement is evident. He can now feel the bedclothes touch his legs, and his hands improve as well in this respect. The swollen, painful, and perspiring conditions of his hands and feet are gradually disappearing. There is still some remains of the pigmentation.

February [illegible]th. He was discharged today from the hospital almost cured. He, however, still complains of slight pain and tenderness in the soles of his feet. He weighs 14 stones 5 lbs.

CASE 2. W. [illegible] J., male, aged [illegible], foreman file-cutter, consulted me on November [illegible]th, complaining of the sensation of "pins and needles" in his feet and of great irritation of the skin.

History of present illness. In May he noticed that he got easily tired though his work was light, and that his feet got hot and tender, becoming raw in places. This he attributed to his boots and to the heat. New boots produced no improvement. Later (July) he experienced numbness in his feet which extended up to the calves, and also tingling in his toes and finger tips. About this time a bulla appeared on the internal malleolus of the right foot, which took a very long time to heal. During October bronzing of the skin with considerable irritation made its appearance - first on the neck then on the lower abdomen and inner aspects of the thighs. About the same time he caught "a cold in his head" making his eyes and nose to "run." There

is no history of sickness or diarrhoea, nor did he suffer from a sore throat. He has lost 18 lbs in weight since August.

He is a very moderate beer drinker, taking only one glass for dinner and the same quantity for supper, with an occasional glass. He is supplied direct from a brewery. Samples of this beer showed the presence of arsenic.

Present condition. The face is slightly pigmented and the eyes glisten. He complains of slight photophobia. The skin of the body, excepting the palmar and plantar surfaces, presents marked bronzing whose tint is deepest round the neck, in the axillae, on the inner surfaces of the upper arms, round the genitals, in the groins, behind the buttocks and in the popliteal surfaces. In these places there is a furfuraceous desquamation. The feet and legs glisten with sweat. On the soles of the feet and to a less extent on the palms, a distinct well demarcated erythema is present, and pressure on these parts produces pain. On the flexor surfaces of the toes and fingers the skin is thick, rough, and is peeling off. The tingling and numbness extends over the flexor and extensor surfaces of the fingers and to a less extent over the palm. These sensations are also felt in the feet. Deep pressure on the muscles of the legs produces some pain. There is not much muscular wasting though motor power is impaired.

There is no evidence of a blue line on the gums or of constipation, or of any sign of lead

poisoning, which might have been present because his occupation as a file-cutter necessitates working with lead.

Progress. This patient improved quickly and on January 4th was nearly well. Pigmentation had almost disappeared with the fine desquamation. The tingling and numbness has altogether disappeared and his weight increases. The only complaint he makes is of the tenderness of the soles of his feet.

CASE 2.

T. O., male, aged 26, clerk, saw me on November 26th. He complained of a burning pain in, and excessive sweating of his feet.

History of Present Illness. He first noticed a puffiness round the eyes with lacrymation about the middle of September, and about the same time he suffered from tenderness of the feet accompanied with a burning sensation and excessive sweating. He at first thought this was due to the hot weather but these conditions being maintained during the colder weather, he sought medical advice.

He says he occasionally experiences the feeling of "pins and needles" in the feet and tips of the fingers. There is no anaesthesia. He has lost half a stone in weight since July. There exists no history of stomachic disturbance, but he suffered from a sore throat in August.

The patient drinks very little beer, only half a pint to supper with an occasional glass. His supply of beer is obtained from the same public house which was patronised by case 1.

Present condition. The eyes are puffy and

glistening. The tongue is covered with a silvery fur. The only places where the bronzing is seen are, round the neck, inner sides of the thighs and genital region, but the bronzing even in those regions is very slight. The skin of the hands is rough and thick. The soles and inner surfaces of the feet are covered with an erythematous blushing, and here, there exists great tenderness on pressure (Erythromelalgia). A burning sensation in the soles is complained of – as well as the feeling of his legs getting easily tired. The feet and legs are moist with sweat.

This is a very mild case which may be explained by the small amount of beer consumed, but the condition of the eyes, the pigmentation of the skin, the well marked erythromelalgia in the feet, and the signs of commencing neuritis, make the diagnosis of arsenical poisoning indisputable.

<u>Progress.</u> In one month he was perfectly well. The bronzing disappeared with desquamation. The skin of the feet also desquamated. The erythromelalgia had entirely gone.

<u>CASE 4.</u>

J. M., Male, aged 40, fitter, saw me on December 5th. He complained of tingling and burning in his feet.

<u>History of Present Illness.</u> Since August he has not been well. He found he was fatigued long before his day's work was finished. The loss of strength has been increasing gradually. In September he first felt the tingling in the toes and the

sensation of burning in his soles, which latter symptom was much aggravated when he was in bed. These symptoms were accompanied with profuse sweating limited to the lower extremities. Blisters appeared on the under surfaces of the toes. Later on he complained of numbness in the soles. Coincident with the appearance of the above symptoms the eyes began to smart and "run" and pigmentation of the skin accompanied with great itching appeared more or less over the whole body.

He drinks beer obtained from the same source of supply as the patient described in cases 1 and 2. He says he drinks "two or three pints a day."

Present condition. The eyes are swollen and watery, the conjunctivae being injected. The face is slightly pigmented. The pigmentation is seen over the whole body. Round the waist there is a well marked broad band of pigment about three inches wide, due to the pressure of a belt which he wears. The pigmentation is deepest round the neck, behind the buttocks, in the groins and on the inner sides of the thighs. The areolae and nipples of the breast are very deeply pigmented and the hair follicles are picked out as dark spots. As in case 1 small white patches of unpigmented skin give a mottled appearance to the body. The skin is beginning to desquamate with a fine branny peeling.

The palms are unusually moist and here the skin is thick, red and very tender. Similarly the soles also shew signs of erythromelalgia. The knee jerks and the superficial reflexes are present.

He has the feeling of "pins and needles" in the soles and slight numbness.

The tongue is coated, but no history of stomachic disturbance exists. The other organs are normal.

__Progress.__ January [illegible]th. As in the other cases the consumption of beer was stopped. The irritation of the skin gradually lessened and the skin exfoliated with a fine desquamation. The band of pigment round his waist is less distinct and large shreds of skin are coming off here. There still are present some tingling and burning in the soles. The eyes give less trouble now.

January [illegible]th. The tingling has altogether disappeared but his feet remain tender.

__CASE [illegible].__

M. C., female, aged [illegible] years, consulted me on November [illegible]th, about numbness of the feet and legs with increasing loss of strength.

__History of Present Illness.__ Since August she has suffered from a burning feeling in the feet and legs and from a feeling of "pins and needles." The burning has always been much worse when she is in bed. Her fingers also, tingled and became numbed. She says that when sewing "the needle keeps slipping out of her fingers." She has not noticed particularly any pigmentation of the skin.

She is a beer drinker but I was unable to get any idea of the quantity consumed.

__Present condition.__ The face is swollen and slightly pigmented and the eyes are watery. The

pigmentation is observed to be specially marked on places liable to pressure. The conditions classed as Erythromelalgia are present in the feet. She is very anaemic and the pulse is soft and rapid. The heart sounds are weak but free from murmurs. The throat shews no redness. Numbness and tingling are present in the fingers and similar conditions exist in the feet. Myalgia is present in the calf and anterior tibial muscles. In the hand the Interossei and Abductor Indicis are greatly wasted as are also the extensor muscles of the forearm. The muscles of the legs are also much atrophied. "Foot drop" is very pronounced and motor paresis of the muscles of the legs also. She says that "her sleep is disturbed with terrible dreams."

Progress. December 14th. The skin of the chest, abdomen and back, is peeling off in large flakes leaving the new skin unpigmented. The tingling has left the fingers and feet but the feeling of numbness still is present. The erythromelalgic condition of the feet is much improved though they still are tender. There is now no pain on deep pressure over the muscles of the leg and the muscular tissues generally are being repaired rapidly with a consequent improvement of the motor power. The heart is much stronger. She does not now suffer from palpitation and dyspnoea on exertion. Her sleep is undisturbed.

January 1[illegible]th. Beyond a slight erythematous appearance of the hands and feet no sign or symptom which formerly existed, are present. She gains

strength quickly and her anaemia is much improved.

CASE 6. A. C., male, aged 47, timekeeper, saw me on November 29th, complaining of "Inflammation of the eyes" and irritation of the skin.

