

conclusions. They thought at first that the acute cases were somewhat benefited, but subsequent events have shown that this was erroneous. Kanavel¹³ tells us that as far as he is able to judge, there is absolutely no justification for thyroid surgery in this condition.

Winslow briefly reports five cases in which operation was done, with rather discouraging results; still he believes there is some connection between the thyroid and the condition in question.

Norbury, who has had an enormous experience among the insane, and who is also a keen observer, fails to see any resemblance between Graves' disease and catatonia, and strongly doubts that the thyroid is the offending member in the last named condition.

SUMMARY OF WORK

The object of this research was to ascertain the percentage of goiter among the insane and the proportional presence of struma among the various forms of insanity.

For this purpose we examined 4,184 insane patients, 2,000 at Kankakee and the rest at Dunning. In palpating the necks of these patients we aimed to be as thorough as possible. Whenever we were in doubt as to the presence of an enlarged thyroid, we consulted between ourselves and with others, and if still in the least doubt the case was discarded. In this way, undoubtedly, some enlarged glands escaped us, but the cases enumerated as goitrous were unmistakably such.

In diagnosing the type of gland we have called a soft gland, simple goiter; a firm hard one, a fibroid, and a distinctly fluctuating one a cystic goiter. Here again, of course, several errors may have been committed.

Among the 4,184 cases there were 270 distinctly palpable thyroids (goiters), 6.45 per cent.

There were 2,125 males with forty-eight goiters, 2.25 per cent.; and 2,059 females with 222 tumors, 10.78 per cent. The relation of goiter between males and females was then about one to four or five. In these goiters the right gland was enlarged 101 times, and the left twenty-four, thus making the relative proportion one to five.

There were 131 bilateral enlarged glands, and in these almost invariably the right gland was the larger.

The middle lobe was enlarged in twelve cases.

There were 244 simple, twenty fibroid and four cystic goiters. Only two cases of typical exophthalmic goiters were found in this series.

Undoubtedly some cases of Basedow's disease, in which the symptoms were not very pronounced, escaped our attention, but it seems that in the territory tributary to Kankakee and Dunning such patients do not often manifest mental symptoms prominent enough for confinement in an asylum.

Leaving out a few types of insanity comprising a small number of cases, dementia præcox presented the greatest percentage of goiters and also the greatest number of insane. As the catatonic form of dementia præcox had been considered due to thyroid disturbance, we expected to find the greatest number of goiters in this type; but we found that the hebephrenic form had 93 per cent. of the goiters.

Next to dementia præcox came involution melancholia and then the paranoic state.

By far most of the goiters, 133, almost 50 per cent., were present in native born; Germans thirty-six, Irish seventeen, Swedish thirteen.

Further summary of the work is given in the accompanying table.

TETANY IN ADULTS

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The first definite description of the peculiar group of symptoms to which Lucian Corvisart afterward gave the name "tetany" was by a German, Steinheim, in 1830. A year later Dance, a Frenchman, published several cases under the name of "intermittent tetanus" and during the next thirty years the French school was most active in recording clinical features of the affection, the classical papers of Trousseau being the most notable of this period. After 1870 the scene of activity was shifted to the other side of the Rhine, probably because the disease appeared less frequently in France and became more common in Germany. The most important communications of the next decade were those of Kussmaul, Riegel, Erb and Chvostek, senior, while the description of the relation of tetany to total thyroidectomy in 1880 by Nathan Weiss, writing from Billroth's clinic, and the many papers which followed slowly the discovery of the parathyroids by Sandstroem in the same year, gave new impetus to the study of etiologic factors. The endemic occurrence of the disease in Vienna afforded particularly favorable opportunity for investigation which has borne fruit in the excellent reports of Frankl-Hochwart, Chvostek junior, Escherich, Pineles, Erdheim, Schlesinger, Biedl and others. The important work of W. G. MacCallum, Halsted, Beebe and Berkeley in this country is well known. The monograph of Frankl-Hochwart (1907), or the more recent works of Ochsner and Thompson ("Thyroid and Parathyroid Glands"), or of Biedl ("Innere Sekretion"), contain extensive bibliographies.

In tetany the characteristic feature is the occurrence of intermittent tonic, usually symmetrical spasms affecting most often the extremities, particularly the arms, and rarely leading to any disturbance of consciousness. In the milder forms the arms alone may be affected and the hands brought into the peculiar position, with fingers extended and approximated, the thumb extended and adducted—*la main d'accoucheur* of Trousseau. The position of the fingers can be imitated by electrical irritation of the ulnar nerve. These illustrations and the sketch by Dr. Sterling Bunnell of a patient of mine during a seizure show the typical tetany hand. In severe types spasm may involve not only the extremities, but the face, jaw, larynx, abdomen, diaphragm and even the eyes. The seizures may last a few moments or, rarely, for hours or days. Nearly always sensory phenomena accompany or precede the motor. Extensive and prolonged spasm occasions intense suffering. Numbness, tingling, prickling and coldness of the surface; heaviness, aching, soreness, tenderness and stiffness of the muscles are the sensations most frequently described. In chronic cases secretory and trophic changes may occur—sweating, edema, pains and swelling in joints, loss of hair and nails. Isolated myotonic phenomena may be manifested and myotonia congenita (Thomsen's disease) simulated. Following or occasionally replacing the spasmotic seizures flaccid or spastic weakness of the lower extremities has been noted. Clouding and loss of consciousness are not infrequent in tetany of gastric origin. Psychoses have been described by Frankl-Hochwart. The relations of tetany and epilepsy are important and will occupy us later.

