1,000 were digested by the gastric juice. Fourteen days later another test made upon the same patient, who in the meantime had taken HCl, showed a tube reading of 1.3; with albumin, 4.4. The difference of 3.1 shows 10.1 parts per 1,000 digested.

CASE II. Hyperacidity, with some dilatation, under the same conditions showed a tube reading of 3.9; with albumin, 5. The difference, 1.1, shows a digestive power of 3.6 per 1,000.

CASE III. Deficient motility. Reading of the tube with albumin, 8 (3 c. c. used and calculated for 6 c. c.); without albumin, reading, 7. Difference, 1 c. c., shows digestive power of 3.3 parts per 1,000.

CASE IV. Subacidity of neurotic origin. Reading of tube without albumin, 1.4; with albumin, 1.7; difference, .3. As the gastric contents were diluted with an equal amount of water, this factor must be multiplied by two, and equals .6 c. c., which gives a digestive power of 2 parts per 1,000.

Upon an examination of these results, one must be struck with the varying amounts of albumose peptone found in the pure gastric contents, and the question arises whether this cannot be a measure of the absorptive power of the stomach. We have excellent authority for this supposition. H. Tappeiner² and J. Brandl³ both declare that not only albumose peptone but also acid albumin, and possibly soluble albumin, are absorbed in the stomach.

These results have been further substantiated by experiments performed upon persons suffering from almost complete closure of the pyloric orifice by malignant disease, in which solutions of albumose peptone of known strength taken into the stomach and after intervals of two to three hours removed by siphonage, showed a loss that could only be accounted for by their absorption in the stomach.

Furthermore, Riegel⁴ states: "One can obtain an idea of the degree of the disturbance of absorption in the stomach by examination of the digestive products present in the stomach contents removed." In addition to this there appears to be a very unsatisfactory method extant of determining absorption. The method of Penzoldt and Faber,⁵ which consists of ingestion of iodide of potash in capsules, has proved very unsatisfactory, and Boas⁶ says: "According to my view, the time of elimination of iodide of potash is in no way a test of the absorptive ability of the stomach." Hence we are compelled to return to the question of the residual albumose peptone in the removed stomach contents as a possible measure of the absorptive power. This seems the more probable as it is incredible that only albumose peptone is poured into the intestine, and the less well-digested products remain in the stomach for further action. When, however, we find a large residual albumose peptone in the stomach, it may be due to faulty absorption or an unusually great activity of the digestive fluid present. But, in general, it seems reasonable to consider the following statement as justified: The less the percentage of albumose peptone present, the greater the absorptive power of the stomach; and, vice versa, the greater the percentage, the less the absorptive power of the stomach. If, then, we re-

gard this albumose peptone present as a measure of absorption, the digestive power of the gastric juice as a measure of its strength and activity, and the amount of gastric contents removed as a measure of motility, we have three factors which give us a fairly clear idea of the condition of the stomach. In order to get a clear idea of the correlative relation between these factors we will arrange the results of these five cases in a table, which reads as follows:

TABLE IV.

Nature of Case.	Amount Albumose Peptone. Per 1,000.	Digestive Power. Per 1,000.	Amount Removed.
Anacidity. First analysis.	4.6	6.3	128 c. c.
Second analysis.	4.3	10.1	105 "
Deficient motility.	13	3.6	135 "
Deficient motility.	23	3.3	100 "
Subacidity.	4.6	2	56 "
Gastric neurosis.	4	3.2	46 "

Upon looking at the above table we find these peculiar combinations: We may have good absorption, good digestive power and deficient motility, or we may have another combination of poor absorption, fair digestive power and deficient motility. These three factors once determined, in connection with the determination of the amount of rennin, make up an analysis which apparently affords us about all that chemical examination offers in the analysis of the stomach contents.

While it is possible that further examination and a larger number of cases may disprove these suggestions presented, yet it seems worth while to carry out this line of work until the truth or falsity of its deductions is proved. While chemistry can never completely supplant the means of physical examination presented to us, yet it must always form a powerful adjunct in the diagnosis of stomach disease.

Clinical Department.

NOTES FROM THE NEUROLOGICAL DEPARTMENT OF THE MASSACHUSETTS GENERAL HOSPITAL.

II. TWO CASES OF THOMPSEN'S DISEASE, AND ONE OF TRANSIENT MYOTONE, OCCURRING IN ONE FAMILY.

BY S. A. LORD, M.D., BOSTON.