History of Present Illness. He relates that his eyes have troubled him since July, and that he has also suffered from a watery discharge from the nose. During September his skin became coloured, first on the neck and chest, then on the abdomen and thighs, and subsequently all over the body. The colouring of the skin was associated with intense itching. About the same time, he experienced a tingling sensation in the tips of the fingers and in his feet, accompanied with excessive sweating of these parts. There is no history of sickness or of diarrhoea. He is a beer drinker taking about three pints a day.

Present Condition. The face is very oedematous and the eyes suffused. The pigmentation is found all over the body excepting the palms and soles, and it is darker round the neck, in the groins, round the genitals and behind the buttocks. A branny desquamation may be seen, the scales coming off from the darker places being larger. The skin of the palms and soles is thick and rough, and there is [illegible] a well demarcated red blushing on the inner side and soles of the feet. Beyond the tingling felt in the tips of the fingers and in his feet there are no sensory disturbances. Otherwise he enjoys good health.

[illegible]. December [illegible]th. The skin peels off

quickly and the tingling has disappeared. The eyes, however, are still watery and red.

February 8th. The patient is quite recovered. His skin has desquamated and his eyes give him no more trouble beyond being liable to water when exposed to the wind.

CASE 7. J. S., male, aged 52, painter. I saw this patient on December 4th, when he complained of the sensations of "pins and needles" in his feet and hands, "running at the eyes," and great irritation of the skin.

History of Present Illness. He first noticed the swollen and watery condition of his eyes about the middle of October, followed in about a month by the appearance of a bronzing of the skin which was accompanied with great itchiness. This bronzing appeared first on the neck and the chest, then on the legs, and gradually spread over the entire body with the exception of the palms and soles. Early in November he experienced the tingling in the fingers, which extended into the hands. He suffered from a similar sensation in the soles and this was associated with a burning pain and sweating.

Towards the end of October he suffered from sickness and diarrhoea, which lasted more or less for four weeks.

He drinks 4 to 5 pints of "Fourpenny ale" daily.

Present Condition. The face is oedematous and the eyes much swollen and inflamed. There is

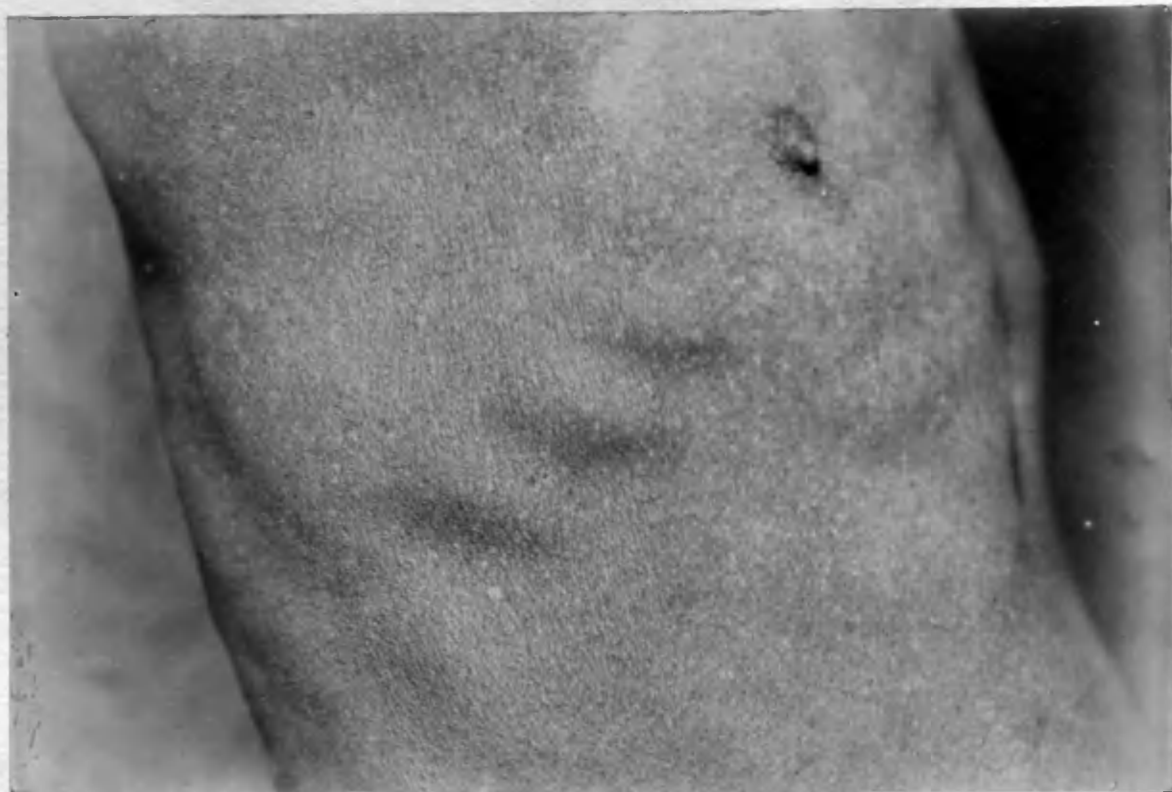


Plate II (Case VII). Arsenical Pigmentation.

This photograph (taken by flash light) shows the general pigmentation of the skin of the thorax, which gradually deepens upwards towards the axilla. It also shows clearly the small white unpigmented or less pigmented patches.

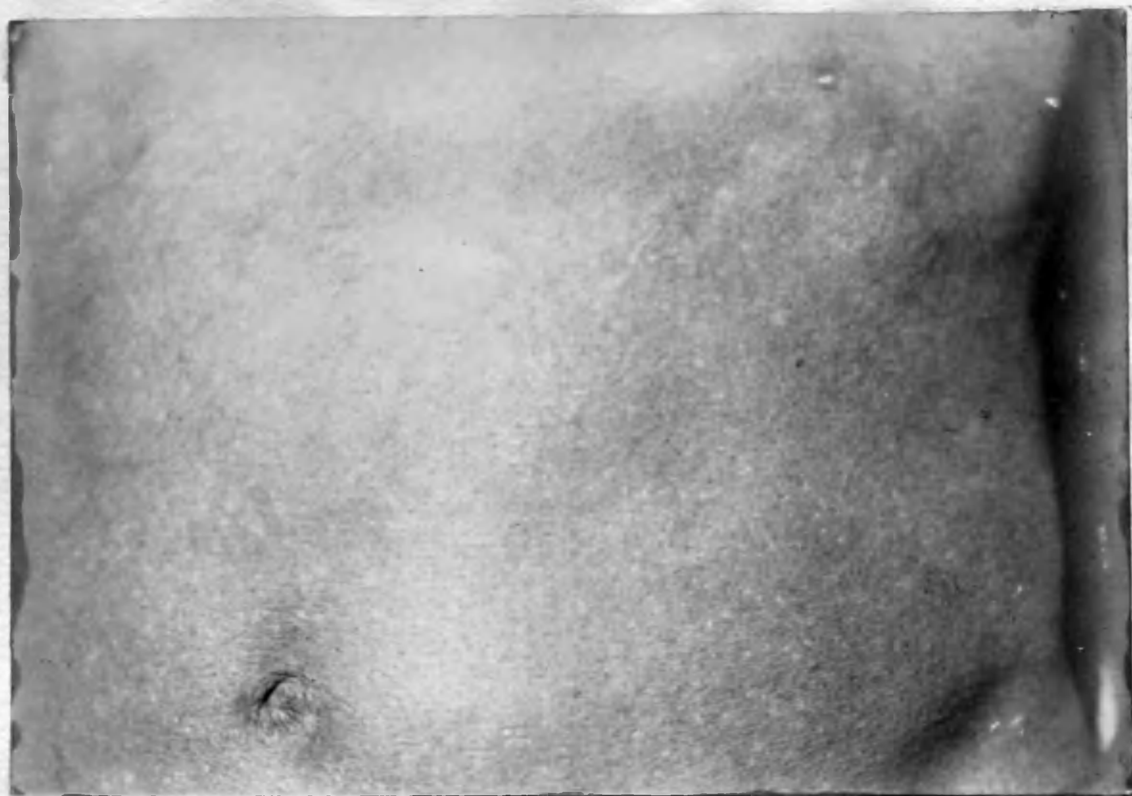


Plate III (Case VII). Arsenical Pigmentation.

This plate (also taken by flash light) shows the general pigmentation of the skin of the abdomen, with the deeper deposit of pigment round the umbilicus, in the groin and over the loins. It also shows the white patches before mentioned

excessive lacrymation - the tears dropping on to his cheeks.

