being in good apposition, there being but slight overlapping. The patient had a very low resisting power; at the end of ten weeks the wound had completely healed, with non-union. Operation was performed twelve weeks after admission. Following the traumatism of the muscles, there developed a streptococcus infection of the muscles, which had existed prior to the closing of the primary wound. Free drainage was established, the pus being quickly evacuated. The wound healed by granulation, the patient making an uneventful recovery. The wounds in the remaining cases healed by first intention, with good, firm bony union. In five cases there was an excess of callus, which caused pain, the patients requesting that the plates be removed. Fifty cases have been traced, the end-results being very satisfactory. In the cases in which both the tibia and fibula were fractured, I have found it necessary to plate only the tibia. There were three cases in which the fibula was broken in two different places. If the tibia is correctly approximated, the fibula will usually be found in reduction. Of the seventeen cases in which it was found necessary to remove the plate, eleven were compound fractures of the tibia, two, simple fractures of the tibia, two on the femur, and two on the clavicle. Where the plate can be buried and well covered with muscles, few plates will necessitate removal. In three cases (femur), the plate broke at the junction of the bar and first screw hole. The condition was early recognized in two cases, the bones being replated, no injurious effect resulting. In the third case, the plate broke some time after the seventh day, the condition not being recognized until the tenth week. There was an angular deformity, with large callus, with good bony union. There was slight interference of function. I have been able to collect twenty cases in which the plate has broken. In order that this mechanical and structural weakness may be overcome, a new vanadium steel plate, patterned after the standard eye-bar (used in bridge construction), has been designed. This plate will withstand, without breaking, any reasonable strain placed on it.

CONCLUSIONS

1. Fractures of long bones should be treated by the open method and the bones plated, if it is found that reasonably accurate approximation cannot be secured by splints, extension and other mechanical appliances.
 2. There is no evidence to justify the assertion that the presence of a foreign body is the exciting cause of rarefying osteitis.
 3. There would be fewer cases of non-union if the faulty approximation were early recognized and corrected.
 4. It is very necessary to have the proper operating equipment and to exercise a most rigid technic. The periosteum should be preserved and tissues handled with delicacy. The operation should be done quickly; thoroughness, however, should not be sacrificed for speed.
 5. The uncertainty of continuous approximation during convalescence, caused by restlessness, delirious patients, or accidents, is obviated by the use of plates.
 6. It will be found necessary to remove the plates and screws in the majority of the compound cases, the plate causing sufficient irritation to allow of the persistence of a small sinus.
- I firmly believe that there is a large field of usefulness for the steel bone plate. Its use will have to be delegated to those whose experience renders such operative work reasonably safe and certain, in order to prevent many of the failures which have happened in the past, and

which were a reproach to the profession. They have been forgotten or excused because no better results were obtainable. This excuse will not hold good to-day. The question of operation must be based on personal experience and judgment.

With the advent of the stereoscopic x-ray plates, we have learned many of the shortcomings of the former method of interpreting plates. The accurate reduction of fractures is becoming more exact and we, as a profession, will be held responsible for many of the defects due to faulty judgment and treatment, if the present treatment is not kept abreast of modern surgical advances.

Recent experiments prove beyond all doubt the superiority of vanadium steel over the high carbon steels formerly used in the manufacture of bone plates. I have collected reports of twenty cases in which the high carbon plates have broken at the weakest point, i. e., junction of cross-bar and first eye.

A new vanadium steel bone plate has been designed which overcomes the mechanical and physical weakness of the old plates. It combines maximum strength with minimum of steel.

A self-tapping machine screw should be used in place of the wood screws heretofore used, on account of the added strength and mechanical advantages gained. Many of the failures of bone-plating operations have been due to lack of consideration of the mechanical features involved.

NOTE.—Since the above article was written, twenty-one additional patients have been operated on with uniformly good results, making at total of seventy-six cases.

Carnegie Building.

A CASE OF ASTHENOBULBOSPINAL PARALYSIS (MYASTHENIA GRAVIS)

ALLAN McLANE HAMILTON, M.D., F.R.S.E.

NEW YORK

That rare disease known as myasthenia gravis is one in which there is a curious train of symptoms, the chief characteristic being a peculiar exhaustion which is confined to the voluntary muscular system, and which is aggravated by repetition of functional acts, the asthenic muscles being those that have generally been used the most.

