

ELSNER (H.L.)

ON THE PRACTICAL VALUE

OF THE

NEWER METHODS OF EXAMINATION IN
THE DISEASES OF THE STOMACH

WITH A CONSIDERATION OF THE INDICATIONS GIVEN FOR
DIET AND TREATMENT BY SUCH EXAMINATIONS
BEING PART OF A DISCUSSION ON THE NEWER METHODS OF
DIAGNOSIS AND TREATMENT OF STOMACH AND INTESTINAL DISEASES

BY

HENRY L. ELSNER, M. D.,

PROFESSOR OF CLINICAL MEDICINE, SYRACUSE MEDICAL COLLEGE;
PHYSICIAN TO ST. JOSEPH'S HOSPITAL;
CONSULTING PHYSICIAN TO ST. ANN'S HOSPITAL, SYRACUSE, N. Y.

REPRINTED FROM
THE NEW YORK MEDICAL JOURNAL
FOR MAY 6 AND 20, 1893



NEW YORK
D. APPLETON AND COMPANY

1893

ON THE PRACTICAL VALUE
OF THE
NEWER METHODS OF EXAMINATION IN
THE DISEASES OF THE STOMACH

WITH A CONSIDERATION OF THE INDICATIONS GIVEN FOR
DIET AND TREATMENT BY SUCH EXAMINATIONS
BEING PART OF A DISCUSSION ON THE NEWER METHODS OF
DIAGNOSIS AND TREATMENT OF STOMACH AND INTESTINAL DISEASES

BY

HENRY L. ELSNER, M. D.,

PROFESSOR OF CLINICAL MEDICINE, SYRACUSE MEDICAL COLLEGE;
PHYSICIAN TO ST. JOSEPH'S HOSPITAL;
CONSULTING PHYSICIAN TO ST. ANN'S HOSPITAL, SYRACUSE, N. Y.

REPRINTED FROM
THE NEW YORK MEDICAL JOURNAL
FOR MAY 6 AND 20, 1893



NEW YORK
D. APPLETON AND COMPANY

1893

COPYRIGHT, 1893,
BY D. APPLETON AND COMPANY.

ON THE PRACTICAL VALUE OF
THE NEWER METHODS OF EXAMINATION IN
THE DISEASES OF THE STOMACH.

THE subject which by your courtesy it is my privilege to introduce for discussion to-day is one which is so full of interest and so important alike to the physician and the surgeon that I approach it with fear and a consciousness of weakness, which increases as I compare my feeble efforts with those which others might have made for your greater enlightenment. Having accepted your invitation, I shall discuss the practical value of the newer methods of examination in diseases of the stomach, and the indications given by such examinations for diet and treatment, impartially, with the view of formulating such conclusions as may appear justified, and a desire to stimulate in the profession a more careful and scientific study of the available methods of diagnosis in stomach diseases.

The great aim of the modern scientific physician is to understand symptoms so thoroughly that it becomes possible for him to localize lesions exactly, or to detect faulty functions with equal certainty.

* Read before the Medical Society of the State of New York at its eighty-seventh annual meeting.

With the discovery of free hydrochloric acid in the gastric mucus by Prout in 1824, and the demonstration of pepsin by Schwann in 1836, the first data for an ultimate and more thorough understanding of the physiological and chemical functions of the stomach were given. These discoveries, with those of Réaumur and Spallanzani, formed the foundation upon which ultimate gastric pathology was to rest, and upon which a structure has been erected to which modern medicine points with just pride.

"The way to pathology is through physiology," says Ewald (1) in his well-known work, and the more we deal with this subject the firmer is the truth of that statement impressed upon our minds. It is not the study of the peptonizing function alone which claims our attention, but it is the proper understanding of the entire work which is performed in this human laboratory, including a large part of the alimentary canal, and a thorough appreciation of the relations which each function bears to the others, that makes a rational anatomical diagnosis and indications for treatment possible and in many cases positive.

While we may not be able from this discussion to draw positive conclusions, it will be the endeavor of all who take part in it to treat the subject without prejudice, for the better understanding of the profession generally, which has not yet given it sufficient thought or the study which is needed to estimate the relative values of these newer methods of examination to the diagnostician of internal diseases.

History.—Though it is a fact established beyond controversy that the stomach tube had been used for various purposes before 1869, it was Kussmaul (2) who during that year became the pioneer in the *treatment* of stomach diseases by the use of the stomach pump and tube. He took advantage of the instrument which had for some time been

used in America for emptying the thoracic cavity in cases of empyema (Kussmaul (2), Martius (3)).

Liebermeister (4), in commenting on this subject, prophesied that the manœuvre of Kussmaul would probably mark an epoch in the treatment of chronic diseases of the stomach.

In 1871 Leube first recommended the stomach tube for purposes of *diagnosis*, since which time a band of earnest workers in Europe, headed by Leube, Kussmaul, and Riegel, with recruits such as Ewald, van den Velden, v. Noorden, Sticker, Honigman, Boas, Leo, and others in Germany, Hayem and Winter in France, and in our own country such men as Kinnicut, Einhorn, and Stockton have done much to clear the way for a thorough discussion of the questions with which we are to-day dealing.

A genuine impulse was given when, in 1874, Ewald substituted the soft, flexible tube for the stiffer, less elastic one which until that time had been used.

Physiological Data.—For the better understanding of this discussion you will bear with me if I hurriedly rehearse a few physiological data which must serve to make clear the digestive activity of the stomach.

I. The fact may be accepted as proved by Miller (5) that the saliva is brought in contact with micro-organisms in the food, and others which find a habitat in the mouth. It is supposed that there are two groups of these organisms, which, both in the mouth and in the stomach, give rise to actual fermentation. The one group, in the presence of the saliva, decomposes carbohydrates with the formation of an acid; the other causes a disorganization of albuminoids with alkaline products. The first class is said to give rise to the production of lactic and fat acids, which in turn, according to Bokai (6), even in small quantities, particularly the former, have a salutary effect in stimulating intestinal peristal-

sis. Whether the presence of lactic acid in the secretions after leaving the buccal cavity is ever normal we will consider later in this chapter. I mention the matter here to remind you that modern physiologists and pathologists are attributing more than a simple amylolytic action to the saliva.

II. *The amylolytic action continues, as a rule, for some time after the changed starch is introduced into the stomach, particularly if accompanied by albuminoids. The further conversion should cease in the normal stomach with the increase of hydrochloric acid secretion, and after the formation of syntonin or acid-albumin (Wesner (7), Wille (8), Boas (9)).*

III. *The introduction of saliva into the stomach has a direct stimulating effect on the gastric mucous membrane (Sticker (10)).*

IV. It may be stated almost with certainty that, as a rule, *the normal stomach is empty during the fasting period, its membrane is pale, covered with a layer of mucus, either neutral or alkaline. It contains no gastric juice.* If hydrochloric acid is present, it is a remnant of a former digestive process, or the passage or presence of the tube has caused it (Wille (11), Ewald (12), Foster (13), Kinnicut (14)).

V. *Variation in the functional activity of the stomach must be expected according to the character of the food ingested.* (This is one of the fundamental rules of modern gastric physiology, and must always be considered when engaged in the diagnosis of stomach diseases.)

VI. *Direct irritation of the mucous membrane of the stomach is necessary for the secretion of the gastric juice.* Normally, it is the food which causes activity immediately upon its entrance into the stomach.

VII. *Lactic acid is never present in the stomach after the first period of digestion; upon this conclusion all writers*

seem to agree. There is said to be an intermediate stage during which it is held that lactic acid is present with hydrochloric acid (Ewald (15)).

This lactic acid is not to be considered as a result of glandular secretion, but it is due to a process of fermentation already described, accompanying the digestion of carbohydrates or the ingestion of meat (Pasteur (16), Huppe (17)). Lactic acid is not present when pure egg albumin alone is taken.

With the establishment of an abundant hydrochloric-acid secretion, and ultimate free hydrochloric acid in the stomach, lactic acid disappears (Miller (18), F. Cohn (19)). As the result of experiment with a pure meat diet I have been able to verify the truth of Boas's statement that lactic acid is occasionally present shortly after the beginning of digestion in very small proportion. In contradistinction to what is taught in all the newer text-books, Martius (20), in a recently published work dealing alone with the gastric juice, holds that in "the normal process of digestion other acids than HCl are not to be taken into consideration"—in other words, are not present; that lactic-acid fermentation to any discoverable extent is always pathological. He opposes the division of the digestive process into three periods, as made by Ewald and Boas (21):

1. Period in which lactic acid is found.
2. Period in which lactic acid and HCl are found.
3. Period in which HCl alone is present.

The safest conclusion for us to accept with our present knowledge is that lactic acid is not normally present in the stomach during the digestive period, unless the ingested food contains carbohydrates in a process of fermentation—*i. e.*, the fermentation lactic acid or the sarcolactic acid as introduced by meat.

VIII. It may be taken for granted that *the most important*

constituent of the gastric juice which the physician is called upon to take into consideration in conjunction with the chemical analyses of the stomach contents for purposes of diagnosis is hydrochloric acid. While the chemical analysis is usually confined to the detection of the presence or absence of free HCl, it must not be forgotten that the free acid found in the later stages of digestion is but a remnant left after the thorough combination of HCl with the albuminoid elements of the food and other bases (Martius (22)).

IX. *HCl is secreted free, molecule for molecule, by the glandular structures of the stomach.* It is quickly brought in contact with the food and other secretions in the stomach, when the period of its utility begins without delay (Bidder and Schmidt (23), Martius (24)).

This statement is made in contradiction of the opinion of the French school, as represented by Hayem and Winter, which holds that absolutely no HCl is secreted as such, but that it results from a combination ultimately formed by a chemical change of the chlorides, more particularly the chloride of sodium, during the process of digestion.

X. *HCl with the pepsin secreted by the peptic glands forms the agent which is instrumental in the ultimate peptonization of the albuminoids,* and this is the most important function of the gastric juice.

XI. It may be taken for granted that the *average time when free HCl can be detected in the stomach contents after the ingestion of food is about one hour.* With large meals and coarse food it may be considerably later, depending largely upon the quantity and quality of the food ingested (Riegel (25)). The *largest amount of free HCl is present two hours* after the ingestion of the ordinary trial meal, when it comprises, as it does at the height of the digestive process, the largest part of the acid constituent of the gastric juice (Lowenthal (26)).