The pigmentation (vide plates 2 and 3) in this case is most marked. It extends over the whole body, being intensified round the neck, in the axillae, in the groins, on the inner sides of the thighs, round the genitals and in the popliteal regions. The areolae and nipples are specially dark and minute dark spots mark out the hair follicles. The rounded, white, unpigmented, or less pigmented patches, of from 1/16th to 1/4 of an inch in diameter are very noticeable, giving the skin a mottled appearance. On the neck and chest a branny desquamation is seen. The patient complains of intense irritation, particularly in those places where the pigment is deepest in tint. The accompanying photographs (plates 2 and 3) taken by flash light, illustrate the appearances described above. The skin of the hands is rough and is peeling off: the loosening skin is seen exfoliating in the furrows of the fingers and palms. The skin on the extensor surfaces of the phalangeal joints is very thick, so that the joints appear like knobs. The palms are very moist and present a red blush. He complains of tingling and numbness in the fingers.

The feet, also, are moist and the red blushing is seen on the soles, and it extends on to the inner side of the foot. This erythematous appearance is distinctly demarcated from the rest of the skin of the feet. He has great tenderness in his feet, with the sensations of burning and of "pins and needles." The burning pain is much worse when

he is in bed. Neuralgic pains shoot down his legs and behind the internal malleoli. When the muscles of the calves are grasped he shouts with pain (Myalgia). There is hardly any muscular wasting or loss of motor power in the limbs. The knee jerks are present.

There is no blue line on the gums and the tongue is coated with a silvery fur.

A dusky redness extends over the soft palate and uvula. His voice is husky and he has a short hacking cough. Lungs and heart are absolutely normal.

Urine, sp. gr. 1·030, no deposit, albumen or sugar.

Progress. January 13th. The skin is rapidly desquamating though there is still a great deal of pigmentation especially about his loins; the itchiness is almost gone. The skin of the hands and feet has lost the roughened, and thickened appearance but he still suffers from excessive perspiration. He still complains of the burning pains in his feet when in bed, but the tingling sensation has almost disappeared.

CASE [illegible].

G. C., male, aged 58, clerk, was seen by me on December [illegible]th. He complained of tingling and numbness in his feet and fingers.

History of [illegible] Illness. Towards the end of August his eyes started to "run" and became swollen and irritable. He then suffered from nasal catarrh. About one month later he first felt the tingling and numbness in the soles of his

feet, which also became very tender and moist. Later on, the same sensations were felt in his fingers and palms. He has not noticed any discolouration of his skin but has complained of slight irritation. He has not suffered from any gastro-intestinal disturbance or sore throat.

He has been in the habit of drinking 4 or 5 pints of beer a day.

Present Condition. The eyes are puffy and watery. There is slight bronzing on the lower abdomen, in the groins, on the inner surfaces of the thighs and behind the buttocks and in these places a fine branny desquamation is noticed. The skin of the hands and of the feet have a rough, thickened appearance. He complains of tingling and numbness in the finger tips and in the soles of the feet. The superficial reflexes are present, as are also the knee jerks. There is no impairment of motor power.

The tongue is coated. All other organs are normal.

Progress. January [illegible]th. The skin has now its normal appearance, with the exception of that of the inner side of the thighs, which is freely desquamating. The eyes are much less swollen and watery, and the only sensory disturbance he now complains of, is slight tingling and numbness in the finger tips and in the soles of the feet.

CASE 2.

A. C., female, aged [illegible], and wife of previous patient. I first saw this patient on December [illegible]th,

when she complained of numbness and of the sensation of tingling in the hands and feet.

History of Present Illness. Since August she has suffered from tingling in the hands and feet, together with numbness and loss of power. These conditions have gradually become worse. About the same date her eyes began to trouble her, and her skin became bronzed. This bronzing appeared frist round the neck and it was accompanied with intense irritation. The numbness and loss of power have gradually increased in severity, so that it became almost impossible to do much in the way of house work or needlework. About the beginning of November the skin began to desquamate. on the chest, abdomen and legs.

It is difficult to get from this patient much idea as to the amount of beer consumed. She does admit being a beer drinker and getting it from a house whose beer has been proved to contain arsenic.

Present Condition. The face is swollen and the eyes puffy and suffused. The pigmentation is more or less spread over the body, excepting the palmar and plantar surfaces. It is most marked in the Hypogastric and Inguinal regions. The skin is desquamating freely over the chest, where large shreds are coming off. It is observed that the skin over the breasts is desquamating in much larger shreds than elsewhere. She complains of great itchiness of the skin. The skin of the hands and feet is thick and moist and is peeling off.

She suffers from the sensation of tingling in the fingers and in the feet and from neuralgic pains in the soles. Anoesthesia exists over the soles, and to a less extent over the dorsi and part way up the legs. Deep pressure, however, in the regions of the Anterior Tibials and of the calves produces pain. The knee jerks are diminished. The emaciation of the muscles of the arms (especially the extensors), hands (the Interossei and Abductor Indicis) and of the muscles of the legs, is most marked and there is a corresponding loss of power. "Foot drop" is very distinct and the hand grasp very feeble. She also complains of numbness in the fingers and she is unable to button her dress or to lift small articles.

Her gait is somewhat ataxic.

There is no sore throat and the tongue is coated with white fur.

The heart is not enlarged and the sounds are feeble though pure.

The mental functions are somewhat dulled and the face has a stupid expression. She complains of loss of memory.

Progress. January 10th. The skin has desquamated all over the body and there is very little of the pigmentation to be seen. She still suffers from the numbness and tingling in the fingers and feet and from the neuralgic pains. Myalgia is also still present. The muscular atrophy is less marked and the motor paresis has improved.

CASE 10. J. M., male, aged 61, labourer, complained of great weakness in the legs and "rheumatism," on December 12th.

History of Present Illness. He has noticed that since July he has gradually been losing strength. About this time his eyes became irritable and watery. Later on, he had the feeling of "pins and needles" in his feet. He expressed it as a feeling of having walked on nettles bare-footed. This sensation was associated with a burning pain in the soles of his feet. He attributed this to rheumatism. By and by, numbness in the soles came on and gradually extended up his legs. His legs became very weak, often bending under him after walking short distances. Loss of appetite and morning sickness have troubled him for some weeks. He does not know when the pigmentation appeared on his skin, but says his skin has been darker in colour for some time. About the beginning of November he became short of breath when walking upstairs and he suffered from palpitation and faintness. A fortnight later his abdomen began to swell.

This patient drinks 6 pints of beer a day and more at the week-ends. He never tastes spirits.

He was admitted to the Cottage Hospital on December [illegible]th.

Present Condition. Beyond a glistening of the eyes and a slight brownish pigmentation of the eye-lids nothing unusual can be noticed in his face. The pigmentation covers the body and

is most marked round the neck, in the axillae, on the buttocks, and in the Inguinal and Popliteal regions. The whole skin is giving off a fine branny desquamation, and he says the irritation is most troublesome when in bed. The areolae and nipples are very dark and the hair follicles are picked out as dark spots.

Upper Limbs. The skin of the palms is thickened and has a red blush. That over the phalangeal joints is very thick and rough making the fingers contrast very much with the otherwise emaciated condition of the hand. The finger nails are dried and shrivelled, and the finger ends clubbed. Atrophy with a corresponding loss of power of the muscles of the hands and arms, especially the Interossei, Abductor Indicis and Extensors (producing wrist drop) is very marked and it gives the skin a wrinkled, shrivelled appearance.

The hand grasp is most feeble.

He suffers from tingling and numbness in the fingers, palms and forearms, and from neuralgic pains in the forearms. Deep pressure over the muscles of the forearm produces pain.

Lower Limbs. The skin of the soles of the feet has the appearance known as Erythromelalgia. The muscles of the lower limbs, also, are much emaciated and the loss of motor power is great.

"Foot-drop" is quite distinct and slight resistance can quite overcome attempts at flexion and extension of the foot.

In the right foot, there is complete anoesthesia on the plantar surfaces including the

toes, and partial over the dorsum extending to about two inches above the ankles.

In the left foot, the sensation of touch is better than in the right, there being partial loss over the whole foot and complete only on the under surfaces of the toes.

The knee jerks are lost. He complains of shooting pains behind the internal malleoli and of pain on deep pressure over the Anterior Tibial and calf muscles.

Thorax. The lungs are normal.

The apex beat of the heart may be seen and felt in the 5th intercostal space and about half an inch outside the nipple line. On percussion the heart is shewn to be enlarged - the left border being nearly one inch outside the nipple line, making the transverse measurement 4½ inches.

The heart sounds are weak, especially the first sound. At the apex may also be heard a soft systolic murmur.

Abdomen. The liver is enlarged measuring 5 inches in the line of the nipple and 2½ inches in the mesial line. It is tender to palpation.