This species of weakness does not necessarily end fatally, unless it be due to some serious lesion, but the prognosis on the whole is bad. There are some patients who have been apparently rapidly cured, although this sometimes seems incredible when we take into account the general and appalling disturbance of function; and it is probable that when lost sight of they have relapsed.

There are several forms of myasthenia gravis, the most common and important of which is the bulbar variety.

As Mills¹ has pointed out, certain cases have been described as "asthenic bulbar paralysis," and others as "asthenobulbospinal paralysis" with reference to the relative predominance of symptoms due to the exhaustion of the bulbar or spinal motor centers. He refers to such examples as does Paul,² who reports an interesting history. To the same form of disease Sir William Gowers,³ in 1902, applied the term "myasthenia bulbaris," presenting three well-described cases.

1. *Med. Fortnight.*, St. Louis, June 26, 1905.

2. *Boston Med. and Surg. Jour.*, cixii, 281.

3. *Brit. Med. Jour.*, May 24, 1902.

Naturally there is a difference in the onset of symptoms in the two forms, there being ophthalmoplegia, paralysis of the levator palpebrarum, and orbicularis, the masseters, zygomatic and risorius muscles, as well as those of the palate, which symptomatize the bulbar variety; while the spinal is ushered in by an asthenic condition of the muscles of the trunk and extremities.

Such paralysis is rarely symmetrical, and there may be a great variation in the susceptibility to overexhaustion. In most of the important cases the bulbar symptoms are coexistent with those presented elsewhere, or closely follow them.

Variable and inconstant manifestations consist in the behavior of the reflexes, and the muscular susceptibility to electrical stimulation. In a fair proportion of the cases the electrical reactions described by Jolly may be observed, and these consist in the lessened irritability of the muscle after moderate electrical tetanization, or the failure to contract after repeated contact. So far as the reflexes are concerned there are some cases in which the activity of the knee-jerks is either diminished or absent, but as a rule they are unaffected or even exaggerated. In more than one example the cremasteric and abdominal reflexes were absent. It has been found when the reflexes were present that repeated local tapping had no effect in diminishing their activity.

Such negative symptoms as absence of fundal changes, conservation of pupillary activity, absence of anesthesia and other sensory phenomena are to be regarded. Atrophy is never found, nor is muscular fibrillation, and of course there is no reaction of degeneration. Ankle-clonus and Babinski symptoms are absent, while there is no paralysis of parts supplied by the levator labii superioris, the hypoglossus, vagus and glossopharyngeal nerves. There is an absence of hysterical symptoms in true cases, although the latter have been occasionally found in connection with myasthenia gravis, and Mills has reported such symptoms in one case. Paul regards the regurgitation of fluids as a symptom only of the true disorder, and he thus distinguishes it from hysteria.

Up to recent times little has been known regarding the morbid anatomy of myasthenia gravis, but we are indebted to the interesting investigations of Mandelbaum and Celler,⁴ who have collected and analyzed the reported cases of a number of observers, among them Senator, Oppenheim, Burr and McCarthy, Link, Fujoni, Liefman, Eisenlohr, Jolly, Hun, Buzzard, Marburg, as well as many others.

The first-named assert that the disease is due more often to a neoplasm or other lesion of the thymus gland which probably gives rise to toxemia, while in nearly all well-observed cases there is a lymphocytic infiltration of the muscular fibers, the adrenals, liver, kidneys and thyroid, which is not the result of an inflammatory reaction. In one case there was chromatolysis of cells in the medulla and pons, but it would seem as if the affection had really some direct association with lesions of the thymus.

The following case is one which is of interest because of the improvement that followed treatment with the thymus gland.

Patient.—J. L., a girl, aged 14, was brought to me by her father during the spring of 1903. She was a native of the island of San Domingo and her parents were double first cousins. She was one of four children, one of whom died at the seventh month from gastro-enteritis, while the second died in her sixth year, probably from acute ascending paralysis.

There is no family history of alcoholism, tuberculosis, or disease of the nervous system; the father appeared to be a healthy, vigorous man.