THE TESTS FOR MILD TETANY

From the study of mild cases during epidemics and of chronic cases following lesions of the parathyroids, or

due to stomach disease, it is evident that, in addition to typical tetany with characteristic spasms, a number of latent, atypical or *fruste* forms exist that are only to be unmasked with aid of certain tests. These tests or signs depend on the increased irritability of sensory and motor nerves to mechanical and electrical stimulation. A knowledge of them is essential in diagnosis.

1. *The Trousseau Phenomenon*.—Trousseau found that by compressing the arm or leg of a patient with tetany, the characteristic spasms could be brought about at will. The phenomenon is best elicited by grasping the upper arm firmly, the thumb externally, the four fingers compressing the brachial plexus strongly against the humerus. Gradually, in positive cases, after an interval varying from a few seconds to four or five minutes, the forearm stiffens, the wrist is flexed and the fingers straightened and adducted. This sign is almost pathognomonic; the muscular contractions following pressure in hysterical individuals occur suddenly and do not bring the hand into the typical position. It depends, as Frankl-Hochwart has demonstrated from animal experiments, on mechanical irritation of the nerves and not of the blood-vessels, as was first supposed. It is a reflex phenomenon and may rarely be occasioned by irritation of more distant nerves.

I have examined several hundred patients for the Trousseau sign and have never found it apart from tetany. In January this year a man entered the University Hospital complaining of paresthesias and occasional severe pain in the extremities, with aching in the muscles, tenderness and intermittent cramps. The character of the muscular spasms and the presence of typical Trousseau and Hoffman phenomena determined the diagnosis of tetany.

2. *The Erb Phenomenon*.—This is perhaps the most characteristic of all tetany signs when present. The irritability of the motor nerves is greatly increased to the galvanic current, much less constantly to the faradic. Very weak currents cause tetanic contractions—even anodal opening or closing tetanus can be frequently demonstrated.

3. *The Chvostek Phenomenon*.—This depends on increased mechanical irritability of the nerves and is most readily demonstrated in the facial distribution. Frankl-Hochwart describes three degrees of irritability; in the highest grade (Chvostek No. 1) a tap on the facial nerve in front of the ear causes twitching in all the muscles supplied by it. In Chvostek No. 3 twitching of the muscles at the corner of the mouth alone occurs. Chvostek, junior, has recently emphasized the importance of this sign, first described by his father. Frankl-Hochwart, Schlesinger and others, without denying its value, have insisted on the fairly frequent occurrence in other conditions, especially neurasthenia, hysteria, tuberculosis.

4. *The Hoffmann Phenomenon*.—This is of much less significance in diagnosis. There is increased irritability of the sensory nerves to both galvanism and faradism and slight currents may cause tingling or pain. Chvostek, junior, has shown that the nerves of special sense may be in a similar state of hyperexcitability. The leg phenomenon recently described by Schlesinger and the methods of producing spasms of the hand by forcible abduction of the arms, thus stretching the brachial plexus, or evoking spasm in the feet by stretching the sciatic nerve by forcible flexion of the trunk on the thighs, are merely modifications of the Trousseau procedure. In a case seen recently the Chvostek and Erb phenomena were most marked, but the Trousseau sign

could not be demonstrated. Extension of the leg on the thigh and forcible flexion of the thigh on the trunk caused spasmodic extension of the foot in equinovarus position—the Schlesinger leg phenomenon.

The above phenomena and the peculiar muscular contractions are identical in all forms of tetany. Following Frankl-Hochwart, it is usual to distinguish seven groups of varied etiology or associations.

THE FORMS OF TETANY

1. Idiopathic, professional or endemic tetany is seen most frequently in Vienna and Heidelberg, occurs most often in young men—particularly in shoemakers and tailors. I saw a number of cases in the clinics of Frankl-Hochwart and Chvostek in 1895 and 1896, but have failed to find any typical ones in California. As goiter is frequent with us the observation of Chvostek is interesting, that tetany rarely occurs in regions where goiter is endemic.

2. Tetany of gastro-intestinal origin is seen most frequently in connection with pyloric stenosis, but has been described with varied diseases of the intestines, gall-bladder, appendix and pancreas, after long-continued diarrhea, or associated with intestinal parasites.

3. The tetany of acute infectious diseases—typhoid most commonly—cholera, influenza, measles, scarlatina.

4. Tetany after poisoning by chloroform, morphin, ergot, filix mas, cocain, novocain, lead, phosphorus; organic intoxication as in nephritis. The experiments of Rudinger have important significance in this connection. Poisons such as atropin, morphin, tuberculin, mercurial salts and ether were injected into cats with no appreciable effect on their nervous system. When, however, the outer parathyroids were removed, after such injections, tetany developed in certain animals and increased electrical excitability of nerves in others.

5. The tetany of pregnancy, the puerperal period and lactation. MacCallum believes that the drain of calcium in lactation or for formation of the fetus in pregnancy may alone in certain cases be sufficient to cause tetany. If parathyroid insufficiency already exists tetany is all the more certain to occur. It has long been known clinically that women with chronic tetany (idiopathic thyreopriva) were subject to exacerbations during pregnancy and lactation. Vassale and Generali early in their important work on the physiology of the parathyroids (1896) noted that animals with partial parathyroidectomy, showing few if any symptoms of tetany, developed severe manifestations of the disease in pregnancy and the puerperium. The experiments of Erdheim, Pineles, Thaler and Adler have served to confirm and elaborate their observations. Vassale would refer considerable importance to parathyroid insufficiency in the production of eclampsia, and Zanfognini is inclined to think he has seen good results follow administration of an extract derived from beef parathyroids.

