Thesis:
The recent Literature of Indigestion.

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Contents

Introduction 1-4

Historical Review, Importance of Subject 6

Diagnosis 4-80

Symptoms 7-11

Pain & Habit 10

Physical Signs

I. Inspection 12-14

II. Palpation 15-16

III. Percussion 18-21

IV. Auscultation 21-22

V. Examination of Stomach Contents 22-25

Introduction 22-25

1. Stomach Acids 25-54

2. Motor Power 54-62

3. Excretion 63-79

4. Absorption 79-80

Etiology 80-

Classification 80-

Treatment 81-106

References (marked with *) 104-110
Though Disorders of Digestion be seldom referred to in Ancient Literature, it can scarce be doubted but that they are as old as the human race. Food obtained at times but sparingly and at irregular intervals, and at other times consumed to excess, must occasionally have given rise to painful and disagreeable symptoms even in the most robust. Then, as now, the state of kingdoms, the course of battles, must have depended to a greater extent on the digestion of monarchs and generals, than is generally supposed. It is quite possible that there may be some distinct literature on the subject, for on the tombs of ancient Egyptians are depicted the figures of ladies ejecting the contents of their stomachs, (4) and it is scarce possible to suppose that human curiosity—of not scientific enlightenment—would not lead to an examination of their vomits. Hippocrates, Celsus, and the Fathers of Modern Medicine discourse on “concoction” and “putrefaction,” but do not lead us to believe that they had any real acquaintance with the process of digestion. If there is no record of any really scientific
Study of the subject till the end of the 16th Century, when Van Helmont by something like scientific method was led to propose a theory of fermentation. A century later, Römmner, in order to test whether digestion was dependent on fermentation, caused animals to swallow perforated balls containing grains of wheat, the condition of which was examined after being withdrawn by a cord from the stomach. Similar experiments were carried out on a more extended scale by Spallanzani (1729-1799), who was perhaps the greatest enthusiast we read of in the literature of digestion. He also experimented on turkeys, pigeons and geese, and by causing them to swallow a piece of clean sponge he obtained a fluid, and he further showed that when this fluid was placed in a tube with small bit of mutton or bruised grains of wheat and was kept warm, the meat alone was dissolved. As there were no gas-regulators in those days he carried the tubes in his arm-pits, so as to maintain the necessary temperature. After experimenting on an immense variety of animals he kept experimented on himself, and after
Swallowing bread enclosed in bags, and bits of meat, membrane, tendon, bone and cartilage in tubes, he wished them that he might observe the progress of their digestion. Last of all, he repeatedly emptied his own stomach and made careful examination of its contents.

The next great epoch in the history of the subject was when in 1826 Beaumont (10) began his famous experiments on St. Martin which are quoted in every text book and repeated in a work extremely interesting but unfortunately so scarce that I have had difficulty in procuring even a single copy of it.

The last stage in the history of the subject was reached a little over 20 years ago, when Kussmaul (11) and others began almost simultaneously to use the stomach tube for diagnosis as well as treatment, and thus began a literature which has once become enormous in bulk and deals with all manner of questions affecting the acids, ferment, motility and absorptive power of the stomach.

In reviewing the literature of this subject the first thing that strikes us is the enormous
Preponderance given to the study of this subject in Germany, compared with what it has received in any other country. Besides the standard text books of Ewald, (1) Bock, (2) Webo (Dziagwicz) (3) one can scarcely take up a German Medical Review or Journal in which is not to be found one or more articles on the recent modes of diagnosis and treatment. In France, Russia, Italy and Denmark the subject has gained some attention, and though no classical work has been published, valuable articles are found in some of the leading reviews. In England besides the able paper on the leucine acids read by Dr. Hamilton at the Meeting of the British Medical Association in 1890 (12), the researches of Mr. Haughton of New-Cloud, and a book by Dr. Herschell of London (4) published a few months ago, containing a rather fuller collection of the results of recent German investigation, little has been done which as yet at least has been given to the public in any tangible form.

The great attention given by the most able investigators in recent years to Bacteriology, is probably one reason why so little attention
has been given to the subject of this thesis. It is
one can deny the importance of the study of
Bacteriology nor the benefit that has been already
derived from it in the prevention of disease.
But, apart from surgery, the treatment of these
diseases, which come within the province of
General Practitioners, can scarce be said to have
been as yet much advanced by remedies of a
bactericidal nature. The removal of the germs
that feed on the morbid products of indigestion
is not equivalent to the removal of the morbid
products themselves. In these circumstances it is
not surprising to find the German Physician
Leiden (13) urging his students and colleagues
to turn their attention a little from Bacteriology
to such common-place subjects as indigestion,
and to hear the English Surgeon Lawson Lindley
of his treads against antiseptics, with more sound
sense than good taste commending a learned
society "to keep their phagocytes up to the mark,
and they need have no fear of microbes."
The question then arises: Has this subject
received in England the attention it deserves? In turning
over the pages of my Prescripition Book I have
not failed to find the large percentage of cases
treated for indigestion, and I do not suppose any experience differs from that of most men in ordinary practice. Its importance as a primary factor in the causation of disease bodily and mental is universally recognized, we might even go so far as to affirm that health and disease are entirely dependent on digestion. If by digestion we mean the whole process of taking nourishment into the body, its metabolism into living tissue, and the removal of waste products, this assumption would by most, I think, be taken for granted, and that consequently all disease is dependent on improper material taken into the body, be it improper food, impure air, or bacteria, its imperfect metabolism within the body, and the non-elimination of waste and noxious products. The ultimate cause of many diseases is as yet probably but vaguely guessed at, e.g. Pneumonia, Rheumatism. In fact the treatment seems to be mainly on the principle of improving the metabolism, or eliminating by skin, lungs, bowels or kidneys, some undefined but noxious product.

It is not of indigestion in this sense, however, we intend to write in this paper, but of indigestion
In the more restricted sense in which the term is generally used, where the stomach is regarded as the main factor in the production of most of our digestive disorders, and as the purpose is not a systematical description but a summary and review of the most recent literature on the subject, the great part of this paper shall be devoted to those subjects (to which investigation has been most recently directed) viz. the diagnosis of disease through the stomach acids, motility and pepsinization.

**Diagnosis.**

The diagnosis of digestive disorders depends on symptoms and on signs.

**Symptoms.**

To enumerate the symptoms would be equivalent to naming almost every abnormal sensation of mind and body of which human beings are conscious; pain of diverse kinds and in the most diverse localities, nausea, vomiting, excessive appetite, entire absence of appetite, flatulence, rumination, irritability of mind and incapacity for mental action, epileptiform attacks (Rusomark), Coma (Litten), aphasia (Hench), Cough, breathlessness, asthma,
(Hench, Tenor), giddiness, incapacity for walking over a smooth or polished surface. (Ewald).

Two of these symptoms have been frequently discussed in recent literature—pain and flatulence.

**Pain.** The increased attention given to nervous diseases in recent years has shown the necessity of careful examination of the spine in all cases of pain in the region of the stomach, combined or not combined with vomiting. Chace has pointed out that frequently lancinating pains in the region of the stomach is the first symptom of tabes dorsalis, while for determining whether the pain proceeds from intercostal neuralgia, muscular rheumatism, gastritis, or nervous dyspepsia, a careful examination of the spine is absolutely necessary. An observation made by the late Dr. Ross of Manchester (14) has not, I think, received the attention it deserves. He pointed out the intimate relation between Meissner's and Auerbach's plexus and the 4th, 5th, and 6th (occasionally 7th and 8th) dorsal nerves and the frequent occurrence in chronic gastritis of pain between the lower thirds of the shoulder-blades, best marked about 2 inches from the centre of the spinal column. This observation of Ross I have frequently found...
of value in distinguishing chronic gastritis from intercostal neuralgia and nervous dyspepsia, where, I think, pain on pressure will generally found nearer the centre of the spinal column and only occasionally on both sides.

By neighbours, Dr. McKenzie of Burnley, has recently been making an extensive series of observations on the exact localization of pain and the area of hyperaesthesia in the different diseases, and has arranged to give a summary of his results at the next meeting of the British Med. Association. So far as the stomach is concerned, he finds that neither the site of pain nor the area of hyperaesthesia is any guide to the differential diagnosis of gastritis, ulceration or cancer. He further finds that in over 90% of stomach affections the pain is in the centre of the upper part of the epigastrium, and that the site of pain is no guide to the localization of disease. In proof of this last statement he quotes 2 cases.

The stomach of one of these is in my possession and preserved because of the interest attaching to the fact that the ulcer at the pyloric end of the stomach had laid bare an atheromatous artery from a small opening in which had evidently
proceeded the bleeding which caused the patient's death. In this case it was found post mortem that the pylorus was dragged down below the level of the umbilicus and yet during life the pain was persistently referred to the point named in the epigastrium. In the other case the pain was found to be exactly in the same spot, and yet it was discovered after an exploratory abdominal section to have evidently arisen from a cancerous growth in the larger curvature of the stomach, the upper border of which was 13 inches below the seat of pain.

Flatus. The gases expelled from the stomach have been carefully analyzed and are well known, but there has been much difference of opinion as to their origin. Chemical combination, fermentation, respiration through a patent pylorus, the swallowing of air with food or during respiration, through the respiratory of the gastric mucous membrane, the presence of bacteria, — one or in most cases more of these causes may have to do with their origin. The intimate relations between fermentation and flatulence was well and on the whole scientifically illustrated by the patient who complained that his stomach was "at one time a gas-works and at another a vinegar factory," and doubtless...
Fermentation has much to do with its production. In cases of severe abdominal operations, where the bowels have been previously well cleared out and no food given for a considerable time before and after, fermentation can scarcely be regarded as an element in the case, and the enormous amount of flatulence generally observed seems more likely to be due to air swallowed during hurried and jerky respiration than to the capacity of the stomach back as a respiratory organ.

Dr. McCraugh (15) has recently described an interesting case of the evolution of inflammable gas, which, on analysis, was found to consist of CO₂ 56%, H₂ 10%, C₂H₄ 6.8% and residual air 32%. Similar cases have been reported where considerable injury was done to the face by its ignition, but to Dr. McCraugh is due the credit of having isolated a bacillus which, when cultivated in Pasteur's fluid, led to the evolution of marsh-gas, and thereby showing that a considerable quantity of the gas evolved in the stomach may be due to the presence of bacteria.
Physical Signs (16) (17)

When the student or practitioner proceeds to an examination of the lungs he adopts the well-known method of inspection, palpation, percussion, auscultation, and examination of the sputum. I do not know any reason why the same method should not be adopted in diagnosing disease of the stomach.

In discussing this subject I shall therefore consider I. Inspection II. Palpation III. Percussion IV. Auscultation V. Examination of the stomach contents.

I. Inspection

1. Unfortunately the only method for directly examining the stomach is by means of Lister's gastroscope, an instrument so expensive and requiring so long time to acquire its proper management that no one seems ever to have seriously attempted it except Mikulicz (8). He has discussed the subject in a brief article and with that the literature of the subject ends. He has described the appearance in carcinoma of the pylorus, but on other grounds the correctness of his observations has been much questioned.
2. There remain two other methods of inspection. Seeing that the lining membrane of the tongue is continuous with that of the stomach, some have gone so far as to regard the tongue as but an exposed sample of the alimentary canal, and as declaring by its changes the existence of similar changes in the stomach itself. Dr. Dickinson (19) who has given great attention to the subject, in a series of articles on the tongue as an indication of disease, affirms exactly the opposite. He states that after careful examination post mortem both with the naked eye and the microscope, he finds "that the stomach presents no changes that are obviously analogous to those of the tongue, and the same statement may be extended to the rest of the alimentary canal." He further adds, "I have not been able to discover any state of tongue especially connected with dyspepsia or ulcers of the stomach." It is just possible that the truth may lie between two extremes, and that notwithstanding Dr. Dickinson and the modern fashion of deeming the condition of the tongue as an indication of gastric disorder, and requesting the patient to open the mouth in deference to custom, but really for the
purpose of examining the state of the teeth with entire indifference to that of the tongue, the older physicians may have had reason in asking the patient, whatever the disease, first of all to put out the tongue that they might form some idea of his general condition. Most people who suffer from the ordinary forms of indigestion find the condition of the tongue to vary a good deal according to the state of the stomach, and most medical men, setting aside of course the changes produced by food and drugs, curiously teeth, inflamed tonsils or pharynx, will continue to regard the tongue as a simple and ready means if not of diagnosing at least of determining the mode of treatment in disorder of the stomach.