History.—The patient, who was large for her years, was quite well until two years previously, and had had no infantile disorders of moment. About this time her present trouble began in the lower extremities, there being difficulty in flexing the right thigh, and at the same time there was some weakness of the upper extremities. The child, who was precocious and somewhat of a composer and pianist, a few months later found difficulty in striking the keys of the piano. The third and ring fingers of the right hand were first affected so that she could not extend them. Six months later both arms became weak, and at the same time there was some return of power in the right lower extremity which at present is not so weak as the other side. In the beginning there was drooping of both upper eyelids, and a history of pain in the back of the head, and in both arms and legs. These pains now occasionally recur but seem more in the nature of an ache. There is no anesthesia of any kind.

Examination.—At the time of her visit there appeared to be a general weakness manifested in the performance of every voluntary act, which increased with repetition, but on the right side it predominated. The left hand was unaffected except that it was impossible to adduct the thumb. There had for a year past been some weakness of the orbicularis oris and the masseters. This condition and embarrassment in the use of the tongue which seemed to be moved awkwardly and with difficulty, although it was not paralyzed, produced a difficulty in eating. Another result of this weakness was that her speech was clumsy and ataxic. There was some drooping of the lower lip so that there was slight escape of saliva and when she swallowed it was common for liquids to escape from her nose. When the tongue was protruded it deviated slightly to the right side. The facial muscles were atonic, and there was no play of expression; she could not whistle and when she attempted to smile there was some weakness more apparent on the right side and depression of the corners of the mouth. There was distention of the ala nasi. The double ptosis gave the patient a sleepy expression, and when she slowly opened her eyes, or they were opened by others, the left eyeball was found to be drawn upward and inward; there was at times diplopia. Her voice was more feeble than formerly. When lying down or sitting she could not arise without assistance. All the muscles of the back appearing to be the seat of weakness, while the weakness of shoulder muscles was shown in her inability to bring her hand to her face; in fact, she sometimes could not raise either arm. She could walk but a short distance and rapidly tired. It was noticeable that the muscles used most were those soonest fatigued. There appeared to be weakness of the right anterior tibial muscles, and some apparent spasm of the right soleus, and of the left to some extent. There was resulting spasticity of both legs and a titubating walk, the patient making contact with the ball of the feet; this disappeared at times. There did not appear to be any muscular hypertrophy or atrophy of the lower extremities, but there was a suspicious flatness of both deltoids, suprascapulae and triceps; both knee-jerks were gone, superficial reflexes present, no ankle-clonus; other organic functions were unimpaired; no myasthenic electrical reaction; no reaction of degeneration. The pulse was always quick, ranging from 70 to 90.

Treatment and Course.—After her return to the West Indies, I from time to time received reports from the patient's father which were not altogether encouraging, although on the whole her condition was greatly ameliorated by treatment, which was more or less empirical.

I had at first prescribed thyroid extract with very bad results, but after taking into consideration the theory that the disease was due to some affection of the thymus, in 1907 I prescribed 5 gm. of thymus extract thrice daily with apparent immediate improvement and this was continued. The report on April 10, 1910, showed that she was able to walk 150 yards, but that in exceeding that distance she became fatigued, her hands and feet became cold, and there was some palpitation. She could raise her arms naturally and could dress

4. Jour. Exper. Med., 1908, x.

her own hair. The movements of the shoulder are perfect. Her eyes are more open than before treatment, except that when she focusses them to read or write she feels pain in the right eye. The fingers are better. She can play the piano, but not with the ease she had before her illness. She has occasional pain in the neck and back of the head, and when she walks she has pains all through the body. She still has difficulty in masticating and swallowing, but less than before. She is less tired than she used to be. She retains her saliva. Her tongue is straight; expression normal; voice stronger. She is still lame; and again feels occasional pains in the head (not always). She often has cold feet and hands, and pains in the body on awakening.

She sent me a sonata composed by herself and wrote a well-expressed and legible letter. It may be stated that at no time has she shown any mental deterioration; on the contrary she has been a precocious, bright young woman and speaks two or three languages. I have had no occasion to suspect hysteria, but the complication of minor sensory symptoms and the spasticity even on the first occasion suggested an unusual syndrome.

It will be seen that the patient has survived for eleven years and has improved; I know of no case of the kind.

It would appear that a sister of J. L. died of undoubted acute ascending paralysis, and this may have some significance. That the latter malady is due to a toxemia, there can be no doubt, and it is possible, although I have not heard of such findings, that there may be some hypertrophy or disease of the thymus. I have reported elsewhere⁵ an example of a recurrent endogenous toxic psychosis, and since its publication the patient died from a well-marked Landry disease which was observed as well by the late E. G. Janeway, and by Gilman Thompson. Unfortunately, no autopsy could be made, so that I was unable to confirm my suspicions.

