tions upon the esophagus than upon the trachea, in which they are common and call for close watching and prompt relief to avoid disastrous results. The risks in the use of chloroform under these circumstances are probably less than are to be expected from the various complications that may arise under ether. The writer has never met with any trouble or untoward symptoms from the use of chloroform in operations about the face and neck, while he is fully aware of the moderate danger of its use in general surgical operations.

INFERENCES TO BE DRAWN FROM THE EXAMINATION OF THE GASTRIC CONTENTS.

BY ELLIOTT P. JOSLIN, M.D., BOSTON.

THE gastric contents are examined chiefly to aid in the diagnosis and treatment of catarrh, dilatation, ulcer, cancer and neuroses of the stomach or to obtain proof that it is in a healthy state. The list is a small one. In reality the diagnosis of the various diseases of the stomach is far easier than is usually thought. The rule of exclusion can be used to great advantage.

The data upon which diagnoses are based are also few, some six in number. Five of these can usually be detected by gross observation, while the chemical tests for the remaining are extremely simple. The subjects which admit of discussion to-day are: (1) Gastric motility. (2) Gastric secretion. (3) Gastric fermentation. (4) Mucus. (5) Blood. (6) Pus.

Another function of the stomach — absorption — is not included in this list. Absorption may be disregarded, because so little takes place through the walls of the stomach. Practically no water is absorbed. When water enters the stomach, it is either expelled through the pylorus, the cardiac orifice or remains. There are one or two exceptions to this rule of the non-absorption of food in the stomach. Sugar and peptones are absorbed to a slight extent, varying with the concentration of the solution. Alcohol is readily absorbed, as is manifested by clinical experience. When alcohol is absorbed from the stomach, water is secreted into it in more than equivalent volume. Since absorption is of such minor importance, the iodide test for it is superfluous.

(1) *Gastric motility.* — The power to expel its contents is the most important function of the stomach. If secretion utterly fails, there occurs only a moderate impairment of digestion. This is due to the compensatory action of other digestive organs. Let gastric motility fail, however, and distressing, urgent or fatal consequences invariably ensue.

Gastric motility is disturbed by various means. Perhaps the commonest is that due to weakness of the gastric muscles themselves. This may form part of a general muscular weakness, and is often associated with a displacement of the

stomach and frequently of other organs. Such a displacement increases the work to be done by the stomach because the pylorus is more firmly fixed than the rest of the organ and the food must be raised before it is expelled. A vicious circle is the result.

Another cause less generally appreciated is interference with the continuity of the inner wall of the stomach. Such a state is brought about by an ulcer or cancer, even when they do not obstruct the pylorus. The interference with motility in such cases is not extreme, but it is quite constant. The detection of slight degrees of disturbed motility is therefore important and a suspicious sign.

Obstruction to the passage of food through the pylorus is the most obvious cause of disturbed muscular action in the stomach. At first the obstruction usually leads to extra efforts on the part of the muscle walls. This is apparent to the patient by the sensations produced and to the physician by his observance of peristalsis. In the advanced stages of this condition exhaustion of the muscles apparently succeeds to active peristalsis and the most extreme grades of dilatation of the stomach result. It is often impossible to determine the cause of a pyloric obstruction at a first visit and it is unwise to attempt a diagnosis. Repeated observation of the behavior of the stomach under varying conditions is essential. In many instances time alone will determine whether the stricture is functional, being due to spasm, or is organic from the presence of a scar, ulcer, cancer or other less common causes.

The determination of gastric motility is the most important test in the diagnosis and treatment of disorders of the stomach. Frequently proof of its derangement is afforded by the story of the patient. Food is vomited which has been eaten more than seven hours previously, or quantities of food are vomited which are so large that they are directly suggestive of a dilatation of the stomach. This is acute or chronic according to the frequency with which such vomiting has occurred. A degree of muscular disturbance sufficient to produce such symptoms is rare, but even when it occurs it is not uncommonly overlooked. It must not bias the practitioner, however, in favor of malignant disease any more than marked loss of weight in an individual with indigestion.

In contrast with this crude method of estimating gastric motility is the accurate test of this function by the passage of the stomach tube into the fasting stomach. The fasting stomach should be empty. If food is obtained from it seven hours after a meal it can be assumed that there is disturbance of gastric motility. This examination is the simplest and most valuable of all examinations of the stomach which are made. In the first instance, the manipulation of the tube is easier with the fasting stomach than after a test meal. In the next place, the contents so removed are more readily examined. Inspection alone will determine the presence of food, secretion, fermentation, mucus, blood and pus —

¹ Read before The Massachusetts Medical Society, June 9, 1903.

the essentials for gastric diagnosis. Too much cannot be said of the value of the examination of the fasting stomach.