3. Indirect inspection may also be made through the abdominal walls. In this way one can frequently observe a dilated stomach and occasionally a tumour. In this subject light percussion may also in organic disease and nervous dyspepsia produce peristaltic motions that are distinctly visible. Beyond this there seems to be little gained by inspection.
11. Palpation.

Perhaps I may be allowed to illustrate the importance of palpation by two cases that have recently come under my observation.

M. S. had suffered for some time from some affection of the stomach. On several occasions she had gone some distance to consult a medical man of deserved reputation. After one of these journeys, I was called during the night to see her, and found her suffering from strangury, which was accounted for by a fly blister on the pit of her stomach. On examination I at once discovered a hard growth, and was astonished to find that the medical man, whom she had consulted, had relied on general symptoms, and had neither palpated nor percussed the stomach. The patient died two months after starvation from malignant disease at the cardiac orifice of the stomach. Had she suffered from any disease of the lungs or heart, no such preliminary examination would have been made. It is to be feared that in more persons than one, the stomach is often the most long-suffering organ in the body.

J. W., an innkeeper and heavy drinker, had
an attack of acute Gastritis and disorders of liver with albuminous serum. The statement that he had been occasionally passing blood with his motions, while there was no symptom of pyelitis, induced me to make careful palpation of the stomach. I found unmistakably an enlargement about the size of a large walnut at the pyloric orifice. The acute symptoms were relieved, and my patient seemed for some time to have quite recovered. Convinced of the accuracy of my first diagnosis, I was surprised that I heard nothing of him again till some months after. When again called in, I found him moribund with a growth at the pylorus that could be quite well distinguished notwithstanding the accompanying ascites. He had motion was allowed but the symptoms pointed unmistakably to the nature of the disease.

The value of palpation depends on the method in which it is carried out. If the points of the fingers be thrust into the abdominal wall, muscular contraction is such that nothing is likely to be discovered. Even with warm hands, the palmar laid gently on the abdomen, and the points
of the fingers gently palpating, with the patent, knees flexed and every effort made to distract attention, it is not always possible, even after two or three attempts to gain the required information without allusion form. Further information is gained in palpation by two methods frequently practised in Germany, but so far as I know, seldom in this country. The first method is that of Friesenich (20) which may be modified according to circumstances. He gives 1 or 2 teaspoonsful of bicarbonate of soda in 2 tablespoonsful of water, and immediately after one teaspoonful of tartaric acid to half a wine-glassful of water. This method may seem simple enough but the disagreeable oppression and Cyanosis often succeeding it, though no fatal case has been reported, are such as to deter from its use.

(b) A more practical and safer method (21, 22) can be adopted unless in the case of those who object to the use of the stomach tube. A simple double-ended syringe, such as is used in any spray apparatus, attached to the end of the stomach tube suffices to fill the stomach with air to the extent required. By this method one can discover almost any enlargement except these
At the small curvature of the stomach, and hence in any case it is almost impossible to discover unless the stomach be displaced from its natural position. These enlargements consist of malignant growths, hypertrophy from cicatrisations, foreign bodies such as balls of hair or snuff and gastric calculi. It is of course often difficult to determine whether the enlargement may not be external to the stomach, e.g., a floating kidney or stygala in the large intestine. Stygala may, however, be removed by fluid injections, and the injection of air per annum will also help to solve the difficulty. It must also be remembered that in a few cases does not become distended by air, and here we may safely assume the existence of a patent pylorus.

The method of palpation by passing a stiff rod into the stomach and feeling it when possible through the abdominal walls is for obvious reasons not to be condemned.

III. Percussion

While percussion is not without value in determining the presence and size of malignant growths, its principal use is in determining the
presence or absence of distention. The method to simple, and while in most cases it helps in diagnosis, it cannot be said that without some of the modifications to be presently mentioned, any conclusion derived from it is without an element of doubt. The colon may be filled with gas or feces; there may be a thin border of lung or liver; these and other circumstances, however much care be taken, may lead, I should think, the most practised observer to a wrong conclusion.

In the frequently hurried examination in every-day practice the most convenient method is to place the patient in a recumbent position, and if it is an advantage when it is 2 or 4 hours after a full meal. In this position and in these circumstances the food gravitates to the posterior portion of the stomach, and that part of the stomach which is nearest the abdominal wall, is filled with gas. If the patient is kept examined in a standing posture, and dull notes be elicited for a space below the tympanitic notes in the epigastrum, one may conclude with a fair amount of probability as to the limits of the stomach.
An observation of Kernig (33) is here also worthy of recording. He finds that when the stomach is empty, the area denoted by percussion does not materially alter in sound digestion, whether the patient be in a horizontal or upright position, but is materially altered in the case of an unhealthy or dilated stomach.

If more exact information be wanted the methods of inflation mentioned, in considering palpation may be adopted.

Still more exact information may be gained (31, 62) by inverting the stomach tube and pouring in a large quantity of fluid, observing to what extent the stomach is dilated and in what direction. Further confirmation of one's conclusions may be gained by gradually withdrawing and adding to the contents of the stomach and percussing accordingly.

In this country, however, where so strong objection is often made to the stomach tube the method of Delio (31, 62) may be adopted. I have found it very useful, though I do not know that it is so generally employed as it might be. The patient is made to drink a glass or two of water or milk. Percussion
is then made directly downwards with the tips of
the fingers in the recumbent posture. In this
way gurgling sounds are elicited which cease
as soon as the lower border of the stomach is
passed. This generally suffices to show whether
the lower border of the stomach passes across a
transverse line at the level of the umbilicus
which line is regarded by most writers as the
dividing line between a normal and dilated
stomach.

IV. Auscultation.

Almost every observer except Helqtor (24)
has come to the conclusion that no information
of any value can be gained from auscultation.
A stethoscope or the cardiac entrance one misses
the sound which denotes the passage of liquid
into the stomach, but often enough also it cannot
be heard where there is no structure or obstruction
whatever.

Another method of auscultation may be mention
which is also generally regarded as misleading
and of no practical value. The stethoscope is
placed in the epigastric region on the left border
of the liver, and percussion is made on a point or
plessimeter. If the plessimeter is placed over the
Stomach, the sound seems as if it passed directly into the stethoscope, but not otherwise. Any conclusion derived from this process is as likely to depend on imagination as on fact.

V. Examination of the Stomach Contents.

As already mentioned in our historical review, from the time that Beaumont made his famous experiments on St. Martin, very little had been done to advance our knowledge of the physiology and pathology of digestion, till about 20 years ago, when the introduction of the stomach tube for diagnosis, as well as treatment, began a new epoch in the history of the subject. Two hundred years ago, Fabricius, at Lepanto, and Rumens(25) had generally in their morning clientele a number who came to have their mouths cleansed. Stomachs cleansed with a brush, after a night's debauch. This practice was soon abandoned, however, nor did the stomach tube find its way into general use till Roussell, in 1867, began to wash out dilated stomachs. In 1841 Leriche (26) recognized its importance in diagnosis, but to Ewald (1656) is due the merit of having brought it into general use, as if having introduced an instrument much less
Completer than that first used by Kussmaul and Lente. Necessity is the mother of invention, and Oswald's discovery was due to the simple accident of having been called to a case of poisoning and finding no ready means of emptying the stomach. A piece of gas tubing that lay to hand he found admirably answered the purpose. A simple piece of rubber tubing with 2 openings at one end and a funnel at the other seems really to be all that is required, and quite as efficient as any of the elaborate instruments that have been invented, and though it has not been extensively used in this country, and though Clifford Allbutt (27) describes the emptying of the stomach by this means as "a filthy and disgusting practice," I can personally affirm that not only have I never experienced any great difficulty in its use, but that when the contents are fairly liquid I can empty my own stomach by this means more effectually and comfortably than by taking an emetic. Nor seems there possibly does the practice in an English and in Continental Hospital differ so much as in this. A number of patients coming in a morning after an experimental breakfast, and having the contents of the stomach withdrawn and carried off for
Careful examination, so far as I can learn, only an exceptional occurrence in an English hospital. Nor is it otherwise in general practice. At least so one would judge from a recent text-book on Physical Diagnosis (28), in which 41 pages are devoted to an examination of the urines, while the 344 pages devoted to examination of the contents of the stomach are not more than sufficient to give the student or practitioner a vague and somewhat misleading idea of the method of carrying it out.

Sir William Roberts in his collected essays on Digestion (29) published only last year speaks of it as a piece of good fortune that when examining a patient's throat the contents of the stomach were ejected, so that an opportunity was given of examining them. Why so great an authority as Sir William Roberts should have experimented only with artificial digestive mixtures and should speak of it as a piece of special good fortune that he has accidentally obtained the contents of the stomach, while he could at any time easily have obtained what he required by a simple piece of rubber tubing and pressure on the abdomen, can only be explained by the strong aversion that
Still exists in this country, to this method of treatment, a procedure quite as simple and generally attended with as little inconvenience as emptying the bladder with a catheter.

Examination of the contents of the stomach is made to determine:

1. Acidity
2. Motor power
3. Peristalsis
4. Absorption

1. Acidity.

Here it may be as well to state, first of all, that the literature of this subject is very extensive, and scattered as it is in lofty books, and to a still greater extent in Journals and Reviews, by no means inviting. There is no doubt that hope and hope such results will be obtained as will show that the subject is one well worthy of investigation, but meantime it presents so many difficulties that no one will care to face them, who has not the firm conviction that every bit of honest labour expended will be a step towards the solution of some of the most practical and important questions in the whole field of Medicine.
We shall begin by looking at the physiological side of the question. The subject is so wide that we shall not stay to consider the much disputed question whether the empty stomach of a healthy individual (afterwards or at least contains any secretion of gastric juice. The quantity obtained by most observers is so small that one has little hesitation in accepting the most generally received opinion that normally there is no secretion and that what has been obtained is simply due to the irritation produced by the methods employed to obtain it or to pathological conditions.

For the purpose of determining what acids are found in the process of digestion, certain test meals are employed which are duly calculated, withdrawn at a fixed time from the stomach, and examined as soon as possible afterwards. The examination of the bowels found at a patient's bedside may occasionally be of some value in ordinary practice, but unless the stomach has been previously empty, the kind of diet well known and the time that has elapsed since it was taken, it will more than probably be misleading. For accurate and scientific
diagnosis the following are the principal test meals employed:

A. Ewald's. The method employed by this on the whole seems to us the best and most convenient in ordinary practice. The patient is told to return the day after being seen shortly after taking a breakfast of 35-40 grains of ordinary wheaten bread, and a cup of weak tea or warm water. The stomach is to be emptied an hour after breakfast. This diet may at first sight appear too simple to make any real demand on digestion, but as Ewald has pointed out, it contains albuminoids, starch, sugar, fat, and mineral salts, in fact all the necessary constituents of food. The time that elapses between the meal and examination, the fact that it can be taken by practically all patients, and the simplicity and comparative cleanliness of the ejected material compared with the lumpy foul-smelling stuff obtained after a more complicated diet are all arguments in its favour.

B. Leube's. The method employed by Leube is superior to that of Ewald in so far the diet makes a greater demand on the stomach, but for other grounds is inferior. At midday a dinner is made of a fixed amount of soup, beefsteak,
Bread and water. The contents of the stomach are examined 4 to 6 hours afterwards.

C. Klempner's [30] Klempner recommends a diet of milk and bread, but this has no apparent advantage over Ewald's, and the disadvantage that milk enters so readily into chemical combination with acids as to render analysis most difficult, while it is not an article of diet acceptable to a considerable number of patients.