CASE I. Howard J. G., an American of eighteen, came to the clinic on December 16, 1899, during the service of Dr. Walton, complaining of difficulty in opening the clenched hand, "crackling" in the joints, "prickling" in the limbs at times, and occasional numbness of the fingers and toes (but only when they became cold). He was "sickly" up to the age of nine, after which he became strong and athletic above the average (so he states), and lived as a farmer. When about twelve years old he began to notice a stiffening of the thigh muscles immediately after starting to climb upstairs, rendering him almost powerless to advance for several moments; this would then slowly lessen, full freedom and power of motion returning when two or three additional steps had been taken. The trouble grew more severe, so that in less than a year after the onset any considerable jar suf-

¹ Ueber Resorption im Magen, Zeitschr. für Biologie, vol. xvi, 1880, p. 497.

² Ueber Resorption und Secretion im Magen, Zeitschr. für Biologie, vol. xi, 1892, p. 277.

³ Magenkrankheiten, 1897, p. 100.

⁴ Berlin. klinische Wochenschr., 1882.

⁵ Magenkrankheiten, 1897, p. 215.

ficed to make his legs rigid in an instant. Finally he refused to go to school, on account of the ridicule to which he was subjected. It then became hard to open the hand after a firm squeeze (eighteen months after the onset). The tendency growing still more marked, every time he "stubbed" his toe he fell to the ground, all voluntary motion of the neck, body and limbs being temporarily abolished by tonic spasm; and, at the present time, the general rigidity is so complete on such occasions that a half minute often elapses before the patient can arise. He can always move the tongue and face muscles during these spasms. Except as a part of such universal rigidity he never perceives involvement of the erector spinae, the motions of stooping and rising being quite free. After a sneeze, it is said, he cannot straighten up for a few moments, on account of the abdominal spasm. Involvement of the pectoralis, trapezius, latissimus dorsi, or deltoid is not often marked enough to inconvenience him. He states that jaw movements are occasionally difficult, especially when he has been exposed to cold; and the same is true of the tongue. In the legs the impeded thigh movements annoy him more than anything else, but the muscles below also are not spared, the flexor spasm of the toes resembling that of the fingers.

The rigidity is described as transient, not returning as long as action is kept up. The patient "could chop wood all day" if no variation in the motion were attempted. Likewise he can walk indefinitely when once over the initial disability, and states that he can run upstairs provided that some preliminary "dancing" is indulged in, and that there is never the slightest hesitation in going downstairs. He is confident that fear has no effect. Provided that he does not sweat, the whole tendency decreases on hot days; sweating exerts a marked influence for the bad, according to him, as does exposure to cold. He thinks that hard work makes the trouble worse, unless he can keep from perspiring. Effort to overcome the spasm is not only almost entirely ineffectual and very painful, but, in addition, is said to prolong distinctly its duration. Damp weather increases it. There has been no opportunity to judge of the effect of alcohol.

The disorder steadily increases in severity. This has been made especially evident recently in connection with the milking of cows, which can now be accomplished only after fifteen minutes' practice. He has, in fact, been inefficient in all employments essayed of late. He states that notwithstanding this progression of the disease, his muscles are becoming stronger as well as larger, and that he is still growing. There has been noticed during the past year a marked tendency to nose-bleed. The general health is excellent, and the mental and vital development normal, puberty having been reached at fourteen and the sexual power being adequate. The patient is temperate and of good habits.

Family history.—This is incomplete on the maternal side, but is said to be in general good. No instances of myotonia except the three here discussed are known in the family.

Status.—The patient is below medium height; he is well nourished, with slightly developed panniculus adiposus and remarkably developed muscles, those in the legs being strikingly large. The thigh measures 21½ inches (54 centimetres) and the calf 15½ inches

(40 centimetres). Over the scrotum and penis there is a condition of vitiligo, but the organs are well developed. The maximum impulse is in the fourth space, and the pulse (patient standing) 106 (it is to be regretted that the constancy of this rapid rate was not confirmed); the sounds and boundaries are normal. The thyroid gland is present, of normal size. Hearing and eyesight are good. Slight ulcerations are found on the septum, accounting for the nose-bleed, and there is a small adenoid. Cover-slips of the blood showed nothing abnormal, either in the character of the reds or in the differential white count. The red count was unfortunately inaccurate, but it seems almost certain that there was no deficiency in number. There was an apparent plethora. The urine is of normal appearance and specific gravity and contains no albumin or sugar.