6. Tetany following extirpation of the thyroid or, as we know now, of the parathyroids.

7. Tetany in association with other nervous diseases—brain tumors, syringomyelia.

In recent years the essential identity of symptomatology in the tetany of these different groups has sought explanation in a possible common cause—the insufficiency of the parathyroid glands. In 1880 the Swedish anatomist, Sanstroem, described certain small glands constantly to be found in the neighborhood of the thyroid and distinctly different from accessory thyroids; these he names parathyroid glands. This anatomic fact was confirmed by other observers, but was first vitalized by

the brilliant experiments of Gley, who found that tetany following operations on the thyroid was due to loss of the parathyroids and not the thyroid. Vassale and Generali removed the parathyroids alone and left the thyroid uniformly producing tetany. From the work of these authors, of Jeandelize, MacCallum, Erdheim, Pineles, Biedl and a host of others it has been firmly established that tetany follows extirpation of the parathyroids in all animals. Tetany in man after thyroidectomy is no longer, therefore, attributed to loss of thyroid function, but to removal or injury of the parathyroids. Simple thyroidectomy leads to myxedema alone.

The etiologic unity of all forms of tetany on a basis of parathyroid insufficiency, first suggested by Jeandelize in 1902, has received the support of such investigators as Chvostek, Pineles and Escherich. Pineles has pointed out that not only are the common symptoms identical in the various groups, but that rarer ones, such as cataract, loss of hair and nails, epileptiform attacks observe the same rule. Frankl-Hochwart has shown that tetany of all varieties is subject to the same seasonal fluctuations; most cases occur in March and April, the flood tide being in March. Very few cases are met with in summer or fall. The fact that chorea is most common in the spring months is of interest in this connection. There is yet no satisfactory pathologic evidence that the various forms of tetany depend on parathyroid lesions. In Escherich's clinic Yanasse found hemorrhagic changes in the glands in thirty-three out of eighty-nine children who had presented tetanoid symptoms. MacCallum and Koenigstein reported proliferative cell-changes suggesting hyperfunction in cases of gastric tetany. Erdheim found the parathyroids perfectly normal in two cases and Opie could find nothing abnormal in a case reported by Kinnicutt. Chvostek has assumed circulatory disturbances with disturbed function as the cause of symptoms even without morphologic changes in the glands.

Although it seems to me premature to adopt the theory of parathyroid insufficiency as the cause of all the clinical conditions to which the name tetany has been given, the vital importance of the glands cannot too strongly be impressed on the mind of the clinician and the surgeon. The anatomic relations of the glands are best shown in these plates from Halsted and Evans and Ochsner and Thompson. "With great regularity these little epithelial bodies are situated on or very near the posterior border of the lateral lobe of the thyroid gland and more or less in line with an important landmark, the 'channel' of anastomosis between the superior and inferior thyroid arteries" (Halsted). The dangers in thyroid operations are chiefly from crushing or from interference with the blood-supply and the safest procedure would seem to be the "subcapsular" operation of C. H. Mayo, with very careful ligature of vessels as near the gland as possible.

Injury of the parathyroids at operation is not necessarily followed by fully developed tetany. In animals with apparent complete parathyroidectomy a peculiar slow cachexia has been observed. In partial thyroidectomy chronic nutritional and trophic disorders such as loss of hair, emaciation, changes in the teeth have been described. Halsted has given a graphic account of post-operative symptoms following thyroidectomy due to insufficiency of the parathyroids. Peculiar nervous states—*anxiety*, waves of numbness and paresthesias, prostration, depression, coldness of the skin, slight hard edema of the legs, arthritic pains, loss of weight—were noted during a long period of observation. Alarming symptoms of the earlier days after operation were relieved by

large doses of dried parathyroid glands and the later condition of invalidism with its manifold distressing symptoms was almost entirely cured by subcutaneous administration of the parathyroid nucleoprotein prepared by Beebe. Halsted has proposed the names *hypoparathyreosis* or *status parathyreoprivus* for the condition. The readiness with which such states could be mistaken for hysteria or neurasthenia is obvious. As will be noted later they occur apart from operative injury to the parathyroids. They are the cases of "latent tetany," chronic tetany or tetanoid conditions described by Frankl-Hochwart, Chvostek, Schlesinger and others.

Lundborg has written most entertainingly of the relations of tetany to other spasmodic affections such as myotonia congenita (Thomsen's disease), myoclonia and paralysis agitans, and has referred them all to parathyroid insufficiency or hypoparathyroidism. On the other hand, he would regard myasthenia gravis and periodic myotonia as affections due to hyperparathyroidism—or dysparathyroidism. Chvostek has recently adopted this view of myasthenia gravis and Berkeley and Camp have seconded the hypothesis of Lundborg concerning paralysis agitans. R. L. Thompson, who compared the parathyroids from nine cases of Parkinson's disease with those of thirty-nine cases of individuals who died of other diseases, failed to substantiate such theory; he writes: "The parathyroid glands in individuals dying with this disease (paralysis agitans) present no change either in number, size, position, or histologic structure that would serve to distinguish them from the parathyroid glands in individuals dying from other diseases."