This fact has been emphasized by me for some time past, and we now find that Lowenthal's (27) experience verifies the truth of the statement made above. He found that with the trial meal of Riegel, with the total acidity of 56.5, there was present 35.5 free HCl one hundred and twenty minutes after the taking of the meal.

(This physiological fact leads me, in practice, to express the stomach contents somewhat earlier than has ordinarily been recommended, and taken in conjunction with the fact that the amount of free HCl, as well as the total acidity, are subject to variations, it would lead to repeated examinations at corresponding periods of digestion, on different days, to determine the working condition of the stomach.)

XII. *The peptogenic function of the stomach may be divided into three stages, in each of which the changed albuminoid can be studied, and gives characteristic reaction. The first combination resulting gives rise to an acid albumin or syntonin, simply a more thorough combination of albumin with the acid. The second is the stage in which propeptone is found; this leads to a third stage, when normally the process of peptonization is ended and peptone has become the final product of albumin digestion, ready to be absorbed or pushed onward to meet its fate in the duodenum.*

XIII. *The percentage of free HCl present in normal gastric juice averages between 0.15 and 0.22 per cent. Any considerable deviation from these figures may be considered abnormal.*

XIV. *Rennet is present in the gastric juices and, like pepsin, is a constant constituent (Raudnitz (28), Boas (29), Johnson (30), Klemperer (31), Rosenthal (32)).*

XV. *The presence of bile in the stomach interferes with the free performance of gastric digestion.*

XVI. *The normal digestion of starch precludes the possi-*

bility of the presence of achroodextrin, maltose, or dextrose, after one hour of stomach activity (Ewald (33)).

XVII. *Normally, evidences of absorption from the mucous membrane of the stomach should be found on chemical analysis to have taken place in from fifteen to twenty minutes after the ingestion of food or drugs (Penzoldt and Faber (34), Ewald (35), Wesener (36)).*

XVIII. *Normally, the stomach is empty, the changed food having passed the pylorus between six and seven hours after the beginning of its digestion (Leube (37), Riegel (38), Wesener (39)).* The motor function normally ought to force a bolus, which is not digested in the stomach, into the small intestine before the end of seventy-five minutes after taking it, as has been demonstrated by Ewald (40), also Klemperer (41).

The following chart shows the changes which are demonstrated by the newer methods of examination in the secretory, motor, and absorptive functions of the stomach, with a tabulation of the diseases with which such changes are often associated.

1. The *qualitative changes* are usually dependent upon a process of abnormal fermentation. These are accompaniments of the various forms of indigestion which have also well-marked quantitative changes in the gastric juice, more particularly associated with a deficiency of the acid of the secretion.

2. *Quantitative changes.*

a, 1 and 2. The deficient secretion of the gastric juice is, as a rule, attended with a greater lack of free HCl than of the pepsin element. With this lack of sufficient free HCl it may be taken for granted that the period of digestion is materially prolonged, that fermentation is likely to take place, and that the albuminoids are tardily and faultily digested. In the fluid taken from a stomach in which

1. Secretory changes.	1. Qualitative.	2.	With abnormal fermentation—usually associated with quantitative changes.
		a, 1.	Anaemia, general and local neuroses.
	2. Quantitative.	a, 1. Deficiency of the secretion and free HCl production.	Constitutional diseases. { Tuberculosis, Syphilis, Diabetes.
			Beginning chronic gastritis, mental diseases, acute febrile diseases, diseases of the heart, lungs (emphysema, bronchitis), chronic nephritis.
1. Secretory changes.	2. Quantitative.	a, 2.	Anaerobicity.
		b.	Hyperacidity, with normal quantity of gastric juice.
			Hyperacidity and hypersecretion.
		d.	Hypersecretion.

Constitutional diseases. {
Tuberculosis,
Syphilis,
Diabetes.

Beginning chronic gastritis, mental diseases, acute febrile diseases, diseases of the heart, lungs (emphysema, bronchitis), chronic nephritis.

a, 2. Anaerobicity.

b. Hyperacidity, with normal quantity of gastric juice.

Hyperacidity and hypersecretion.

Constitutional diseases. {
Tuberculosis,
Syphilis,
Cancer (?),
Uterine disorders and those of annexa.

Cancerous disease of liver, pancreas, duodenum, and colon [Boas (42)]. (Denied by Leube (43) and by the author as result of clinical experience.)

Alkaline and caustic poisons—also with large doses of alkalies not poisonous [Boas (44)].

Gastric neurosis, ulcer of stomach and duodenum, polypoid gastritis, cicatricial base with central ulceration (stomach).

Gastric ulceration resting on a *carcinomatous* base, without far-reaching inflammation.

Neuroses (gastric), ulcer of stomach, gastroxyntosis [Rossbach, Reichman (45)].

Gastrothoæ acidæ simplex (Jaworski), non-cancerous gastroæstasia.

Rarely found alone, occasionally with alcoholic gastritis.

Usually accompanies hyperacidity.

Constitutional diseases. {
Tuberculosis,
Amyloid diseases,
Addison's disease,
Pernicious anaemia,

Uterine disorders and those of annexa.

Cancerous disease of liver, pancreas, duodenum, and colon [Boas (42)]. (Denied by Leube (43) and by the author as result of clinical experience.)

Alkaline and caustic poisons—also with large doses of alkalies not poisonous [Boas (44)].

Gastric neurosis, ulcer of stomach and duodenum, polypoid gastritis, cicatricial base with central ulceration (stomach).

Gastric ulceration resting on a *carcinomatous* base, without far-reaching inflammation.

Neuroses (gastric), ulcer of stomach, gastroxyntosis [Rossbach, Reichman (45)].

Gastrothoæ acidæ simplex (Jaworski), non-cancerous gastroæstasia.

Rarely found alone, occasionally with alcoholic gastritis.

Usually accompanies hyperacidity.

2. Motor changes.
- a.* Increased motor activity.
- a.* Hysteria, neurasthenia, idiopathic form of nervous vomiting [Leyden (46)], tormina ventriculi [Kussmaul (47)] (peristaltic unrest), rapid emptying (*i. e.*, hypermotility) of ingesta into the duodenum [Leo (48)]. Spastic closure of cardia [Poensgen (49)], pylorismus, spastic closure of pylorus [Ziemssen (50), Kussmaul (51)].
- b.* Diminished motor activity.
- b.* 1. Weakened motor force. Atony.
2. Changes in the stomach.
3. Extra gastric pressure.
- a.* and *b.*
3. Absorptive changes.
- a.* Tardy absorption.
- b.* Complete absorptive failure.
- Anæmia, chlorosis, improper diet, phthisis, leukæmia, alcoholism, diabetes mellitus, amyloid degeneration, syphilis, acute infection (typhoid, etc.), cholera, puerperal fever, chronic catarrh of the stomach.
- Obstruction (usually at pylorus, carcinomatous, cicatricial, non-malignant tumor).
- Gastroctasia.
- Ulcer, cancerous degeneration of stomach wall.
- Hypertrophy of muscular coat with congenital narrowing of pylorus.
- Tumors pressing on pylorus.
- Adhesions to neighboring organs (gall bladder), liver, pancreas, duodenum.
- Ligamentous bands.
- Hernia [Boas (52)].
- Diseased gastric mucous membrane (often accompanied with atrophy of the gastric follicles).
- Connective-tissue overgrowth in stomach wall.
- Cancerous infiltration.
- Amyloid disease.
- Impeded circulation from whatever cause.

there is deficient HCl after a trial meal we find the meat undigested, its fibers slightly swollen, but little changed. Lactic acid and other organic acids are present after we have reason to expect an active digestive period.

There may be either reduced HCl, or the quantitative change may show an acidity.

b. Hyperacidity with normal quantity of gastric juice.

This change we often find in both acute and chronic diseases of the stomach. With Reigel, we consider these cases as including only those in which the hyperacidity can be demonstrated during the digestive period. Any excess of HCl above 0.3 per cent. may be considered as belonging to this class. In contradistinction to the anacid or deficient HCl gastric secretion, we find with hyperacidity the albuminoids well and rapidly digested in the majority of cases. In some cases, and these have been carefully described by Sticker, we find the meat digestion tardy, owing to the disproportion between the pepsin and HCl.

c. Hyperacidity and supersecretion.

We classify under this division such cases as are supplied with a gastric juice of good digestive quality, but in which there is an overactivity of the secretory glands, giving rise to an *almost continuous acid secretion independent of the digestive period.*

It is possible, therefore, to express from the stomachs of these patients, long after digestion has ceased, a fluid which is free from all remnants of ingested foods, but on examination is found to be sufficient to digest albuminoids. This condition can only be diagnosed after emptying the stomach thoroughly, and allowing a period to lapse without the ingestion of food, when the tube is introduced and a fluid extracted with the characteristics already mentioned. As a rule, the motor function of the stomach in these cases is faulty; there remain in the stomach undi-

gested starch and undivided bread particles; but, as a rule, the meat has been thoroughly and completely digested, and fermentation is not likely to occur.

d. Supersecretion.

It is a question whether there is a simple supersecretion which is unattended by hyperacidity. Riegel's experience emphasizes the statement that hyperacidity can occur alone, while supersecretion, in its most pronounced forms, is, as a rule, which is almost without exception, accompanied with hyperacidity.

2. *a and b. Motor disturbances* may be considered to be due to secondary changes. There may be overactivity or motor weakness. The more severe cases of the latter are found with some impediment to the free emptying of the stomach at the pylorus, when there may be simple diminution of the motor function, or it may be almost completely abolished. Believing, as I do, that a disturbance of the motor function is rarely found without some fault in the gastric chemical function, I am anxious to impress upon you the importance of gaining positive evidence of the motor strength, and giving to each abnormality of motion its proper significance. The clinical evidences which this paper is to furnish will, I think, in conjunction with what Professor Stockton shall offer in detail, on this subject, prove the value of a thorough understanding of the motor function of the stomach. In very many doubtful cases, indeed, I hold that, when coupled with absorptive disturbances, it furnishes data of equal if not greater import than are supplied by a study of the secretory function alone; for if the latter be at fault, we may still hope, with a sufficient motor function, to advance the food into the duodenum, for its ultimate digestion and absorption there.