Conclusions regarding gastric motility may be reached by measuring the quantity of food removed from the stomach one hour after the administration of an Ewald test breakfast. The slice and a half of bread and the glass and a half of water of which this consists should leave a residue of not more than 3 oz. when removed under the above conditions. Excess of this quantity suggests a deranged muscular activity. Another method of reaching the same result is to give Hemmeter's test meal. This consists of one small piece of beef (2½ oz.), one soft boiled egg, 1 oz. boiled rice, one-half pint milk and a piece of bread. Four to five hours later an Ewald test breakfast is given and the contents removed in one hour. The complete disappearance of the earlier meal points to normal motility. Gastric motility has been tested in still another way by directing the patient to eat at night a few spoonfuls of dried English currants. These would not be found on the following morning in a healthy stomach.

Normal motility is present in two diseases of the stomach—gastric catarrh and in the group of cases included under the term "achylia gastrica." In the latter instance excessive motility has been supposed to be present. This idea may have arisen from the fact that undigested fragments of food are expelled with difficulty through the stomach tube. The stomach is then considered empty when this is really not the case. The water has passed on, but the solid particles of undigested food remain and can be obtained by prolonged expression, aspiration or lavage.

(2) *Gastric secretion.*—The healthy stomach produces about three pints of gastric juice in twenty-four hours. Ordinarily this passes on with the food into the intestine without causing disturbance. It is obvious, however, from what has been said of the slight degree of absorption which takes place in the stomach and the various conditions in which the muscular power of the gastric wall is affected, that such quantities of secretion can cause many symptoms. Much confusion exists between slight degrees of deficient motility and excessive production of gastric juice. But the pronounced states of either are clear. When the secretory function is in a normal condition the fasting stomach will be empty; if hypersecretion is present, varying quantities of gastric juice up to several ounces can be removed from the fasting organ. Increased secretion of gastric juice is pathognomonic of no single disease. It most frequently occurs as a neurosis in connection with an overproduction of hydrochloric acid. It is a precursor of ulcer of the stomach and is the signal for prophylactic treatment. It accompanies ulcer.

The constituents of gastric secretion which are most important for recognition are hydrochloric acid and pepsin. Their presence in normal quantities may be inferred with great probability from the gross appearance of an Ewald test

breakfast. Such contents removed from a normal stomach look "well digested." If gastric secretion is absent the contents resemble closely a mixture of bread and water. It is not safe, however, to rely wholly on gross appearances, for occasionally with excessive amounts of hydrochloric acid a somewhat similiar condition is produced.

The safest test for hydrochloric acid is with Günzburg's reagent.² This is performed by slowly heating a few drops of this solution with an equal amount of the stomach contents. A red color develops. Another test is with Congo red paper.³ This turns blue when moistened with a solution containing free hydrochloric acid. The development of a brownish color with Congo red denotes the presence of some organic acid. Congo red paper is very useful in a general practice because it requires no apparatus. Following a suggestion of Dr. Pfaff, it can be prepared in different strengths, and with these an approximate idea of the percent of free hydrochloric acid in the stomach can be obtained.

Excess of hydrochloric acid occurs most commonly as a neurosis. It is the torment of the nervous dyspeptic and the nervously tired-out individual. Like hypersecretion it frequently precedes ulcer of the stomach and generally accompanies the condition when established. Often hyperchlorhydria occurs in dilatation of the stomach due to a benignant stenosis of the pylorus. In such cases the stagnant food appears to call it forth. Ulcer is usually associated with the presence of free hydrochloric acid, often in excessive amounts. In cancer, free hydrochloric acid is the exception. It is by no means seldom, however, that a chronic ulcer exists without free hydrochloric acid and that a cancer is accompanied by free hydrochloric acid. In the latter instance the cancer has usually developed from an old ulcer—a much rarer condition than supposed.

The hydrochloric acid is diminished in catarrh of the stomach to a greater or less extent according to the severity of the disease. It is completely absent in atrophy of the mucous membrane and sometimes absent when no atrophy exists, perhaps due to a secretory neurosis. Patients in whose gastric contents no hydrochloric acid can be found after repeated trials are said to have achylia gastrica. (Strictly speaking, the absence or marked diminution of pepsin and renin also should be proven to establish this condition.) The acidity of such contents hardly suffices to react red with litmus. The gross appearance of an Ewald test breakfast removed from a patient with achylia gastrica

² Günzburg's Phloroglucin-Vanillin Test.

Phloroglucin . . . 2
Vanillin . . . 1
Alcohol . . . 30

³ Filter paper saturated with aqueous solutions of Congo red of the following strengths will react with the given percents of free hydrochloric acid:

Congo Red, Percent.	Hydrochloric Acid, Percent.
0.001	0.200
0.00175	0.150
0.0025	0.075
0.0062	0.050
0.01	0.025
0.05	0.01

resembles a mixture of bread and water, so incomplete is its digestion. It is a rule for the hydrochloric acid to be absent in cancer.