The exact manner in which parathyroid removal or disease gives rise to tetany is not yet determined. The present state of our knowledge is excellently reviewed in the recent article by Beebe in Hare's "Modern Treatment," from which the following quotation is taken:

"We may summarize the present ideas in regard to this matter by stating that one set of investigators maintain that a deranged calcium metabolism is the origin of the disturbance, while others believe that it is an essential damage to the nitrogenous metabolism. McCallum and Voegtlin find that parathyroidectomy is followed by an actively increased excretion of calcium, amounting to a calcium diabetes. The evidence in favor of what may be called the calcium deficiency theory may be summarized as follows:

1. There is a low retention of calcium during the eclamptic period of gastric tetany, a condition probably similar to that of tetany parathyreoprivus (Cybulski, Pineles).
2. Surgical removal of the parathyroid gland is followed by an increased excretion of calcium, and the brain of an animal dead of tetany contains less calcium than is found in the brain of a normal animal (McCallum and Voegtlin).
3. Intravenous administration of a soluble calcium salt promptly relieves the symptoms of tetany parathyreoprivus.
4. The inactivation of the circulating calcium by means of intravenous injections of trisodic citrate is accompanied by muscular twitching and convulsions identical in character with those of tetany, and these may be relieved by the injection of soluble salts in sufficient quantity to restore the equilibrium (Sabbatini).

The evidence in favor of the symptoms having their origin in a metabolic toxin may be summarized as follows:

- I. The symptoms have a central origin.
- II. Symptoms are shown best in young animals, and are more severe if the animal has been kept on a meat diet.
- III. The symptoms have close relation to certain clinical conditions which are accompanied by severe nutritional disturbances.
- IV. Gastric tetany is accompanied by severe metabolic disturbance, it has similar symptoms, and is promptly relieved

by intravenous calcium injections and by parathyroid nucleoprotein.

V. Bleeding, followed by intravenous infusion, relieves the animal, a procedure well suited to free the body from a circulating poison.

VI. Symptoms are promptly relieved by the injection of fresh parathyroid nucleoprotein.

VII. Injection of known simple poisons, such as ammonia and xanthin, produce symptoms which can be promptly relieved by the injection of calcium or strontium salts, similar to the relief obtained by the same means in tetany.

VIII. Parathyroid tetany has a deranged metabolism, accompanied by a large increase in the excretion of ammonia.

It is certain that the symptoms are caused by removal of the parathyroids and that they may be relieved by the administration of parathyroid protein. For therapeutic purpose, the most effective method of administering the gland extract is hypodermic injection.

CLINICAL REPORTS

CASE 1.—In February, 1906, a man aged 50 was seen in St. Luke's Hospital with severe gastric symptoms. There was a definite history of ulcer some ten or twelve years previously, with a period of comparative health following, and of vomiting attacks during the last two years. During the last six months the man had been in hospital several times with typical symptoms and signs of a greatly dilated stomach. Three or four quarts of material would be vomited at different times. Examination of the content showed free hydrochloric acid and sarcine. There was most marked gastric peristalsis. Operation was obstinately refused and therapy was limited to diet and lavage. Two weeks before the final examination the phenomena of tetany were looked for but not found. After leaving the hospital, the patient had several severe vomiting spells, and on the day previous to being seen, had a convulsive seizure which lasted some hours, and was succeeded by stupor. When seen there were typical spasms of hands and feet with involvement at times of the abdominal muscles and of the mouth and eyes. There was low delirium and no complaint of paresthesias or pain. The Chvostek and Trousseau phenomena were readily demonstrated. The seizures lasted a few minutes only and were repeated several times during the day. No vomiting occurred. The patient was given salt under the skin, thyroid extract by mouth and rectum, and bromid and chloral enemata. Stupor gradually deepened and death occurred forty-eight hours after the first seizure.

CASE 2.—In April, 1907, a woman of 40 was seen in consultation because of attacks of vomiting severer than any of those to which she had been long accustomed. There was a history of indigestion dating back fifteen years. From the occurrence of severe pain in previous attacks and of blood vomiting, there was no doubt of a chronic ulcer as the chief cause of the condition. For three years she was known to have had pyloric stenosis and a dilated stomach. With careful dieting and stomach washing she had been fairly comfortable, but in the last month, had been losing weight and strength. The amount of material vomited was far in excess of what she had taken—as much as six quarts were collected in twelve hours. Previous examinations had shown hyperchlorhydria and constant presence of sarcine. In the past two weeks she had grown extremely nervous, had slept badly, had grown weak, and twice, after having the stomach washed and emptied of several quarts of stagnating content, had suddenly lost her sight, complained of general numbness and had lost consciousness. On examination stomach-splashing was elicited just above the pubes, the stomach outline was plainly apparent and waves of peristalsis rolled across the hypogastrium. There was a peculiar anxious, rigid facies that suggested examination for the phenomena of tetany. A history was elicited of painful cramps in the left leg and arm during the past month, and of numbness and tingling of the hands apart from the vomiting attacks. The Chvostek, Trousseau and Hoffmann signs were more marked and contraction of the abdominal muscles could be occasioned by percussing the epigastrium. There were no signs of organic nervous disease. The eye-grounds were normal. The thyroid was moderately

enlarged. Operation was strongly urged, but was refused. The patient fell into the hands of a quack and died two months later.

CASE 3.—A woman aged 31 was first seen April 5, 1905. She had facial crysipelas as a child and always had considerable nose and throat trouble. This, by the way, has an important bearing on thyroid disease. For five or six years vomiting had been frequent. The least nervousness would bring it on. Sometimes there was nausea but most often not. Two years previous there had been severe recurring cramps in the right hand and arm and she had to stop work as a bookkeeper on account of this and extreme nervousness. The past year there had been palpitation, trembling and sweating.

