systoles, however, it would succeed in discharging the red blood collected in its cavities to such an extent that they could receive some of that which lay in the pulmonary veins and lungs. Space being thus gained, the black blood which the pulmonary artery contained would reach the capillaries of the lungs in amount proportionate to that of the arterial which had gone forward, and sufficient air would be drawn into the chest to aërate so much blood. That very act would carry forward a still larger charge of arterial blood to the left side, and make room for the reception, by the lungs, of a still further increase of venous blood, and, as a consequence, a still deeper inspiration would follow, and the deepest would occur when the largest quantity of venous and the smallest quantity of arterial blood lay in the lungs. The red blood, reaching the left heart, would excite it to those frequent and irregular contractions which accompany the respiratory distress, but frequent and irregular they would be also ineffectual, red blood would begin again to accumulate in the left heart, the pulmonary veins, and the lungs, till at last their capillaries would contain little else, and the exciting cause of inspiration, the venous blood, being no longer present, the act itself would again cease."

ART. XIV.—*Tetany*^{*}; with an Illustrative Case. By
C. W. CHESTER MYLES, B.A.

IN considering the subject of Tetany we are dealing with a disease about which there is a wide difference of opinion amongst medical men, and one which, because of its comparative rarity, has not, as yet, got beyond the experimental stage so far as its treatment is concerned.

It is characterised by tonic muscular spasms involving especially the distal portions of the limbs, but in severe cases extending to the trunk, neck, face, eyes or larynx.

^{*}A Communication read before the Dublin University Biological Association, December 8, 1910.

It is usually bi-lateral, and the spasms may be either paroxysmal or continuous.

But even its essential characteristics are not agreed upon. Some writers distinguish adult and puerile forms; others totally deny its existence in early childhood; others draw a distinction between "true tetany" and what they call "pseudo-tetany." Again, some regard increased irritability of muscles and nerves to mechanical and electrical stimuli as a distinguishing feature; others do not consider this essential. It is best, I think, to conclude that there is a wide variation in degree of severity ranging from the mild carpo-pedal contractions of rickety children to general spasms, which may in severity almost simulate tetanus. Spasmodic ergotism is sometimes considered as a variety of tetany; but two considerations, I think, are opposed to this—viz., the different nature of the degenerative changes in the nervous system and the fact that the condition is due to a definite drug, for, as we shall see later, no definite toxin of tetany has yet been isolated.

The condition of tetany was described nearly one hundred years ago, but its present name was not used for another forty years. The number of names by which it has been known at various times is, indeed, almost in inverse ratio to the extent of our knowledge about it. Amongst others, Horsley by experimental and Kocher by surgical investigation showed the relation between tetany and disease of the thyroid gland, while Weiss first drew attention to it as a result of complete removal of the thyroid.

Tetany occurs at all periods of life, but chiefly in children and young adults. On the whole, it is slightly more frequent in males than in females. In early childhood the great majority of cases are males, while after twenty years of age the reverse is the case. Some families show a peculiar liability to it, several members being affected, but it is seldom hereditary. Its geographical distribution is very irregular. In Vienna it is

found about seven times in every one thousand nervous cases, and it is also very common, comparatively speaking, in Heidelberg. In these islands, as in America and Northern Germany, it is very rare, while in Paris, where the variety connected with pregnancy and lactation was once very common, it is now almost unknown.

The causes to which tetany has been attributed are many, and they fall naturally into the following groups :—

1. Gastro-intestinal trouble. In young people it may occur with chronic diarrhoea or persistent constipation. Cases have been recorded in association with catarrhal jaundice and intestinal worms, and in one case the spasms ceased the day after the expulsion of a tape worm. But the most usual and, at the same time, the most obstinate form is in connection with gastric dilatation. In such cases attacks have been brought on by washing out the stomach, on percussion over the epigastric region, or as the result of administering an enema. It is seldom found where there is merely lack of tone in the muscular coat, but rather along with gastric or duodenal ulcers or malignant disease.

2. It may follow complete removal of the thyroid gland; in this case the real source of the trouble is the loss of the parathyroid bodies. It has also been found in cases of atrophy of the thyroid and of myxœdema.