Pepsin varies in the gastric juice to a greater or less extent with the hydrochloric acid. In most examinations of the stomach contents the tests for it can be omitted. It can be demonstrated as follows: Add a portion of the white of a hard-boiled egg of about the size of a dime to 2 dr. of filtered gastric juice. Keep at body temperature. The egg normally is digested or disintegrated in two to six hours. If free hydrochloric acid is not present, add dilute hydrochloric acid one drop at a time until its appearance is shown by Günzburg's or the Congo red test.

(3) *Gastric fermentation.*—Fermentation in the stomach is proof of diminished motility. It is recognized by the appearance of three layers in the gastric contents, which form about a quarter of an hour after their removal. This is best shown by placing the contents in a glass. The lower layer consists of partially digested food, the middle layer is liquid and contains the soluble products of digestion, while the upper is frothy, due to the admixture of gas (chiefly carbonic acid) with small particles of food. The exciting agent of the fermentation varies, and, as Dr. Hewes has shown to the students of the Harvard Medical School this year, can be isolated. Especial interest attaches at present to but two sorts of fermentation—that caused by *sarcinæ* and that due to the lactic acid bacillus. *Sarcinæ* grow abundantly in the presence of hydrochloric acid, and lactic acid bacilli only in its absence. The presence of *sarcinæ* therefore implies fermentation in a stomach which is still secreting hydrochloric acid, while lactic acid implies that no hydrochloric acid is being produced. In both, motor insufficiency is present. Sarcinous fermentation has a peculiar odor which is so distinctive that when once appreciated it is easily recognized. The sense of smell alone can in this way lead to a conclusion that hydrochloric acid is present. Conclusive proof is afforded by the detection of the "cotton-bale" shaped *sarcinæ* under the microscope. Lactic acid is demonstrated by the distinct appearance of a canary yellow color on the addition of filtered gastric contents to a nearly colorless solution of ferric chloride. The demonstration of *sarcinæ* or lactic acid in a stomach contents adds therefore nothing new to our knowledge. It is simply another method of showing that a state of deficient motility, associated with or without hydrochloric acid, exists.

(4) *Mucus.*—Mucus is present in the stomach when there is catarrh of that organ. Acute or chronic gastric catarrh exists only when associated with mucus. The acute cases attract little attention, for the duration of the disease is so short that an examination of the stomach is seldom necessary. Chronic catarrh of the stomach is a rare disease, notwithstanding it is so common in the minds of the laity, and for that matter in the diagnoses of the profession. In a recent four months' out-patient female medical

service in which about one thousand new patients were seen, only one typical case of chronic gastric catarrh was recognized. In fact, one of the decided advantages of the examination of stomach contents is the opportunity it affords of disabusing the patient's mind of the idea that he or she has a chronic catarrh. On the other hand it must be remembered that catarrh may exist with cancer or dilatation of the stomach. The mucus obtained from the mouth, throat and esophagus during the passage of the stomach tube should always be distinguished from mucus formed in the stomach. Gastric mucus is intimately mixed with the food; other mucus is not. Mucus is most easily detected in the fasting stomach.

(5) *Blood.*—Blood is not uncommonly obtained from the fasting stomach. Cancer is the disease most uniformly associated with it, for either a little blood is present in the stomach before the introduction of the tube or is set free by the irritation of the tube itself. Ulcer behaves similarly. Very small quantities or little clots of blood are frequently obtained from patients with achylia gastrica. These three diseases can often be differentiated by the state of gastric motility and the hydrochloric acid. Blood may also be obtained from the healthy stomach by too forcible straining and struggling on the patient's part or too powerful aspiration of the contents by the doctor. Coffee-ground vomitus perhaps is more commonly associated with cancer than with ulcer, but it is by no means proof of it. It may occur daily for a week in ulcer.

(6) *Pus.*—Pus is common in any gastric catarrh. It is frequently met with in the fasting stomach of patients with cancer or ulcer, and so in the absence of mucus gives valuable evidence.

Diseases of the stomach can be treated empirically or with a certain degree of scientific accuracy. The scientific method is usually successful, while empiricism favors a migratory tendency on the part of the patient. If, on the other hand, empiricism is successful and the patient is cured, in the end more real harm results, for the doctor is encouraged to repeat his lucky experiment and his medical progress thereby comes to an end.