We need not specially to refer to the tests made elsewhere, e.g. Sawonicki and Gliwiski [33], and Robin of Paris [34], as practically all observers agree with Ewald whose conclusions we give in his own words: 'After fifteen minutes after a test breakfast, the expressed contents of the stomach are found to be acid. When at this stage we enquire into the nature of the acidity, we find that it is due not to HCl, but to Lactic acid. For the first half hour (30–45 minutes) the acidity of the stomach contents is due to Lactic acid. Then follows a second stage in which we find besides Lactic acid easily demonstrable quantities of HCl. Lastly, the Lactic acid entirely disappears, and in normal digestion we find after the first half hour only HCl.' The slightly divergent results obtained by others may for most part be explained by the different meals and methods.
employed, the only exception being that several regard
the absence of HCl for a whole hour as having no
pathological significance. R. v. Sachs [32] e.g.
has found after employing different test meals
and quantitative analysis by Sjögren's method,
that after administration of food the quantity of HCl
increases not in a constant ratio, but intermittently
and reaches its maximum in one to three hours,
that there is a greater secretion after flesh food
after milk and still greater than after starch, and
that its absence for more than an hour implies a
disordered digestion.

**Acid tests.** Passing from the physiological side
of the question, we now proceed to consider the various
tests employed for acidity, and to endeavour in
some measure to estimate their value. To enumerate
these tests and give the verdict of half a dozen
observers would be simple enough, but no mere
enumeration of tests such as our friends in some
text-books will be of any material assistance
in our investigations, unless first of all the reasons
for the contradictory and even entirely opposite
conclusions of equally able observers be clearly
understood, and some effort be made to discover
not merely whether these tests are useful for—
determining whether this, or that acid exists in the stomach, but whether also, as some have affirmed, they may not be useful in showing not merely how far digestion has proceeded, but what power and capacity the stomach possesses for carrying on the work of further digestion. Here it may be as well that I set down the difficulties I have myself encountered in endeavouring to arrive at some definite conclusion on this subject.

2. Apart from the aversion to the use of the stomach tube in this country, there is difficulty in getting test meals supplied and withdrawn at fixed hours, and in getting them examined almost immediately after. To the Hospital Physician this is no real difficulty. The test meal can be supplied by a nurse at a fixed hour previous to the time appointed for emptying the stomach, and the Physician is not obliged to consult every whim or caprice of the patient. It is different with the regular Practitioners, who generally find it difficult enough to get the patient to submit to stomach-washing for the purpose of treatment, quite apart from diagnosis. The test meal may be given and when the time comes for emptying
The stomach, as likely as not the medical man is elsewhere. When one is told, however, by Lembary of Leipzig, that from April 1888 to Dec. 1889, he examined 390 patients by means of the stomach-pump (33,002) and emptied the stomach for diagnostic purposes about 900 times, and this to a considerable extent in private practice, it seems evident that the small amount of work done in this country is due to want of perseverance as much as to difference in nationality. The small amount of work done in this way has, however, enabled me by independent enquiry to confirm the results of the leading observers.

(6). To determine the exact amount of the different acids in the stomach, a quantitative analysis is necessary. That may be true, and though it is quite possible that work of this kind may be done outside a laboratory, still when even an expert chemist requires at least two hours to make a single quantitative analysis by any satisfactory method it is not often possible for the busy practitioner to find the probably much longer time he would require for the purpose. We shall endeavour to show, however, that though quantitative analysis is at one time or other...
It is unnecessary to corroborate the value of the qualitative tests, which, through all that the medical man now requires, is to know how to handle a few good qualitative tests, and to understand the process of a quantitative analysis, and it may be to carry it out to a limited extent.

C. Much confusion and difficulty arise from the fact that some observers, when they speak of the amount of HCl in the stomach, mean HCl free and uncombined, while others, when they speak of HCl, mean HCl both free and combined with bases, and consequently that while some have adapted their tests to the discovery of free HCl, others have adapted to the discovery of HCl both free and combined. This divergence in method has led to the most opposite conclusions. Calain and V. Mering (34) e.g. affirm that the presence of HCl in the contents of a cancerous stomach is the rule and its absence the exception. Other observers affirm, emphatically the opposite. Are the majority of medical men right then when in presence of such contradiction among capable observers, they conclude that there is no possibility of arriving at any certainty, and the employment of tests for HCl and other acids is a useless and useless procedure? Whatever other difficulties
Then may be in this matter, it can easily be shown that this divergence of opinion between Cahn and other observers is more apparent than real.

In order, however, to a clear understanding it will be necessary to set down the relation that exists in the stomach between acids and bases. It is now some years since Klemperer found that after HCl was added in considerable quantity to the contents of a cancerous stomach, the chemical tests did not show that there was any HCl present. So Schaeffer is due the credit of having in a few pages put the matter on a clear and apparently satisfactory basis, and to Schaeffer (36) I am indebted for the solution I now give.

It has been already stated that 15 minutes after good lactic acid only is present, and the HCl is gone in the stomach. The reason of this is not that HCl is not secreted,—that it is secreted can be shown on other grounds,—but simply that HCl having a closer affinity to bases than lactic acid enters into combination with the bases in albuminoids and the lactic acid is set free. In the second stage of healthy digestion, a small quantity of HCl
is generally found, and the amount of lactic acid is diminished. The reason of this evaporation is, that after all the broth has entered into combination with bases, what is secreted over and above remains free. In the third stage of healthy digestion the lactic acid has finally disappeared, but in what manner has not been fully explained, and yet it only remains. In unhealthy digestion, as we shall afterwards see, the lactic acid generally persists, and not all remains free after what has been secreted enters into combination with bases.

The truth of this theory has been confirmed by the experiments of Honegger and others. They have found by careful analysis, that if HCl be added to an artificial digestive mixture, or to the expressive contents of the stomach, there will not be found the same amount of HCl as has been added, but the amount of HCl will be found to have diminished in proportion as the lactic acid has increased. This may be readily shown by the following table:—

<table>
<thead>
<tr>
<th>Acidity of Content</th>
<th>Amount of HCl added</th>
<th>Total acidity of mixture</th>
<th>Lactie A</th>
<th>HCl</th>
<th>Bicarb. A</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8.8</td>
<td>0</td>
<td>8.8</td>
<td>2.5</td>
<td>5.5</td>
</tr>
<tr>
<td>10</td>
<td>8.8</td>
<td>3.5</td>
<td>12.3</td>
<td>4</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Here then we have in the course of digestion certain acids, bases, and salts present in the stomach, and the question for the chemist would be to determine the exact amount of each acid, base or salt, but the only question of real interest for the Physician, to determine is, which of these acids, bases or salts are most useful in promoting digestion. How if it be found that digestion depends on HCl combined with bases, then by all means our tests should be adapted to the discovery of the amount of combined HCl. If, on the other hand, digestion depends on the amount of HCl free and uncombined, then our tests should be adapted to the discovery of free HCl.

Rosenheim has discussed this subject in a recent paper. He finds that though it is possible for digestion to proceed without the presence of free HCl, yet the process is very slow and unsatisfactory, the rate of digestion depending on the quality of the substances holding the HCl in combination, as far as they affect the working of its affinities. He finds also that digestion is much hindered by the presence of peptones and albumoses, less so by the amido-acids. The great majority of other observers have arrived at the same conclusion. It is true that Ewald affirms that "lactic acid
takes a very important part in the formation of peptones, that in the first hour of digestion lactic acid alone or preponderantly alone is concerned in its production. Gould does not seem, however, to have sufficiently emphasized the fact, that in wheaten bread, eggs &c., there is a considerable amount of peptones already formed, and it has otherwise been abundantly proved, that for the purpose of digestion lactic acid is of no value unless 5% is present, and of little value unless stronger, and while a percentage of this amount may be found in an extremely dilated stomach with contracted pylorus, it is on all hands admitted that its existence, unless in cases of this sort, is very uncommon.

From these and other observations we may conclude that Cahn and U. Mering are decidedly on the wrong track when they adapt their tests to the discovery not only of free HCl, but of HCl combined with bases.

A. We now come to inquire whether any of the qualitative tests commonly employed are really of any use in determining the presence of free HCl. To solve this question shreds or slices of albumen have been placed in incubators together with a
quantity of HCl (about 2 ounces) and prepare an approximating as nearly as possible what is found in healthy digestion. From experiments of this sort it has been found that several of the qualitative tests employed give a result which closely corresponds with that obtained by careful quantitative analysis.

Of still more importance is it that these tests have been found also by numerous experiments to closely correspond with the power of digestion. So long as digestion continued in the artificial mixture, these tests gave a positive reaction, and became negative only when digestion had practically ceased. The only exception to this rule is in cases of extreme hyperacidity where the HCl present is over 10 per mille. In these qualitative tests gave a positive reaction, though digestion is then impossible. So great an acidity is practically never found in the stomach. In all ordinary conditions, therefore, the power of digestion and the positive reaction with certain qualitative tests are found to exactly correspond.

By experiments of this sort an estimate can also be formed of the respective value of qualitative tests in digestive solutions. If the solution is diluted with water or neutralized by soda, it will then be
Seen what tests fail to give a reaction before digestion ceases, or continue to give a reaction after digestion has become impossible, and what tests most closely correspond after dilution or neutralization with the remaining amount of digestive power (36, 164).

It may of course be objected that while these tests may be reliable guides in artificial digestion, they may not hold good in gastric digestion. It must be at once admitted that there are important differences in the two modes of digestion. The same acids may be present as in natural digestion, and the same temperature be maintained, but it is impossible to produce the same peristaltic action, to provide any artificial means of absorption, or the gradual removal of digested products.

Hoffmann (40) has endeavored to remedy this difficulty by a process too intricate to be here fully described. He divides the albumen carefully by Maly’s method, and employs revolving perforated cylinders. By this means he probably approximates more closely natural digestion, but his results are not materially different from those of other observers who have used the ordinary incubator. It must, however, be added that all observers have not confined themselves to artificial
digestive solutions, but that Schaffer, e.g., has made similar experiments with about 1100 samples of 
contents removed not only from the stomachs of healthy persons, but of those suffering from all 
the varieties of gastric disease.

These three points, therefore, we desire to emphasize: 1. That there are certain qualitative tests for HCl 
which closely correspond with the results of quantitative analysis. 2. That these qualitative tests give a positive reaction 
so long as digestion continues, and a negative reaction when digestion fails. 3. That as digestion 
is found to depend on the presence of a certain quantity of HCl, there are qualitative tests which 
determine not only the presence or absence of HCl, 
but the presence or absence of digestion.

We now proceed briefly to consider some of 
the most important qualitative tests. The full 
discussion of each qualitative test would alone 
occupy more than the space of an average thesis. 
Dreyer (41) mentions 18, and 30 (3) about the same 
number.

There are two conditions which must be 
fulfilled by a good qualitative test. 1. It must 
not give a reaction with any other chemical.
Substance 2. Its reaction must not be prevented by the additional presence of any other chemical substance.

We shall see how far the tests mentioned comply with these conditions. (1) (3) (36) (41) (23) or 1. Methyl-violet.

Methyl-violet, as is well known, gives a blue coloration with small quantities of HCl, and a green coloration when a large quantity of HCl is added. Most observers agree that it is possible by this test to detect HCl in digestive solutions containing 1 part per mille. Though in very rare cases it fails, owing possibly to some bacterial action, still in the vast majority of cases it holds good to determine in digestive solutions quantities of HCl so small, that digestion is practically impossible. Thus far it fulfills one of the conditions of a good test, that if any quantity of HCl be present it is almost certain to detect it.

Unfortunately it fails to fulfill the other essential of a good test, as it gives the same reaction as with HCl, with other substances e.g. neutral solutions of the chlorides of K, Na, Mg, Ca, NH₄, with lactic acid in 10% solution; with acetate, and with peptone.

The reaction with peptone is the greatest
drawback to the use of this test. To obviate this
Kutz[4] has recommended that the peptones be
first precipitated with a 10% solution of Tannin,
but this method has not been found successful.

2. Ispapaolin 0 0 which at one time fell
into disrepute owing to inferior preparations— the
only good preparation being made by Schenckel
of Görlitz— has again been employed in various forms.
Besides the ordinary method of mixing in a test-tube,
Boas recommends that strips of filter paper be
dipped in Ispapaolin and dried, and heated after
contact with the digestive solution. He also found
that by heating it slowly with the mixture in a
Sankor he obtained a color reaction sooner than
by mixing in a test-tube.