3. The third group—that which occurs in pregnancy and lactation—is closely allied to the thyroid group, for statistics show that the thyroid is enlarged in about 80 per cent. of pregnant women, and in the case of dogs no ill effects have been found to follow partial removal of the thyroid unless the animal happened to be pregnant, when symptoms of tetany have appeared a few days before delivery. This form of tetany was first described by Trousseau under the name “nurses’ contracture.” It appears usually during the latter half of pregnancy, while in lactation there is a latent period of from two to six months after gestation. The spasms seldom occur during

labour, but when menstruation is established again there may be a recurrence of the spasms with each period. Cases are recorded in which girls suffering from tetany experienced a spontaneous cure at the onset of their first menses.

4. Tetany sometimes follows acute fevers, particularly enteric, smallpox, scarlatina, and measles. In enteric its onset is usually during convalescence.

5. Several toxic conditions may give rise to tetany. It has been found with kidney disease, with albuminuria (the two disappearing together), and in delirium tremens.

6. An epidemic form of tetany is fairly frequent in Vienna and Heidelberg. Males are principally affected, and there seems to be some connection with the occupation of the victims, as out of 399 cases investigated at one time 174 were shoemakers and 94 tailors, while 83 per cent. of the patients were between the ages of sixteen and twenty-five. In Vienna it has been noticed that epidemics occur usually in March and April.

7. Epilepsy and tetany are sometimes found together, and some think that the former may be a manifestation of the latter. Tetany is also met associated with hysteria.

8. The infantile form of tetany, which differs in some ways from the adult forms, is more common than the latter in London and also in parts of France and Germany. It usually follows gastro-intestinal trouble. A minor degree is seen in rickety children under the name of carpopedal contractions.

The changes which have been found *post-mortem* in tetany are very varied. Hyperæmia of the dura and pia mater with subarachnoid effusions at the base of the brain and softening of the brain substance, hyperæmia of the pons, medulla, upper cervical portion of the cord, and of the peripheral nerves most affected in life have been described in addition to the sclerosis of the posterior columns of the spinal cord found in cases of spasmodic ergotism. On the other hand, the peripheral nerves and muscles have sometimes been found perfectly normal.

The ganglion cells in the cord have been found shrunken and vacuolated. Weiss reports three cases following removal of the thyroid in which the cells of the anterior horn were swollen and vacuolated, and one case in which they were atrophied. In two more recent cases the changes were best marked in the cervical and lumbo-sacral portions of the cord. The meninges and outer parts of the cord were normal, but nearer the centre there was considerable rarefaction and in parts total absence of nerve fibres near the grey matter, and the grey matter, especially in the anterior horn, showed atrophy and rarefaction of the ganglion cells. The characteristic lesions, then, seem to be shown in the cells of the anterior horn, beginning with hyperæmia and swelling, and going on into atrophy and sclerosis. It must be remembered, however, that the deaths from tetany uncomplicated are very few, and the opportunity for pathological research is correspondingly limited.

As to the seat of the original trouble many views are held. Some think it begins in the muscle, others in the peripheral nerves, others, again, in the cells of the anterior horn. Gowers holds that the nerve cells of the medulla are first affected, while Weiss suspects some derangement of the sympathetic system. From their altered reaction to mechanical and electrical stimuli it seems clear that the nutrition of the peripheral nerves is altered, and the occasional association of epilepsy, hysteria, and insanity would suggest that the cerebrum may be involved.

Other pathologists have suggested some affinity between rheumatism and tetany, but this theory has been abandoned. Kussmaul, having in mind gastric dilatation, put forward a theory of increased dehydration of the blood which, though he later abandoned it, has been revived by others. From the association of gastric ulcer a theory of the presence of an excessive amount of hydrochloric acid in the gastric secretion has been suggested.

The theory now generally held is that of auto-intoxication from the decomposition and fermentation of con-

tents of dilated stomachs which have not managed to escape. One patient had the attacks stopped by the administration of an emetic, which Galliard maintained was proof that tetany is reflex, not toxic, in origin. Bouveret and Devic isolated a substance from the gastric contents of patients which, when injected into animals, caused general convulsions. Albu obtained from the urine of a patient an alkaloid which was absent in the intervals between attacks. Halliburton also contributed to this theory by a series of experiments, to which I shall refer later.

The relation between tetany and the thyroid gland has already been dealt with.

Bacteriological research and experimental inoculation of rabbits with the blood of patients have not yielded any positive result.

The occurrence of an epidemic form would seem to indicate that the disease may sometimes be infective, a view which is supported by the occasional presence of fever and hallucinations as complications.