3. *a and b. Absorptive changes.*

Tardy or complete failure of the stomach to absorb

must be taken into account for the better understanding of the condition of the mucous membrane of that organ.

If the accompanying chart is carefully studied it will be found that here, as in most diseases which require thorough physical examination for their accurate diagnosis, there is no *one* change in either secretion, motion, or absorption which is pathognomonic or which justifies a positive diagnosis.

The practical value of the newer methods of examination of the stomach and its contents lies in the knowledge which we gain of the changes in the functional activity of that organ, as epitomized above, and the addition of such information to our other subjective and objective symptoms. Our fondest hope can not make the results more than confirmatory, while the study of these methods emphasizes the importance of adding every detail which all cases present.

Absence of Free HCl.—Within the past few years the diagnostic value which had been accorded to the absence of free HCl from the stomach during the height of digestion has been materially modified, and we are daily leaning more toward the conclusion that it points more directly to a disturbed function and less to any one diseased condition of the stomach.

The diagnostic value of the absence or diminution of free HCl in the stomach secretion, associated more particularly with pyloric cancer and ultimate dilatation, was first systematically investigated by R. von den Velden at the clinic of Kussmaul in Strassburg.

It seems strange that the knowledge of this fact, which was given to the profession as long ago as 1842 by Golding Bird (53), did not lead to its application for diagnostic purposes. Bird's patient was a man, aged forty-two, with pyloric cancer and dilatation. The diagnosis was verified by autopsy. Bird made three chemical analyses in about three

weeks, and concluded that "during the more irritative stage of the disease free HCl is present in the vomit in considerable quantities; but it gradually diminishes in proportion to the patient's loss of strength, and the organic acids increase proportionally as the free HCl diminishes."

It has been held that the absence or diminution of HCl from the gastric secretion is an almost constant attendant of all forms of cancers, regardless of their location or histological structure. That this is not true I am able to state positively as the result of experimentation during the past two years in eight cases of cancer—three uterine, two omental, with ultimate secondary nodules in the liver, two recurring cancers of the breast, and one medullary cancer probably of the right kidney after removal of the right testicle for the same disease about one year previous. In all of these eight cases Leube-Riegel test meals were given and repeated chemical examinations were made with positive results. HCl was present, both combined and free, in over ninety per cent. of the tests. In the case of cancer of the right kidney HCl was absent at times, owing to the regurgitation into the stomach of the bile, due to extra-intestinal pressure and constriction.

In conjunction with the study of the importance of free HCl as a diagnostic sign, we must remember that in not a few cases a feeble digestive process has progressed without the characteristic color reaction at the height of digestion. It must not be taken for granted that digestion begins at the moment when the secretion is expected to react to these tests; but let the clinician note that at that time a large part of the stomach work has been done and digestion is almost ended (Martius (54)). "Free HCl" might then more properly be spoken of as "surplus HCl." It is, in fact, the remnant left after all affinities have been satisfied.

Cancer of the Stomach.—The pathological condition with

which absence or diminution of HCl has been most frequently associated by clinicians is cancer of the stomach. With your permission I will spend a few minutes in considering the diagnosis of this condition, with special reference to the newer methods of examination of the stomach contents.

The positive statement is made by Riegel (55) (after emphasizing the fact that our examinations must be oft-repeated and made with accuracy and reliable reagents before formulating conclusions) "that the constant presence in a gastric juice of free HCl and a normal peptic strength allows the exclusion of cancer of the stomach with certainty, regardless of the other symptoms, however strongly they point to that disorder."

If we accept the statement of Riegel, we are forced to determine the factor which causes the changed secretion and functional inactivity. That there is nothing in the cancer *per se* to check the HCl secretion is shown by innumerable cases of cancerous diseases of other organs, as already mentioned, in which free HCl is almost always present in the gastric juice. It has been the experience of others that in a few cases of cancer of the stomach free HCl continues in the gastric secretion, and within the past three years the writer has had a similar experience in two cases in which free HCl could always be demonstrated at the height of digestion. In all of these cases there has been a functionally active gastric juice. In both of my cases the autopsies revealed the presence of cancer of the stomach, but without the usual accompaniment of far-reaching atrophy or degeneration of the gastric follicles. The writer has notes of an autopsy made during the winter of 1890 in a case of pneumonia ending in three days where the patient was also in the early stages of cancer of the stomach. In this case there was always presence of free HCl. The post-mortem showed a small scirrhus nodule at the pylorus; the mucous

membrane of the stomach was but little changed; the microscope gave evidences of unchanged peptic glands.

Without dilating too long on the causes of anacidity in cancer of the stomach, it may be assumed with great certainty that the prime factor in its causation is the infiltrating character of carcinoma, involving the glandular elements of the stomach in a process of atrophy with more or less additional gastritis.

Jaworski and Gluczinski (56) held that in cancer of the stomach there was no free HCl, little pepsin, and no peptones. Their study of the subject seemed to them sufficient to justify the conclusion that with free HCl and normal digestive faculty carcinoma should be excluded. To this view Ewald (57) also subscribes. How contradictory are the statements of Cahn and v. Mering (58), who conclude that "with cancer of the pylorus the presence of HCl is the rule, its absence the exception"!

The largest number of examinations have been made by Riegel (59), who reports two hundred and seventy-four analyses in thirteen cases. Free HCl was never detected. He (Riegel (60)) reported three cases of cancer of the stomach in which a feeble HCl reaction took place early in the disease.

Rosenheim (61) reports sixteen cases, in fourteen of which there was an absence of free HCl; in the other two there was a transitory presence of free HCl and hyperacidity, respectively.

Kinnicut (62) reports eight cases with one hundred and thirty-two analyses. Free HCl was demonstrable only in two cases, in one of which a trace was detected in two examinations out of twelve; in the second a feeble HCl reaction was once obtained.

In ten cases under my own observation with one hundred and twenty tests, free HCl was absent in 92.7 per

cent. of the tests, and present, as a rule feebly, in 7.3 per cent.

Thiersch (63), in an interesting article On the Presence of Free HCl in the Gastric Juice in Beginning Cancer of the Stomach, reports a case in which HCl was present, and Krause (64) has established beyond doubt the fact that HCl may persist in cases of ulcerating carcinomata of the pylorus. A continuous absence of HCl is found in all cases in which there is atrophy or amyloid degeneration of the mucous membrane of the stomach accompanying cancer (Levy (65), Edinger (66)).

In considering the diagnosis of gastric cancer from the chemical analysis of the stomach contents, it must be remembered that in most forms of gastritis (Boas (67), Jaworski (68)) HCl is reduced (from 0.22 per cent., 0.28 per cent., to 0.1217 per cent.).

Boas has found that in marasmus, Riegel (69) in fever, Honigman in regurgitated bile (a fact to which I have already referred in my own statistics) free HCl is absent, and Grundzach (70) has shown that in perfectly healthy individuals with normal digestion there may be a transitory deficiency of free HCl.

With such data before us no one will assert that we are justified in diagnosing cancer of the stomach from the absence or presence of free HCl alone, while in the majority of cases of cancer of the stomach, as shown by the results of the tests made by Riegel, Rosenheim, Kinnicut, and myself, absence of HCl has been demonstrated; "the diagnostic value of this circumstance is materially lessened by the occurrence of this same deficiency in other diseases with similar symptoms." Ewald (71) concludes: "But granting this, the proposition which I was the first to announce is still true, that the demonstration of the presence of HCl points with very great probability against the existence of

cancer of the stomach, for the cases of this disease in which there is a positive reaction to the carefully applied tests are so rare that they have very little bearing on the question."

1. *Latency of Gastric Cancer.*—The frequent examination of the stomach contents has demonstrated, to my mind, at least, the fact that in a large number of cases there are periods of latency during which there remains a certain amount of functional inactivity, but in properly managed cases immunity from many of the painful and depressing symptoms of the original disease.

Latent gastric cancer has not been generally recognized, and in many cases the first and correct diagnosis has been changed by the unsuspecting physician, owing to this period of latency with evident improvement and deviation from the ordinary course of the disease. I have in mind at this time a number of cases, and in most of them, if seen sufficiently early, there is decreasing HCl in the secretion, a tardy absorption, with more or less motor involvement, according to the location of the tumor and the amount of secondary dilatation with the period of latency. The examination of the stomach contents shows no improvement, neither does the amount of HCl vary materially from that found at the beginning of the period of latency.

In many of these cases the olive-oil and salol tests prove increasing motor strength, and in those patients who have accompanying glandular atrophy and yet show general improvement it may be assumed that constriction does not exist to any great degree, and that the duodenum and intestines are performing their functions with sufficient activity to nourish the patient. It follows, therefore, that the cases in which we most frequently find latent gastric cancer are either those with localized tumor without much

constriction and ultimate gastrectasia, or the infiltrating variety, with only moderate thickening at the pylorus.

It is surprising to note the length of time during which the disease remains latent and the long duration of the disease as a result of these periods of latency.

I have at the present time a case under observation which has continued for almost six years—that of a woman, now sixty years old, which, seven years ago, commenced with vague symptoms of indigestion and anorexia. For two years there was an increase of these symptoms, with the characteristic changes in the blood found in cancerous diseases, as shown by microscopic examination. Four years ago she had coffee-ground vomit, and later considerable hæmatemesis. Three years ago there was almost complete absence of HCl, with tardy absorption and weakened motor strength. With these symptoms no tumor could be felt, neither was there gastrectasia. At that time she commenced to improve; trial meals showed absence of HCl, but the motor function had improved so that gradually the stomach learned to empty itself, to allow of the more thorough digestion in the small intestine. The subsequent history shows periods of exacerbation and latency until now, when we find a well-marked tumor in the anterior stomach wall, as shown by distending that organ, and secondary nodules in the groin, and probably in the liver.

Some may say that this was originally a case of ulcer which now has a carcinomatous base. This is not probable, for there has been no time when there was hyperacidity or supersecretion, always deficient HCl; at no time was the secretion of the stomach competent to digest albuminoid foods, while the seat of the tumor, with the early cachexia and blood changes, preclude the presence of an original *ulcus ventriculi*. In these cases of latent cancer without tumor formation the disease strongly resembles

pernicious anæmia; but here the microscope comes to our aid and the experienced hæmatologist will have no trouble in distinguishing.