In 1901 curettage was done for painful and irregular menstruation, with relief for six months. In October, 1904, the patient was curetted again and this was followed by infection, with considerable pain about the appendix and up along the colon. Her first examination suggested a *fruste* form of exophthalmic goiter. There was a moderate goiter, marked tremor of eyelids, tongue and hands, Moebius' sign positive, pulse 90 to 100. One sister had a moderately enlarged thyroid.

After long observation it became apparent that she had a dilated ascending colon and cecum, due presumably to adhesions of the hepatic flexure, of gall-bladder or stomach origin, or possibly a result of infection following curettage. Under bromids and rest the thyroid symptoms disappeared. There was ptosis of the stomach with atony, ptosis of the colon, but very little displacement of the kidneys.

In August, 1906, Dr. W. I. Terry made an exploratory incision and found extensive adhesions about the hepatic flexure, with an acute kinking of the colon. There were some adhesions of the colon to the duodenum, but no gastric or duodenal ulcer was demonstrable. The adhesions were freed and nothing further done. Recovery was made eventful by persistent cramps in the thigh and calf muscles. No signs of tetany were elicited. The patient did not do well, and in October, 1907, signs of more serious stomach trouble became apparent. The stomach became dilated, the lesser curvature being 2 cm. above the umbilicus, and the greater curvature reaching into 2 or 3 cm. above the pubes. There was no visible peristalsis, but vomiting was more frequent and stomach tests showed stagnation. Free hydrochloric acid varied from 27 to 35, and total acidity from 47 to 65.

Under regular lavage, improvement took place for a time, but operation was demanded later by the continued vomiting, pain and malnutrition. Dr. Terry operated in February, 1908. There were dense adhesions about the hepatic flexure and pylorus, the stomach was greatly dilated and prolapsed, the transverse colon was long and hypertrophied. Adhesions were loosened and a posterior gastro-enterostomy done. Owing to encasing of the pylorus in adhesions a Finney operation was not deemed possible.

During the days following operation there was much vomiting, often of large amounts of greenish fluid. On the 17th another of these attacks occurred and stomach peristalsis was seen. Sudden loss of vision for a few minutes occurred next day. There was much complaint of general pain and aching in the muscles. On the 19th there was vomiting of 900 c.c. at one time and this was followed by an attack of faintness, numbness and tingling in the extremities. A stomach-tube, which was well borne up to this time, now caused great distress and a feeling of constriction in the throat, and its use was discontinued. On the 21st Chvostek and Trousseau phenomena were quite marked and there was a spontaneous spasm involving the hands, arms and feet. During the next three days these typical paroxysms of tetany were repeated several times a day. They seemed to follow vigorous peristalsis of the dilated stomach, which caused intense abdominal pain, or they were brought on by excitement or other emotion. In several seizures there was great distress in the chest, a feeling of constriction in the neck and throat, and rigidity of the muscles of the face. The vomiting continued and the patient was given large amounts of water in order to wash the stomach out without the use of the tube; food was discontinued by stomach and enemata of salt solution were given every four or six hours. As the attacks continued, treatment with parathyroid

extract was begun, at first dried powder and later by hypodermics of an aqueous solution of the nucleoproteid from beef parathyroids. These extracts were prepared by the method kindly given me by Dr. McCallum. The use of the parathyroids seemed both to Dr. Terry and myself to have a distinct influence in controlling the attacks. After February 26 there were no spontaneous spasms, although there would be occasional complaint of paresthesias in the hands. Chvostek and Trousseau phenomena could be elicited on almost every examination.

It became apparent that the patient could not be kept alive under existing conditions and on March 1 an enterostomy was done by Dr. Terry in order to shunt out the stomach and permit of sufficient feeding. Consequent on the patient's removal to the hospital and the preparation for operation, spasms of the arms and feet returned. The spasms were much more marked in the left arm, as had been noticed a number of times previously. Operation was done under ether and it was interesting to note that during the operation, although reflexes were everywhere abolished, the rigidity of the hands persisted. Throughout the operation also, there was a rhythmic tremor in the interossei muscles identical with the tremor of Parkinson. There were four to six oscillations to the second and the movements of the fingers, when coming out from ether after the spasm had relaxed, were the same as in paralysis agitans. At the end of the anesthesia, the electric irritability of the hand muscles was tested both to faradism and to galvanism and found to be greatly increased. Unlike what is usually noted, there seemed to be the same increase of irritability to faradism as to galvanism.

As a precautionary measure, two or three doses of parathyroid extract were given subcutaneously and for a few days three hashed-up beef parathyroid glands were given through the enterostomy tube. For three or four days the patient did well, but after that vomiting occurred, there was great complaint of abdominal pain and it became apparent that there was regurgitation from the jejunum into the stomach. Despite the vomiting, considerable food passed into the bowel and marked attacks of tetany did not recur. There was still complaint of paresthesias and the Chvostek phenomenon could at times be obtained. The patient's general condition for a long time was miserable. She was unable to see well, but an examination of the eyes by Dr. Alexander failed to show cataract or fundus changes. Gradual improvement took place during April and May and the patient was able to go to the country. Death from drowning occurred the same summer through an unfortunate automobile accident.

It is interesting that the attacks of tetany came only after gastroenterostomy. Signs of it were looked for but never found until some days after the first operation. It is noteworthy in the history that severe cramps occurred after the first operation and that the patient had for years been subject to muscle cramps in different areas. The spasms seemed to be excited by violent peristaltic contraction of the stomach or by emotional disturbances. They did not seem to have any particular reference to the amount or character of the vomitus. After operation, although the vomiting continued, peristalsis of the stomach almost wholly ceased, and with this cessation the attacks of tetany disappeared. The toxic theory of gastric tetany would hardly seem to be borne out by our observations.