Tetaniform convulsions are occasionally found in ergot, chloroform, and alcohol poisoning, and this, I think, supports the theory of the existence of some toxin.

Regarding infantile tetany, some consider it a direct derivative of rickets, pointing out that the curvature in rickets and tetany arise together, while phosphorus has a beneficial effect in both. Others think the truth is that similar circumstances favour the occurrence of the two.

On the whole, then, there seems to be a decided balance of opinion in favour of the toxic origin of tetany, though it cannot as yet be definitely attributed to any one substance.

Many symptoms have been described, but in very few cases have they all been found.

Before the actual muscular spasm sets in there are, as a rule, some sensory premonitions which usually take the form of a "numb," "tingling," or "burning" sensation. This may continue for as much as some hours, or even a

day, before the spasm comes on ; very occasionally there may be headache and vomiting, while sometimes there may be no warning whatever.

The spasms are usually symmetrical, and commence in one extremity, usually the hands, and then pass to the other limbs, trunk, and face. Sometimes they begin on one side only and then spread to the other ; at other times one side of the body only is involved, while in a few cases one arm and the opposite leg have been affected. The spasms are tonic, and the limbs become so rigid that voluntary movements are impossible. The position of the hand is very remarkable. The thumb is brought close to the index finger, the palm hollowed, and the fingers drawn close together, so that the whole hand is cone-shaped—the accoucheur's hand, as it is called ; in rare cases the fingers may be partly flexed or the fist clenched. The hand is slightly inclined to the ulnar side and the wrist partly flexed. If the arm is involved, the forearm is strongly pronated, the elbow flexed, and the upper arm drawn a little forwards and inwards. In the lower limb the toes are strongly flexed and adducted, the foot arched and extended and inverted at the ankle ; the knees are extended, and the thighs adducted so much that they may cross one another. On the trunk it is usually the ventral muscles which are involved ; the head is bent slightly forwards, and both sterno-mastoids are usually involved. In the face the spasm of the masseters is best marked, but all the muscles are involved, and in the eyes there may be strabismus, conjugate deviation, or immobility of the pupils. The tongue and muscles of the pharynx and larynx may be affected, causing difficulty in swallowing and speaking. Facial spasms are usually found only in severe cases. If the spasm is of long duration, and larynx and pharynx are involved, there may be temporary cyanosis due to a certain amount of asphyxia, or there may even be loss of consciousness. The spasms are usually paroxysmal, and may last for anything from a few seconds to a few days, then gradually passing

off, to be repeated in a few hours or days. The relaxation is occasionally incomplete. Fibrillary contractions are sometimes visible in the muscles. Attacks have been induced in several ways—*e.g.*, by muscular effort during the period of relaxation, by washing out the stomach, by percussing the abdomen, or by steady pressure on the affected limb, so as to check the circulation and press on the nerve trunks; the evoking of spasms by this last method is known as Trousseau's sign. In the affected parts there is increased irritability of muscles and nerves to mechanical stimuli. Chvostek's sign is the contraction of the facial muscles which may be produced by a few taps over the facial nerve in the region of the stylo-mastoid foramen. Erb has demonstrated the increased excitability of nerves to both interrupted and constant currents. The order of response to the constant current is—

ACC		AOC		KCC
AOC		ACC		ACC
KCC	or	KCC	instead of	AOC
			the normal	
KOC		KOC		KOC

The contraction is somewhat more prolonged than in health, so that there is tetanus; in fact, this is the only known condition in which anodal opening tetanus has been demonstrated in man. The increased excitability to the constant current is almost always found, that to the interrupted current less frequently.

In severe cases there may be extreme cramp-like pains, usually deep-seated. Superficial pains, if present, are generally referred to the fingers or dorsum of the hand or the arch of the foot. In the intervals between spasms there may be sensations of heat or cold or "pins and needles," and there may be some blunting of sensation.

The knee-jerk is usually exaggerated, but in a few cases it has been lost. Other reflexes are usually normal.

There is often vaso-dilatation in the extremities, and a severe attack may terminate in profuse sweating.

The pulse is rather rapid, and the temperature may be a little raised, but rarely exceeds 101° F.

The urine is normal in amount, and may contain traces of albumen, sugar, acetone, or indican; children especially are liable to have indican present.