The abdomen is considerably enlarged with Ascites, measuring [illegible] inches round the broadest part.

The urine is scanty, specific gravity, 1·0[illegible], some deposit of red urates, no albumen, nor sugar. A sample of this urine was tested for arsenic but no trace was found.

Progress. February 1st. His main

complaint is of the painful condition of his feet and legs. There is no improvement in the condition of his heart, liver, or any diminution of the ascites. There is very little pigmentation left. The muscles of his legs and arms are much firmer and there is less emaciation in the limbs. This is due to systematic massage and passive movements. The knee jerks are reappearing. He was discharged from the hospital slightly improved.

March 8th. The patient is very much better. The heart is stronger and the systolic murmur has gone. The ascites has entirely disappeared and the liver much reduced in size. He is, however, much emaciated but says he is getting stronger.

CASE 11.

G. P., male, 47 years, blacksmith, saw me on the 7th of December complaining of tingling in the fingers and feet.

History of Present Illness. At the beginning of October he first felt tingling and numbness in his fingers, and later on, in his hands and feet. For some weeks his eyes have been watery. About the same time the skin became coloured. The colour appeared first on the neck and subsequently on the chest, abdomen and legs. During the last two months he has had occasional attacks of sickness and diarrhoea. He has been losing flesh and strength. He drinks beer at the rate of one and a half pints a day.

Present Condition. The eyes glisten and are puffy. The pigmentation may be seen more or

less over the whole body, excepting the palms and soles. It is very marked round the neck, and on the upper portion of chest. It shades off towards the epigastrium and increases in depth towards the hypogastrium. The areolae of the breasts are deeply pigmented. In the groins and round the genitals it is very deep. Besides the bronzing over the back there are many papules. Here and there is seen a branny desquamation. The skin of the hands and fingers is thick and rough and in the palmar surfaces it is peeling off.

The feet shew the same conditions, but the skin of the soles is covered with a red blushing. The hands, arms, feet and legs are moist with perspiration.

He complains of the sensations of tingling and burning in his feet and fingers, and also of numbness in the same places.

The knee jerks are weak. There is some loss of muscular tissue in the arms, hands and legs and a corresponding loss of motor power.

The heart is enlarged but this condition has existed for some years and is the result of Chronic Bronchitis.

<u>Progress.</u> January 6th. The eyes are less suffused and the pigmentation has almost disappeared. He still complains of the tingling in the finger tips and in his feet, and also of the burning pain. The knee jerks are stronger, and the paresis has altogether gone.

CASE 12. R. J., male, aged 48, labourer, complained on December 7th, of great muscular weakness and of swelling of the abdomen.

History of Present Illness. In August he first experienced tingling and numbness in his finger tips. His feet also had the same feeling of tingling but no numbness or tenderness. At the beginning of October he suffered from an acute sore throat which has troubled him ever since. He has been losing flesh rapidly and his legs have become very weak. At this time his breathing became quick and short and he was subject to attacks of faintness. About the first week in November his abdomen began to swell.

He says he is in the habit of drinking a "few pints" of "fourpenny ale" daily.

Present Condition. The face is much emaciated and is pigmented under the eyes, which glisten with moisture. The bronzing is less general than in most of the other cases, but on the anterior and outer surfaces of the thighs, there is a large patch of pigment which gradually shades off at the edges to the normal colour of the skin. The small white unpigmented patches are scattered over this bronzed area. The areolae of the breasts are deeply pigmented. On the chest a papular eruption causes much irritation. The skin of the palms and soles has a distinct erythematous blush which disappears on pressure and returns quickly when the pressure is removed. The finger nails are curved and grooved. There is much general emaciation of the whole body and this is most

evident in the muscles of the arms, the Interossei muscles of the hands and in the muscles of the legs.

Paresis of the Extensor muscles of the arm, producing "wrist-drop" and in those of the legs, producing "foot-drop" is present. Slight resistance can quite overcome such movements as extension of the wrist, and extension and flexion of the knees and foot.

In the fingers and feet he feels the sensations of tingling and numbness. Myalgia is present and he complains of neuralgic pains in his legs. The knee jerks are absent.

The tongue is coated with a silvery fur and the appetite is poor. There has been no complaint of sickness or of diarrhoea.

Over the soft palate, uvula, and tonsils, there is a dusky redness with patches of a much duskier hue. He has a short hacking cough. The heart is enlarged, the left border of the cardiac dulness being one inch to the left of the nipple line, making the transverse measuremnet 4[illegible] inches. The sounds are very weak, especially the first, with which is a slight roughness.

The pulse is one of low tension and beats 11[illegible] per minute when he is lying down and 1[illegible]0 per minute when he sits up, shewing not only a weak heart but an irritable one.

The lungs are normal.

The abdomen is much distended with fluid (Ascites), measuring [illegible] inches round the broadest part. The liver is enlarged and tender - the measurements being 5 inches in the nipple line and [illegible] inches

in the mesial line.

Progress. January 8th. The large patch of pigment on his thigh has disappeared with the desquamation. He takes his food well and sleeps well. The muscles of the arms and legs are getting firmer and the interosseal spaces are filling up. There is less paresis and the knee jerks are reappearing. The heart is stronger - the pulse beating 100 per minute. The abdomen now measures 34 inches.

February 10th. The skin of the hands and feet is much smoother but is still rather moist. The sensory disturbances have wholly disappeared from the fingers but not from the toes.

The atrophy of the muscles is being rapidly repaired and his legs do not tire on slight exertion. The knee jerks are now present though somewhat feeble. The ascites has gone and the liver has lost its tenderness and is much reduced in size, measuring 4 inches in the nipple line.

The heart sounds are much stronger, the pulse beating 90 per minute. He can go upstairs without suffering from dyspnoea and palpitation.

CASE 12. G. B., male, aged 40, gas stoker, consulted me on December 10th, about an eruption on his face.

History of Present Illness. For ten weeks he has suffered from tenderness of the soles of his feet associated with tingling and numbness. Later on , the same sensations were felt in the fingers. Gradually the numbness affected the hands. He also suffered from pains in the legs on walking which darted from the ankles to the calves. In

about the same length of time his eyes have been inflamed and watery, and his face has been covered with pimples. He has not noticed much discolouration of the skin though he has complained of itchiness. He drinks about 5 or 6 pints of "Fourpenny Ale" per diem, which amount is considerably increased on Saturdays, 10 to 12 pints being consumed on that day.

<u>Present Condition.</u> The face is oedematous and is covered with an erythematous rash with an eruption of large papules, some of which have gone on to a pustular stage. The eyes are puffy and glistening - the conjunctivae being inflamed. Photophobia is present.

Pigmentation is only seen on the buttocks and lower abdomen, in which latter position are seen numerous small white patches. Many papules are scattered over the back.

Erythromelalgia is present in the palms and soles.

Tingling and numbness is limited to the palmar surface of the two terminal phalanges of all the fingers.

There is no loss of muscular tissue either in the hands or legs. The knee jerks are rather weak - and the plantar reflex is present.

The tongue is coated and the throat has a congested appearance.

<u>Progress.</u> December 30th. This patient's condition does not improve. This may be accounted for by his persisting in drinking beer to excess.

<u>CASE 14.</u>

B. S., male, aged 54, farm labourer, complained

on December 4th of burning and of a feeling of "pins and needles" in his feet.

<u>History of Present Illness.</u> Since the middle of September he has felt the tingling in the hands and feet, which became very tender, hot and sweaty. About the same time the eyes became inflamed and watery and he suffered from nasal discharge. During the last fortnight these conditions have become much aggravated. He also suffered from shooting pains darting from the heels to the calves. About the middle of September a pigmentation appeared on his neck, and then on his legs.

There is no history of gastro-intestinal disturbance.

This patient gets a small barrel of beer direct from a brewery and says he takes about 1½ pints a day. Samples of this beer were tested for Arsenic by Reinsch's Test and typical arsenical crystals were obtained in the reduction tube.

<u>Present Condition.</u> The eyes are inflamed and watery. The pigmentation, which is seen on the whole of the body, is most marked in places which are ~~lia~~ liable to pressure. On each leg about three inches below the knee is a band, 1½ inches broad, of dark pigment. This is due to the pressure of garters.

The hands and feet shew the usual rough condition of the skin - the skin of the knuckles being much thickened.

The tingling and numbness is felt most in the fingers and in the soles of the feet. The feet

sweat excessively and muscular pain on deep pressure is present.

Plantar reflexes and knee jerks are present. There is no atrophy or paresis.