Henry (72), in a clinical lecture on diagnosis of cancer of the stomach, says: "I had under my care at the same time two cases—one with pernicious anæmia, the other with cancer of the stomach. The latter was far more emaciated, far more feeble than the former, while the red blood-corpuscles were four or five times as numerous. Surely nothing in the whole field of clinical medicine can be more diagnostic than such facts. In carcinoma of the stomach the reduction of the number of red blood-corpuscles does not keep pace with the cachexia; in pernicious anæmia the cachexia does not keep pace with the reduction of the red blood-corpuscles."

2. *Infiltrating cancer of the stomach* without distinct tumor formation is not of infrequent occurrence. Unless the infiltration or new tissue formation in the neighborhood of the pylorus is sufficient to cause constriction with more or less dilatation, the diagnosis between this condition and atrophy of the gastric follicles becomes very difficult.

Here again our tests will come to our assistance if made, for physical signs will not avail until secondary changes have taken place. In both, HCl, pepsin, and rennet may be absent. In atrophy there is never hæmatemesis, while the presence of altered blood and pigment gives the stomach contents a characteristic color in carcinoma (Ewald (73)).

With infiltrating cancer we find—

- a. During fasting, the presence of the food taken the day before in the stomach.
- b. With trial meal, absence of free HCl.
- c. Lactic acid present.

d. Progression of disease, never an improvement of functional activity of the stomach.

3. *Pyloric Carcinoma, Stenosis, and Gastrectasia.*—In these cases the symptoms gradually appear. If the patient presents early, there is complaint of occasional vomiting, with more or less sternal and epigastric distress. As the disease advances, even before the tumor is palpable, percussion elicits a changed note over or near the normal location of the pylorus.

The examination of the stomach contents after a test meal shows acidity due to the organic acids, lactic mainly. The food taken during the previous day is found in the stomach. As a rule, free HCl is absent; if not entirely absent, is reduced in quantity. As the disease advances there may still be presence of pepsin in a reduced quantity, while rennet may or may not be present, also peptone and propeptone.

It may be taken for granted that if, on repeated examination with the tube and with a proper diet, composed in part of albuminous food, the stomach retains the ingesta, but slightly changed and undigested for more than seven hours, a constriction is present at the pylorus; and if free HCl is absent, with the absorptive function of the stomach deranged, the chances are decidedly in favor of carcinoma. Dilatation is usually present under such circumstances; if not, it will not be long in showing itself. The amount of fluid expressed through the tube gives an approximate idea of the degree of the constriction and the amount of gastrectasia.

4. *Carcinomatous Infiltration of the Base of Old Ulcers* (particularly at the Pylorus).—From seven to nine per cent. of all gastric cancers are located in and take their origin from ulcers (Haberlin (74), Rosenheim (75)).

In a private communication from Professor Billroth, to

which I will again refer, he writes: "I consider the differential diagnosis of an ulcer of the stomach with cicatrization and beginning carcinomatous infiltration from primary cancer as very difficult and usually impossible—ofttimes impossible when the fresh specimen is before us and cut into, only possible after many and large sections have been microscopically examined." It may be said at this juncture that given a case (Rosenheim (76)) in which there is tumor formation, pain, anorexia, and rapid emaciation, with the characteristic blood changes of cancer, free HCl constantly present at the height of digestion, with possibly hyperacidity and ultimate gastrectasia, we may conclude with a considerable degree of certainty that we are dealing with a cancerous infiltration of the base of an old gastric ulcer. Here, too, we must be careful to exclude extragastric growths, which cause compression of the pylorus and dilatation in consequence, and may at the same time have accompanying hyperacidity. Such cases have been reported by Plawski (77), who dilates very fully on this subject in his article.

5. *Localized cancers without constriction and with but little glandular atrophy* occasionally occur, and HCl may continue to be present in the secretion until within a short time before death.

Here the diagnosis requires a thorough physical examination. The stomach must be outlined after the method of Piorry and allowance must be made for absorptive and motor functions according to the location of the neoplasm and the extent of the change in the mucous membrane as the disease progresses.

6. *Non-malignant and Fibrous Stenoses of the Pylorus.*—In this connection it must not be forgotten that there are cases of non-malignant and fibrous stenoses of the pylorus. In many of these cases we have a previous history of ulcer,

with attending hyperacidity, characteristic pain, and hæmorrhage. In other cases the stenosis is gradually formed, the ætiology remains obscure, and a differentiation from cancerous obstruction becomes necessary.

In fibrous stricture we find HCl present, in some cases in excess, peptic action slow, but ultimately satisfactory. In thirty-three cases studied by Riegel (78), he found 0.10 to 0.46 per cent. of HCl, and in twenty cases titrated by Ewald (79) he found 0.17 to 0.30 per cent. of the acid.

As a rule, after the Ewald test meal, I have found hyperacidity, similar to the experience of Einhorn, as related to me in a personal communication of great value. Free HCl is present, food is held in the stomach longer than normal, while albuminoids are changed and partially digested, while the organic acids, particularly lactic acid and butyric acid, are present and in the ascendency, displacing in some cases the free HCl, which is again found after thorough disinfection and washing out of the stomach.

In most of the modern works on carcinomatous diseases of the stomach it appears to the writer that too little importance has been placed on a more careful study of the motor and absorptive function of the stomach, while the HCl estimation has been constantly placed in the foreground.

The newer methods of diagnosis must include in the diagnosis of gastric cancer the frequent examination of the blood for hæmoglobin as dwelt upon by Haberlin (80) in his monograph, and the examination of the urine for indican (Rosenheim (81)), in order to give valuable information.

In association with the subject of cancer of the stomach, with your kind permission I will report two cases which show the value of examination of the stomach contents as an aid in differential diagnosis:

CASE I.—On the 27th of May, 1891, I was called to see Ellen R., aged forty-two, unmarried, with a negative family history. For several months she had been complaining of a feeling of distress after taking food, pains radiating through the upper half of the abdomen, progressive but gradual emaciation, with increasing muscular enfeeblement and considerable anæmia. The pains bore no relation to the ingestion of food, though she complained of flatulence about two hours after her meals. She had vomited at various times during the preceding two months, never blood, usually a light-yellow, sour-tasting, but not foul-smelling fluid.

At times the vomited matter had been of a darker, almost brown color. There were no other subjective symptoms save a chronic constipation. Ovarian and uterine functions were normal, though she gave a vague history of a pelvic peritonitis, for which she had been treated about two years before the beginning of the symptoms of which she now complained. There was also a slight accentuation of the mitral sounds over that area. With these symptoms, the character of the pain, the vomiting, more particularly the occasional ejection of a brownish, almost coffee-colored fluid, malignant disease of the stomach or duodenum was strongly suspected.

Physical examination of the abdomen at the first visit failed to give satisfactory evidence of the existence of such a lesion. On pressure over the epigastrium there was increased tenderness, while percussion was normal all over the abdomen. The size of the stomach was tested after the method of Piorry and Penzoldt, and was found to be normal. After this she refused the trial meal, preferring treatment for a number of days before the reintroduction of the tube. An examination of the urine at this time showed it to be normal, with a specific gravity of 1.024. During the week following, the patient's condition did not change materially. On the 5th of June, about nine days after my first visit, the patient was given a Leube-Riegel test meal, which was expressed after five hours by means of a soft tube, when it was found that most of the albuminoid food had been digested. The extracted remnant contained neither starch nor any of its products, gave positive evidence of the presence of

HCl with Congo paper and the Gunzburg test, as well as that of Boas. The amount of HCl was 0.25 per cent. The Uffelmann test failed to show the presence of organic acids. The test for pepsin and rennet showed a good digestive fluid.

The result of this examination, after the strong suspicion of gastric cancer, was surprising and puzzling. The test of the motor function with salol, and the absorptive function also, showed normal motor and absorptive activity. Gastric cancer was at once excluded, though I now leaned very strongly, strengthened by the increasing emaciation and anæmia of the patient, to the diagnosis of malignant disease of some one of the abdominal viscera other than the stomach. No positive diagnosis was made.

The subsequent course of the case proved the correctness of that view. During the following month a distinct nodule could be felt in the epigastric region, near the normal position of the pylorus. To localize this nodule more exactly the stomach was inflated, when it was found that the nodule was situated behind its posterior wall. The diagnosis of retroperitoneal or pancreatic cancer seemed justified. In the course of the next few weeks it became evident that there were cancer nodules in the omentum and in the retroperitoneal folds and the pancreas.

The addition of glycosuria to her other symptoms several weeks before her death led me to conclude that the nodule felt in her epigastrium was connected with the pancreas, though there was no fat in her stools at any time.

On the 31st of July, 1891, she was suddenly taken with a profuse diarrhœa, and died in collapse during the following night.

The post-mortem examination, made by Dr. Curtin, showed cancer nodules involving the retroperitoneal glands and omentum, with a large cancerous mass occupying the normal seat of the head of the pancreas. This organ was adherent to the stomach, and the latter organ was found entirely free from disease.

In this case it may be said that the chemical analysis was of great value in distinguishing and in a measure locat-

ing the seat of the disease. Without the examination, but with the presence of a tumor ultimately in the epigastric region, palpable, with the symptoms already given during the period preceding the glycosuria, no physician would have leaned as strongly to any other diagnosis as to that of gastric cancer.

The absence of fat from the stools, in spite of the persistence of glycosuria, would have had no material bearing in the diagnosing of the case without the positive evidences of a normally acting stomach, such as we obtained from our chemical analysis.

This case is one of many which might be related to convince the most skeptical of the truth of the statement that we possess in the newer methods of examination aids of practical value for the differential diagnosis of diseases which have a great similarity to the organic stomach disturbances. The cases which have given me the greatest satisfaction have been those in which I have been able by these methods to exclude almost positively the existence of organic disease of the alimentary tract when there were present well-marked evidences of some serious organic disease. In such cases, in spite of the fact that there are symptoms referable to the stomach, it may be said, indeed we may be almost justified in formulating the rule, that without marked change in the contour of the stomach, without a tumor which can with certainty be located in the stomach wall, without unequivocal signs of organic disease of the stomach, with, on chemical analysis, the evidences of normal secretory, motor, and absorptive functions, organic disease of the stomach can be excluded with certainty. The cases in which nodules in the epigastrium or its immediate neighborhood connected with the liver, gall bladder, pancreas, or omentum require accurate differentiation are constantly coming to us, and require all of the skill and acumen of the

careful and painstaking diagnostician. In a recent personal communication from Boas I was pleased to note that he expressed his belief in the fact that one of the most important achievements of the chemical analyses of the stomach contents was the certainty with which they permit of the exclusion of the diseases of the stomach.