The diagnosis is seldom of difficulty if one has had the opportunity of seeing the patient in an attack, so characteristic are the spasms. This, coupled with altered response to mechanical and electrical stimuli, should be sufficient, but if Trousseau's, Chvostek's, and Erb's signs are all absolutely essential features of tetany, the disease is a very rare one indeed. But one sometimes finds an obscure or unusual case where the symptoms are either very slight or extraordinarily severe, and these may present considerable difficulty. In mild cases, especially in the early stages, the motor symptoms may be totally overlooked by the patient, whose attention is attracted only by the premonitory sensations, so that a history of muscular spasm may be very difficult to elicit. In these cases the principal aids to diagnosis—viz., Trousseau's, Chvostek's, and Erb's signs—may be absent. In such cases the subjects most likely to yield assistance in diagnosis are lactation, pregnancy, gastric trouble, and diarrhœa. In very severe cases the condition may be mistaken for tetanus; in tetanus, however, the hands and fingers usually escape, in tetany they are first affected; spasm of the masseters is an early symptom in tetanus, a late complication in tetany; in tetanus the extensors, abductors, external rotators and supinators are the groups of muscles most affected, while in tetany it is the flexors, adductors, internal rotators, and pronators, and, in addition, the spasms are intermittent.

In spinal meningitis there is usually greater fever and severe pain in the back; pain in the limbs accurately follows the course of the sensory nerves: Trousseau's, Chvostek's, and Erb's phenomena are absent—the affected parts are liable to paralysis, and the sphincters are involved.

Children are most liable to tubercular meningitis between three and five years of age, to tetany from one to three; and in the former disease there is a long premonitory stage, spasm is infrequent, and does not follow the same order as in tetany, headache and vomiting are more severe, and there may be optic neuritis or inequality of the pupils. The pulse is usually slow and somewhat irregular.

In epilepsy there is loss of consciousness, seldom found in tetany. Jacksonian epilepsy has been mistaken for tetany, but in it the convulsions are both tonic and clonic, and begin in one upper or lower limb, or on one side of the face, not on both sides at the same time. If they become general, consciousness is lost; headache and optic neuritis are usually present.

The prognosis in tetany is usually favourable, except in cases resulting from thyroidectomy and gastric dilatation. In the former, thyroid extract may be of service, but in the latter the prospect is unpromising. Of the other forms of tetany, the infantile is the most serious (owing to the low resisting power of children), especially if there are general convulsions or spasms of the glottis. In these cases there is usually severe diarrhoea, which in itself may be enough to cause death. In fatal cases the immediate cause of death in children is usually asphyxia, the result of spasmodic closure of the glottis, or pneumonia developing from the same cause. In adults death is more likely to be due to general debility resulting from the increasing virulence of the toxins. It is not easy to forecast the probable duration of the disease. Mild attacks of the continuous form usually last for a short time only, as do cases in which the spasm is prolonged over several days. Where it occurs during pregnancy it will almost certainly continue until delivery. In the event of a recurrence in subsequent pregnancies the course followed will be very much the same as in the first instance. In other varieties also there is a predisposition to recurring attacks if the patient is exposed to any of the influencing conditions, but this is about all that can be said on the subject.

The complications met with are few. Hysteria, though rare, is the commonest. Epilepsy is sometimes found, and mental derangement is very unusual. Patients who have recovered may subsequently develop chorea, or there may follow muscular atrophy of varying extent and severity.

The treatment for tetany is rather unsatisfactory. In France at one time every patient was subjected to bleeding. The use of some form of thyroid extract is, of course, indicated in cases which are the result of thyroidectomy, and in such cases the results have been as remarkably beneficial as in myxœdema, but in cases from other causes thyroid extract has not been so successful. The relation between this form and that in pregnancy is so close, however, that it should be tried in the latter, and in some cases it has been of considerable benefit. Apart from this, however, no definite antidote to the auto-intoxication is known.

To patients with dilated stomachs an emetic should be given, and, if adults, the stomach may be washed out with warm water and resorcin or some similar antiseptic. In cases of constipation, particularly in children, calomel may be given every second day, and enemata are also useful. Excretion by the kidneys and skin should be encouraged by Turkish baths, hot packs, and other suitable methods.

The diet should be regulated so as to reduce the production of toxins. It should be liberal and nutritive and at the same time easily digested. In the case of children, feeding should be systematic, and nourishment should be given in quantities and at intervals suitable to the age of the patient. Milk should be the basis of the food, and solids should be partly or entirely cut off according to age.