Progress. January 10th. The skin is desquamating and the deeply pigmented bands below the knees have almost disappeared. The eyes have completely recovered. He still complains of tingling in the soles of the feet, and of a burning pain in the same place.

February 12th. There is no trace of pigmentation and the only symptoms he now complains of are, the tingling in the finger tips and tenderness of the feet.

CASE 15. S. S., female, aged 50, wife of the patient described as case 14, saw me on December 14th. She also complained of tingling in the fingers and feet.

History of Present Illness. From the last month she has suffered from the sensations of tingling and numbness in the fingers and feet, associated with much sweating. Two weeks before these symptoms appeared, she had a persistent "cold in the head" producing nasal discharge and lacrymation. These still exist.

She drinks the same beer as her husband, but only takes one glass to dinner and another to supper, i.e., about one pint daily.

Present Condition. Beyond the suffused condition of the eyes, and the tingling and numbness in the fingers and feet, there is little else to record. Pigmentation is altogether absent, but the

hands and feet shew the conditions known as Erythromelalgia in a very mild form.

<u>Progress.</u> January 10th. The eyes are less suf suffused and the tingling and numbness are only felt at intervals.

<u>CASE 1[illegible].</u>

J. C., male, aged 25, fitter, came to me on December 1[illegible]th complaining of a discolouration of the skin.

<u>History of Present Illness.</u> About three weeks ago his illness began with inflammation of the eyes, and his skin slowly assumed a brown colour which gradually deepened. This colouring of the skin was associated with an intense itchiness. One week ago he felt slight tingling and numbness in the finger tips. Two days ago he suffered from a sore throat. For some time his appetite has been poor and he has experienced increasing loss of strength and energy. There has been no sickness or diarrhoea.

He drinks about two glasses of stout daily - and the stout is supplied by a firm of brewers, whose beer is known to be contaminated with arsenic.

<u>Present Condition.</u> The face is oedematous and deeply pigmented and the eyes are swollen, red and watery. Nasal catarrh is present.

The skin of the whole body is pigmented, and there is a deeper pigmentation in places liable to pressure. The areolae of the breasts are very dark, and there is a deposit of very dark pigment round each hair follicle. There is not much bronzing

of the legs, but here the skin has begun to desquamate.

The skin of the palms is not coloured, but is thickened and rough and peeling off in shreds. The dorsal as well as the palmar skin is thickened, and this is especially the case over the knuckles and phalangeal joints. Similar appearances exist in the feet.

There is slight tingling and numbness in the finger tips, but no such sensations are present in the feet, which, however, sweat very much and get painfully hot when in bed.

The tongue is coated with a white fur, and he complains of a feeling of discomfort in the epigastrium which is tender on palpation. The Tonsils, Soft Palate, Uvula and Posterior Pharynx are much congested and relaxed. His voice is husky and he has a hacking cough.

Progress. January 6th. The eyes are much less red and watery and the oedema of the face has gone down. The skin is desquamating freely. Tingling and numbness are still felt in the fingers.

CASE 17.

J. J., male, aged 41, labourer, came to me on December 10th, and complained of the feeling of "pins and needles" in his feet and hands.

History of Present Illness. One month ago his eyes became red, irritable and watery. He first felt the tingling in his feet and hands eight days ago. He has not seen any pigmentation or

desquamation, though the skin was red and itching three weeks ago. He has had several attacks of sickness and diarrhoea during the last month.

He drinks three or four pints daily and patronizes two public houses, only one of which has been selling arsenicated beer.

Present Condition. The eyes are watery, the conjunctivae being injected. No distinct pigmentation can be seen anywhere. The skin of the hands and feet is red and very tender. Tingling and numbness are felt in the fingers and hands, - the tingling going up to the elbows. The same sensations are felt in the feet, together with great tenderness and much perspiration. He suffers from shooting pains in the legs.

There is no emaciation but he complains of his legs becoming easily tired. The knee jerks are present.

The tongue is furred and he complains of a feeling of sickness.

Progress. January 20th. The tingling and numbness are still present in the fingers and feet. The eyes glisten and exposure to wind produces profuse lacrymation. He is much better in general health and has resumed work.

CASE 18.

T. W., male, aged 41, labourer, saw me on December 10th. He complained of "pins and needles" in his feet, more especially the right foot.

History of Present Illness. The eyes have been watery for three or four months. Three months

ago he noticed a colouration of his skin round the neck and on the inside of the thighs. This pigmentation was accompanied with itching and was followed by a fine desquamation four weeks later. For over two months he has felt tingling in his feet, which became very tender.

This patient drinks two bottles of porter daily. The porter is supplied by one of the breweries known to be producing arsenicated beer.

Present Condition. The face is somewhat swollen and the eyes glisten. The only pigmentation to be seen takes the form of numerous small, brown patches ($\frac{1}{16}$th to $\frac{1}{4}$ of an inch in diameter), like freckles, on both legs. The palmar skin is thickened and is desquamating.

There is no evidence of sensory disturbance in the hands but in the feet the sensations of "pins and needles" and of numbness are felt. The feet are tender and very moist.

Beyond the silvery coating of his tongue and loss of appetite there are no gastro-intestinal symptoms.

Progress. January 14th. The eyes still glisten and he still suffers from the sensory disturbances in the feet, but to a less extent. The brown patches have disappeared from the legs. The skin of the hands and feet has desquamated.

February 10th. This patient has almost recovered only complaining of slight tingling, now and again, in his feet.

CASE 19.

E. T., male, aged 43, fitter. I saw this patient on December 30th, when he complained of running from the eyes and of tingling and numbness in his fingers and feet.

__History of Present Illness.__ The eyes have troubled him for two months and about the same time a "rash" appeared on his neck which gradually extended over the body. This "rash" was accompanied by intense itching.

One week ago he suffered from an attack of diarrhoea, but no sickness.

He drinks two or three pints of beer a day.

__Present Condition.__. The face is oedematous and pigmented and the eyes red and watery. The pigmentation is slight over the body and the legs are quite free from it.

The hands and feet produce the usual characters of Erythromelalgia. There is not any muscle waste or any loss of motor power. The sensations of tingling and numbness, he feels in the fingers and soles of the feet. He also suffers from a hot burning pain in the feet and much sweating. Neuralgic pains shoot up the back of his legs, but there is no muscular pain on deep pressure.

The tongue is furred and there is loss of appetite.

__Progress.__ January [illegible]th. The skin has begun to desquamate. The eyes are less watery but the sensory disturbances in the hands and feet still persist.

CASE 20. J. S., male, aged 42, stoker, complained on January 4th of diarrhoea and running of the eyes.

History of Present Illness. The eyes have been more or less troublesome since July, 1900, and he has suffered from numerous attacks of diarrhoea but never any sickness. He has never seen any pigmentation of his skin, nor beyond numbness and tingling in the fingers has he ever suffered from any nervous symptoms.

He drinks beer at the rate of one or two pints a day, which has been proved to be arsenicated.

Present Condition. This patient suffers from conjunctivitis, with lacrymation and photophobia.

On the sides of the chest and on the buttocks, brownish pigmentation may be seen and also desquamation. The skin of the hands and feet is thickened and peeling off. Hyperidiosis of the feet and legs is present.

He complains of tingling and numbness in the fingers.

The tongue is coated with a silvery fur.

Progress. February 8th. The condition of the eyes is very much improved. He does not now have any tingling or numbness in the fingers and the skin of the hands and feet has completely desquamated.

CASE 21. J. H., male, aged 55, blacksmith, consulted me on February 18th, regarding tingling and numbness in the soles of the feet.

History of Present Illness. About the beginning of October he was much troubled about the condition of the eyes, which were much inflamed,

irritable and watery. At this time he became an out-patient of an Eye Hospital, where treatment for six weeks did not seem to do any good. Some time later the fingers began to swell so that he had difficulty in closing his hands. Subsequently the sensation of "pins and needles" and of numbness appeared in the fingers and in the palms. Coincidently with these, his feet became so tender that he was compelled to wear boots two sizes larger than usual. Following on this tenderness came tingling, numbness and a burning pain. He does not know whether his skin was pigmented or not, but his skin began to "scale" about the beginning of December and he was able to peel large shreds off his hands and feet.

Before the end of November (the commencement of the beer scare in this district) he had been in the habit of drinking not less than two or three pints a day, but since then he has abstained totally from beer, but occasionally takes a little whiskey.

<u>Present Condition.</u> The eyes are watery. There is no sign of any pigmentation - nor of desquamation.

The palms and soles still retain a red blush and he complains of tingling and numbness in the fingers and feet, which are sweaty. Tenderness, also, is complained of in the soles.