Sensation.—Everywhere normal, unless the remarkable intolerance of the skin to painful and (less decidedly) to tactile stimuli be deemed hyperesthesia; there was no examination of visual fields or fundus. On palpation, the muscles are found to be abnormally firm, especially those of the legs. There is slight, fine tremor of the hands; no fibrillation or inco-ordination. The muscle bellies are of the short type.

Reflexes.—The pupils are normal. The knee-jerk is difficult to obtain; with re-enforcement it is present in normal degree, but shows tendency to weaken after three or four repetitions. The observations as to whether it was completely abolished on repetition were somewhat contradictory on different occasions; this is not surprising, considering the well-known variations in degree which the symptoms present in the individual case of myotonia. It happened at least once that I was unable to obtain the knee-jerk after several responses, successively lessening in vigor, had been excited. Local myotatic irritability may still be observed during the (only apparent?) absence of knee-jerk. The Achilles phenomenon presents a contrast: repetition certainly does not weaken it and it is easily obtained. There is no ankle clonus or triceps- or wrist-jerk. The front-tap contraction is present. The cremasteric, abdominal and plantar reflexes are normal.

Voluntary motion.—The gait and leg movements in general are somewhat slow. Two or three trials in quick succession did not enable the patient to run rapidly upstairs, even after the initial spasm had passed away. This residual awkwardness is probably pathological, and is accounted for perhaps by the fact that in this patient the subsidence of myotonic rigidity is not at once perfect, that after cessation of the evident spasm some further improvement in functional ability goes on, perhaps also in part by the abnormal consistency of the hypertrophied muscles. The muscular strength is poor compared to the development, but there is no evidence that the muscles tire quickly. Motions of the face, lips, eyes, eyelids, pharynx and larynx are absolutely normal, and there is no hindrance to the actions of spinal flexion and extension or to respiration. When the jaws are closed tightly the masseters become very firm and prominent and remain so for several moments after attempt is made to relax. Lateral but not forward movements of the jaws also result in after-spasm. The action of the genioglossus in the motions of the tongue is perfect, but the intrinsic muscles work slowly for an instant when an attempt is made to curl the tongue

backward or to execute lateral movements rapidly. The disorder is well marked in the neck muscles; on forced rotation the neck becomes set in that position for a time. In anteroposterior action the spasm appears after two or three oscillations, the head then becoming fixed; on lateral flexion the spasm is not so marked. The trapezius and other shoulder girdle muscles and those of the upper arm all present the characteristic tonic after-contraction; it is extremely pronounced in the biceps, triceps and in the flexor group of the forearm. On shutting the hand tightly it can be opened only with the greatest effort and slowness, and there is a high degree of resistance to passive extension; not so great, however, but that it can be overcome. Ordinary hand movements are free after two or three voluntary openings and closings. Severer tests, requiring much continued effort (as in the action of milking, already alluded to), would probably make it evident that a certain amount of impediment to motion persists several minutes; this statement seems justified in view of the positive testimony of the patient as to the protracted difficulty now experienced in milking cows. The gradual betterment of his walking power during the first mile or two bears equal significance, and is mentioned here to emphasize this point. The extensors of the fingers, contrasting sharply with the flexors, show a remarkable exemption from spasm—apparently complete—for the open hand can always be closed with instant readiness. The wrist, again, is involved both in extension and flexion. The small hand muscles are also involved in some motions, but writing, though labored, causes no spasm. There is momentary after-spasm of the abdomen on coughing. Lateral and rotatory trunk movements are similarly affected. The thigh muscles become rigid with the attempt to sit down on a chair twice or thrice rapidly, the patient being finally left standing, unable to bend his stiff legs. Adduction of the thighs is involved, but abduction shows an apparent exemption. The toes, like the fingers, can always be flexed at will, but extension is slow and difficult. The spasm is most intense, prompt and prolonged in the forearm and thigh. An attempt to go briskly upstairs is arrested on the third or fourth step, but not absolutely, progress being possible, though barely perceptible, throughout the duration of the spasm. The degree of rigidity in the legs is brought sharply to notice by the loud snapping of knee tendons during relaxation of the spasms. On placing the phonendoscope upon the joints in action, vibrations of seemingly abnormal intensity are heard.

