

A STUDY OF THE
ACIDITY CURVE AND THE CORRELATED X-RAY FINDINGS
in
CONSECUTIVE CASES OF GASTRIC DISORDER.

by

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Perhaps no organ of the body is more long suffering or more abused than the Stomach.

It is hardly wonderful then that Gastric Disorders are extremely common.

It is however remarkable that our knowledge of the working of the Human Stomach in health and disease is neither extensive nor definite.

Pavlov has taught us much with regard to the actual amount and the digestive power of the Gastric Juice secreted in response to the entry into the Stomach of different classes of food stuffs.

Cannon has further shown that the motility of the Stomach, or its capacity for passing along its contents, varies with the nature of the food. Quality rather than quantity appears to be the essential factor in arousing a secretory or a motor response.

But it is noteworthy that while Proteins elicit the greatest flow of secretion, Carbohydrates call forth the greatest motor reaction.

The functioning of the Stomach in any case has therefore to be studied from these two aspects - the Secretory and the Motor.

Such accurate knowledge as we possess at present upon/

upon these points has been largely derived from observations made upon lower animals.

For this reason the present investigation of the Acidity of the Gastric Contents as it varies during the course of digestion of a test meal in the Human subject and the correlation in the same subject, if possible, of the appearance shown in the Fluorescent screen after a Bismuth meal was recommended by Professor Meakins.*

That there is room for such an enquiry is evident from a review of the clinical procedure at present in vogue.

In the routine physical examination of hospital cases suspected to be suffering from Gastric disorder it is customary to make a quantitative estimation of the acidity of the stomach contents withdrawn one hour after a test breakfast.

In many cases only one such estimate is made. If, however, several test meals are given it is always at the same period that the contents are withdrawn, viz. one hour.

It appears that this period has been arbitrarily fixed upon as the outcome of a few observations made upon/

* Note. The work done by Rehfuss, Bergeim & Hawk was unknown to me for nearly two months after I had commenced making observations upon the course of digestion in health and disease by the Fractional Method.

upon normal stomachs from which portions of the contents have been aspirated during digestion at a series of fixed intervals after the injection of a test meal and the results plotted out upon a chart.

In this way a curve has been obtained which shows the evolution of acidity during the process of digestion. In Sahli's "Diagnostic Methods" such a curve is given. It is taken from the observations of Schüle who found that Free Hydrochloric acid usually attained its maximum at about one hour after the test breakfast and fixed the limits of time in different normal individuals as varying from three quarters of an hour to one hour and a quarter.

He also estimated that the Free acidity varied from .05 and .07 to .2% or 20 to 55 and the total acidity from 30 to 70 or from .11 to .26% HCl.

These observations appear to have been accepted as a fairly complete picture of the physiological process of digestion after a test breakfast.

But all that they really do show is that in many normal individuals the maximum acidity is reached in one hour and that it lies within the above limits.

They do not show anything whatever with regard to the evolution of acidity during digestion in disorder of the stomach. Nevertheless it appears to be presumed from the Clinical methods in vogue, that disease only alters/

alters the height of the summit of the curve but not its portion in time. That in other words if we estimate the acidity at one hour we are justified in labelling it as normal, excessive or deficient.

It is however unfortunately a rare thing for the physician to trace out the curve of acidity at all.

In examining his Heart cases he takes a tracing of the pulse sufficiently long to permit of abnormalities displaying themselves.

Where temperature is a matter of importance he is not satisfied with one or even two readings of the thermometer per day.

Why then, it may be asked, is he content with one estimation of acidity taken at a purely arbitrary point in the course of digestion?

What does he hope to learn from the information obtained?

The answer to both these questions must be unsatisfactory. It therefore seems wise at present to trace the whole course of acidity after a test meal in any case we wish to investigate.

TECHNIQUE FOLLOWED IN OBTAINING THE CURVES OF ACIDITY.

Upon the advice of Professor Meakins the following technique was decided upon and rigidly adhered to in all the observations made.

The Test meal given (except where otherwise stated) in all cases was a Ewald Test Breakfast consisting of plain Toast - 30 grms - and two cups of tea without sugar or milk - 400 cc.

This was given in the morning after a night's fast. The time when the meal was consumed was noted and shortly after a fine tube was passed into the stomach.

The Tube, of a diameter of about 6 millimetres, was weighted at the end with small shot firmly bound in place by bindings of strong thread to ensure the extremity occupying the most dependent spot.

Several openings were cut into the tube, each as large as its lumen (about 4 millimetres in diameter).

Linear markings were drawn on the tube at distances of 45 cm. and 48 cm. from the highest opening, and it was usually found that if the tube were passed until a point between these two lines was opposite the incisor teeth, fluid would easily be withdrawn.

This tube can easily be cleansed and boiled and it is so fine that it causes very little discomfort to a patient.

A receptacle for saliva was always given to the patient who was instructed to spit out all saliva which accumulated in the mouth.

As will be seen later this is a very essential precaution.

To aspirate portions of the stomach contents an all glass syringe of 20 cc. capacity was employed.