This test has not the same defect as methyl-
indet in as far as it is not readily affected by
other substances. Neither lactic nor organic
acids give the same reaction, but as it cannot
detect any smaller quantity of HCl than 1.5% probably
it is of little value where any very exact diagnosis
is required.

3. Congo-red was at one time a good deal-
deployed, but since Boas carefully examined
its powers, and found that lactic acid even in
Small quantity, peptones or gave the same reaction, it has fallen almost entirely into disuse.

4. Benzopurpurine is more sensitive to HCl than Veronal or Congo-red, but the same reaction is produced by Lactic, Acetic and Formic acids. To obviate this, filter papers prepared with this substance, after being placed in the digestive mixture, are dipped in ether to displace the Lactic acid, and when heated a light violet color is produced which shows the presence of HCl. This test is of considerable value as it is not affected by peptones or albuminoids.

5. Mohr's Kech's test have been strongly commended. They have this advantage that the reagents are almost always at hand or at least easily procured. Jorul states that they are not affected by salts or peptones, but Schaefer has found that though they may correspond fairly with the results of quantitative analysis they do not give a fair idea of the digestive power of the gastric secretion.

6. Marfan's test is deserving of mention for two reasons; (a) that it does not require the use of the stomach tube and (b) that it is one of the very few tests (Drenckfelds of Manchester 29) that have not emanated from Germany.
grains of iodide of Potash enclosed in capsule of india-rubber tied with threads of fibrin, and preserved in glycerine and dried before use with filter-paper and absolute alcohol, are swallowed. The saliva is tested at frequent intervals for iodine, on the principle that when the gastric juice has dissolved the fibrin, the iodide is set free, and the iodine almost immediately absorbed. Marfan obtains by this method results very similar to those of German observers.

"L. Gunzburg's Phloroglucin-Vanillin Test.
Phloroglucin   2 parts
Vanillin      1 "
Absolute Alcohol 30 "

This test which has been largely employed in Germany ever since first proposed by Gunzburg in 1884, has only slowly found its way in this country, but is now, I understand, well known and frequently used in the principal Hospitals and to some extent in private practice. When I wanted a supply of this reagent, however, 2 or 3 years ago, I had difficulty in procuring it, as it was apparently unknown to some of the principal drug firms and their analysts.

So highly was it appreciated by Ewald that
in the 1st edition of his work (1888) he speaks of it as being of such value that in comparison "all other agents can only have a historical interest, and be kept on hand merely because it is useful to try several," and see how far they correspond. This task certainly falls to, as no other (except possibly that of Bros) does, the two principal requirements of a good test. When a few drops are added to the diluted stomach content, and slowly and carefully heated the faint wavy red lines arising to the circumference show the presence of 0.5 HCl for well. But the reaction produced by any other material is of such importance as frequently to require the co-operation of the Physician. Sponberg(46) has himself replied to a complaint that solutions of organic and inorganic salts might lead to confusion through giving a red color that might be mistaken for HCl, clearly stated the limitations of the test. He found that organic salts mixed with organic acids might possibly lead to precipitate e.g. lactate or acetate of soda; that Chloride of calcium gives a distinctly the same reaction as HCl, but only when in such strength as is not found in the stomach; and that the red color given by inorganic salts can only be the products of continued evaporation & Charme.
It has also been found by numerous experiments that digestion begins, continues, and ends, synchronously with the Gunzburg reaction.

Bovard went so far as to claim for the test a quantitative value. By gradually diluting the chymase, contact to 1/12, 1/20, till the extreme limit (0.05 per 1000) of the reaction is reached, it is pointed out how we may at least approximately determine the amount of the present. I have frequently tried this method, but found it more beautiful in theory than convenient in practice.


Resorcin reaction 5
Sacchar 3
Spirit dilut 25 per 100.

Though this test is by no means so frequently employed as Gunzburg's, it is not inferior to it in reliability, being exactly as sensitive and as little affected by the presence of other substances. It has this disadvantage, however, that it requires a little more care and time in using it. If the oxidiser be not heated and cooled very frequently and slowly, brown charring will take place more readily than with Gunzburg's. On the other hand it has an advantage in costing about 1/3 of the price (Gunzburg's)
We shall pass by the tests for the other acids, as they have not given rise to much difference of opinion.
Lactic acid is best recognized by its effervescence with Carbamide, a solution of Carbohydrate or with Chloride of Silver; Acetic acid by the nose or by heating with Carbonate of Soda, and adding Chloride of Silver; Methylene blue by the presence of oil globules after being shaken up by ether, or by the addition of Chloride of Calcium. Barium and acetic acids can also be drawn off by distillation.

Nor shall we discuss those variations in the acidity of the juice which are supposed to denote the secretion or non-secretion of HCL. The diagnosis of the stomach-acids may be ascertained by an examination of the urine, on the principle that when the urine remains abnormally acid for some hours after food, HCL is not secreted in sufficient quantity. The subject has not, however, been fully investigated, nor is a marked increase in urea at all diagnostic of Cancer. (47)

Quantitative Analysis.

We now proceed to mention some of the simpler methods that may be carried out in ordinary practice, and to state such as are necessary for any special purpose in exact and scientific diagnosis.
An estimation of the total acidity of the contents of the stomach is attended with no difficulty. A solution of Carlsbad Soda, 12 grams to a litre -- litmus paper, or a solution of phenol. Phenolein (about 1 in 500) are all that is required for the purpose. The phenol. Phenolein is fully more convenient than the litmus, but I cannot find, as some have said, that it gives a finer reaction. The method is as follows. To 100 parts of stomach content add as much of the above-named solution as will prevent any change of color in the litmus. The amount of soda solution added to 100 parts of the stomach content gives in convenient terms a standard for the general acidity. If e.g., 60 parts of the soda solution be necessary to neutralize 100 parts of the stomach contents, the total acidity is set down as 60. If this acidity depends entirely on the presence of HCl, the amount of HCl would be easily calculated as 1°Cm. of soda solution corresponds exactly with .0036446 HCl. Take the acidity as 100, and multiply by .0036446 and the result will be about .22. This gives the percentage of HCl in the stomach contents, the total acidity below 40 or above 65 is set
down by Ewald as abnormal, but Ewald's limitation is regarded by most observers as too narrow.

It is evident that could we get rid of the lactic and volatile acids, and acid salts, we have by the above method a very simple means of determining the amount of HCl. The volatile acids are readily driven off by distillation. The lactic acid may be taken up by repeating shaking with ether, and easily separated, but it is doubtful if even by this means the lactic acid is entirely separated. In the residue we have free HCl and of it may be acid salts. Whether the residue consist of HCl or acid salts may be determined with a fair amount of accuracy by a method proposed by Lea. I proceed on the principle (3191) that chalk, which must be chemically pure, enters readily into combination with HCl, but not with acid phosphates. If to the residue of stomach contents which are found to be acid, chalk be added, and it is found by litmus paper that the acidity disappears, then, as concludes, it must be due to HCl. If the acidity does not disappear after the addition of chalk, then it must be due to acid phosphates, and if the litmus paper shows a modified acid reaction, both presence of chalk and acid phosphates.
Proceeding further on this principle of this method, Lec has worked out a system of quantitative analysis which was given by Dr. Hamilton in his address to the British Medical Association, and a paper in his "Diagnose," but which has not been regarded by capable observers as sufficiently exact.

Of other methods of quantitative analysis those of Frieden and Schmidt (48), Richet and Mebhit have been practically abandoned. That of Cohn (49) has also fallen a good deal into disuse, for as we have seen, it does not determine the amount of free HCl apart from its combination with base.

The method most employed at the present day are those of Windisch, Hoffmann (49) Bourget and Hayem, Winter and Sjögren (50). The method of Sjögren is most frequently used, and is probably the best. It is founded, first, on the principle that the acids of secretion may be changed into their barium salts by Carbonate of Barium, and when these are incinerated, the Barium salts of the organic acids leave Carbonate of Barium, while the chloride of Barium remains unchanged. The chloride is then separated from the Carbonate, and its quantity may be estimated by titration with Chromate solution.
Practical Value of tests for acidity.

We have thus endeavoured to set down those qualitative and quantitative tests that best suit the Chemist, but those which we have concluded after a good deal of consideration to be most reliable and best suited to medical men in practice.

We now come to the practical issue. Of what value is a knowledge of these tests in the diagnosis and treatment of disease? From different quarters we have different replies. We have, e.g., some of the younger German Physicians who would classify all stomach affections according to the amount of acid found in the stomach. On the other hand we have men like Herschell (who—(4. p. 86) cannot be credited, however, with more than a superficial knowledge of the subject, yet whose book is almost the only one that gives any systematic form the results of recent German research) affirming as his "deliberate Conviction that the Chemical examination of the Stomach Contents is of little or no use in the diagnosis or treatment of Cases of indigestion," that the presence or absence of bile may be known by the presence or absence of flatulence and eructations, and when relief is obtained by a dose of bicarbonate of soda we can conclude with
almost absolute certainty that the excess of acid is
butyric, acetic and lactic, because it is 10 extremely
rare to find increase in the amount of hydrochloric.
It is true that since 1888 when Cawdell published his
work on digestion, great expectations have been aroused
as to what might result from a study of acidity.
Unfortunately these expectations have only been to a
limited extent realized. Cawdell, with that fairness
which characterizes all his work, did not affirm
that the absence of HCl was any absolute
proof of the existence of Cancer, or its excess of
the existence of ulcer. It is true that the result-
given by careful observers on this subject greatly
differ. It is true that even in healthy digestion
the amount of acidity greatly varies. It is true
that in many cases where there is not the slightest
symptom of gastric disorder, there is a total
absence of HCl. So what purpose then is the
enormous amount of time and labor expended
by all men on this subject? Has the mountain
been in labor, and the product a mouse? We
do not think so, and though the expectations
originally entertained can not be realized, yet
we are firmly convinced that the labor of the past
dozens years will not be without fruit both in the
diagnosis and treatment of disease.

Acidity in Cancer. One of the most noteworthy facts in the whole history of this subject is the practical issue of so much investigation in recent years was anticipated so long ago as 1842 by Dr. Goldring Bird of Guy's Hospital, London. He found that "free HCl was found in considerable quantity in the blood during the more irritative stage of the disease, and gradually decreased in quantity as the strength failed, while the organic acids increased in proportion as the HCl diminished." In these words Dr. Bird has stated almost everything that is yet known on the subject, and this may seem a good argument for those who regard the great amount of labor expended on the cancer efforts of a "middle-headed" industry. Had Dr. Bird continued his investigations, and not, however, been deterred, as he himself states, by the amount of trouble and time required, we would probably have known a little more about indigestion than we do, and not be still in the absurd position of scarce being able to tell whether to give a patient an acid or an alkali.

It is now universally admitted that there
is no inherent peculiarity in cancer which prevents the secretion of HCl. Any local disease which temporarily blocks up or permanently destroys the secreting tubules of the stomach will prevent its secretion. It is never found in atrophy or amyloid degeneration, and very seldom in acute gastritis, chronic mucous gastritis, advanced Pyloritis, and is occasionally absent in nervous dyspepsia. So far as atrophy is concerned, the non-secretion of gastric juice is permanent, but in almost all other conditions it is temporary. We can fully understand Blau's position then, that while disclaiming for cancer any specific power to prevent the secretion of HCl, he nevertheless adds that the presence of HCl speaks with great probability against the existence of cancer. (569) This statement is fully confirmed by Reigels' statistical analyses and by others.

Acidity in Ulceration. The publication of Reigels' statistics (53) in 1884, affirming the existence of hyperacidity in almost all cases of ulceration, was useful in as far as the results were so striking as to give an impetus to further research. The subject has since been investigated by many others, but I cannot find that any observer has
given any such results as would justify us in hesitating to accept Regel's conclusions. As the stomach tube is not a very instrument for use in ulceration, the number of cases examined have been few. Lenzhofer examined 13 cases and found hypersecretion in 3, normal secretion in 5, subnormal secretion in 4, and entire absence of HCl in 1. Ketter and Dietrich examined 5 cases and found slight hyperacidity in 2. Raaheh (1873) examined 8 cases, and found hypersecretion in 2, normal acidity in 4, and subnormal acidity in 2. Gerhardt (1871) found among 34 cases, an entire absence of HCl in 1.