With regard to voluntary movement after rest, then, rigidity is seen never to manifest itself till the intended contraction, with its entailed single motion, has been performed. If, now, that contraction has been extreme, if the effort is intense, the muscle will not relax despite the pulling of antagonists. Spasm does not therefore occur strictly at the *beginning* of intended movement. With less vigorous effort the spasm is less marked, and its development is not abrupt, one or two relaxations and contractions being possible before motion is suspended. The rigidity at its maximum does not utterly abolish motion. It is not seen to last more than eight seconds, begins to decrease with the third, and has disappeared with the fourth movement. Attention exercises no visible influence. Prolongation of the resting time has distinct influence in intensifying the next spasm. To ensure the appearance of

spasm at resumption of motion a rest of at least sixty seconds is necessary if the muscles have been brought to a freely working state. The rapid cessation of spasm observed during the third and fourth movements seems to be followed by further improvement in muscular control, which is mostly subjective and extends over fifteen minutes or more if action continues. The immediate cause of impeded motion is the failure of the muscle, once contracted, to relax; involvement of the antagonists is seen as an augmenting factor, but this does not seem to be an element in the case of finger-and-toe movements, in which the singular immunity of the extensors results in the arrest of motion in flexion. The sudden generalized rigidity following a stumble, previously mentioned, doubtless has in its direct production the elements both of mechanical excitation and of intense effort.

Mechanical irritability of the muscles.—This is exaggerated in a way absolutely typical of congenital myotonia. The facial muscles and the masseters do not show the reaction. In general, a fairly sharp blow is needed to bring it forth. On striking the deltoid, the whole muscle becomes rigid, the rigidity being greatest at the point struck, with the production there of a deep furrow, lasting several seconds. It is less easily produced in the forearm muscles. I could not obtain it in the erector-spinae mass. It is very marked in the thigh; here a quick blow with the fist causes a prolonged tonic spasm of the whole extensor group, the separate bellies standing out prominently. Well-defined furrows can be called forth by brisk strokes with small instruments; the vastus externus is especially susceptible. The same phenomena may be observed in all the groups of leg muscles. No idiomyotonic mound was seen, and a trial to obtain the contraction by pressure was unsuccessful. The persistence of this irritability during apparent absence of knee-jerk has been mentioned. Attempt to elicit the "paradoxical contraction" by dorsal foot-flexion was without success. The *nerves* do not show increased mechanical excitability (facial, peroneal).

Myotonic electrical reactions.—These were studied in the deltoid, the arm and forearm and thigh muscles; those of the face reacted normally to both currents. Faradism: The muscles react to weak currents, which call forth momentary contractions when momentarily applied, tetanic after-spasm when the stimulation is longer. A deep furrow lasting nearly ten seconds after slightly prolonged stimulation can be produced with a very weak current. Galvanism: Weak currents act like the faradic. Tetanic after-spasm is seen in the quadriceps with five milliamperes, both poles; the spasm slowly disappears and successive shocks lose their efficacy, there being finally no response. If the poles are then reversed the contraction again appears. No rhythmical contraction could be demonstrated; the strength and duration of current found requisite by other observers could not be borne by this patient. Commonly it is impossible to obtain opening contractions in this disease, but they were twice seen in this case, in the quadriceps at the anode. With a strength of ten milliamperes a remarkable pulsating contraction, not exactly rhythmical, and showing no appreciable polar relation, was observed in the same muscle. The relations of the poles are apparently not entirely constant; in the quadriceps $\text{CaClC} > \text{AnClC}$ and $\text{CaClC} < \text{AnClC}$ were both noticed. In the deltoid, however, the anodal contrac-

tions are constantly greater than the cathodal. *The reaction of the nerves to electricity is normal to both currents.* Labile galvanic stimulation, mentioned by Oppenheim in his text-book as giving rise to myotonic reaction, was not tried.

CASE II. Brother of Howard G.; is a clinical counterpart if the descriptions are correct. This person lives in a distant State, and I have not seen him. He is two years older than H.; the symptoms came on at the same time of life — two years before puberty — and are of like severity. He is said to be subject to occasional attacks, in which there is complete loss of consciousness along with myotonic condition of body and limbs (resembling that of H. after stumbling), thus presenting the not infrequent combination (Oppenheim) of Thompson's disease with epilepsy, in all probability. It is to be understood that myotonia exists in typical form in the intervals.