<u>Progress.</u> February [illegible]th. The eyes still glisten. The tingling and numbness have completely disappeared from the fingers and feet, but the feet remain tender.

CHAPTER 3.

THE MOST NOTEWORTHY FEATURES OF THE CASES, THE DIFFERENTIAL DIAGNOSIS AND TREATMENT.

A. A SUMMARY OF THE MOST NOTEWORTHY FEATURES OF THE FOREGOING CASES.

1. The Amount of Beer Consumed.

All the cases were regular beer drinkers, with the exception of cases 16 and 18, who drank stout and porter respectively. The stout and porter were supplied by the same brewers who supplied the impure beers.

In three cases it was impossible to arrive at any approximate amount of the beer consumed, and of these three, two were females. In the other cases I can fairly well rely on the accuracy of the amount stated.

Of the remaining 18 cases, 9 drank not more than 2 pints, 4 drank between 2 and 3 pints, and 5 drank over 3 pints a day. Of course, one must always allow for a greater consumption of beer at the week-ends.

Table shewing amount of beer taken per day-

Not more than 2 pints	2 to 3 pints	over 3 pints	quantity not known	Total
9*	4	5	3	21

* Includes the patients who drank porter and stout.

The source of the beer has been traced

to three breweries. These three breweries had the supply of glucose which was common to the Manchester and Salford breweries, whose beers were contaminated with arsenic.

The number of the patients who drank the beer etc., of the different breweries is shewn in the following table.

Brewery A	Brewery B	Brewery C.
11[xx]	9[xx]	2

[xx]One patient drank beer supplied by both breweries A and B.

2. General Appearances.

All the cases shewed more or less, the heavy, swollen appearance of the face, with the same suffused, watery condition of the eyes. The conjunctivitis varied much. In some cases it was very severe and attended with lacrymation and photophobia. In one or two cases the lacrymation was so profuse that tears dropped continually on to the cheeks (Vide cases 1 and 7). In the less severe cases and in those who were recovering, a glistening of the conjunctivae was evident.

An "alcoholic look" was not generally present. The aspect of the face of case 1 would, however, be described as typically alcoholic. (Vide plate 1).

One patient (case 9) had a stupid appearance suggesting dulness of the mental faculties.

General emaciation was marked in some of the cases. (Vide cases 10 and 12).

3. The Skin and Appendages.

(1) Pigmentation was present in all the cases (except in cases 15, 1[illegible] and 21) to a greater or less extent and was the most distinctive feature of the cases. It consisted of a "browning" or "bronzing" of the skin, and the depth of the discolouration usually varied with the severity of the case.

The distribution of the pigment in each case also varied in different regions of the body. Those places liable to pressure were much more deeply pigmented than others, e.g., the skin round the neck, in the axillae, on the inner surfaces of the upper arms, on the loins, in the groins, round the genitals and on the buttocks. Such articles as braces, belts and garters produced deep pigmentation on the places where they exercised greater pressure. Thus, in Case 4 there was a broad band round the waist caused by a belt, and in Case 14 a band of pigment round the legs, below the knees, was caused by the pressure of garters. The deep pigmentation gradually shaded off to a lesser degree in the other parts. In such places as are normally pigmented, e.g., the areolae of the breasts, the genitals and anus the skin was extremely dark in colour. In places where there is hair, the hair follicles could easily be seen by the dark spot of pigment round them.

The distribution of the pigment in each place was also uneven. Many cases shewed numerous

little white patches in the midst of the pigmentation, where there was little or no pigment. These patches varied from 1/16th to ¼ of an inch in diameter. They are well shewn in the accompanying photographs of the skin of Case 7, (Vide plates 2 and 3).

The Arsenical pigmentation resembles that of Addison's Disease, but in these cases no colouration was seen on any mucous membrane.

(2) Erythromelalgia. This condition was in most of the cases very well marked. It consisted of a bright red, erythematous "blushing" on the soles and palms, associated with great tenderness on pressure, and with a burning pain which was aggravated when the patient was in bed. The blushing disappeared on pressure and quickly returned when the pressure was removed. The red surface was well demarcated from the surrounding skin.

(3) Papules and Pustules. were present in a few cases and these lesions were generally very irritable. In Case 13 the papular eruption on the face was the chief complaint.

(4) Itchiness of the Skin. This irritation was sometimes very intense, and it was noticed that where the pigmentation was deepest, there the irritation of the skin was most troublesome.

(5) Keratosis. was seen in most of the cases on the hands and feet. In most, the palmar and plantar skin became very thick and rough, and in some there was also a similar condition of the dorsal surfaces of the fingers. This was especially noticed in the skin over the phalangeal joints,

giving these joints a knob-like appearance.

(6) Desquamation occurred in all cases which had pigmentation of the skin. In most cases the skin peeled off as a fine branny desquamation, but in some it came off in shreds. The desquamation was very noticeable on the palms and soles, where it started to exfoliate in the grooves.

(7) Hyperidrosis. Increased secretion of the sweat glands was a common cause of complaint. This Hyperidrosis was usually confined to the legs and arms. In several cases beads of sweat could be seen on the legs. The sweat had rather a foul odour.

(8) The Nails, were in some cases hard and brittle and the surface became roughened and grooved. (Vide cases 10 and 12).

4. The Nervous System.

(1) Motor Disturbance.

Only in the worst cases did impairment of the muscular power occur. Most of the patients complained of having been more easily fatigued than usual and some that on walking short distances their legs became quite tired. The loss of motor power varied from this feeling of getting easily tired, to complete paralysis of the muscles.

The legs were most often affected but in those cases which shewed paralysis of the muscles of the leg, there was also more or less the same condition in the upper limbs. Of the lower limb, the muscles of the lower leg were usually affected and "foot-drop" was very noticeable

usually affected and "foot-drop"

in some cases. (Vide cases Ø 1, 5, 9, 10, and 12). In the upper limbs the extensors were more usually impaired producing "drop-wrist." (Vide cases 9 and 10). The small muscles of the hands and fingers were commonly involved.

(2) Sensory Disturbances.

Sensory disturbances of more or less severity were present in all the cases. The chief complaint of the patient was of such sensations as tingling, numbness, feelings of "pins and needles," of burning, of tenderness in the soles and of shooting pains in legs.

Anoesthesia was very pronounced in Case 1. There was a loss of the sensation of touch in several other cases. (Vide Case 9).

Myalgia was present in the more severe cases, i.e., in those cases where there was some motor impairment. In Case 1, however, where there was hardly any loss of muscular power this symptom was present. In these cases the patients shouted with pain when the calves were grasped.

Erythromelalgia has been mentioned under the lesions of the skin, though it is rather a combination of a sensory and trophic disturbance with a cutaneous manifestation. This condition occurred on the palms but was much more pronounced on the soles. These places were tender on pressure, and there was also present a burning pain which was aggravated when the feet were warm.

Neuralgia in the form of darting pains along the lines of nerves, was most troublesome in some cases. (Vide Cases 1, 10 and 12).

(3) Trophic Disturbances.

The most important trophic mischief was the atrophy of the muscles, which occurred in the cases suffering from Paresis or Paralysis of the muscles of the arms and legs. In the legs, the muscles of the calf and those of the Anterior Tibial regions were usually affected and sometimes those of the thigh. In the arms, the extensors of the forearm and the small muscles of the hand and fingers were the ones attacked. The loss of muscular tissue between the metacarpal bones of the thumb and first finger was most striking.

Increased secretion of the sweat glands (Hyperidrosis) was a common condition.

The hard dry and brittle condition of the nails is also of the nature of a trophic disturbance.

Erythromelalgia has been mentioned before.

(4) The Reflexes.

In none of the cases were the knee jerks exaggerated. In the moderately severe cases they were diminished, and in the most severe altogether lost. (Vide Cases 10 and 12).
On recovery the knee jerks reappeared early.

(5) Ataxia.

This condition may be mentioned alone. It was present to a slight degree in one or two cases. (Vide Cases 1 and 9).

(6) Psychical Disturbances.

One patient had a dull

stupid expression of the face and complained of loss of memory. (Vide Case 9). Others complained of having had their sleep disturbed with frightful dreams. (Vide Cases 1 and 5). With these exceptions, there were no indications that the mental faculties were involved.

5. <u>Gastro-Intestinal Disturbances.</u>

These were not prominent in the foregoing cases. Sickness and diarrhoea were in some cases symptoms of a temporary nature. Nausea and loss of appetite were, however, common complaints. It was noticed that in the majority of the cases the tongue was coated with a fine, white, silvery fur.

Enlargement of the liver associated with tenderness on palpation was present in certain cases. (Vide Cases 10 and 12).