This permitted of easy cleansing and also of simple measurement of the fluid aspirated.

Fluid was first withdrawn 15 minutes after the consumption of the meal and thereafter at intervals of 15 minutes, as long as the observations were continued.

5 cc. were found as a rule to be sufficient and in some cases one had to be content with less.

Method of Analysis.

The Gastric contents were not filtered but if too thick to pass through the measuring pipette they were strained through a double layer of fresh white gauze.

A graduated pipette of 2.5 cc. capacity subdivided into tenths and fiftieths of a cc. was employed.

1 cc. of fluid was taken for each test and diluted with 50 cc. of distilled water.

Centinormal Caustic Soda solution was employed for neutralisation and dropped from the usual graduated burette./

burette. As an indicator of Free acid Dimethyl-Amido-azo-benzol (methyl orange) was used and for total acidity alcoholic solution of Phenolphthalein.

The readings of the Burette as shown in cc. and converted into percentages of HCl, were marked upon graph paper at each 15 minute test.

In all the curves shown the Total acidity, of course, occupies the upper position and the Combined acidity is shown by the interval between it and the curve of Free acidity.

Curves of Acidity in the Normal Stomach.

In two cases this method was applied to persons believed to be of sound digestion.

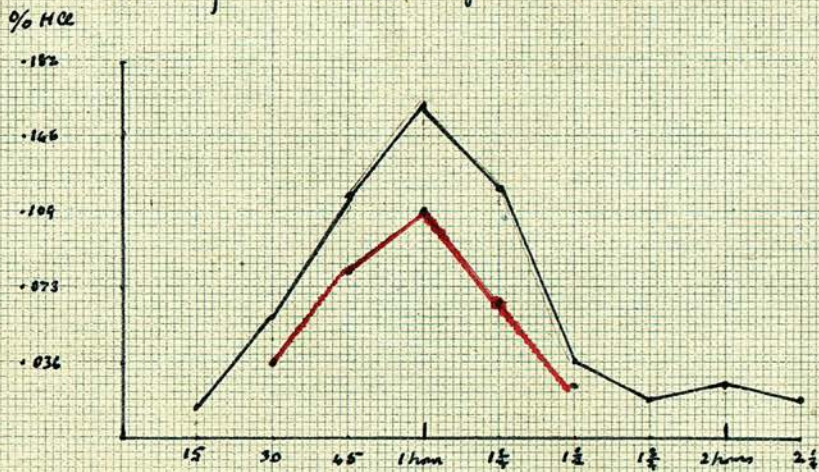
Incidentally it may be remarked how difficult it was to get healthy subjects leading a normal existence, to submit to examination.

The preliminary fact, the swallowing of the tube and the time required for observation - $2\frac{1}{2}$ hours at least - were sufficient to deter them.

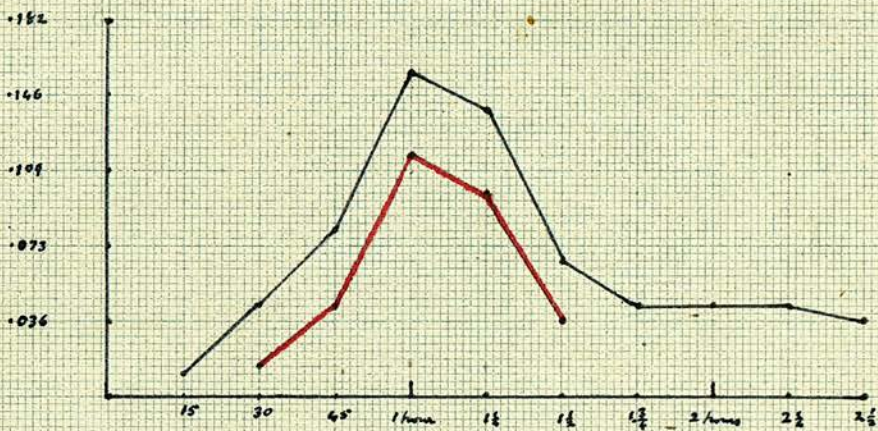
Of the two cases here shown, the first was a convalescent patient and the second a Medical man. Both were about the same age but leading different types of existence. The second was at the time leading a very active life.

It is extraordinary how closely these curves tally/

Acidity curve in normal subject no I



Total acidity in blue. Free acidity in red.



Total acidity in blue. Free acidity in red.

Acidity curve in normal subject no II

tally with each other. In each the Free HCl appears in the sample withdrawn at 30 minutes after the meal.

Both Total acidities rise steadily to a maximum of .16 and .15 respectively at one hour. They fall steadily from that point and in both Free HCl is absent in the specimen examined at $1\frac{3}{4}$ hours after the meal. Free HCl reaches its height in both at one hour.

Both subjects showed absence of food residues in $2\frac{1}{4}$ hours. Throughout, the Free and Total acid curves follow very parallel courses, the interval between them never becoming great although the Free acidity approaches the Total acidity more closely at its appearance and disappearance than at the apex of the curve.