The examination of gastric contents is often neglected because it is thought to be too difficult and too time-consuming. These views are erroneous. The examination requires no more time than the examination of the urine, and is far simpler. In fact, the gross examination of the gastric contents furnishes the most valuable data of all, and these can be recognized almost at a glance. There is no necessity for the busy practitioner to titrate the percent of hydrochloric acid in the gastric contents. It is far more important that he should determine whether the organ contains food and secretion in the fasting condition and that he should make the simple tests necessary for their examination. More important still is the need for a proper interpretation of the results so obtained.

Rules are no more hard and fast in this branch

of medicine than in any other, and satisfactory deductions can only be drawn when the history of the patient, the physical signs and the data relative to the contents of the stomach are considered together.

DISCUSSION.

DR. R. F. CHASE of Brookline: Dr. Joslin has very thoroughly and concisely discussed a very broad subject. He has left very little to be said upon this subject. There are, however, a few points to which I wish to refer with the object mainly of emphasizing their importance:

When a patient comes to the physician for an examination of the stomach, he should not have eaten anything for at least six hours.

With a fasting stomach the physician can at once proceed to give a test meal and later examine the gastric contents obtained therefrom. Or, should it seem preferable, he can obtain the fasting contents (if there are any), then inflate and determine the size and position of the stomach.

Either part or the whole of such an examination may be made at the first visit, providing the patient comes with a fasting stomach. Whereas if he comes with a full stomach none of these tests can be conveniently carried out at the first visit. Dr. Joslin has already said that several examinations may be necessary to establish a diagnosis.

I particularly desire to emphasize the importance of this point, because I know there are physicians who have the impression that one chemical examination of the gastric contents is sufficient to enable one to make a diagnosis of any gastric affection. Such, however, is not the case. Besides the chemical examination of the gastric contents, the size, shape and motility of the stomach must be determined in all cases, and in many cases new phases of a disease appear which require prolonged study that they may be recognized and properly treated.

The average amount of gastric contents obtained one hour after the administration of an Ewald test meal has been stated by the reader as 90 cc., or 3 oz. I consider this amount a very fair average, but one must remember that it is only an average, the maximum and minimum normal limits being very wide, varying from about 20 to 150 cc.

A healthy student upon whom I recently made some tests yielded, on several successive days, from 120 to 160 cc. of gastric contents. On a certain day preceding a school examination which he was to take, I was able to obtain only 10 cc. one hour after the Ewald meal, and this gastric juice contained no free HCl, whereas on the previous examinations the free HCl had always been normal. This temporary suppression of the gastric secretion I attributed solely to nervousness arising from anxiety over his pending school examination.

Small amounts of gastric contents are obtained in the conditions referred to by Dr. Joslin, namely, in diminished secretion, in hypermotility of the stomach and in cases of patent or lax pylorus.

In these conditions it is frequently, I may say usually, necessary to introduce the stomach tube within thirty or forty minutes after giving the Ewald meal, to obtain any contents for examination.

Failure to obtain the average amount of gastric contents one hour after the Ewald meal does not necessarily indicate the existence of one of the conditions just mentioned; it may mean that the entire contents of the stomach have not been removed.

Lavage of the stomach will clear up this point, because if the contents have not been entirely removed crumbs of bread and cloudiness of the wash water will be observed. Formerly I used (as recommended by some) a Davidson's syringe bulb in evacuating the stomach contents and in 20 to 30% of all cases I obtained small amounts of blood. I now use a different bulb, and do not encounter blood in more than 2 to 4% of all patients. Small amounts of blood, however, are frequently of no significance.

Mucus must *not* be confounded with saliva, which as a rule runs freely down the *outside* of the tube. The former is recognized by its stringy nature and comes of course only from the *inside* of the tube; it is also well seen when pouring the contents from one vessel into another.

Excepting the detection of blood, or food which has been eaten one or two days previous, an examination of the vomitus from a patient does not aid one much in the diagnosis of gastric disease.

Dr. Joslin has stated that during a three months' hospital service he has failed to encounter one case of chronic gastritis.

During a present ten weeks' service I have also not met one case of chronic gastritis. This disease of the stomach, of which we hear so much, is not nearly so common as is generally supposed.

New Instrument.

A CHEAP TRACTION SPLINT.¹

LOUIS T. WILSON, M.D., BOSTON.

This splint was made primarily to fill a need for a cheap, light splint suitable for bed traction on hip cases at the Children's Hospital, Boston. The average hip splint is heavy, requires a skilled mechanic to manufacture it, is therefore costly and thus often beyond the reach of the physician, outside the large cities, who may have hip cases under his care. It was desired, therefore, at the same time, to make a splint of such simple construction and material that it could be easily made by any mechanic, blacksmith or even the physician himself if necessary, at a very small cost. Sheet steel and gas-pipe can be easily obtained in almost any town, and from these materials this splint was made.

¹ Presented at the Annual Meeting of the American Orthopedic Association, Washington, D. C., May 14, 1903.