From these results it will appear that though there may be a tendency to hyperacidity in ulcer it can by no means be regarded as absolutely diagnostic of the disease. The intimate relation between Chlorosis and ulceration is generally recognized, and the fact that in chlorotic individuals there is more frequently absence of HCl than in ulceration, might lead one also to suppose that some relation does exist between hyperacidity and ulceration, but not so close as to make us regard hyperacidity as a necessary factor in the disease.

Acidity in Nervous Dyspepsia. Herzog (54)
has carefully examined a number of cases both in regard to acidity and motility and their relation to each other, and finds that neither hyperacidity, nor subacidity, nor normal acidity bear any definite relation to this disease.

Conclusions as to tests for acidity. Our conclusion as to the value of tests for acidity is, that while neither hyperacidity nor hypoacidity is absolutely characteristic of any disease, yet the absence of acid gives a presumption in favour of cancer, and its excess in favour of ulceration, and as already pointed out, that any tests which give us information as to the acids found during digestion, and also view the amount of digestive power possessed by the stomach are useful both for the diagnosis and treatment of disease.


Passing over the older methods for determining or guessing the motility of the stomach, which are given in detail by Boas gen (53), we find in the literature of the past few years four that are deserving of attention.

A. Lemberg and Rögel (56) The methods...
adopted by Leube has the merit of simplicity and directness, and if the premises on which he proceeds were taken for granted, then would be no doubt as to its value. He assumes that after a full meal of beef, steak, soup, and bread, the stomach will empty itself in 4 hours in healthy digestion. If any part of the meal remain in the stomach longer than 4 hours, he regards its epiplectic power as deficient. A whole array of writers have contradicted this assertion, giving instances where this time was exceeded or otherwise.

Among the objection to Riegel, whose method is to use the stomach pump after 5 hours, and if any contents be found by this means to form a conclusion from the stage of digestion in which they are found. Riegel's method can scarcely be said to be an improvement on Leube's, as it lacks the merit of simplicity and directness and leaves the conclusion to be formed to the judgment of the individual observer.

Leo has done good work by carrying out a similar mode of observations in infants (3-80) infants. The digestion of subjects is less varies than that of adults. Leo has found that in normal digestion the stomach of an infant fed on mother's milk is
empty in 11/2 hours. In infants fed on cow's milk
the digestion is somewhat slower. In either case,
he concludes on apparently a sound basis, that
if the time exceed two hours, the digestion may
be regarded as abnormal.

B. Sievers and Ewald. The method first proposed
by Sievers and Ewald (58) has this advantage that it
can be easily carried out in ordinary practice, and
seems at first sight entitled to the favor it
originally received. Salol, a compound of salicylic
and carbolic acids, they found readily split up
into its constituent parts in an alkaline medium,
but in an acid medium remained intact. The
method was to give 1 or 2 grams of salol in capsules
if preferred after an ordinary meal. Taking ad-
vantage of the fact that the addition of perchloride
of iron to salicylic acid gives a violet color, the
urine was examined at frequent intervals, and the
time when the violet color was first observed was
regarded as the time when the salol had passed
from the acid medium of the stomach into the
alkaline medium of the duodenum. For more
exact observation the urine was accumulated and shaken
up with ether, which readily take up the salicylic
acid. By this means the first trace of salicylic acid were
Sooner discovered. This and other modifications of
the original method seem, however, quite unnecessary
in ordinary practice. The time at which the violet
reaction was expected to appear was from 40 to 60
minutes. If delayed beyond 45 minutes, the
motility was regarded as impaired.
To meet the objection that the salicylic acid
might possibly be absorbed by the stomach, Ewald
tied the pylorus of a dog, and found that when
perchloride of iron was added to the urine there
was no violet reaction. He also found that
when alkalis were given in sufficient doses to neutralize
the acidity of the gastric contents, there was an
earlier appearance of the reaction.

It is to be regretted that a method so beautiful and
simple as this, and apparently so well adapted to the
solution of what had proved a difficult problem,
should be liable to objection. That it will continue
to be used by many in ordinary practice there is
no doubt, for it holds good in the great majority
of cases, but it can by no means be regarded as
infallible. Too many other observers have found
numerous instances of good digestion where the
reaction did not appear till long after the time
specified by Ewald, and others where the reaction
appeared at different times and in precisely similar circumstances in the same individual.

C. Huber's Among others who have given a list of cases where Ewald's method was evidently misleading is Huber, whose investigations led him to propose a method of his own, which is deserving of special mention. Reasoning from an a priori point of view, he concluded that the motility of the stomach should be determined not by the time when the first portion of salol left the stomach, but rather by the time when the last portion of salol was split up in the alkaline medium of the duodenum. After testing a great number of cases by this method, he thought it possible to draw a limit, and hence gave forth the dictum that when the motor power of the stomach was normal, the violet reaction disappeared in 24 hours, but was 3, 6, or more hours later in disappearing when the motor power was deficient. Among others he tested 19 cases of Pthiric, dividing them into (a) those who were in the first stage of Pthiric, and (b) those in whom the disease was far advanced. In
The time was over 24 hours, and these with one exception belonged to the second list. Different opinions have been given as to the duration of Phthisis. Fewer patients have been found by Leube's method that in 51 out of 524 pathological patients, the motility was unimpaired. It has been directly contradicted by Kleinover, who adopting the method to the best mentioned came to the conclusion that in the first stage of Phthisis there is a slight diminution of motility power, which rapidly becomes more marked during the progress of the disease. It will thus be seen that Huber's results coincide with those of Kleinover, and it may be added with those of most other observers. Since Huber has written, objections both theoretical and practical have been urged against his method. It has been urged that as small quantities of saline may lie for an indefinite length of time in the folds of the mucous membrane, the time at which the last particle leaves the stomach cannot be regarded as a test of its muscular power. It has been further urged that the varying acidity and alkalinity of the contents of the small intestine are such as to militate against any fixed conclusion derived from the time when saline will
be entirely broken up into its constituents. Passing over theoretical objections we find Praeger, e.g., giving instances which directly contradict (60) the truth of both Ewald's and Haber's methods. It must be admitted, however, that notwithstanding the opposition of Praeger his statistics, only in isolated instances show a contradiction of Ewald's, more especially Haber's method.

D. Klemperer (61) The last method to which we shall particularly refer is that proposed and ably advocated by Klemperer. He takes advantage of the generally received opinion that practically no fat is absorbed by the stomach. Klemperer was not content, however, to accept the generally received opinion but has satisfied himself of its truth by a number of carefully conducted experiments.

His method is as follows: - Let a fixed quantity of oil be injected into the stomach, and what remains after two hours be withdrawn. As none can be absorbed, the quantity withdrawn will show how much has passed into the intestine, and give in simple terms the precise amount of work effected by the stomach. For this purpose he injected at 105 grams of olive oil, 5 grams being
about the amount that will adhere to the feiler and tube, and concludes from numerous experiments that, if after 2 hours more than 20 or 30 grams are withdrawn, the stomach does not possess the approx motor capacity.

Many objections have been raised to this method. It has been objected that (a) the method is both disagreeable to observer and patient, and is not suited for ordinary practice, that (b) oil can not be regarded as fully equivalent to an ordinary deed in promoting muscular contraction, that (c) the quantity is too small to make any real demand on the motor power, and that (d) it is doubtful if it can all be recovered. To these objections Klemperer replies (a) that the method is neither intended nor suited for ordinary practice, and need only be adopted in a few typical cases that may serve as a rule for those of a similar kind, that (b) the motor power of the stomach is dependent on the nerve centers, and not, as is generally supposed on the kind of food taken, that Jungen's record of 111 cases of dyspepsia, in which was found post morten a degeneration of neurosensory fiber, brain, plexus, has not received the attention it deserves, and that the generally accepted doctrine that the rate at which the stomach
empties, depends on the acidity of its contents, has no foundation in fact, as he has found only in one case any material difference from neutralizing its contents with alkalis. (3) He further replies that there can be no mistake as to all the quantity of oil being recovered from the stomach, as he not merely expresses by the ordinary method, but washes out several times with water, and carefully calculates after shaking up with ether the exact quantity of oil recovered. And finally, impatient of the argument of objectors, he refers to the 280 cases in which he had carried out this experiment, the results of which not only entirely agreed with the general symptoms and condition of the individuals, but with the determination of acidity and digestive power of the gastric secretions.

In brief, we may conclude that the method of Klemperer will seldom be employed except for purely scientific purposes, the method of Leube and Rieger but seldom, and that the methods of Ewald Huber, though inferior in correctness to that of Klemperer, will continue to be used by average Practitioners as a fair test for dilatation and deficient motor power of stomach.
3. Peptization. We now come to consider what information can be gained from an examination of the contents of the stomach as to the place and power of peptic and rennet in promoting digestion, and how far the presence or absence of peptone, in the stomach, is of importance in the diagnosis of disease.

Though in recent years this subject has not received the same amount of attention as the stomach-acids, it is one of much interest, and about which a great deal more requires to be known before we can arrive at any conclusion which is free from an element of doubt. Out of a mass of confused and conflicting statements we abstract the following which we think may be safely set down as facts. It may be regarded as beyond dispute that a certain amount of albumenoids are by the influence of peptic gradually transformed through the medium of albumenase into the end product of peptone, and that there are certain tests, the bein test and others, which give with a fair amount of certainty the course of this transformation. By withdrawing the contents of the stomach and placing in them a piece of albumen, we can see how far the albumen is broken up, and by using the bein test and other tests we can observe the gradual
transformation of albumens into peptones, and how far this process is hastened or slowed by the addition of HCl or pepsin. Ewald's method (p. 38) is simple. He cuts off with a razor a number of thin slices of egg albumen, and puts them aside for use. He next prepares 4 test glasses, each containing a definite amount of filtered stomach contents. In the 1st glass he places one or two slices of albumen only. In the 2nd he adds HCl, 3 N to 5 per cent., to the 3rd to 5 per cent. pepsin. In the 4th HCl and pepsin. These glasses are placed in an incubator; the Ewald and other reactions noted. Observations made by the addition of varying quantities of HCl and pepsin show the rapidity of solution, and how they can be brought more quickly to respond to the chemical reagents. That all these changes take place in artificial digestion may be set down as a fact, but it would probably be too much to assume from this, that precisely the same changes take place in natural digestion, and the most sturdy believer in pharma co would scarcely contend that the addition of HCl or pepsin would produce precisely the same changes in the stomach as in an incubator.
Experiments, such as those of Escherich, would be
of value for determining at least the solution of
albumen, provided, as already said, the natural
was identical with the artificial mode of digestion,
but when we proceed further we have to face
some rather troublesome questions as to whether pepsin
are after all a physiological or only a pathological
product of albumen, or whether it is at all necessary
to nutrition that albumenoids be transformed into
peptones or even peptones and proteptones before
they can be absorbed by the stomach, and though
the strongest arguments and evidence are still on
the side of the generally received opinion, yet it
cannot be denied that the question is still
but judicious and the time has probably not yet
come for a final and irrevocable answer.

The subject has recently been discussed in a
monograph by Gorlach (62) but it contains many
uninteresting particulars, a brief historical
summary may not be without interest.

So far back as 1834, Ebenezer (63) found that
mucus paraffins from the stomach and debated with
the, digested in the same manner as gastric
juice. The artificial digestion was thus supposed
to correspond with the natural digestion, and as
it was well-known that albumen could not pass through dead animal membrane, and that peptone passed freely, it was naturally enough concluded by Eberle, held by Messerschmied, Miller, Hermann, and others, and indeed was the universally accepted doctrine till a few years ago, that pepton existed for the purpose of transforming albumen into peptone, and that only by the formation of peptone and their passage through the mucus membrane of the stomach and bowels could nutrition be sustained.