Hyperacidity or the reverse in the gastric secretion should be corrected by prescribing alkalies or acids as indicated. Opium may be given if there is persistent diarrhœa. Rickets should be combated by suitable feeding with milk, cream, and raw meat juice, and lime salts

and iron may be prescribed. Every means should be used to build up the patient's general strength, and for this cod-liver oil, malt, and various forms of arsenic, iron and phosphorus are very useful.

When a spasm occurs a tepid bath may help it to pass off more quickly, and a bath three or four times a day at a temperature of about 90° F. sometimes helps to reduce the number of attacks. In chronic cases baths are of little use.

Everything possible should be done to prevent the occurrence of spasms. The room should be kept at an even temperature, the patient should be warmly clothed both day and night, and tepid water should be used for washing.

Electrical treatment is of very little use, but feeble descending constant currents with the anode applied over the spine and kathode over the peripheral nerve trunks may help to reduce the irritability of the spinal cord. This is most likely to be effective when the condition is becoming chronic.

Of drugs, bromides and chloral are frequently prescribed; morphin is liable to cause constipation. Chloral may be conveniently administered to children by the rectum, as in this way it is not so likely to increase the spasms as is sometimes the case when it is given by the mouth. In one case, where bromides and chloral failed, Cheadle found that extract of Calabar bean given three times a day in doses commencing at $\frac{1}{32}$ of a grain and gradually increased to $\frac{1}{8}$ was successful. At the same time the patient was taking iron and cod-liver oil, however, and this alone might account for the improvement.

If there is danger of death from asphyxia, chloroform inhalations may be given, but great care is required, as the first effect of the chloroform may be to increase the spasm. Two cases are recorded in which active massage during chloroform anæsthesia had beneficial results. By inducing sweating, a hypodermic injection of pilocarpin may hasten the relaxation of the spasm.

In nocturnal tetany, Gowers recommends digitalis at bedtime. Bromides are sometimes successful, and tonics should be given during the daytime. Robson has published records which, he claims, show that immediate pylorotomy and gastro-enterostomy relieve the symptoms and prevent a recurrence in cases of gastro-tetany. In this connection I may mention that a patient with dilated stomach treated in the Richmond Hospital last spring had an attack of tetany almost every time his stomach was washed out. Gastro-enterostomy and pylorotomy were done, and the patient made an excellent recovery. The pylorus proved to be malignant.

The most recent case of tetany published in this country, so far as I have been able to trace, was described by Dr. Moorhead in *The Practitioner* about six years ago. It was a case of gastro-tetany, and had a fatal termination three weeks after admission to hospital. There was a history of intermittent vomiting for two periods of two years each, separated by a latent period of two years, and of chronic nasal discharge for two years previous to admission. In six months she had lost about two and a half stones weight. There was distinct splashing audible in the stomach, which was dilated; the urine was alkaline, slightly turbid, and contained a few hyaline tube casts and some bladder epithelium cells, but no albumen or sugar; the amount was small. Knee-jerks and plantar reflexes were exaggerated. Vomited matter contained .3 per cent. of free hydrochloric acid, a slight trace of lactic acid, and abundance of albumoses and peptones. On admission resorcin was prescribed in a mixture. A characteristic attack, involving both arms and the face and neck, was induced, two days after, by washing out the stomach. There was no spasm in the legs, but tingling and pain; knee-jerks were lost, plantar reflexes normal. A blood examination showed a reduced number of red corpuscles with an increase in white corpuscles. Pulse regular, but weak, 84 per minute; respirations, 22; temperature. 98° F. Only sixteen ounces of urine were

passed in the next twenty-four hours. The spasm had not wholly subsided until the second day after its onset. Neither Trousseau's, Erb's, nor Chvostek's symptoms were ever elicited. After this the stomach was washed out daily and the patient seemed to improve steadily. The vomiting ceased, and for nearly a week the size of the stomach seemed reduced. During the spasm a considerable quantity of albumen was present in the urine, and this continued up to the end. There was an increase in both red and white corpuscles of about 50 per cent. of the numbers first found. One morning the patient woke in a collapsed condition; a partial rally followed the administration of brandy; but in a few hours she became comatose again and died. Just before death she vomited a large amount of dirty greenish material. No urine had been passed for about twelve hours, so a catheter was passed and drew off half an ounce of urine, which on boiling gave a solid coagulum of albumen. On *post-mortem* examination the stomach was found enlarged and full of material similar to what was vomited. The mucous membrane was somewhat atrophic and chronically inflamed. The kidneys showed characteristics of acute nephritis, and the liver and spleen were congested. The alveoli of the thyroid gland were greatly distended with colloid material, and contained patches of calcareous deposit. No abnormal change was found in the spinal cord.