CASE 4.—In December, 1909, a man of 48 was seen on account of stomach symptoms dating back seven years. For three years distress, vomiting, pain and occasional blood vomiting had been the chief symptoms. Then he began to vomit large amounts occasionally and to notice residue from meals eaten days before. Since beginning the regular use of the stomach tube there had been comparative freedom from vomiting and serious attacks until the spring of 1909. He then grew very weak and nervous, was troubled greatly by numbness and twitching in the extremities, with spasmodic seizures involving the hands, feet and calf muscles. Two days before being seen he vomited and subsequently had numbness of the extremities and cramping of the hands and feet. Examination Dec. 10, 1909, showed a tremendously dilated stomach with peristaltic stiffening on tapping the epigastrium, and 1,000 c.c. were evacuated after an Ewald meal, with grape-

seeds said to have been eaten three weeks previously; free hydrochloric acid 24, total acidity 104, sarcosine numerous. The man was emaciated, weak and nervous. The Chvostek, Trousseau and Erb phenomena were all positive. Deep reflexes were increased. The thyroid was not enlarged. The urine contained a slight trace of albumin. After three days' preparation with lavage, salt solution by rectum and 4 gm. (60 gr.) calcium lactate daily by mouth, he was operated on by Dr. Stanley Stillman. A greatly dilated stomach with marked stenosis of the pylorus was found and a posterior gastro-enterostomy was done. Recovery from operation was uneventful, there were no signs of tetany when examined three weeks later and the man was well when last heard from six months prior to this report.

Three other cases of gastric tetany, with less typical symptoms, might be reported in detail if time allowed. In a woman of 28 seen in March, 1909, dilatation of the stomach resulted from duodenal adhesions following gall-bladder disease. Operation relieved the condition and tetany did not recur.

In a man of 50 seen in February, 1908, epileptiform attacks ended in stupor and death. At autopsy the stomach was found tremendously thickened but not dilated; there was pyloric stenosis of long standing.

A man of 40 was seen in consultation in January, 1910. There had been symptoms of a dilated stomach for two years and severe tetanic seizures had been occurring in the last month. The man was moribund when seen. No autopsy was obtained.

Gastric tetany was first described by Kussmaul. It is, on the whole, a rare condition. Fleiner, in 1903, collected reports of forty cases and reported eight of his own. Since 1903 there have been reports of about thirty additional cases. The condition is generally associated with ulcer of the stomach or duodenum, with resulting stenosis and gastric dilatation. Most of the cases have been with benignant stenosis, but several cases of carcinoma have been reported. Cases have occurred with stenosis of the duodenum due to pressure from a pancreatic cyst or following stenosis due to gall-stone ulceration or from stricture of the bowel lower down. Warbasse has reported a case of tetany due to foreign bodies in the stomach, with cure after removal of the offending agents. As a rule hyperchlorhydria has been found, but this is not at all necessary, as several cases have been reported with an acidity. All degrees of spasm may be noted and isolated muscle cramps should always suggest, when they occur in a patient with pyloric stenosis, with or without a dilated stomach, the possibility of latent tetany. It is necessary in these cases, to test the Trousseau, Chvostek and Erb phenomena. In the majority of cases, however, gastric tetany is of a severe type, is of bad prognosis and in a great majority of the cases reported the patients have died. In 1898 Mayo Robson reported several cases of gastric tetany in patients treated by gastro-enterostomy, and since then about thirty patients thus treated. The results are far more favorable than by any other method and it becomes our duty to urge operation in all cases.

As noted above, it has been attempted to refer gastric tetany, as the other forms of tetany, to parathyroid insufficiency or to calcium deficit, but practically all questions concerning gastric tetany still await solution. We do not know why some cases of pyloric stenosis, particularly those associated with dilatation of the stomach, are followed by tetany while the great majority of apparently similar cases never show any symptoms of the disease. It may be perfectly well that in persons with parathyroid insufficiency brought about in other ways, the added intoxication from the stomach is suffi-

cient to call forth an attack. With removal of the stomach factor by operation the tetany is apparently cured. It would be interesting to observe such cases in future years and to see whether the tetany has actually disappeared or is merely latent. In women, pregnancy would be rather a crucial test of the completeness of the cure. It is worthy of note, as Frankl-Hochwart has indicated, that the gastric cases follow the general rule and are decidedly more common in the months from December to May. Of the cases above noted, one was seen in December, one in January, three in February, one in March, one in April.

CASE 5.—A married woman of 41 was first seen Feb. 28, 1908. She had two children 19 and 13 years of age; a pelvic infection had followed the first birth. She had lived for years in malarial districts but remembers no infections except so-called grip in the spring of 1905. In September, 1905, without obvious cause she had an acute collapse and was for some weeks prostrated and without appetite. Gradually she partially regained her strength but in May and September, 1906, she had a repetition of what she called her severe attacks. These recurred about twice a year, usually in spring and fall, apparently without cause. They were characterized by general nervousness, prostration, loss of weight and appetite, indefinite gastric symptoms and peculiar paresthesias—prickling and tingling of the extremities and numbness that comes in waves and extends all over the body. With this numbness was associated a peculiar anxiety, a feeling of "goneness" and of dread. The important data on examination were an absence of the usual physical stigmata of neurasthenia or hysteria, slight signs in hair and skin of thyroid insufficiency, a decided soft enlargement of the thyroid gland, enteroptosis with a large atonic stomach and a dilated colon. The pulse varied from 90 to 96, there was slight tremor of the eyelids and fingers. Pressure on the arms in the attempt to elicit the Trousseau phenomenon caused disagreeable paresthesias in the ulnar distribution and a general numb feeling such as she had already described. Neither Trousseau nor Chvostek signs could be demonstrated. A year later the patient was seen again with approximately the same sensory symptoms. During one of the periods of exacerbation in January, 1909, typical spasms of the hands had occurred. In April, 1909, Trousseau and Chvostek signs were both positive. Considerable improvement had occurred from abstaining from meat, regulation of constipation, small doses of thyroid extract and frequent administration of calcium lactate. The tetany was more probably due to parathyroid insufficiency, associated with the evident goiter and slight thyroid insufficiency, rather than of gastro-intestinal origin.