CASE II.—In a case which recently came to my notice there was a small nodule in the lower right corner of the epigastrium, which followed in about ten months after the removal of the right testicle for medullary cancer in a man aged thirty-seven. There were some symptoms which made the exact localization of the tumor impossible. There was repeated vomiting at first of an acid mucus. As the nodule increased in size it was found that the stomach symptoms grew worse. An examination of the stomach contents after a trial meal failed to show any change in the functional activity of that organ; as a result, gastric cancer was excluded.

In the course of a few weeks, as the tumor enlarged, it was found that at times so much bile was present in the stomach, regardless of the digestive period, that a constriction of the intestine below the entrance of the common duct was strongly suspected, thus causing a regurgitation of the bile into the stomach. When the stomach was thoroughly emptied and all bile removed, the reactions were normal after a test meal at the height of digestion. The subsequent history, I think, justified the diagnosis of a growth connected with the right kidney, by pressure almost occluding the duodenum at a point below the entrance of the ductus choledochus. Unfortunately, no post-mortem was allowed.

Atrophy of the Gastric Follicles.—The pathological condition which can be diagnosed with the greatest amount of certainty by our newer methods of examination is atrophy of the gastric follicles, or, as Ewald calls it, anadenia.

This may be either an independent lesion or an accompaniment of cancer, or it may complicate the later stages of chronic gastritis.

Einhorn (82) has spoken of a similar condition as "achylia gastrica" in a very able article, preferring this term—meaning lack of gastric juice—to any other.

Fenwick (83) was the first to call the attention of the profession to this condition in 1877, while Ewald (84), Kinnicut (85), and Boas (86) have added important data, which, in conjunction with those of Nothnagel (87), Osler (88), and Eisenlohr (89), show the clinical picture of the disease to correspond very closely with that of pernicious anæmia.

It is still an unsettled question whether the progressive anæmia always precedes the atrophy of the gastric follicles, or whether the latter is in a large measure due to the same underlying vice which gives rise to the former condition. It is certain, however (and Eisenlohr (90) has recently written an article which gives abundant clinical data), that several forms of anæmia and various system diseases of the cord are intimately associated with the anadenia of Ewald.

This fact was first insisted upon by Lichtheim (91), who never found the cord normal in cases of atrophy of the gastric follicles with pernicious anæmia.

In these cases the stomach is usually empty while fasting; the expressed contents, after a trial meal, contain neither mucus, HCl, pepsin, nor rennet. In all of these cases, where there is atrophy and attending absence of pepsin, Jaworski's method of administering a diluted HCl solution (200 to 300 c. c.), and siphoning it from the stomach in half an hour after its administration, during which time it should have stimulated the secretion of pepsin, and then testing the fluid as to its digestive power, will demonstrate the complete inactivity of the same. This test gives positive evidence of changed or unproductive peptic glands. This is a very valuable point in the differentiation between atrophy and carcinoma. In the latter there is usually, with

similar treatment, a small quantity of pepsin present. These cases require for their more thorough study a microscopic examination of the blood, when poikilocytosis as well as microcytes with characteristic granular and large cells, as described by Ehrlich (92), will be demonstrated.

With an active motor function in the early stages of these cases, and an active digestion in the duodenum and intestines, these patients remain in a fairly well nourished condition. In most cases, however, which have come to my notice, the process of atrophy extends to the intestinal glands and duodenum, when the disease runs a rapid course.

While the diagnosis of atrophy of the gastric follicles in the majority of cases can be made after a number of weeks of careful watching and chemical examination, Ewald (93), in his recent publication, mentions the difficulty experienced in distinguishing this condition from carcinoma and some of the more severe gastric neuroses. The form of carcinoma which is most readily confounded with simple atrophy is the infiltrating variety. Here physical signs avail little, for aside from the compensatory hypertrophy of the muscularis there may be no constriction at the pylorus, and consequently no gastrectasia. In these cases the microscopical examination of the expressed fluid will afford data for distinction; the carcinomatous stomach contents will, as a rule, contain altered blood pigment, though hæmatemesis be absent, while with atrophy its presence is unknown.

All of the chemical characteristics mentioned in conjunction with the study of atrophy may be present in cases of grave neuroses, or nervous anachlorhydria; indeed, these cases may assume such a serious aspect as to simulate infiltrating carcinoma. Ewald, in the article above quoted, after mentioning some of the differential points already re-

hearsed, says that "for the differentiation of anadenia from severe neuroses there are as yet no characteristic symptoms."

The neuroses simulating achylia are usually associated with general disturbances of the system, so that it is possible to recognize evidences of hysteria, neurasthenia, or spinal irritation, and thus establish the neuro-psyche element.

As able a diagnostician as Ewald reports the case of a woman in whom he had all of the symptoms which seemed to justify the diagnosis of nervous anacidity, and which he made after long-continued watching. The woman under treatment improved, and returned from Berlin to her home in Russia, where, after a few weeks, a tumor of the liver was palpable and another in the epigastric region. The early symptoms were undoubtedly connected with development of the case.

Gastritis.—The large quantity of mucus removed by the tube in the average cases of gastritis must serve, in conjunction with the chemical examination of the stomach contents, to make the diagnosis of that disease comparatively easy. In the milder cases of gastritis free hydrochloric acid is present in reduced quantity at the height of the digestive process.

With a progression of the disease there is usually entire absence of free HCl, traces of peptone, rennet absent, propeptone present. With the waning of free HCl, pepsin is absent in like proportion. In many of the more severe cases peptonization may still progress, until in the later stages, if the disease is unrelieved, complete atrophy, with its characteristic anomalies, finish the picture of the disease.

In these cases the reaction of the stomach contents is strongly acid, a condition produced by the presence of the

organic acids (lactic, acetic, butyric, and fatty acids), mainly due to the fermentation of the carbohydrates.

Usually the motor function is found disturbed; there is an atony corresponding with that so often found in the bladder muscle (Rosenheim (94)), which may be functional or due to interstitial overgrowth, or degeneration of the muscular coat. As the disease advances, the absorptive function gradually gives way with the destruction of the epithelial elements.

Hyperacidity.—The disease with which hyperacidity is most frequently associated is ulcer of the stomach. There is a condition of superacidity and hypersecretion, to which we will also refer later in this article, which may exist without ulceration of the gastric mucous membrane.

Riegel (95) was the first to call our attention to the fact that with ulcer of the stomach there is, as a rule, a conspicuously high percentage of HCl, and Van den Velden (96) has demonstrated beyond controversy that in many cases of ulcer of the stomach the chyme contains an abnormally great amount of the acid. In considering the diagnosis of simple typical ulcer of the stomach before an assemblage of educated physicians, I feel that I will be sustained in making the assertion that in the majority of these cases there are sufficient data to make clear the diagnosis without recourse to the chemical examination of the stomach contents which we are to-day considering. The age of the patient, the characteristic anæmia, the microscopical appearance of the blood, the menstrual anomalies, oftentimes the hæmatemesis, the character of the pain, with the time of its occurrence—all these give sufficient data in the ordinary case to make the diagnosis clear.

On the other hand, there are cases in which the usual symptoms fail to clear the field for an easy and positive diagnosis. The case may be atypical, or there may be a

combination of circumstances with symptoms which make differentiation difficult, and we are consequently forced to resort to our tests for a solution of the question.

It is safe to teach that in all cases of ulcer of the stomach the stomach tube should not be used without great caution, and only in cases where its use is made imperative for the purpose of diagnosing the existing condition when other means fail.

Ewald, in his work, asks the question whether it is justifiable or necessary in a case of gastric ulcer to introduce the stomach tube. In answering, he says: "You know that until recently this question was answered in the negative. The introduction of the soft, flexible tube has reduced the dangers very materially, but they are by no means overcome; and when we consider how easily vomiting and retching are provoked, the tube will not be introduced without a thorough appreciation of the facts enumerated, and the adoption of means to prevent accidents which may lead to serious results." In no case of stomach disease, no matter what lesion we suspect, would it be wise to resort to the use of the tube for purposes of diagnosis during the persistence of hæmatemesis; or the presence of symptoms which are suggestive of acute localized peritonitis or acute gastritis. In these cases the stomach remains a *noli me tangere* (Rosenheim (97)). It may be concluded that in cases of ulcer in which there is no gastrectasia the motor function is usually good, as is also the absorptive; that the secretory function in the great majority of cases (as shown by Van den Velden (98), Riegel (99), and Jaworski (100)) is associated with hyperacidity.

As a rule, and this has many exceptions, according to my experience, HCl is present in quantity to exceed 0.3 per cent. after a simple test breakfast, and with a full Riegel-Leube meal it may reach as high as 0.6 per cent. In

one third of the cases of ulcer the acidity is found normal (Rosenheim (101)), while in other cases the quantity of HCl may be markedly reduced. In the latter, cancerous degeneration of the base of an ulcer may be strongly suspected, when an ultimate anacidity may be expected before death, or there may be with reduced HCl beginning involvement of the glandular elements of the mucous membrane (Rosenheim (102)).

Riegel (103) reports three hundred and eighty-two analyses of the stomach contents in forty-two cases of ulcer of the stomach, in which he found the percentage of free HCl—at the height of digestion abnormally high—values of 0.4 to 0.5 per cent.

Gerhardt (104) reported twenty-four cases of gastric ulcer with presence of HCl, as shown by the color test in seventeen, while in seven there was no response.

Rosenheim (105), in eight cases, was able to demonstrate hyperacidity in two only; in four, HCl was within normal limits; in two there was subacidity.

Kinnicut (106) reports four cases, in all of which HCl was found, with thirty-one examinations after test meals, values of 0.17 per cent. to 0.23 per cent.

My own experience in six cases of ulcer of the stomach, with repeated examinations during the past three years (forty tests), leads me to conclude that in the majority of cases free HCl is present; that in two thirds of all cases there is an excess of HCl, and in one third there are normal and subnormal percentages.

With these facts and the statistics before us, we must conclude that in cases of ulcer *the gastric juice always contains HCl*, and usually an excess of it (Ewald (107)).