Ascites was very pronounced in the same two cases.

6. <u>Circulatory Disturbances.</u>

Affections of the heart were not common but some of the patients suffered from considerable cardiac weakness. (Vide Case 5).

In two cases the cardiac condition was most serious. (Vide Cases 10 and 12). In both, there was dilatation of the heart producing dyspnoea, etc.

<u>The Pulse.</u> Only in these two cases mentioned above, was the pulse affected. Here, there was a pulse of low tension and very rapid. Again, the rapidity varied with the patient's posture, shewing an irritable heart.

In the two cases mentioned, viz., 10 and 12,

the alcoholic element must not be overlooked. There is no doubt that the cardiac mischief and the enlargement of the liver with the consequent ascites, were to a great measure due to alcoholism.

7. Respiratory Disturbances.

The Lungs. There were no abnormal conditions found in the lungs.

The Throat. In several cases there was a history of "sore-throat" and on examining the throat there was discovered a dusky redness over the soft palate, uvula and tonsils and in some even on the posterior pharyngeal wall. (Vide Cases 1, 7 and 16).

8. Genito-Urinary Disturbances.

The urine was diminished in quantity in a few of the cases, but beyond being loaded with urates it was normal.

Three urines were examined for Arsenic but I failed to find any.

B. DIFFERENTIAL DIAGNOSIS.

1. Alcoholic Neuritis.

The comparatively small quantity of alcohol imbibed, the acute onset of the symptoms, the more pronounced sensory disturbances, the typical pigmentation of the skin with desquamation, the catarrhal symptoms (eyes and nose), and the erythromelalgia (rarely seen in alcoholic neuritis) serve to distinguish these cases of arsenical poisoning from alcoholic peripheral neuritis.

2. Addison's Disease.

The presence of the signs and symptoms of peripheral neuritis and the absence

of persistent vomiting and profound asthenia, exclude these cases from being classed as Addison's Disease; though the distribution of the pigment is common to both classes of cases with the difference that in these cases of arsenical poisoning there was no pigmentation of any mucous membrane.

3. Erythromelalgia.

Erythromelalgia has by some observers been considered as a well defined form of disease and in the beginning of this epidemic many of the cases were diagnosed as such. Its occurrence in the majority of the cases, makes one think that there is no such disease as Idiopathic Erythromelalgia, but that when it does occur it is a symptom of toxic peripheral neuritis.

4. Scarlet Fever.

The extensive desquamation may cause some of these cases to be confused with cases of Scarlet Fever, especially when a history of sore-throat is gained and a congestive condition of the fauces and palate is present.

5. Rheumatism.

Some of the patients at first thought that they were suffering from Rheumatism. They regarded the pain in the soles of the feet and the neuralgic pains in the legs as rheumatic.

6. Beri-Beri.

Several cases of arsenical peripheral neuritis occurring in Chester were said to be cases of Beri-Beri, because it was considered that the amount of arsenic per gallon was not sufficient to produce toxicological effects. But, in

Beri-Beri there is no pigmentation and oedema of the extremities is a marked feature.

C. TREATMENT.

1. The Prohibition of the Poison.

In all cases the consumption of beer was prohibited, and in most cases this injunction was complied with. A few of the spirits patients took spirits and one or two persisted in drinking beer. It may here be said that when the brewers were made acquainted with the nature and cause of the epidemic the majority quickly withdrew and destroyed all contaminated beers.

2. Rest.

There is no doubt that those cases which rested in bed made the quickest and best recovery, but I was only able to get the most severe type of case to rest absolutely. Those shewing the symptoms in a mild form continued their employment and the majority, though they did not rest in bed abstained from their occupations.

3. Diet.

The diet recommended was mild and non-irritating. In most cases the appetite was bad and in few was there much gastro- intestinal disturbance requiring reduced diets. Plenty of fluid was recommended.

4. Drugs.

At first simple alteratives with Iodide of Potassium in 5 grain doses thrice daily were given. Later, strychnine was the main drug, beginning with 4 minim doses of the Liquor and

increasing to 12 or 16 minims thrice daily.

In some cases sedatives were necessary.

Antipyrin and Phenacetine in 5 and 10 grains doses respectively were given for the neuralgic pains.

In the cardiac cases Digitalis was combined with Strychnine, and preparations of Iron were used for Anaemia.

For the painful condition of the feet lead and opium lotions were used.

5. Massage and Passive Movements.

Those cases suffering from Paresis and Paralysis associated with muscular atrophy had the affected parts massaged. Passive movements of the limbs were also employed. Massage was prohibited in the acute stages.

CHAPTER 4.

THE CHEMISTRY OF THE SUBJECT.

The Theories respecting the Presence of the Arsenic in Beer.

When it was known that the recent epidemic of Peripheral Neuritis was due to the presence of arsenic in the cheap beers, many explanations were offered regarding the source of this arsenic.

Dr. Reynolds in his first paper which appeared in the British Medical Journal (November 24th, 1900), held that "the source of the arsenic was to be found in the sulphur used in the hop industry."

An eminent chemist attributed the presence of arsenic in the beer, not to the use of invert sugar or glucose in the preparation of which impure sulphuric acid had been employed, but to the addition of phosphate of soda which has some phosphate of arsenic (more likely to be arseniate of soda) as an impurity. The excise tests are to discover the amount of phosphates in the beer, because they represent the chemical result of malt and hops and other vegetable matter. He affirms that adulterated phosphate of soda is added to bring the beer up to the chemical standard demanded by the excise authorities.

Another chemist (Mr. William Thomson, F.R.S., Ed., F.I.C.) believed that the source of the arsenic was to be found in the malt. Of 16

samples of malt which he had tested, he found arsenic, varying in quantity from 1-[illegible]3rd to 1-140th part of a grain per pound.

Mr. John Brown of Bacup, though maintaining that the main source of arsenic is the use of arsenicated sulphuric acid in making glucose and invert sugar, says that he has discovered another source. He detected arsenic in beer from two brewers who had only used malt and hops and no glucose, in the proportion of one grain in [illegible]50,000. The beer in passing from the barrels to the pipes, passes through india-rubber tubing and he suggested that this tubing was responsible. "It was found that there was arsenic in the beer in the pumps, though the beer in the barrels was free. The amount of arsenic in the beer in the pipes was easily detected and in the rubber tubing the quantity was larger." Thus he proved that the tubing was a source of arsenic.

Mr. Lyon suggested another source. Empty beer barrels used to be cleaned with boiling water and a circular brush. Now sulphuric acid is used in the process and he held that the source of the arsenic is to be found in the impure sulphuric acid so used.

These are possible sources of arsenic, yet the amount of the poison which may get into the beer by these means is so infinitesimal as to produce no toxicological effects.

<u>Sugar the Main Source of the Arsenic.</u>

The method for determining the source of the arsenic adopted by Delépine of Manchester was the

following.

He obtained samples of all articles used in the brewing of the arsenicated beer, and "arsenic in considerable quantities" was found in the cheap brewing sugars, viz., glucose and invert sugar. These sugars were supplied by one firm of sugar manufacturers to the brewers. These sugar works were visited and it was discovered that only in the sulphuric acid was arsenic present. This sulphuric acid had been prepared from arsenical pyrites and had never been purified.

There remained, therefore, no doubt that although a minute trace of arsenic might get into beer from other sources, the main source was the use of impure sulphuric acid in the preparation of brewing sugars - which were used as substitutes for malt.

Brewing Sugars and their Preparation.

Sugar is the generic name for the group of bodies belonging to the class of compounds known as Carbohydrates. They all contain 6. or some multiple of 6. atoms of Carbon, united with hydrogen and oxygen, the two latter in the proportion to form water (H_2O).

There are three kinds of sugars, viz., Saccharoids, Glucoses and Saccharoses.

(1) Saccharoids or non-fermentable sugars ($C_6H_{14}O_6$) are not capable of undergoing fermentation with yeast. No common sugars belong to this group.

(2) Glucoses ($C_6H_{12}O_6$) readily undergo the alcoholic fermentation with yeast. They include

grape-sugar and starch-sugars.

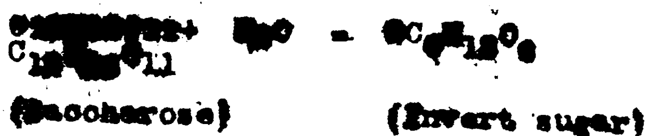
(3) Saccharoses ($C_{12}H_{22}O_{11}$) are not capable of <u>direct</u> fermentation, though by the action of dilute acids they are converted with greater or less facility into glucoses, and then undergo fermentation. They include cane sugar, maltose, milk sugar, etc.