Two considerations led however to doubt of the absolute truth of these statements. 1. If albumoinoids are changed into peptone in the stomach, what becomes of these peptones, as no trace of them can be found in the chyle or blood? 2. It began to be surmised and is now abundantly proved that though albumoinoids can not in any appreciable quantity pass through dead animal membrane, still they can pass and freely enough, through the living tissues of the stomach and bowels. Considerations of this sort led Brücke (65) in 1885 to say: "Through a series of misunderstandings and errors he
idea was formed that for most part or entirely albuminoids as such could not be absorbed, and so it was absolutely necessary to conclude that they were changed into peptone, and afterwards reformed. We now know, however, that albuminoids, as such, and in so inconsiderable quantity, are subject to absorption." And again: "That in (651,320) gastric digestion by no means all albuminoids are transformed into peptone, can be most fully (auf das schlagendste) proved."

Long before Brücke had written, Voit, Raney, Eichhorst (66) and others had shown that albumen, which are injected into the large intestine are absorbed, and there is found no trace of peptone, that acid albumen is absorbed as quickly as peptone, blood serum more slowly, still more slowly albumen. Eichhorst also showed that casein, argin, and gelatin are absorbed by the large intestine and leave no trace of albumen.

The most pronounced opponents of the generally received opinion are Jaworski and Glagunici (67) who in a very able contribution to the Zeitschrift J. Klein. Medicine, since published separately, have brought a considerable number of observations to bear in behalf of their conclusions. They affir...
that the ascendant pepticizing power of the (67.67) gastric juice gives no conclusion for the normal course of digestion, that "the peptone reaction (67.6) of digestive fluid, pumped from the stomach is most strikingly manifested in truly pathological conditions, and to least manifest in individuals who complain of little or no gastric discomfort." In healthy men they found in the contents of the stomach 4 hours after taking food no trace of peptone or peptone reaction. Even hours after a healthy man had consumed a beef-stake, they found several pieces of meat but no trace of peptone. When the same material was afterwards digested artificially, there was intense peptone reaction. They also found in a patient suffering from intestinal Catarrh with high temperature, 4 hours after a diet of eggs intense peptone reaction. From these and similar observations they concluded that egg-albumen passes into the intestine in almost entirely undigested condition, and that the sooner it passes the less likely is one to suffer any gastric discomfort, and consequently they regard the stomach not as a chemical digester but simply as a receptacle for the collection and breaking down of food, from
which it is expelled by degrees into the intestine, where true digestion begins.

Extreme as these statements may appear, they do not seem to differ materially from what Sir William Roberts affirms in his Book on Digestion and Diet (67, p. 530).

There is another point of view from which this question may be discussed. If, by feeding on peptones alone, life cannot be sustained in animals, this is a strong argument in favor of the view of Jaworski and Glaeser, that in healthy digestion albuminoids are not transformed into peptones.

Several experiments of this kind have been recorded differing somewhat in their results, and not, I think, so complete and satisfactory as to justify any one in coming to a definite conclusion. Ploetz (68) fed calves and other animals on peptones, and found that they continued in good health and increased in weight. C. Voit (69) on the other hand says that in his experience the increase in weight is no proof that peptones can take the place of albuminoids, as animals fed on an exclusively non-nitrogenous diet can gain in fat and water. From experiments on rats, he found that though they could live and
even gain weight by exclusive feeding on peptones, they died after 4 months, but those that survived to whose food for some time previously albuminoids had been added,

Brinck and Poppel (43) have endeavoured to solve the question by another method. By thoroughly "washing out" a frog's heart they found that serum albumen was a nutrient but not peptone. The same experiments were made with a like result on skeletal muscle. Their Conclusions differ from those of Rüger (49) who, however, does not seem to have adopted the same precautions.

Granted then that albuminoids may be absorbed without being changed into peptones, that though the re-formation of peptones into albuminoids probably takes place in the mucous membrane of the stomach and intestine yet the change is not easily made out. That animals cannot survive who are exclusively fed on peptones, and that "washed out" muscle cannot be nourished by peptone, a strong case would be made out against the generally received opinions. It is extremely doubtful, however, whether all these statements can be accepted, and we cannot lightly set aside the evidence of many capable observers who tell us that they find a large amount of peptone
in healthy digestion, and a small amount only.

The absence of peptone in stomachs with deficient
acid secretion or impaired motor power. We cannot
profess, after a considerable study of the literature of
this subject, to have arrived at a definite conclusion.

Still it is natural enough to suppose that further
investigation may probably show that nutrition
is sustained to some extent by albuminoids, to a
large extent by the intermediate products, syrinx,
and prepeptone; and to some extent also by peptone.

At whatever conclusion we may arrive it is
admitted on all hands that there is such a
substance as peptogen, and its further development
peptone, that it fulfills some useful in digestion,
if not in peptogenizing, at least in breaking up
albuminoids, and leaving them in a more fit state
for digestion in the intestine.

Before proceeding further in our enquiry as
whether the formation of peptone is a proof of
healthy digestion, or their absence the diagnostic
of disease, we shall have to note a few facts as
to the amount of peptone and milk-curdling
ferment found in healthy and diseased
stomachs.

I do not know that any more carefully conducted
and reliable observations have been made on this subject than by Holmgren of Christiana in the wards of the Berlin Hospital (13). Without detailing the method adopted it may be sufficient to state the rather striking conclusions at which he arrived. He has found that in cases of healthy digestion, the stomach contents may be diluted to 1 in 1000 or 2000, occasionally even to 1 in 10,000, and if 0.2% of HCl be added, then, still enough for healthy digestion, and that it is only in cases of advanced atrophy that pepsin is entirely absent. He also found that the secretion of pepsin bears no definite relation to that of HCl, nor of the milk caustic ferment. This is the substance of his conclusions, but particular cases were found which manifested a great variety of action. In a considerable number of cases, of gastritis and dilatation, he found that when HCl was added to the stomach contents, greatly diluted, digestion went on freely and in many instances better than in the undiluted stomach content. Other cases were found where HCl was almost entirely absent, and yet digestion went on slowly and satisfactorily, but to such an extent as to induce him to accept Ewald's conclusion, that lactie acid and acetic acid have also the power
of developing peptic ulcer. (p. 36 of thesis)

A considerable amount of investigation has also been made in recent years as to the milk-curdling ferment. Different writers have assigned a different value to its presence and development as a test of pepsin digestion. Bos(d) attaches a considerable diagnostic value to its presence, and holds that its presence or absence gives a fair idea of the condition of the gastric follicles. Klempner(e) does not attach much importance to it as a test, as he could not find it either invariably present or absent in cancer and motor insufficiency. From a great deal that has been written on the subject, since it was first investigated by Hammerstein (not Hammerstein, loc. cit.) Johnson and others, one can practically discover nothing new from their investigations, than that corresponding to pepsinosis and peptic ulcer, there is an antecedent condition (Labryynose) and milk-curdling ferment (Lab or Lab-ferment), that it is practically always found unless in extreme atrophy, to a lesser extent in cancer and severe gastritis, that the amount of its secretion bears a general but by no means definite relation to that of HCl or pepson, and that consequently
its determination is of small value in diagnosis.

We now return to our former enquiry. As we have already said, the generally received opinion that in healthy digestion albuminoids are for most part or entirely changed into peptone and digested in the stomach can not yet be set down as a fully established fact. Before passing from this subject, however, we shall set down some further observations that may clear the question in a clearer light, and may help at the same time to show what position the stomach really takes in the general work of digestion.

It is quite evident that if albuminoids be not digested in the stomach, they must be digested in the bowels. Is there then any means by which we can determine whether albuminoids can be digested in the bowels and nutrition sustained independently of the stomach? Czerny (45) divided the stomach of a dog, and by moderately careful feeding its equilibrium of weight and strength was sustained for five years. There is no exactly parallel case, however, to this in man, as the stomach, though partially has never been wholly spared, and through health has been
sustained for a time by feeding on enema and through intestinal fistulae, still this cannot be regarded as quite equivalent to the entire absence of stomach. Besides nutrition could be sustained, as has been proved, by a diet consisting almost entirely of carbohydrates and fat, and with the digestion of these substances the stomach has little if anything to do. The question is not, however, whether nutrition can be sustained by a diet of carbohydrates and fat, but whether albuminoids which must enter in considerable proportion into the regular diet if we are to be in really sound health and fit for exertion, can be digested by the bowels when the stomach is either entirely absent or its functions totally in abeyance.

V. Mooren (76) has put the matter in a careful, and apparently unobjectionable test. His observations were made on several patients in whose stomach was found no trace of bile, and the evacuated contents showed no sign of peptic digestion. The cases selected were those in which motility was good, and the contents, soon emptied, otherwise it might have been objected that digestion was accomplished by other acids, the result of long fermentation. In these cases nutrition
was sustained by rest and careful feeding, and weight increased, while a careful analysis of the faeces and urine showed that no more albumen was excreted than in healthy digestion. In view of these facts, it is difficult to resist the conclusion that it is quite possible for albumen to be digested in the intestine, quite independent of the stomach or gastric secretion. But if so, the question naturally arises—why does the general health suffer so much in atrophy and cancer of the stomach and other types of severe disease? It cannot be accounted for by pain, for pain may be entirely absent. It is possible to explain it by the fact that, in disordered digestion, the molecules of albumen split up in an abnormal and irregular manner and that wasting and malnutrition are not produced by the non-elimination of some of the secondary products of digestion, which are now with much probability set down as the cause of many diseases. The likelihood of this being the case is further confirmed by the frequency with which leucin, lysin, and similar compounds are found in considerable quantities in the urine and faeces of those suffering from
atrophy or any other condition that prevents the flow of the gastric secretion.

It is quite possible that HCl or pepsin may also serve some other purpose, than the hypothetical one of preventing the irregular splitting up of the albumin, of albuminogen. Ponsere, Koch, and others, question who thoroughly deny that HCl or pepsin takes any necessary or active part in primary digestion, and affirm that the principal value of HCl is that of an antagonist. This is quite possibly true, but, so far, we have no satisfactory proof. If, e.g., a brisk meal had been given to a dog with an emptied stomach, and the acidity did not disappear in the course of the digestive tract, this would certainly be a strong argument in favour of the antagonistic properties of HCl. So far as we know, no such experiment was ever tried. Nor can the argument drawn from the amount of \( \text{H}_2 \text{SO}_4 \) in the urine be regarded as satisfactory. That \( \text{H}_2 \text{SO}_4 \) is found in the urine in proportion to the amount of gastric material in the intestine is generally granted. Proceeding from this conclusion, some have given large quantities of chalk to neutralize the HCl in the gastric secretion. It has been found that after
doing so the H₂SO₄ was diminished or disappeared in two or three days, but it is exceedingly doubtful if this disappearance of H₂SO₄ is due to the neutralisation by chalk, as the alkali must have a considerable time before ceased to act, and it is scarcely possible to form any definite conclusion when the natural process of digestion is so completely changed.

The influence of the gastric secretion, on Bactin has as yet also been little investigated. That we swallow more with the food than are secreted from the intestines has been satisfactorily proved by Legendre, but it is by no means evident in what part of the alimentary canal or by what means they are destroyed. We are also in such ignorance of the leucocytes and phlogocytes, a subject lately investigated by Bienger and popularized by Samuel Brunton in his work on Digestion, and how far their formation is prevented by the gastric secretions, that we shall not here give any place to the discussion of the subject.

Reviewing the whole, we conclude, that though it may be desirable to know what amount of pepsin is in the stomach contents, their presence or absence
Cannot give us any material assistance in diagnosing disorders of digestion.

Examination of the stomach content is made for determining the time of
Absorption.

Penfold's method of determining the time of absorption is well known. If the grains of
India of Potter are taken with food and the saliva frequently tested for iodine. This
shows clearly enough when iodine is absorbed, but cannot, I think, give any information as
to the absorption of Carbo hydrates, fats and albuminoids. The small value that may be
attached to this test may be seen from the
fact that Penfold set down 15 minutes,
Wolff (80) 1's hour as the limit for normal
digestion. For this investigation some more
reliable method than that of Penfold is
required.

The principal causes of delay in absorption
are generally recognized as being processes
covering the lining membrane of the stomach,
viscus, damage from any obstruction to the circu-
lation in heart, lungs, or liver, and weakening
or degeneration of the ganglia and nerves.
Supplying the mucous membrane of the stomach or regulating the muscular contraction of its walls.