CASE 6.—A woman aged 45 was first examined March 22, 1909. She had always been subject to periodic headaches, evidently migraine. Her mother and mother's mother had suffered from headache of the same type. Both parents died of tuberculosis and in childhood she had had suppurations of the cervical glands and glands had been removed by operation. In recent years there had been some distress in the right hypochondrium at times, much flatulence and marked constipation. There had never been definite signs of appendix or gall-bladder disease. A laceration during birth of her only child, now 25 years old, had been repaired eight years previously and since that time she had not been so well. There had been occasional attacks of cramps in the muscles of the back of the neck and of the legs. She thought that her muscles had always been unusually sore and tender and she had always been bruised easily. Since an attack of bronchitis in January, 1908, she had felt weak and tired mentally and physically. The periods had become irregular the last few months. The facies suggested myxedema, which further examination confirmed. There was a large fat pad at the nape of the neck and tender pads were prominent over the back, arms and inside of the knees. There were old scars beneath the jaw and along the anterior margin of the right sternomastoid. The tissues below the jaw and over the front of the neck were decidedly thickened. The thyroid gland could not be felt. The eyebrows and scalp hair were thin, the temperature subnormal, the voice slow and

weak. The heart was moderately dilated; the urine contained a slight trace of albumin. The abdomen was lax and the colon dilated. The blood-count on two occasions showed a moderate secondary anemia, leukocytes 9,000 to 10,500, and a relative increase of mononuclear elements. There were no phenomena of tetany at this time. Under small doses of thyroid extract, 0.06 to 0.20 gm. (1 to 3 gr.) daily, she felt much better, headaches were less frequent and objective signs improved. Thyroid could not be taken in larger doses as it caused palpitation and dizziness. It was omitted in June and July, and in August, during a day of headache, there was numbness and tingling from elbows to the fingers followed by characteristic cramping of the fingers. On Aug. 31, 1909, there were strongly marked Chvostek and Trousseau signs. During the winter and spring of 1909-10, the attacks were controlled by occasional administration of calcium lactate, a diet without meat, and small doses of thyroid extract and arsenic. She went abroad in the summer of 1910 and took no regular treatment. On Sept. 21, 1910, she came complaining of a feeling of tension, aching and stiffness all over and not confined to the extremities as formerly. During the past weeks she had had painful spasms in the feet associated with arching and inversion of the foot. The Trousseau, Chvostek and Hoffmann phenomena were marked. The same night there were repeated severe attacks with general rigidity and contractions of the muscles of the abdomen, jaw and face. Under rest, diet, calcium lactate 4 gm. (60 gr.) daily for a week, and later on tablets of parathyroid extract, the attacks have been controlled. Her general condition at the time of writing is still far from good, however. Weakness, nervousness and paresthesia are prominent symptoms. The Chvostek sign is still positive; Trousseau sign not obtained. The prognosis is grave. Hypodermic treatment with the parathyroid nucleoproteid or transplantation of both parathyroid and thyroid glands is contemplated in the future.

Two months since a woman was sent me for examination on account of protean nervous symptoms. The history of peculiar epileptiform attacks and the presence of a most marked Chvostek phenomenon suggested the possibility of tetany, and treatment with calcium salts was advised. Only continued observation will decide if such cases are really *fruste* forms of tetany or hysteria. During the month previous to making this report a girl of 16 had been under observation to determine the nature of epileptiform seizures that had been recurring during the previous two years. There was a history of loss of consciousness with some of the attacks. Those seen in hospital were hysteroid and not epileptic. Since the age of 16 there had been irregular motor phenomena—twitching and jerking, but no tonic spasms. In the hospital the Chvostek sign No. 1 was constantly present and the Erb phenomenon most marked. The Trousseau sign was not elicited, but the Schlesinger leg phenomenon was obtained. This would seem a case of tetany plus hysterical symptoms, rather than hysteria. Treatment with calcium salts and parathyroid extract is indicated. In this connection may be mentioned the frequent association of tetany and epilepsy; Dr. C. M. Cooper has recently reported an instructive case of this type. An article by Saiz² reviews the literature of the subject. We may recall that reports are accumulating which show apparent benefit in idiopathic epilepsy from treatment with calcium salts. Other spasmodic affections, blepharospasm and other tic, seem at times to improve under calcium or parathyroid administration. Berkeley has reported definite improvement in eighteen of twenty-six cases of paralysis agitans in which the patients were treated for long periods by small doses of parathyroid nucleoproteid prepared after the manner described by Beebe.² I have records of three patients with Parkin-

1. Berl. klin. Wchnschr., Feb. 6, 1911.
2. Modern Treatment, 1, 501.

son's disease treated for months with fresh beef parathyroids and of one patient treated with injections of the nucleoproteid. No influence on the disease could be determined.