The two forms of sugar employed in brewing are, artificially made glucose and invert sugar - the former being obtained from starch sugar and the latter from cane sugar.

<u>Glucose</u> is prepared by the action of sulphuric acid on starch (marge, sago, rice or potato starch). Chalk is added to neutralize the excess of the acid and calcium sulphate is formed and is removed by filtration. If the sulphuric acid contains arsenic, an arseniate is formed and as this is soluble, the arsenic remains in the sugar.

<u>Invert Sugar</u> is prepared by the action of dilute sulphuric acid on cane sugar. The cane sugar (Saccharose) assimilates the elements of water (H_2O) and is thus converted into a glucose.

The following chemical equation shews the action-



$$C_{12}H_{22}O_{11} + H_2O = 2C_6H_{12}O_6$$

(Saccharose) (Invert sugar)

Again, chalk is added to neutralize the free acid, and calcium sulphate is formed. Any arsenic in the sulphuric acid is retained in the sugar after filtration to remove the calcium sulphate. The name given to this sugar is "invert sugar" and the operation is known as "hydrolysis."

Thus we see how the brewing sugars (glucose

and invert sugar) may contain arsenic, if that poison is present in the sulphuric acid which is used in this manufacture.

The Analysis of Crewe Beers.

Qualitative Analysis.

The Crewe beers were tested for arsenic by Reinsch's test and the following are the details of that test as employed at Crewe.

Firstly the purity of the reagents and copper foil was tested thus:- Place in a flask 10 c.c. of pure strong hydrochloric acid (arsenic free) together with 50 c.c. of water, thus making a proportion of 1 in 6. In this, also place 4 or 5 thin strips of copper foil and boil for about a quarter of an hour. If the copper foil is free from film at the end of this process, then one may assume that the reagents are free from arsenic.

Pour away this mixture of hydrochloric acid with water, leaving the copper foil at the bottom of the flask, and replace with 120 c.c. of the sample of suspected beer and about 24 c.c. of strong hydrochloric acid (arsenic free), thus again making a proportion of 1 in 6. Boil gently for about half an hour; pour away the beer and gently wash the pieces of copper foil several times so as to render them quite free from acid; now transfer the copper foil to a piece of blotting paper where they are dried. When thoroughly dryed place 2 pieces in a flat reduction tube and heat very gently in a Bunsen flame. If arsenic is present a white deposit will form on the side of

the tube some little distance above the copper foil, and on examination by the microscope, this will be seen to consist of numerous crystals, which have an octahedral shape.

Thirteen beers were examined in this way, and the following is a table shewing the results. The letters A, B and C refer to the breweries, and the numbers to the samples.

Breweries.		Result.
A.	1.	+
	2.	+
	3.	+
	4.	+
	5.	-
	6.	-
	7.	-
B.	1.	+
	2.	-
	3.	-
C.	1.	+
	2.	+
	3.	+

*Thus 8 out of 13 thirteen samples contained arsenic.

*Samples A.5., A.6., A.7., B.2., and B.3., were obtained later than the others and were evidently samples of the beer which was sold in place of contaminated beer which had been withdrawn and destroyed.

All these three Brewers represented here,

used in the brewing the same glucose or invert sugar which caused the "epidemic" in Manchester and district.

Quantitative Analysis.

Four samples of Crewe beers were examined quantitatively and the estimated quantities were:- ·16, ·004, ·01, and ·015 grains of arsenious acid per gallon.

Kirkby, who has tested numerous samples of the Manchester beers, reports that he has found arsenious acid varying in amount from ·01 to 1·4 grains per gallon.

Thus we see that in the Crewe beers, as well as in the Manchester beers the amount of arsenic varied considerably.

Dosage.

Taking the largest amount found in the Crewe beers, for calculation, viz., ·16 grain per gallon, every pint of this beer contained $\frac{1}{60}$th of a grain of arsenious acid. The official dose of this poison is $\frac{1}{60}$th to $\frac{1}{12}$th of a grain so that in one pint of beer, the minimum medicinal dose was taken. As the average of the alleged quantities of beer consumed by my patients did not come to more than 4 or 5 pints per diem, one has some difficulty in ascribing the symptoms exhibited by the patients, as being altogether due to the amount of arsenic taken. Of course where the quantity of beer has been much greater, and where as in some of the Manchester beers the quantity of arsenic per gallon was greater, there can be no such difficulty

in assigning the cause of the poisoning. I suggest that this difficulty may be overcome in one or more of the following ways:-

(1) The association of arsenic and alcohol. Alcohol certainly has a deteriorating effect on the tissues generally, and persons who consume alcohol regularly have their eliminative powers more or less impaired, and are thus rendered more liable to the effects of the poison.

(2) The formation in the system of an alcoholic compound of arsenic, more poisonous than arsenic itself or its better known compounds. This is merely a suggestion which would be difficult to prove.

(3) Cumulative action of arsenic. Until recently arsenic was not supposed to have any cumulative action. Now, however, there seems some reason to accept a theory of cumulative action for the following reasons.

(a) The adulterated brewing sugars were placed on the market as early as April, 1900, according to the evidence given by an agent of the firm of sugar manufacturers before the Manchester Coroner, and consequently the arsenicated beers must have been on sale shortly after this. The symptoms of poisoning, however, did not appear in the beer drinkers till late in June and in some much later.

(b) It has been stated (Vide evidence given ~~in~~ before the Royal Commission

on Beer Poisoning) that the desquamated skin and even the hair of patients suffering from arsenical poisoning, contained arsenic long after the consumption of the arsenicated beer was stopped.

(4) Idiosyncrasy. Only a small proportion of the people who regularly consumed arsenicated beer were affected. About one sixth of the public houses in Crewe sold arsenicated beers and not more than forty cases of poisoning were reported to the Medical Officer of Health. Consequently, idiosyncrasy of the people must be reckoned with, when the causation of the epidemic is enquired into.

In conclusion, it has been proved that the amount of arsenic taken by patients consuming 4 or 5 pints of beer per diem, did not exceed the medicinal dose of that drug, and that the cause of the appearance of the symptoms of poisoning must be, either the association of arsenic and alcohol, or the cumulative action of arsenic, or idiosyncrasy, or a combination of these conditions.

CHAPTER 5.

CONCLUSIONS.

The conslusions drawn from the whole of the investigations may be divided in A. General and B. Special.

A. General Conclusions.

(1) The Crewe "epidemic" of arsenical poisoning may be regarded as part of that of Manchester and district.

(2) The same adulterated sugar which caused the wholesale poisoning of beer in Manchester was the cause of the Crewe cases.

(3) The symptoms of poisoning by arsenic appeared in beer and stout drinkers only. Jam, sweets and syrups were declared free from arsenic.

(4) The average amount of beer consumed was remarkably small, but regularly taken, considering that the symptoms of poisoning were well marked.

(5) The foregoing cases were not so severe as those occurring in Manchester.

(6) The removal of the cause was followed by a cessation in the occurrence of new cases.

(7) The removal of the cause in each case was followed by an improvement of the symptoms of poisoning.

(8) The mortality was NIL.

B. Special Conclusions.

(1) The cases vary in severity - the cause being the variation in the amount of beer consumed.

(2) The foregoing cases may be divided into three classes:-

(a) Those representing symptoms of arsenical poisoning, with symptoms of incipient peripheral neuritis.

(b) Those representing symptoms of arsenical poisoning, together with symptoms of well marked peripheral neuritis.

(c) Those representing symptoms of arsenical poisoning, including symptoms of well marked peripheral neuritis, and symptoms of cardiac mischief. Alcohol as well as arsenic has entered into the causation of the conditions mentioned in this class.

(3) The dose of arsenic taken by these patients was very small, leading one to think that arsenic itself was not the only cause of the poisoning, but that other elements entered into the causation, viz., the association of alcohol and arsenic, the cumulative action of arsenic, or idiosyncrasy.

(4) The pigmentation of the skin should be a great aid in the diagnosis of arsenical poisoning. The distribution of the pigment, the presence of small

white unpigmented or lesser pigmented patches, and the desquamation were distinctive.

(5) The catarrhal symptoms (especially of the eyes) were present in every case.

(6) The sensory disturbances were almost invariably the complaint of the patient.

(7) The predominence of the sensory over the motor disturbances was most noticeable.

(8) Erythromelalgia was an almost constant condition in the cases.

(9) The Gastro-intestinal symptoms were not at all prominent.

(10) The symptoms exhibited by the foregoing cases were those of arsenical poisoning.