CASE III. Cordelia G., age twenty-three, single, sister of Howard G.; is well and strong except that for a week before each catamenial period she experiences a peculiar momentary motor incapacity of the legs on going upstairs, after taking two or three steps; it never amounts to anything like total arrest of power, but is well marked. This gradually increases as the period approaches, but disappears wholly when the flow begins. There is also some difficulty in arising from a squatting posture at such times. Nothing but true myotonic affection, in very slight degree, seems to explain these symptoms. The hands and arms are not affected, nor any other muscles, according to the patient's knowledge. The trouble came on at sixteen. This woman I saw personally, but have not seen the manifestations she describes. They are best termed "transient myotone," but the propensity is probably congenital.

In the other cases the diagnosis — Thompson's disease — cannot be questioned; and though the name myotonia congenita has not its usual applicability here, inasmuch as the affection did not appear in infancy, it is more suitable than that of myotonia *acquisita*, because the symptoms are otherwise typical of the congenital form and because the family tendency is pronounced; such late onset is uncommon in the family type, but has been observed. Myotonia may indeed have existed unnoticed in early childhood.

In the literature are many atypical cases and numerous instances of associated conditions, of which two — progressive muscular dystrophy and paramyotonia congenita — deserve mention here, for in the case of Howard G. there is a resemblance to dystrophy in the weak, short-bellied and hypertrophied muscles, which present further an abnormally firm (though not lumpy) consistence; a likeness to paramyotonia on the other hand is seen in the influence of cold on the actions of the tongue and jaw muscles.

Worthy of recapitulation are the following points of particular interest: (1) The unusually late onset; (2) the continued progression of the disease; (3) the brief duration of the after-spasm — considering that the occasional occurrence of almost universal rigidity indicates a severe form of the affection; (4) the protracted persistence of a slight amount of spasm, usually in this case not evident except subjectively as a feeling of awkwardness; (5) the exemption of the erector spinæ and of the finger and toe extensors from spasm; (6) the diminished knee-jerks and their tendency to

disappear; (7) the final absence of response to electric shocks after repetition, and (8) the reappearance of the response if the poles are reversed; (9) the presence of opening contractions, and (10) the absolute periodicity of the myotonic symptoms in the sister, this condition not having been previously reported so far as I know.

These cases present nothing new concerning the most interesting question in connection with myotonia — its etiology. The remarkable periodicity observed in the case of the sister seems to indicate merely either that wholly new conditions exist in the organism at the catamenial time, sufficient to bring about a myotonic state, or that a constant latent tendency is aggravated into evidence by the disturbance of vital equilibrium common at the menstrual period. Of the immediate or ultimate causes of myotonic spasm we have no knowledge. The much-divided opinion as to the direct cause has perhaps favored a muscular origin, while there are still adherents of the auto-intoxication theories. The classic muscle-fibre appearances have now a doubtful significance, however, particularly since Jacoby showed that they may arise through faulty technique.

It will always be difficult to rule out the participation of either one of the structural elements concerned, the nervous and the muscular, on account of their intimate and inseparable connection in function. But it is permissible to remark that, regarding the immediate, direct cause of the spasm, more will probably be heard of *inhibition* than heretofore, in view of the great importance now attached to it in the minds of physiologists, as a normal and constant element in all vital phenomena. If these phenomena are but resultants of the antagonistic actions of the two nervous forces, acting always concomitantly, of which inhibition is one, then we may reasonably regard myotonic spasm as the result of defective inhibitory supply. This would express only the immediate cause of the spasm, for those subtle influences determining the quantity and distribution of inhibitory impulses — in this conception the ultimate causes of the spasm — are of course unknown to us in our absolute ignorance of the nature of inhibition itself. Such a supposition is apparently as plausible as others put forth, and offers the further advantage of allowing an expression of the facts (in part imperfectly, it must be acknowledged) in terms of a physiological process, of simply a loss of balance between the opposing forces in the delicately adjusted nervous system. As Schultze has recently remarked, however, it is hardly profitable to speculate at length concerning the etiology of this disease so long as our knowledge of the physiology of muscular contraction remains far from complete. And Bernhardt, still more recently, in reporting a unique case combining the symptoms of atypical Thompson's disease with those of paramyotonia and atrophy (questionably neuritic), comments upon the possible importance of the relation of myotonia congenita to those and other diseases, and urges an exhaustive review of the subject of etiology, with a complete recasting of our ideas as to it from the point of view of such relation.

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