The variations and recurrence of symptoms in many of these cases, and the behavior of my own case under the administration of an extract of thymus gland, naturally raises the question whether the disease may not have had such an origin.

950 Madison Avenue.

"GAS ON THE STOMACH" *

THOMAS WRAY GRAYSON, A.M., M.D.
PITTSBURGH

The subject of this paper is in quotation marks, for this popular but inelegant phrase comes as near expressing my subject as any I can find.

In the beginning, let us consider what gas or gases are found in the stomach, although this has been investigated and the knowledge gained has resulted in little or no good. Observations have identified carbon dioxide, hydrogen, methane and acetylene, but in a vast majority of instances simple atmospheric air alone is present. It is only in the presence of true fermentation that carbon dioxide and other gases are found, and this fermentation takes place only when stasis is present.

Usually the gas, as I say, is atmospheric air swallowed with food, and this is its source in nine cases out of ten—yes, in ninety-nine out of a hundred. It is still a common practice among physicians to allow patients to think that food lies in the stomach and ferments and that this is the cause of the gas. At any rate, this is invariably the belief of our patients.

As result of ten years' observation of this condition the following is, to my mind, more nearly the case. In the first place, one cannot help swallowing a good deal of air with his food and drink. As a result of peristaltic action of the stomach and of the breaking down of the food by the gastric juice this air is liberated and accumulates in the upper or cardiac end of the viscus. Now, in a healthy person with normal muscular tone the cardiac orifice is not tightly closed and is easily forced open by a small accumulation of gas. This gas rises through the esophagus and finds its way out of the mouth or nose, attracting little or no attention even from the subject himself.

Some of this air may be absorbed through the walls of the stomach, although this is probably not the case. A small part of it may also pass through the pylorus with the food and be absorbed through the intestinal walls.

The above is the course of things in a healthy person. Now, when belching is a symptom of gastric or general disease, the course of things is entirely changed. I do not believe any more gas enters the stomach than in the healthy person, nor do I believe any more is expelled. In a vast majority of these cases a nervous hyperchlorhydria exists and these two words will explain the whole thing. The oversupply of hydrochloric acid in the stomach juice irritates the walls of the organ. In fact, this symptom begins to trouble the patient as soon as an excess of hydrochloric acid appears after a meal, and probably at first it is this discomfort (of the excess of acid) which is thought to be caused by the presence of gas.

This annoying symptom very rarely occurs except in nervous patients. The nervous or muscular hypertension holds the cardiac and pyloric openings tightly closed, the stomach-walls being irritated by the presence of the excess of the free acid. Hence, the cardiac opening will not relax easily and an accumulation of air takes place in the upper end of the stomach, as I have said above. Because this is in the bony chest it quickly gives rise to disagreeable symptoms, crowding of the heart, palpitation and sense of fulness and dyspnea.

In most cases, also, the presence of gas in the stomach is evident by percussion over the organ and the fulness and pressure symptoms in the epigastrium.

When this accumulated air forces its way through the cardiac sphincter it naturally attracts the patient's attention, both because of its quantity, and especially because the subject has his mind on his digestive tract and is ready to notice every symptom—just as the neurasthenic often notices and is annoyed by a perfectly normal beating of his heart.

Fearsome as it may be, this accumulation of gas is in no way dangerous, except in elderly patients in whom arteriosclerosis, some heart lesion, or some other serious condition exists and is complicated by the flatulence. Then we may have a fatal case of "acute indigestion."

I do not consider all cases in which we have much "gas on the stomach" as having this explanation. There are, of course, many cases of stenosis of the pylorus with stasis, and dilatation of the stomach in which the food lies in the stomach and ferments (even in the presence of hydrochloric acid); but I believe these cases are much rarer than we think, and when we encounter this symptom there is no true fermentation as a usual thing.

In some diseased conditions of the stomach or the neighboring organs we have the discomfort attributed by the patient to gas on the stomach, and then efforts to get rid of it are made. Of course, belching is a volun-

5. Hamilton: Tr. Med. Soc. London, 1896, xix.

* Read before the College of Physicians of Pittsburgh, March 14, 1912.