PROGNOSIS

Prognosis in tetany will naturally vary according to the etiologic factors and to the severity and acuity of the seizures. Operative tetany has become rare since careful methods of thyroid extirpation have been adopted and due regard paid to the preservation of the parathyroid. In gastric tetany the mortality is still 50 to 75 per cent. With prompt control of severe attacks by calcium intravenously or by hypodermic administration of parathyroid nucleoproteid, many more cases may be brought to operation and permanently cured. Frankl-Hochwart, from a recent review of fifty-five cases seen ten to fifteen years before, concludes that the prognosis of the idiopathic tetany is not nearly so good as was supposed. Of the patients eleven died, seven had chronic tetany, nineteen had slight symptoms described as "tetanoid," six had myxedema; only nine remained well.

TREATMENT

In the treatment of tetany causal factors should be remembered. In children rachitis should be treated with phosphorus and cod-liver oil. In gastric tetany surgery must remedy the underlying mechanical conditions that are the cause of stagnation, dilatation and intoxication. Emotional disturbances, exposure to heat or cold must be avoided. Meat should be excluded from the diet. Milk is well tolerated and may be of advantage by reason of its large calcium contents. Moderate catharsis and diaphoresis, saline irrigations and the ingestion of large amounts of water may be of slight value in elimination of metabolic poisons. Formerly thyroid preparations were frequently given and apparently with benefit. Kocher has seen disappearance of tetany symptoms under thyroid and thyroïd preparations. Frankl-Hochwart and others have seen no benefit from thyroid preparations; rather the reverse.

There can no longer be any question about the efficiency of calcium and parathyroid administration. In severe acute attacks, whether postoperative, idiopathic or of gastric origin, 3 to 5 gm. (45 to 75 gr.) of calcium lactate in 400 or 500 c.c. of normal salt solution should be given intravenously. The action of calcium on control of symptoms is evanescent and the dose may have to be repeated in twelve or twenty-four hours. The parathyroid proteid prepared according to the directions of Beebe is of equal value and should be given hypodermically, 1 c.c. of a 1 per cent. solution every three or four hours for two or three days and then less frequently. Good results from both calcium and the parathyroid proteid in chronic cases have been reported by Beebe, MacCallum, Halsted, Putnam, Poole and others. Dried extracts of the gland have proved less efficacious. Pal reported marked benefit from the use of pituitary extracts in a boy with severe tetany. Ott from experiments on cats concludes that pituitary extract given hypodermically is equal to calcium in the control of spasm. In man the 20 per cent. infundibular extract that is now on the market may be given intramuscularly 7 to 10 drops three times daily. Transplantation of the parathyroids may be of great service in the future in chronic cases of tetany. Christiani has transplanted parathyroids in rats and cats and found the grafts successful after periods of two to five years. Von Eiselsberg transplanted a parathyroid obtained during a goiter operation into the rectus muscle of a woman suffering

from chronic tetany, the result of a total thyroidectomy that had been done twenty-seven years before. The tetanic seizures disappeared except for occasional slight spasms of the glottis and electrical irritability became normal.

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A REVIEW OF 542 CASES OF PROSTATECTOMY*

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Included in this study are all of the cases in which a total or partial prostatectomy had been performed previous to April 1, 1911, in St. Mary's Hospital. Four hundred and sixty-one operations were performed for benign hypertrophy of the prostate, seventy-four for cancer, and seven for tuberculosis. The relative occurrence of cancer and hypertrophy was about one in six. Cancer and hypertrophy were observed together in several instances.

Although we were unable to determine any specific etiologic factors in this type of hypertrophy, the cases under our observation differed in this respect from those reported by von Frisch¹ and others. We noted that the condition occurred twice as frequently in men living in the country as in those living in the city. Only a small percentage of them had ever had specific infection.

The greater number of these patients were operated on between the ages of 60 and 70 years. In the series of 542 cases, eleven were under 45 years, 105 were from 50 to 60 years, 268 were from 60 to 70 years, 131 were from 70 to 80 years, fifteen were over 80, and the ages of the remaining twelve were unknown.

Regarding the civil state: 417 were married, ninety-four were widowers and nineteen were single.

The average duration of symptoms before the patient came for operation was 5.96 years. Although we have not chosen our patients because they were good risks for operation and have operated on patients many times that we knew had lesions of vital organs, we have endeavored to operate only on patients whose specific symptoms were dependent on prostatic enlargement. In our experience it has not always been easy to determine this point.

The primary symptoms of mechanical obstruction at the neck of the bladder are frequency, burning, pain and tenesmus. The secondary symptoms are loss of appetite, insomnia, loss of strength and weight. These secondary symptoms may be caused by damming back in the ureters and pressure in the kidneys; or they may be caused by intoxication from the presence of residual urine. The symptoms are identically the same and are probably caused by the same factors which produce symptoms in patients having insufficient kidney elimination. It is then very important to determine whether the patient is suffering from renal insufficiency alone, or whether he is suffering from auto-intoxication resulting from absorption and interference with kidney function, which interference is caused primarily by mechanical obstruction of the enlarged prostate.

Thompson² and Guyon³ state that 34 per cent. of men 60 years of age and over are affected with genuine hyper-

* Read in the Section on Surgery of the American Medical Association, at the Sixty-Second Annual Session, held at Los Angeles, June, 1911.

1. von Frisch, A.: Die Krankheiten der Prostata, Leipzig, 1910.

2. Thompson: Quoted from Die Krankheiten der Prostata by von Frisch, Vienna.

3. Guyon: Quoted from von Frisch.