Leucocytosis had only been recorded by two other observers besides Dr. Moorhead, as he points out, and in every case more than 80 per cent. of the white cells were polynuclear neutrophiles. The maximum numbers found in the respective cases were 40,000, 31,500 (Dr. Moorhead's patient), and 24,000 per cubic millimetre. The only other observer in recent times who appears to have made a blood count recorded 9,400 per c.mm.

An examination of matter vomited during the spasm showed an acid reaction, but no free HCl; lactic acid was present. The vomit immediately before death contained a large amount of sandy material in suspension, which

was soluble in nitric acid, but was not further identified, a trace of lactic acid was found, but no hydrochloric acid or acetone, and there was a distinct murexide reaction. At an interval of an hour, two amounts of 10 c.cs. each of the first vomit were injected into a rabbit, but no toxic effects were observed. From each vomit an alkaloid substance which gave the reaction of a di-amine was isolated. The first specimen, injected intravenously into rabbits, caused no toxic effects, while in the second case some temporary dyspnoea alone was produced.

In conclusion, I would like to draw your attention to a series of most interesting experiments published by Halliburton in connection with a case of gastro-tetany. In this case there were strong contractions of both arms and hands, and on one occasion consciousness was lost for thirty-six hours. The urine, of specific gravity 1028, showed traces of albumen and acetone during the spasms; afterwards these disappeared, and a trace of sugar was found. Matter vomited in the intervals between attacks contained acetone and hydrochloric, acetic, and butyric acids. On one occasion hydrochloric acid was present in excess, while once it was absent. From the vomited matter a preparation was made of what he calls a "tetany fluid," which he used in a series of five sets of experiments. The acidity of the vomit was equivalent to .115 parts of HCl in 100.

1. In the first, 5 c.cs. of the tetany fluid, representing 20 c.cs. of the original vomited matter, were injected into the external jugular vein of a cat, which was anæsthetised. No spasms or convulsions followed, but there was considerable slowing of the heart, and a great fall in arterial pressure. This slowly recovered its usual height, while at the same time the heart was faster than before.

2. The two vagi were then cut, and an equal amount of the fluid injected, with practically no result. From these two he concludes that the main fall in arterial pressure was due to the action of some toxin on the cardio-inhibitory centres.

3. It was thought that the fall might be due to the acid substances present, so an equal amount was injected, after neutralisation, into another cat under similar conditions. There was only a slight fall in blood pressure, which he attributes to the use of potash instead of soda as the neutralising agent. Hence he concludes that the fall in blood pressure is due to some acid substance present.

4. He draws attention to a series of experiments by Bouveret and Devic, who injected solutions of hydrochloric acid of strengths varying from .1 per cent. to .9 per cent. into animals. The weaker and medium solutions resulted in a fall of temperature of from a little more than one to rather less than three degrees Fahrenheit. The strongest solution resulted in general convulsions with a rapid fall in temperature of nearly 2° F. The conclusion was that the normal percentage of hydrochloric acid in gastric juice caused little disturbance if injected intravenously. Working on the same lines, Halliburton found that solutions of free hydrochloric acid of the same acidity as the tetany fluid gave only a slight fall in blood pressure not abolished by section of the vagi, and concludes that the substance responsible for the result with the tetany fluid is much more poisonous than hydrochloric acid and acid in reaction. No peptone or pepsin was present in the tetany fluid, and he states that the convulsions after injection of large quantities of these substances are very different from those he observed.

5. To complete the series of experiments he took the gastric contents of two patients, who, at the most, suffered from very slight dyspepsia. In the first case the acidity was equivalent to .13 per cent. of free hydrochloric acid.

- (a) He first injected the equivalent of 20 c.cs. of the original gastric contents, and found a slight fall in blood pressure.
- (b) 5 c.cs. of .2 per cent. hydrochloric acid gave the same result.

(c) After section of the vagi the fall in blood pressure on injection of 5 c.cs. of .2 per cent. HCl was a little more marked.

(d) After section of the vagi the equivalent of 20 c.cs. of the original juice was injected, giving a correspondingly increased fall in blood pressure.