Etiology.

It has been said that every man has the stomach he deserves. "This is doubtful. Sufficient observation have not yet been made to show how far deppepara and other forms of gastric disorder are hereditary. All the other main causes are well understood and admit of little difference of opinion. Habershon (87) has done good work in describing them in a clear and systematic manner.

Classification.

We might classify according to symptoms generally, to function, or pathological change in structure. A great variety of classification have been given, all more or less satisfactory. A logical division seems, however, impossible. Dilatation e.g. may be the result of over feeding, muscular weakness, cicatrization ulcer or cancer at pylorus. chiefly also may result from various causes. We think it better, however, to give Dilatation and
Atrophy a separate and distinct position, leaving the cause to be afterwards enquired into. The following is the classification we have found most convenient in practice: I Acute Gastritis, II Chronic Gastritis, III Atrophy, IV Dilatation, V Ulcer, VI Cancer, VII Nervous Dyseppepsia.

Treatment.

In the history of disease treatment almost always precedes diagnosis. This is especially the case in Indigestion, where the most frequent symptoms appeal so plainly for relief to the common understanding that many modes of treatment have been tried and drugs given before any exact diagnosis or rationale of treatment has been possible. In this, then, we have not proposed to give any systematic account of disease, but have directed our attention for most part to new methods of diagnosis. Nor shall we now attempt to give any systematic order of treatment, but simply endeavour to explain how far clinical experience of relief obtained corresponds with the new method of diagnosis, and offer some suggestions for the further extension of treatment on that basis.
We shall pass in a sentence or two the treatment of some of the best marked kinds of disease.

Acute. In the treatment of acute disease there is really nothing new, nor is it likely that the old treatment by rest and liquid diet will soon be set aside, while the employment of Karlsbad and other salts, which without doubt lessen the secretion of HCl, cannot always be relied on, as we have found that frequently in acute disease HCl is not secreted in excess nor even in normal quantity.

Cancer. The treatment by Condurango at one time strongly advised by Esralf (1837) and others as relieving the accompanying symptoms, has now been practically abandoned, as it has not been found to cause any material improvement in relief of symptoms, or secretion of HCl. I have frequently tried it, and my experience is not different from that of most other observers, who cannot see any difference in its action from Quassia, Sanjine, or any other vegetable bitter.

There has been rather more than the usual crop of quack remedies during past years, among others that of Count Mattei (82), va...
Very few medical men seem to have regarded it as worthy of serious attention.

The publication of the statistics of Billroth's (83) successful cases of surgical removal gave an impetus to a closer consideration of this subject.

Dr. Allan of Glasgow discusses the question of operation in the British Medical Journal of April 23, 1892.

From a consideration of the results in Glasgow, he agrees with Dr. Guinard of Paris (84) who has recently written an exhaustive work on the subject, concluding that "there is not at present any operation which can ensure the cure of Cancer of the Stomach." The difficulty seems to consist in the fact that the disease frequently cannot be diagnosed in its early stages, in the presence of adhesions, and the existence of cancer nodules in other organs. Oswald (85) has also just pointed out the particular case of a case of gastrosis, when the digestive function was entirely destroyed, and the secretion of mucus was markedly increased, and when nutrition depended on the intestines.

Abolishing the fact that Carbo-hydrates and fats are easily digested in the stomach, and that albuminoids can be digested in the bowels, and that in such cases every treatment fails to produce any appreciable quantity
of gastric secretion, would suggest feeding largely with carbohydrates and fats, moderately with albumen, the use of massage for more quickly emptying the stomach of its contents, and antiseptic to prevent fermentation when they are too long retained.

Dilatation. It is quite evident that when dilatation arises from stenosis of the pylorus through cancer or cicatrized ulcer, the patient may as well be left alone, or passed over to the surgeon. There is no doubt, however, that in the treatment of dilatation from other causes, the introduction of stomach washing has proved to be one of the greatest advances in medicine in recent years. The advantages of stomach washing have been carefully stated by Ewald as consisting in the cleansing of the stomach by the removal of half-digested food which has been too long retained, in removing partly by chemical partly by mechanical means the mucus which adheres to the walls of the stomach in increasing not only the peristaltic and muscular power by the elevation of the stomach-like and the pouring in and withdrawing of fluid, but also favorably influencing the cells so that a sound secretion is called forth. (p. 298). Not without
reason possibly has it been claimed that what digitalis can effect for the muscles of the heart, washing can effect for the stomach. Klemperer (86) who has probably devoted more care to the study of this subject than any one, recommends that the last food be given at 4 pm, and the stomach be washed out at 8 pm, that during the night the stomach be allowed to rest, and a little brandy given only if necessary, that a trich is applied, and that in most cases, rest in bed on the right side be enjoyed for 2 or 3 weeks. At the commencement he gives every hour a glass of milk with cream, and in most cases, brandy; afterwards a diet containing carbohydrates, and fats as well as albuminoids. The "easily digested diet," generally prescribed, is what and the avoidance of carbohydrates and fats, he regards as both unreasonable and unscientific: it also makes use of mace, soap, electricity, vegetable bitters occasionally, and aloe. Klemperer claims that by this treatment, in few cases, will the care of the physician be so richly rewarded as in this disease.

Acute Gastritis. Most medical men in every day practice will be grateful to Galvani for insisting so strongly and with such good reasons are giving
The stomach can endure much for 24 to 48 hours, and nothing beyond possibly some mild saline effervescence.

"The lady," as Oswald says, "will probably object, but the German proves that a man cannot remain two days without food; is one of the foolishest for a man can thrive very well a day or longer on his own fat, and if this the great public might be sufficiently aware from the famous fasting performer of last year." (p. 264)

We have quoted fully Oswald's very plain words, because several years' observation and inquiry into the causes of indigestion, have given us the firm conviction that much suffering through gastritis proceeding in after years even to atrophy and dilatation might have been avoided by attention to this simple rule of Oswald's.

Alimentary Dyspepsia. The most important of the disease depending so much as it does on the general constitution, cannot possibly be dealt with within our limits.

Chronic Gastritis. or

In what remains of this paper we shall consider the treatment to be adopted in Chronic Gastritis, or what is generally known by dyspepsia,
and as in one form or another it is an accom
paniment of almost all other diseases of the
stomach, the general principles of treatment
have a very wide application.
The aim in treatment should be, so far as
we know, directed toward improvement of
gastric secretion, motility, absorption, appetite.
Before turning our attention, however, to what
may be regarded as the final aim of treatment,
it may be necessary to administer for temporary
relief some of the numerous and well-known
sedatives. Among these, though perhaps no
definite reason can be given for its action,
Rimaunette will always hold the prominent
place which clinical experience has assigned
it. Morphia also is indispensable, though
perhaps the assumption that it can act in
small doses as a sedative to the mucous
membrane of the stomach, without affecting
the general system, is rather gratuitous.
The final aim of treatment being the improvement
of secretion, motility, absorption, and appetite, the question
arises—To which of these ought our attention to be
first and chiefly directed? As has been often shown
these functions are in almost every case interdependent,
so that if one function be impaired the others are likely to suffer, and if one impaired function be improved the others are likely soon to share in the improvement.

The eloquent advocacy of Klemperer leads (83) us to turn our attention first to motility. There are three methods by which the motor power may be strengthened: (a) By drugs. (b) By massage. (c) By electricity. (a) By drugs. Klemperer is almost the only one who has gone beyond mere symptoms, and tested, by careful experiment, the influence of drugs on motility. A great deal has been written on the subject, and a great deal more yet requires to be done before it can be regarded as absolutely proved that excess of acidity causes contraction of the pylorus, and that neutralization by alkalies will materially hasten the passage of food into the intestines. Klemperer, who tested motility after neutralizing the acids by carbonate of soda, does not seem to have arrived at any definite conclusion in the matter. The other drugs mostly employed by him in testing by his method were alcohol and bitters. In healthy digestion he found that alcohol in small quantity and bitters
has no appreciable influence on motility, but that in large doses alcohol materially diminished it. In dyspepsia, on the other hand, he found that alcohol in small doses and to a less extent better's decidedly improved the motor power.

The influence of drugs on motility might also be easily shown by Oswald's and Huber's methods, but I have not been able to complete and put in tangible form some observations I had begun to make on this subject.

(b) The motor power of the stomach may also be improved by massage. The pictorial representation of the effect produced, which is given in Land's Brunton well-known work, has drawn considerable attention to the subject. Coèr (88) in an able article on the subject strongly advocates its employment for 3 hours after food, and claims that by its use gas is expelled, relieving the contracted pylorus, muscular power strengthened, and secretions improved.

(c) Motor power is also strengthened by electricity. There is not space here to discuss the different methods employed, and the different advantages claimed for them by different observers.
The interrupted current is generally preferred. It may be as well to note that by this means Stockton of Buffalo, in an article on the subject (89) relates how one of those extremely intractable cases occasionally met with in practice, when the food is regularly brought up in half-digested clumps from the stomach, was cured in a month by faradic therapy after all other means had failed.

Improvement in gastric secretion must also be put down as a final aim in treatment. The physician of indisposition may be termed a summation of under acid, and alkaline, sedatives, bitters, and tonics. Among these, acid and alkaline do not take the least prominent place upon every medical man in actual practice is in the habit of daily administering them, but the principles on which they are given are by no means well understood.

In Ringer's Therapeutics as well as in almost all textbooks on treatment it is put down as a rule that acids stimulate alkaline and diminish acid secretion, and that alkaline stimulate acid and diminish alkaline secretion. Ringer sets this down as a theory that serves as a useful guide to the correct employment of acids and


alkalis in disease". He further adds, "Repeated and careful experiments have established the fact that dilute acid, taken into the stomach, check its secretion; alkalis, on the other hand, powerfully exert the secretion of gastric juice." (90, p. 148) Like most medical men I have been vastly indebted to Ringer, and greatly value his able work on therapeutics, but with all deference to Ringer and the able men who have written books on the Practice of Medicine, I cannot, by any possibility, regard such statements as proved, nor accept them as my guide in the administration of acids and alkalis in digestion. Having searched through the best Books in Physiology of Suck, Dalton, Landor, and Stirling, Hermann and Waller, but can find nothing recorded that would justify Ringer in saying that "repeated and careful experiments have established the fact" that acids check the gastric secretion and alkalis excite it. The only experiments that I can find directly bearing on this subject are those of Matthew Hay (91) who found that the injection of a solution of a neutral salt of sodium (chloride or sulphate) into the stomach produces an alkaline secretion, and this can scarcely be said to be in favour of Ringer's statement. The question might possibly be solved by giving acids
and alkalies, and with drawing them out of
from the stomach, but it would be difficult to
conceive a modus operandi that would not be
open to objection. From the limited number of experiments
that have been made with Carlsbad and other
alkaline mineral waters, it seems not unlikely
that Ringer's statement will be and may be
disproved. Ringer adds, as the leading argument
in favor of his theory the relation of acid and alkalies
to this secretion, This reasoning from analogy is
by no means reliable. Besides, are the facts sufficient
to substantiate this argument? It is admitted that
acids promote the secretion of alkaline salivas. The
fact that a glass-rod dipped in acid and applied
to the end of the gall-duct causes an increased flow
of bile speaks well for its action on the connective
tissue of the gall-bladder but scarcely for any
influence on the secretion of bile, and while Rushe's
food's experiments have showed that bile is increased
by the internal administration of hydrochloric
acid, they have also showed that it can be increased
by the administration of various soda salts.
I am not altogether alone in questioning this
dogma. Wolff(92) in a long and very able article
on the action of foods and drugs on gastric
digestion expresses his surprise at the partiality of Englishmen for this form of treatment, but as belief almost universally accepted die hard, does not seem anxious to oppose it.

So much for the general statement as to the relation of acids and alkalies to gastric secretion, but when Ringer further sets it down as a rule that "acids given shortly before a meal generally check acidity," and says on the same page (97) "acids given before a meal check the secretion of gastric juice, and so hinder, instead of aiding digestion," I am at a loss to understand, on his own showing, how this is intelligible. It is well known that in the vast majority of cases of acid dyspepsia, the acidity is due to excess of lactic and volatile acids, and these are not found in excess where there is sufficient secretion of HCl. If then acids be given on the principle of checking HCl secretion, no treatment seems better adapted to the development of the lactic and other acids, on which the vast majority of cases of acid dyspepsia depend.