The chemical analyses in a case of stomach disease in which there are symptoms of both ulcer and cancer becomes of the greatest value to the physician and surgeon

alike. The constant presence of free HCl, in a case where such differentiation becomes necessary, may be regarded as strong evidence in favor of ulcer of the stomach and absence of cancerous infiltration. The greatest difficulty in practice is oftentimes experienced in distinguishing between gastric ulcer, gallstone colic, and duodenal ulcer. A case which has been under treatment during the past winter demonstrated that fact very forcibly. Without giving details of the case, it may be said that the patient was a man, aged eighty-one years, who had renal colic during the active years of his life, and for seven years has had more or less severe pain in the epigastrium, usually more severe during the afternoon about four o'clock. No one tender spot could be found; the entire epigastrium seemed hypersensitive to pressure. He had consulted prominent physicians in the East and West, with almost as many different diagnoses as physicians consulted, but without relief. For five weeks before he consulted me he resorted to morphine without benefit. At the first visit nothing could be elicited from the history which aided in making the diagnosis, but in examining the vomited matter, six hours after a meal of milk only, we found more free HCl than is normally present at the height of digestion after an ordinary trial meal (0.4 per cent.). The fluid contained both pepsin and rennet. After a trial meal of milk and egg albumin, it was found that there was marked hyperacidity (0.6 per cent.). This gave us abundant evidence, in conjunction with the examination of the vomited matter, to diagnose both hyperacidity and supersecretion. Close questioning revealed the fact that the patient, seven years before, had a well-marked intestinal hæmorrhage, which fact he forgot to give. The diagnosis was clear—duodenal ulcer with supersecretion. It would not have been made without chemical examination. Morphine, after a short struggle, was discontinued.

Lavage with alkalis, resorcin, arsenious acid, and a suitable diet, rigorously followed, were substituted for his previous treatment. The aged patient is well, at least without a symptom, in the full possession of his faculties, relieved from the slavery which would soon have made him more wretched than the disease from which he was suffering.

Bucquoy (108) lays great stress in the diagnosis of duodenal ulcer on the following points :

1. "Sudden intestinal hæmorrhages in apparently healthy people, which tend to recur and produce a profound anæmia (hæmorrhage of the stomach may precede or accompany the melæna)."

2. "Pain in the right hypochondriac region coming on late, two or three hours after eating."

3. "Gastric crisis of extreme violence, the hæmorrhage being more apt to occur about the time of these attacks."

4. Osler (109) says: "The point upon which the greatest stress has been laid in the diagnosis of duodenal ulcer is the occurrence of melæna without hæmatemesis." To which I would add the great importance and value in doubtful cases of chemical examination to determine the degree of acidity and the amount of secretion.

Gastric Neuroses.—After a very thorough clinical consideration of the more frequent neuroses which were formerly included in the chapter of "nervous dyspepsia"—a term which Leube (110) still insists upon using—I am fully satisfied that, with but few exceptions, and to these I will refer later, the newer methods of chemical examination have added little to make the diagnosis easier, or in any way explain the many vagaries of these disorders, whose symptoms are as variable as the colors of the chameleon.

Leube holds that the diagnosis, or rather the suspicion that the disease is of nervous origin, is made a certainty by the examination of the stomach with the tube. He lays

down the rule that, seven hours after the trial meal, the stomach is invariably empty. To this many take exception, and it appears to me with reason; while Leube grants that there are rare exceptions, he says "these ought not to upset the rule."

Supersecretion and Hyperacidity.—It is certain that these conditions exist oftener than has been suspected in the past. These conditions are usually associated. When we speak of supersecretion we include that pathological condition in which the excessive secretion gives a functionally active juice not only during the digestive period, but long after the stomach has been emptied of its food. In other words, it is not so much an increase during digestion as it is a continuous secretion, entirely independent of the digestive act.

Reichman (111) was the first to call our attention to this condition. Since his publication, Riegel (112) and Van den Velden (113) have added valuable reports of cases to our literature on the subject.

The examination of the vomited matter in these cases is of the utmost importance, for it not only reveals the presence of the hypersecretion when the stomach should be empty, but the hyperacidity as well. This must be the "exception" to which Riegel (114) refers when speaking of the value of the examination of the vomited matter in diseases of the stomach.

The symptoms in these cases are well marked. If long continued, we ultimately have motor insufficiency, in some cases almost complete atony of the muscular coat.

Gastralgia, recurring at intervals after great mental emotion or other excitement, is a prominent symptom.

Kinnicut (115) says: "I have fixed as high a limit as fifty cubic centimetres of gastric juice as a basis for a diagnosis of hypersecretion."

In a case which recently came to my notice I found, after washing out the stomach the previous night, on the following morning before food had been taken two hundred cubic centimetres of an acid fluid, with 0.15 per cent. HCl, pepsin, and rennet, as shown with the milk test. In this case there were repeated gastralgic attacks, requiring hypodermics of morphine, which have entirely ceased since the recognition of the disease and its proper treatment.

Sahli (116) found this condition present in the gastric crisis of tabes; it has also been observed in cases of melancholia, hysteria, neurasthenia, and many other neuroses.

The diagnosis is made, as above mentioned, by expressing the secretion after having washed out the stomach six or seven hours before, the patient fasting during the interval. It will be found that the fluid digests albumin readily, is without organic acids and peptone, has free HCl, is, as Kinnicut says, "hyperacid gastric juice."

It has been held by Talma (117) and also Suyling (118) that there is a neurosis which shows itself in a hyperæsthesia of the gastric mucous membrane, more particularly to HCl. Löwenthal (119) has failed to show, by the administration of HCl in large doses to perfectly healthy subjects, that there is such hyperæsthesia, and his experiments with subjects who have diseased stomachs, some of them ulcers, with HCl administration have been negative. The same he found to be true also with the organic acids, mainly lactic acid, with healthy subjects and those suffering from organic diseases.

It may be taken for granted that, in cases where there is pain after eating, which ceases when the gastric juice is neutralized by alkalies, or diluted with water, or removed, a gastric ulcer may be strongly suspected, and not a neurosis or hyperæsthesia to HCl.

If gastric ulcer can be eliminated with certainty, we must

suspect in these cases with supposed hyperæsthesia to HCl that the gastralgia is due to hæmorrhagic erosions.

The more the simple neuroses are studied, the more firmly and indelibly are impressed the facts that their recognition must depend largely on the presence of a well-defined neurotic habit, evidences of a combine of symptoms which, for want of a better and more scientific term, we must call neurasthenia—in many cases a faulty metabolism—and, excepting the supersecretion and hyperacidity without changes in the mucous membrane of the stomach and, as Klemperer has pointed out, reduced motor force, we can not rely for definite information upon the examination of the stomach contents.

From what has been said of the practical results of the examination of the stomach contents, you are able, without further infliction from me, to draw your own conclusions. Certain it is that by these newer methods we are made to understand *just what the stomach is doing*—a knowledge which is necessary in every doubtful case. No case of chronic disease of the stomach, in which the diagnosis can not positively be made, should fail to be examined, that the physician may thoroughly acquaint himself with the workings of that organ, not only for his own enlightenment, but for the greater satisfaction and benefit of his patients.

While the statement of Hirschfeld (120)—that “the chemical method of investigating the stomach has been to diseases of that organ what the ophthalmoscope is to the diseases of the eye”—may be somewhat exaggerated, the tempered conclusions of Ewald (121) may be readily accepted. He says: “I consider the diagnostic importance of the expression method to be so great and the safety to be absolute, a very few cases excepted, that I would reproach myself had I neglected to resort to it in any doubtful case.”

INDICATIONS FOR TREATMENT AND DIET—MEDICAL AND
SURGICAL.

Medical.—It naturally occurs to us, in considering the question of the practical value of the chemical examinations in diseases of the stomach, to inquire into the indications which have been offered for diet and treatment as an outcome of such study.

It may be said, and I think with a considerable degree of certainty, that the dietetics and therapeutics of gastrointestinal diseases have been placed on a more solid and scientific basis by these newer methods.

It is not within my province to dilate upon these subjects, but I wish to add a few observations which seemed to me indicated after considering the work which we have been doing in this domain.

First, it needs no comment to prove that an exact diagnosis has therapeutic advantages; second, we have learned from our recent studies that the most important treatment of stomach diseases must always remain dietetic, and must depend for its successful administration upon the chemical constitution of the digestive fluid, whether anacid, hyperacid, or normal.

Without such knowledge we are groping in the dark, unscientifically and unsuccessfully. What the dietetic rules are each case will indicate for itself, if the stomach contents are macroscopically, microscopically, and chemically examined.

The satisfaction which a physician feels in outlining a diet which he knows will positively find a suitable reception and ultimate assimilation must be sufficient recompense for the extra time which he has taken to study his case. It would be as nonsensical to give a patient with hyperacidity a diet composed of starchy food as it would be unwise and

fatal to give a meat diet to one without a digestive fluid containing the necessary HCl for its digestion.

Another much-abused method of treatment has been the lavage of the stomach. How often have we heard of its use when absolutely no indications demanded it! Useful and beneficial only when indicated, the tube must be used only with caution and judgment. (See Rosenheim's (122) exhaustive article, Ueber die Magendousche, *Therap. Monatshefte*, August, 1892.)

Ever since the discovery of the fact that pepsin and hydrochloric acid are the important constituents of the gastric juice, physicians have been giving these drugs, in many cases without reference to the pathological condition of the stomach or the chemical constitution of the secretion which they were expected to modify or supplement.

To-day, when it is comparatively easy to inform one's self of the condition of stomach digestion, drugs, more particularly pepsin and HCl, are administered empirically to the detriment of the patient, and in many cases their long-continued use has given rise to a glandular inactivity or true atrophy of disuse which can never be remedied.

If we take into consideration the results which have been recently obtained from repeated experiments with alkalis and acids in healthy stomachs, we can readily epitomize the indications for their administration and explain the statement which is made by Leube (123) when speaking of the effect of Carlsbad water. He says: "Carbonate of soda not only overcomes the superfluous acidity of the stomach, but, what is more important, it has the power of stimulating the mucous membrane to renewed energy and a further secretion of gastric juice.

The truth of that statement is demonstrated by Jaworski (124), and also by Geigel and Abend (125), who found, after repeated experiments on healthy and diseased stom-

achs, that moderate doses of the sodium salt (one to two grammes) neutralize a part of the gastric juice; but the alkaline reaction which first follows their administration is soon followed by an acid secretion in excess of that preceding the administration of the alkali (Mesnil (126)).