The acidity of the other specimen of gastric juice was equivalent to a .06 per cent. solution of HCl. Experiments similar to those first performed merely resulted in a slight fall in blood pressure.

Halliburton claims that these experiments establish beyond doubt the theory of auto-intoxication, and that the effect of the toxic substance, which has an acid reaction, was, in this case at all events, some excitation, either direct or reflex, of the cardio-inhibitory centres, and possibly of some other centres in the brain and spinal cord.

A. O'L., male, aged twenty, draper's assistant, was admitted to hospital on November 17th, 1910. He complained of what he called "nervousness," taking the form of paroxysmal seizures.

He has suffered from these since August, 1903. At first he only noticed that his jaw became rigid, and he was unable to close his mouth. About two months later the limbs became involved. Four months later—in February, 1904—he saw a Dublin physician, who gave him two prescriptions, one of which contained opium, but his condition did not improve. At this time severe attacks were bi-lateral, milder ones usually right-sided, and he suffered frequently from headache. In July, 1904, he consulted a surgeon, who trephined over Broca's area on the left side. Since then the headache has diminished both in frequency and severity, and in about 90 per cent. of unilateral spasms the left side is involved, but their frequency has not decreased.

In the course of an attack he first feels a "crawling" sensation up along the thigh; this lasts for about ten seconds, extending upwards, and is sufficient to enable him to seek a support if standing up. The general spasm then comes on. The wrist and elbow are semi-flexed, the forearm

strongly pronated, and the upper arm brought forwards and slightly inwards. The thenar and hypothenar eminences of the hand are approximated, and the fingers are drawn close together, so that the hand becomes conical. The toes are flexed and inverted, and the legs rigidly extended. There is sometimes accompanying dimness of vision, and temporary aphasia, partial or complete, but never any loss of consciousness. The spasms are always tonic. The attacks last for less than a minute, but recur frequently, and he has had as many as thirty bi-lateral attacks (besides many unilateral) in twenty-four hours. For a week or ten days they become very severe and frequent, and then gradually decrease in frequency and severity, for about four weeks. This cycle constantly repeats itself.

He thinks he can to some extent fight off an impending attack by turning out the toes as forcibly as possible and firmly grasping some support.

His bowels have been fairly regular, and he has always corrected any tendency towards constipation. He occasionally has cramps in the sole of the foot in the intervals of attacks, especially when lying in bed. He used frequently to suffer from stitches in the side, but latterly they have almost disappeared.

In infancy the patient had measles and "inflammation of the lungs"; five and a half years before the onset of the spasms he had typhoid fever, and two months before they appeared he unexpectedly got a severe shock from a penny-in-the-slot electric machine. Up to eleven years of age he used to have bilious attacks with severe headache and vomiting of green matter; but these disappeared as he grew older.

His father, a shoemaker, aged sixty, has for years suffered from "a bad stomach." Mother and only sister are alive and well; no brothers; three step-brothers, children of the father by a previous marriage, died of consumption acquired from their maternal side; one step-sister suffers from gastric trouble with headache and vomiting.

Patient has good muscular power in all limbs. If anything, the left side is slightly the weaker. There is occasionally some slight incoordination or awkwardness in movements of the hands and arms.

The knee-jerk is exaggerated in both legs. There is occasional suspicion of horizontal nystagmus. Other reflexes

are normal. Trousseau's sign may occasionally be demonstrated. Heart and lungs are normal.

The stomach is not dilated; nothing abnormal is palpable in the abdomen.

The thyroid gland shows no signs of abnormality.

To constant currents, AOC, ACC and KCC are about equal.

Urine (specimen passed thirty minutes after a severe spasm).—Reaction acid, specific gravity 1035, no albumen, sugar, indican, or acetone.

Blood.—Red corpuscles 5,750,000 per c.mm.; white cells 22,800 per c.mm., of which 70 per cent. are polymorphonuclear neutrophiles.

Temperature constantly subnormal.

Highest pulse-rate 94 per minute.

Note.—Since the above was written the patient has been under observation for a further period of ten weeks, during which there has been a marked improvement in his condition. Since December 1st he has not had a single bi-lateral spasm and a much smaller number of unilateral ones than previously. He has been taking $7\frac{1}{2}$ grains of bromides three times a day continuously, with $7\frac{1}{2}$ minims of liquid extract of cascara sagrada. For the last six weeks this dose has been doubled, and he has been instructed to continue this for some weeks longer.

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