It is quite possible that Ringer's mode of treatment may be correct, but I can find neither facts nor arguments in support of it.

So it possible then to suggest any line of treatment
in accordance with the results of recent inves\textasciitilde;igation of stomach acids. It is universally agreed that in hyperacidity from excess of HCl, alkaline given not in small but in large doses will give at least temporary relief. Robin of Paris\textsuperscript{31} objects to this mode of treatment and gives picrotoxin, veratrum viride, and ergot, on the principle of combating the too active vaso-dilatation and too energetic secretory power which he regards as the cause of hyperacidity. By own limited experience has led me to trust rather to Wolffi prescription:—(92)

\begin{align*}
\text{Sulphate of Soda, } & 30 \text{ gr.} \\
\text{Sulphate of Potash, } & 5 \text{ gr.} \\
\text{Chloride of Soda, } & 30 \text{ gr.} \\
\text{Ricarbonate of Soda, } & 25 \text{ gr.} \\
\text{Borax, } & 10 \text{ gr. M.} \\
\end{align*}

Half a teaspoonful of the mixed salts dissolved in half a glass of warm water to be taken three times daily on an empty stomach.

Of more importance is it to inquire whether alkalies should be given to relieve acidity in cases of deficient HCl secretion, and excessive presence of lactie acid. From my own experience definite that in most cases of dyspepsia a bicarbonate, borax, or glycerin taken after food not only gives temporary relief but improve the facility of digestion. It is quite possible that Ringer's principle may be correct. Alkalies given to the extent of producing an alkaline reaction in the gut, would seem as
as likely a means of calling from a larger secretion of HCl, as giving a few grains of soda on an empty stomach. Granted that this is a clinical fact, the following, I think, though not free from objection, would seem a reasonable solution. We have seen that when there is an excess of lactic acid, it is not necessarily from the fact that HCl is not secreted, but that HCl has been secreted in so small an amount as to enter entirely into combination with bases. If alkalies be given, then the lactic acid enters with them into combination, and what is secreted over and above of HCl remains for a short time free. I am sure that chemists would say that the HCl could not possibly remain free in presence of lactate, but would at once displace the acid from the salt, but from the fact that free HCl, lactic acid and salt have been found to coexist in the stomach, one might conclude that it is just possible the chemical combination in the stomach may not be exactly the same as those found in a chemical laboratory.

There is a general impression that the administration of alkalis, though giving temporary relief, will in the long run materially injure the digestive power of the stomach. So those who have been giving
alkalies, and may fear that they have been giving temporary relief, at the expense of serious injury to the welfare of patients. The testimony of Dr. Roberts founded on a large experience will be a great relief. It is true that his method of giving alkalies is modified by certain restrictions. He uses for most part Bicarbonate of Soda, and enjoins that they be not mixed with or near meal, but are to be given as occasion requires and that they be discontinued when they do not cure short pain.

He then adds:—The more attended my experience has become, the more I have been satisfied that (with due precautions, the practice of taking alkalies) is harmless, and I know of no valid evidence from any other quarter to justify a contrary conclusion. (1611:256) Done without it, Dr. Roberts' restrictions, it is doubtful if much harm has ever been done by a reasonable employment of alkalies.

As we have already probably exceeded the space which a paper is expected to occupy, we shall only in a few words refer to the administration of acids. The best remedies for deficient gastric secretion are of course those that stimulate a larger secretion, yet it seems not unreasonable
to expect that the addition of NHC may also serve some purpose in promoting digestion. When a feeling of weight and incapacity for mental action is experienced some time after food, it has been found by Jeanne and many others that the administration of HHC gives relief. For this purpose, however, it is necessary that comparatively large doses be given—36 to 37 grains, hydromelol, ete. In water to be supplied slowly at intervals—and that amount is of course considerably less than is required to be secreted by the stomach for the digestion of an ordinary meal.

Administration of Ferments.

Pepsin. As already said, experiment has clearly showed that in the great majority of cases, sufficient pepsin existed, when the stomach contents were diluted 1 in 1000 or even 1 in 5000, to carry on digestion, and that it is practically never absent unless in cases of atrophy. We further concluded that in atrophy the best course is to hasten intestinal digestion. The subject has been carefully investigated by Bors. He concludes that the proper sphere of action of pepsin is limited to those exceedingly rare cases where there exists a disproportion between acid-
-selection and pepsin-secretion." The case referred
to are those of such extreme hyperacidity, that one
can not find an instance in the whole course,
of Practice. (2 pp. 234, 256.) Its value in the preparation
of artificially digested food, we need not discuss, as
it is now almost entirely displaced by pancreatin.

But even granting that pepsin has its uses, the
difficulty is to procure it. It is almost universally
admitted that in many of the forms in which it is
supplied it is practically useless. In solution it
will rapidly deteriorate in the presence of alcohol
or a strong acid. Dr. Herschell gives the results
of investigations made by Dr. Eccles, which he com-
"municated to the American Pharmaceutical Assoc.
iation and which are given in the Druggist-
Circular and Chemical Gazette of 1890. Dr. Eccles
found that it requires 2½ droppers of the best
pepsin supplied to the market to dissolve 1 lb. of
beef steak, that the best preparation he could
procure contained only 2.7% of pepsin, and that
had been regarded as really a superb article
was found by analysis and its action on
albumin to contain only 1 part in 500. It is
possible that these supplies to the English market
may be better, but in view of statements like these
it is surprising to find how some medical men preserve their faith in pepain. But the
surprise is greater when we consider the extent to which have	
employ lacto-pepsin and similar combinations. In lacto-pepsin, e.g., we have
sugar, milk, pepain, pancreatic, ptyalin, lactic and hydrochloric acid, that is lactic
acid which is never required, ptyalin and
pancreatin which may be required but in
what condition, possibly no man can tell and
which in any case are rendered inert by
the presence of acid, hydrochloric acid is too
small quantity to be of any value, and pepain
the reason for giving which those who have
solved the other part of the problem would
probably be able to give.

Pancreatin. In opposition to Duprezon, Sir Jno.
Roberts and others have distinctly proved that
pancreatin is rendered totally inert by the gastric
secretions. This, however, does not settle the question
of the value of pancreatin or artificially digested
food. The problem is too complex and more intimately
connected with intestinal digestion to be discussed
in this paper. When food that has been digested
by pancreatic or intestinal digestion is taken

into the stomach and subjected, unless the gastric functions are totally inert, to acid digestion, and then passed into the bowels and subjected to alkaline digestion, it would require some
able observer to tell what becomes of it. It is quite possible that food previously digested may be better absorbed by the stomach, and one would theoretically conclude that artificial digestion may not be without value in atrophy or other conditions where there is entire absence of gastric secretion. It might be still more valuable if there was an absence of pancreatic secretion. The subject has by no means yet been fully investigated, but whatever personal opinion one may have as to its value, the testimony of men with large clinical experience like Sir Robert
cannot be lightly set aside.

Bitters. This subject has recently been investigated by Reichman (93) Wolff (92) Stelbofen, Saworski and others. Among scientific observers there were practically not two different opinions as to their
value, and this is no less satisfactory, as some medical men put them down as useless, while others seem to think that no possible gastric disorder can be treated without them.
The popularity which Bitters have so long enjoyed in this country may be partly due to other reasons than those directly concerned with the cure of indigestion. They are cheap, easily prepared, harmless and to the palate of many not disagreeable. Some of them are also useful in constipation. There has also been a general impression that somehow or other they must increase the secretion of gastric juice, whether by extravascular pressure, or irritating the nerves of the stomach, or by sympathy with the nerves of taste. But, however, till quite recently, has the question been put to any really scientific test.

Reichmann (93) has probably done more than any other to guide us to some reliable conclusions. He experimented with Gentian, Quassia, Gentiana and Alum. Because of the difficulties he had to contend with before arriving at any definite conclusion, (a) that though he found them in many cases advantageous in treatment, he was uncertain whether to attribute the result to their influence on stomach, liver, bowels or pancreas. (b) As they contained beside the bitter principle, salt, coloring stuff, ethereal oils and organic acids, it was difficult to say on which of these their
action principally depended.

From an examination of the stomach contents in nearly 200 cases, he arrived at the following conclusion: 1. That there is no great difference in the action of different bitters. 2. When given on an empty stomach they did not produce so great a secretion as distilled water. 3. After their disappearance from the stomach, there was an increase of gastric secretion. 4. When given during digestion digestion was materially improved. 5. When acid secretion was normal they made no appreciable difference; when deficient they somewhat improved it, when absent they did not produce it. 6. No harm was done through their being given for a considerable length of time. From all this it will appear that the exhibition of bitters to an exhausted stomach is useless, but that in case of weak digestion when given at least half an hour before food they may be decidedly beneficial.

We shall only briefly refer to two or three drugs, not generally included among the vegetable bitters, but whose influence on digestion is probably in great measure due to the bitter principle they contain. Suffice it to name three: Strychnia, Cinchona and Quinine —
Strychnia. Of all the bitterst, it is the opinion of almost
any observer that Strychnia is the best, both as
regards its influence on motility and secretion, and
as having a tonic action on the whole nervous system.

Opiate. The virtues of Opiate (44) have been set
forth by Schatzold, but it does not seem to have
found much favour in this country at least. Yet
it may have a good effect in great exhaustion and
complete absence of appetite, if possible, but I
have not found it so, and the extremely acid
effect, the hydrochlorate has on the mucous membrane
of the mouth has driven me from continuing its use
even in the form of pill, as the pill is readily
dissolved and must have a similarly acid
effect on the lining membrane of the stomach.

Guaiac. Buxton has made a long series of experiments (98)
with guaiac on 11 healthy young men. He found
that the hydrochlorate of guaiac in 10 grain doses
has no retarding influence on digestion, but that
the sulphate has to a smaller extent in the early
stages, that both salts increase acidity and
absorption, but produce no change in putrefaction,
that in smaller doses, the effect are favorable in
those with weak digestion, that the hydrochlorate
is preferable to the sulphate, and that the common
practice of adding hydrochloric acid to the subject, is therefore commendable.

It would be quite beyond the limits of this paper to discuss the effect of different salts, mineral waters, alcohol, tea, coffee, tobacco &c. Sir W. Robert has tested their influence on artificial digestion merely, and a large number of German observers by means of the stomach tube have tested their influence on motility and secretion in natural digestion. The subject has been fully discussed, and the results of different investigators are given in Wolff's contribution to the Jahrbücher für klinische Medizin of 1889, which has already been referred to.

Before leaving the subject, however, it may be as well to remark that it may not always be desirable to hasten gastric digestion, to strengthen motor power, nor stimulate a larger secretion of gastric juice. If we proceed on this principle, there are many substances in everyday use we must necessarily give up, such as tea, coffee, and even common salt.

It has been abundantly shown that all these do more hinder than further digestion, and Sir W. Robert's theory is probably correct that it is not always advisable that the food be rapidly driven from the stomach, for, if the liver which has been regarded
as the penciled placed to watch the passage of digested products into the general circulation be not active, Jupiter's, and other secondary products of digestion might pass into the general system at a speed that would by no means tend to a sound and well-balanced nutrition.

In these, it may be fairly claimed that new methods of diagnosis have done not a little to advance treatment. They have given the assurance that some forms of treatment which clinical experience had found valuable, depended for their success on assured scientific principles. They have shown that other kinds of treatment which had been adopted in a mere delectante manner are but useless trifling. They have opened up a wide field for further investigation, and given an impetus to raise the whole system of treatment above empiricism and establish it on a sound scientific basis. They have shown that the present spirit of hopelessness that is abroad as to the power of drugs is unreasonable. They have at the same time shown that the power of drugs has a limit, and that a pinch of soda or a few drops of mineral acid added to a pint or quart of food will not present the
evil consequences that must arise from an
excessive or unwholesome diet, and a
careless disregard of the laws of hygiene.
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