Small doses (0.5 gramme) are more likely to neutralize a normal acid secretion, while with hyperacidity we must use the larger doses of the sodium salt in conjunction with our mechanical treatment, for we have not only the original hyperacidity to overcome, but must administer sufficient to neutralize the excess of the free acid secreted as a result of the stimulation by the alkali. From the foregoing it is clear that the alkaline treatment of stomach diseases must be limited to such cases as have an excess of HCl, or a deficiency of the acid with glandular structures intact, or a sufficient remnant to respond to stimulus. (Subacidity, chlorosis, and nervous dyspepsia with subacidity—Ritter and Hirsch (127), Manassein (128), Cahn and Mering (129).)

On the other hand, HCl increases the pepsin but not the HCl (Mesnil (130)). Excess of HCl is very likely to reduce the secretion of the gastric juice and the percentage of HCl (Jaworski (131)). HCl does not increase the secretion in proportion to the size of the dose administered. HCl and pepsin are therefore of the greatest value in those cases where the mucous membrane and glands are diseased, as we find in catarrhal inflammation, glandular atrophy, and amyloid degeneration (here in small doses only to protect the remnant of glands still functionally active). Also in carcinomatous disease, nodular and infiltrating.

If HCl could be administered in sufficiently large doses without corroding the mucous membrane of the stomach, it would at once relieve the severest case of hyperacidity by checking the secretion of the gastric juice.

To improve or influence the absorptive function of the stomach, we possess no agent, unless it be electricity.

The motor function will be considered by another more worthy and competent to enlighten you with the result of his ripe experience.

Surgical.—It has occurred to me, in considering this question, to consider the value of the newer examinations as related to surgery. The literature on this subject has until recently been very meager, and, as the study of my cases was intended for diagnosis and medical treatment only, I felt justified for the preparation of this paper in consulting many of the leading surgeons of this country, England, Germany, and Austria for an unbiased opinion on this important question. To them I sent circular letters asking for a response to the following questions, and such other information as they might offer relating to the clinical data and to the literature of the subject. (Forty such letters were written, to which I have received thirty-eight replies. At this time and place I thank those earnest workers who so kindly and fully answered and aided me in my work.)

I. Have you in any case been led by a chemical examination of the stomach contents to operate for disease of that organ?

II. Do you believe that such analysis will aid in the early recognition of malignant diseases and thus lead to early radical operations for their removal?

III. Have you formed any opinion of the practical value of the chemical analysis of the stomach contents in the recognition of stomach disease?

As a rule, the answers were not separately given. The majority have held, in answer to the first question mainly, that while chemical analyses give evidence of great importance, they can be considered as confirmatory only, and can

not be relied upon alone in deciding the question of operative interference.

Those consulted who had no personal experience, or insufficient to warrant conclusions, were Sir Joseph Lister, Sir William MacCormac, McBurney, Davies-Colley, and Vander Veer.

Billroth writes: "It is true that free HCl is more often absent from the gastric juice in gastric cancer than in ulcer; but this phenomenon is not sufficiently constant and may be physiological. It is not sufficiently definite to be of practical value."

Among those who would not rely on chemical analysis for surgical indications we find besides Billroth, Thomas Bryant, Jessett, of London; Klemperer, Willy Meyer, Leo, Marcey, Leube, Goodhart, W. H. H. Jacobson (London), Boas, Mayo-Robson, Lange, of New York, Weir, and Halsted.

Most of these grant the fact that the results can only be considered confirmatory, a link in the chain of evidence which at times is of great importance as an adjunct. Senn, who might be included in the foregoing, writes: "I would never rely on chemical examination in deciding upon the propriety of operative interference. I regard chemical tests of value in making an early differential diagnosis between ulcer and carcinoma." Senn recognizes the great value of these methods without relying upon them exclusively. The answers of Keen and Bull to the questions asked correspond very closely to those of Senn. Weir, after his large experience, says: "I have received help, but never relied upon chemical gastric evidences alone in considering the question of surgical interference in carcinoma of the stomach."

Pilcher reports a case in his answer which shows a failure of the tests. In his case there was pyloric stenosis,

with all chemical tests indicating non-malignant disease; he did a gastro-enterostomy, finding a typical scirrhus.

Czerny, of Heidelberg, besides his answer, in which he grants a confirmatory value to the chemical tests, sends his monograph, taken from the *Beiträge zur klinischen Chirurgie*, in which he reports twenty resections of the pylorus for cancer and thirteen exploratory laparotomies, in most of which the tests were considered and were of value in the process of differentiation.

In Case IX he found HCl absent at one time after a test meal, and present at another in the vomited matter, with tumor and constriction at the pylorus. The growth was due to a simple ulcer with enormous hypertrophy and consequent stenosis. Czerny afterward upbraided himself for paying so little attention to the results of his chemical tests.

Unless I mistake the meaning of the answers received from Roswell Park, Einhorn, Stockton, Ewald, and even Riegel and Kinnicut (the latter has written a valuable paper on this subject in conjunction with Bull), they do not wish to rely in doubtful cases on the chemical tests alone. I judge still further that Riegel, Kinnicut, Ewald, Stockton, and Einhorn are positive in their belief that in the majority of doubtful cases, where repeated examinations are made and free HCl is absent, that the diagnosis of cancer is justified, and they probably agree with Boas that with such anacidity and the presence of two classical symptoms, such as emaciation, œdema, or tumor, the chances are decidedly in favor of cancer, and the surgeon has ample indications for an exploratory laparotomy.

This exploratory operation (from an extended study of the literature of this subject with which it is useless to burden you), we are positive, is as a rule without danger, and can ultimately lead only to the saving of many lives which

are now sacrificed for want of a consideration of all the diagnostic means which ought to be used for the conscientious study of these cases.

It may be held that while the surgeon is not justified in making a diagnosis from the chemical examination alone, he ought not to operate without a thorough understanding of the working ability of the stomach which claims his attention.

So far as the simple diagnosis of pyloric stricture is concerned, no method can equal in value the revelation made by the stomach tube.

It is not within the province of this paper to dilate upon the results or advantages of the different operations for the removal of gastric cancer. This can be studied from the statistics of Rydigier, Czerny, and McArdle. Suffice it to say that in sixty-two pylorus resections twenty-seven (or 43·5 per cent.) were cured (Rosenheim (132)).

In fifty-one per cent. of all cases of gastric cancers (Ewald (133)) the growth is situated at the pylorus; the medical treatment of this condition gives an absolutely hopeless prognosis; the surgical offers some hope, as seen from the above statistics and also from a further study of all the cases reported in Virchow and Hirsch's *Jahresberichte* during the past six years. The consensus of opinion of all consulted tends to strengthen the conclusion that *pyloric cancer is a purely surgical affection*; its diagnosis, if it can be made early, must be sufficient indication for surgical treatment.

The modern surgeon has learned two valuable points from a consideration of this subject:

1. Without the possibility of emptying the stomach into the duodenum it is impossible to live.

2. The obstruction at the pylorus removed, chemical analyses have proved beyond doubt the ability of the stom-

ach after a few months to regain its motor activity when the duodenum carries on the further digestion.

With methods which would lead to the earlier recognition of these cases, why are we not justified in hoping for results which will approximate those which follow the early removal of cancers from other organs of the body?

Appreciate if you will the positive fact that no operator has, after the removal of the pylorus or any part of the stomach for cancerous disease, had a functionally active stomach left, but that after removal of the pylorus the motor function of the stomach, as shown in Mikulicz's Klinik (134), also by Rosenheim (135), is sufficiently improved in three months to empty the stomach of its contents in five hours and a half, that the duodenum and small intestines assume the stomach's work, and you have sufficient data to justify you in concluding that in no field of medicine is concerted action of the physician and the surgeon more necessary for the benefit of mankind.

While at present we are forced to repeat that our tests are strongly confirmatory, we are certainly working in the right direction. With a larger experience and more exact methods of examination which must be evolved from the present, we entertain for the future a well-founded hope of diagnosing malignant diseases of the stomach before adhesions are formed, before the tumor becomes of a size which makes it easily palpable with its surroundings infiltrated.

When the skilled physician reaches such a stage of proficiency in the art of diagnosis, the surgeon as his helpmate will no longer be charged with making autopsies *in vivo*, many lives will be prolonged, possibly saved, and medicine will have become more nearly an exact science.

Bibliography.

1. Ewald. *Klinik der Verdauungskrank.*, II. Auflage, 1886.
2. Kussmaul. *Deutsches Archiv für klin. Medicin*, Bd. vi, p. 455.
3. Martius u. Lüttke. *Die Magensäure des Menschen*, 1892, p. 2.
4. Liebermeister. Virchow u. Hirsch's *Jahresbericht*, vol. ii, 1869, p. 129.
5. Miller, W. D. *Die Mikroorganismen der Mundhöhle*, Leipzig, 1889.
6. Bokai. Experimentelle Beiträge zur Kenntniss der Darmbewegung. *Archiv f. exp. Pathol.*, Bd. xxiv, 1888.
7. Wesener. *Lehrbuch der chemischen Untersuchungsmethoden etc.*, 1890, p. 182.
8. Wille. *Die chemische Diagnose der Magenkrank.*, 1889, p. 4.
9. Boas. *Allg. Diagnos. u. Therapie der Magenkrank.*, 1890, p. 18.
10. Sticker. Wechselbez. zwischen Speichel u. Magensaft. Volkmann's *Sammlung klin. Vorträge*, No. 297.
11. Wille. *Loc. cit.*, p. 4.
12. Ewald. (Translated by Manges.) *Loc. cit.*, p. 73, also p. 195.
13. Foster. *Text-book of Physiology*, 1891, p. 402.
14. Kinnicut. *Medical Record*, May 24, 1890.
15. Ewald. *Loc. cit.*, p. 33.
16. Pasteur. *Annales de chimie et de physiologie*, 1857.
17. Huppe. Ueber die Zersetzung der Milch. *Mittheilung des Reichsgesundheitsamts*, Band ii, p. 307.
18. Miller. *Loc. cit.*, p. 254.
19. F. Cohn. Inaug. Thesis, Strassburg, 1889.
20. Martius. *Loc. cit.*, pp. 156, 158, 159.
21. Ewald and Boas. Quoted by Ewald. *Loc. cit.*, p. 33, etc.
22. Martius. *Loc. cit.*, p. 156.
23. Bidder and Schmidt. *Die Verdauungssäfte u. der Stoffwechsel*, 1852.
24. Martius. *Loc. cit.*, p. 156, etc.

25. Riegel. Ueber Diagnostik u. Therapie der Magenkrank. Volkmann's *Sammlung klinischer Vorträge*, No. 289.

26. Löwenthal. *Berliner klinische Wochenschrift*, November, 1892, p. 1225.

27. Löwenthal. *Loc. cit.*, p. 1225.

28. Raudnitz. Vorkommen des Labfermentes, etc. *Prager medicin. Wochenschrift*, 1887, No. 24.

29. Boas. Labferm. u. Labzymogen im gesunden u. kranken Magen. *Zeitschrift f. klinische Medicin*, Bd. xiv, p. 249.

30. Johnson. Ueber das Vorkommen des Labferm., etc. *Ibid.*, p. 240.

31. Klemperer. Die diagnost. Verwerthbarkeit des Labferm. *Ibid.*, p. 240.

32. Rosenthal. Ueber das Labferment u. s. w. bei Phthisikern. *Berliner klinische Wochenschrift*, 1888, No. 45.

33. Ewald. *Loc. cit.*, p. 51.

34. Penzoldt u. Faber. Resorptionsfähigkeit des menschlichen Magens. *Berliner klin. Wochenschrift*, 1882, No. 21.

35. Ewald. *Loc. cit.*, p. 52.

36. Wesener. *Loc. cit.*, p. 211.

37. Leube. *Specielle Diagnose der inneren Krankheiten*, Leipsic, 1889, p. 232, etc.

38. Riegel. Volkmann's *Sammlung klin. Vorträge*, No. 289.

39. Wesener. *Loc. cit.*, p. 211.

40. Sievers u. Ewald. Zur Pathologie u. Therapie der Magenectasien. *Therap. Monatshefte*, August, 1887.

41. Klemperer. Ueber die motorische Thätigkeit des menschlichen Magens. *Deutsche medicinische Wochenschrift*, 1887, p. 47.

42. Boas. *Loc. cit.*, p. 138.

43. Leube. *Loc. cit.*, Leipsic, 1889. General consideration, etc.

44. Boas. *Loc. cit.*, p. 138, etc.

45. Reichman. *Berliner klinische Wochenschrift*, 1882, p. 606; 1884, p. 768; 1887, p. 12.

* 46. Leyden. Volkmann's *Sammlung klinischer Vorträge*, No. 155.

47. Kussmaul. Volkmann's *Sammlung klin. Vorträge*, No. 181.
48. Leo. *Deutsche med. Woch.*, 1889.
49. Poensgen. *Die motorischen Verrichtungen des Magens*, Strassburg, 1882, p. 66.
50. V. Ziemssen. Volkmann's *Sammlung klin. Vorträge*, No. 15.
51. Kussmaul. *Loc. cit.*, No. 181.
52. Boas. *Loc. cit.*, p. 161.
53. Bird. *Contributions to the Chemical Pathology of some Forms of Morbid Digestion*.
54. Martius. *Loc. cit.*, p. 16 ff.
55. Riegel. *Loc. cit. Innere Medicin*, Volkmann's *Samml.*, No. 99.
56. Jaworski and Gluczinski. *Zeitschrift f. klin. Medicin*, Bd. xi, Hefte 1, 2, and 3, 1886.
57. Ewald. *Berliner klin. Woch.*, 1886, No. 23.
58. Cahn and v. Mering. *Deutsche Archiv für klin. Medicin*, 1886, No. 34, 3 and 4, p. 213.
59. Riegel. *Zeitschrift für klin. Medicin*, 1887, xii, p. 426.
60. Riegel. *Loc. cit.*, Heft 2 u. 3, S. 167, 1886.
61. Rosenheim. *Deutsche med. Woch.*, No. 22; also *Zeitschrift für klin. Medicin*, January, 1890.
62. Kinnicut. *Medical Record*, May 24, 1890.
63. Thiersch. *Münchener med. Woch.*, 1886, 33.
64. Krause. *Prager med. Woch.*, 1887, No. 12.
65. Levy. *Berliner klin. Woch.*, 1887, No. 24.
66. Edinger. *Berliner klin. Woch.*, 1886, p. 71, No. 9.
67. Boas. *Deutsche medicinische Wochenschrift*, 1883, No. 24.
68. Jaworski. *Münch. med. Wochenschrift*, 1887, No. 24.
69. Riegel. *Loc. cit.* (Volkmann's *Sammlung*, etc., No. 289).
70. Grundzach. *Berliner klinische Wochenschrift*, 1887, No. 24, p. 543.
71. Ewald. *Loc. cit.*, pp. 194, 195.
72. Henry. *International Clinics*, vol. ii, second series, p. 55.
73. Ewald. *Loc. cit.*, p. 340.

74. Haberland. *Deutsche Archiv für klinische Medicin*, Band xlv, p. 491.
75. Rosenheim. *Krankheiten der Speiseröhre u. des Magens*, p. 182.
76. Rosenheim. *Zeitschrift für klinische Medicin*, Bd. xvii, p. 135.
77. Pulawski. *Berliner klinische Wochenschrift*, No. 42, 1892.
78. Riegel. Beiträge zur Diagnostik u. s. w. der Magenkrankheiten. *Zeitschrift für klinische Medicin*, Bd. xi, Heft 2 u. 8.
79. Ewald. *Loc. cit.*, p. 141. (Manges's translation.)
80. Haberland. *Deutsche Archiv für klinische Medicin*, Band xlv.
81. Rosenheim. *Krankheiten des Magens*, p. 212.
82. Einhorn. On Achylia Gastrica. *Medical Record*, June 11, 1892, p. 650.
83. Fenwick. Atrophy of the Stomach. *London Lancet*, July, 1877.
84. Ewald. *Berliner klinische Wochenschrift*, No. 32, 1892, p. 886.
85. Kinnicut. *American Journal of the Medical Sciences*, October, 1887.
86. Boas. *Münch. medicinische Wochenschrift*, 1887, No. 42.
87. Nothnagel. *Deutsche Archiv für klinische Medicin*, Bd. xxiv, Heft 4 u. 5.
88. Osler. *American Journal of the Medical Sciences*, April, 1886.
89. Eisenlohr. Primäre Atrophie, etc. *Deutsche medicinische Wochenschrift*, No. 49, 1892.
90. Eisenlohr. *Ibid.*
91. Lichtheim. *Heidelberger Naturforscher Versammlung*, 1889.
92. Ehrlich. (Rosenheim quotes him.) *Krankheiten der Speiseröhre u. des Magens*, p. 121.
93. Ewald. *Berliner klin. Woch.*, June 27, 1892.
94. Rosenheim. *Loc. cit.*, p. 118.
95. Riegel. *Loc. cit.*, p. 434.

96. Van den Velden, Ewald. *Loc. cit.* (translation), p. 228.
97. Rosenheim. *Loc. cit.*, p. 176.
98. Van den Velden. Volkmann's *Sammlung klin. Vorträge*, No. 280.
99. Riegel. Beiträge zur Diagnose u. Therapie, etc. *Zeitschrift für klin. Medicin*, Band xi.
100. Jaworski, Ewald. *Loc. cit.*, p. 229 (German ed., ii).
101. Rosenheim. *Loc. cit.*, p. 176.
102. Rosenheim. *Loc. cit.*, p. 177.
103. Riegel. *Zeitschrift für klin. Medicin*, Bd. xii, p. 434.
104. Gerhardt. *Deutsche med. Woch.*, 1888, No. 18.
105. Rosenheim. *Idem*, No. 22.
106. Kinnicut. Modern Methods of Examination in Diseases of the Stomach. *Medical Record*, May 24, 1890.
107. Ewald. *Loc. cit.* (Appleton & Co.), p. 230.
108. Bucquoy. *Archives générales*, April, May, June, 1887.
109. Osler. On the Diagnosis of Duodenal Ulcer. *N. Y. Med. Jour.*, Nov. 24, 1888.
110. Leube. *Specielle Diagnose der inneren Krankheiten* p. 256, etc.
111. Reichman. *Berliner klin. Woch.*, 1886, Nos. 32 and 33.
112. Riegel. *Zeitschrift für klin. Medicin*, Band xi.
113. Van den Velden. Volkmann's *Sammlung klin. Vorträge*, No. 280.
114. Riegel. Volkmann's *Sammlung klin. Vorträge*, No. 289, p. 2669.
115. Kinnicut. *Loc. cit.* (reprint), p. 21.
116. Sahli. *Correspondenzbl. für schweizer Aertzte*, 1885.
117. Talma. *Zeitschrift für klin. Medicin*, Bd. viii, 1884.
118. Suyling. *Berliner klin. Woch.*, 1889, p. 869.
119. Löwenthal. *Berliner klin. Woch.*, No. 47, 1892.
120. Hirschfeld. *International Clinics*, Philadelphia, vol. iii, October, 1891, p. 2.
121. Ewald. *Loc. cit.* (translation), p. 12.
122. Rosenheim. Ueber die Magendousche, etc. *Therapeutische Monatshefte*, August, 1892.
123. Leube. V. Ziemssen's *Handbuch der Therapie*, etc.

124. Jaworski. *Wiener med. Woch.*, 1886.
125. Geigel u. Abend. *Virchow's Archiv*, 1892, p. 130.
126. Mesnil. *Deutsche med. Woch.*, No. 49, 1892.
127. Ritter u. Hirsch. *Zeitschrift für klin. Medicin*, 1888.
128. Manassein. *Hoppe-Seyler's Physiol. Chemie*, p. 241.
129. Cahn and Mering. *Jahresbericht für Thierchemie*, 1886.
130. Mesnil. *Deutsche med. Woch.*, No. 49, 1892.
131. Jaworski. *Deutsche med. Woch.*, 1887.
132. Rosenheim. *Loc. cit.*, p. 228.
133. Ewald. *Loc. cit.*, p. 171.
134. Mikulicz Klinik. *Deutsche med. Woch.*, No. 49, 1892.
135. Rosenheim. *Deutsche med. Woch.*, No. 49, 1892.