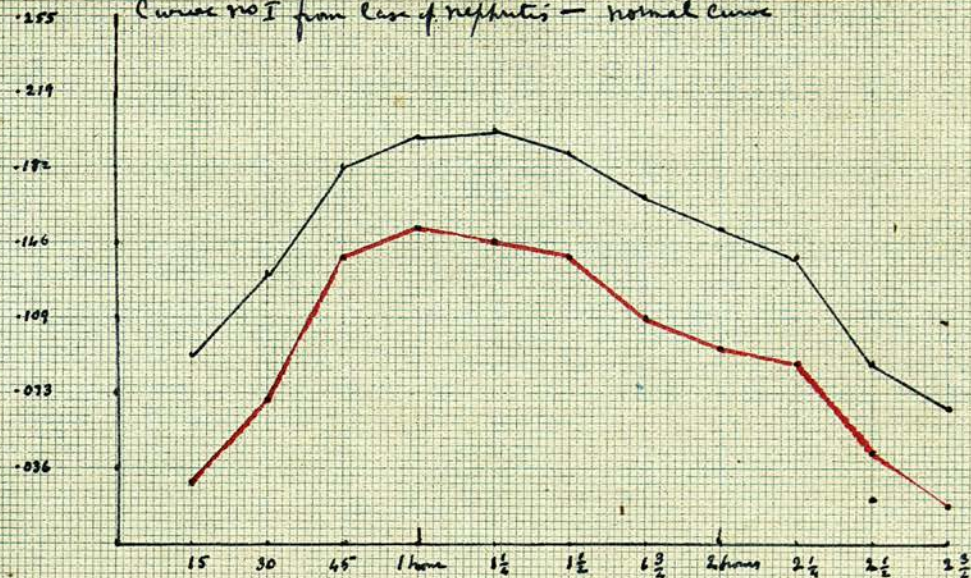
The curve shown by Sahli is very similar to this. The Free HCl appears in from 30 to 35 minutes, the maximum is reached in 50 to 60 minutes and the Free Acid has almost gone in 90 minutes.

Another curve is shown which was taken from a case of Nephritis. It was taken as the patient's history showed vomiting some time before admission and it was further possible that some variation in acidity might be found owing to the Kidney trouble.

Burnaki studied 25 cases of Nephritis and found that/

% HCl

Curve no I from case of nephritis - normal curve



Total acidity in blue Free acidity in red.

% HCl

Curve no II from case of nephritis



Saliva swallowed during shaded period terminating at cross *

that the quantity of HCl is reduced in severe cases in proportion to the oedema, the secretion of albumen and reduction in secretion of urine.

The curve shows the same regularity of rise and fall with acme at one hour. The summit is rounded and the acme .19. The fall is more delayed than in the preceding curves. It is a normal curve.

The curve taken from this same patient a week earlier exhibits a different picture altogether.

The reason is that he swallowed saliva for a period of at least one hour until he was stopped doing so at the point marked by a cross.

He was a smoker and salivated heavily.

The modification of his acidity in consequence is very interesting.

The tube was passed in this case shortly before 30 minutes after the meal, so the first sample was withdrawn at that time.

The rise is seen to be delayed by the alkaline saliva though by no means prevented, and the combined acidity increased in amount. After the swallowing of saliva is stopped it becomes steeper and actually reaches a higher acme of .23 at 2 hours.

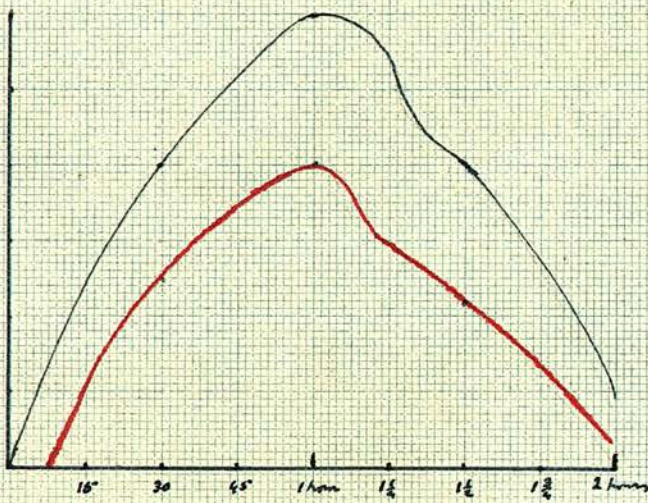
The whole process of digestion appears to be protracted and the curve as it were shifted to the right as compared with the other.

His/

Incretory Type of Curve (after Rehfuess, Bergheim and Hawks)

% HCl

• 219
• 182
• 166
• 109
• 073
• 036



Total acidity in blue. Free acidity in red

His saliva was tested against $\frac{N}{50}$ acid and showed an alkalinity which is expressed by the fact that 1 cc. saliva = 1.2 cc. $\frac{Na OH}{100}$. It looks as if the stomach had actually been stimulated to secrete more acid in consequence of the alkali swallowed.

A further point of interest is that his oedema was greater when the second curve was taken. So his gastric juice does not appear to have been affected to any extent by the Kidney condition.

These curves all conform to one type.

The question then arises, what other normal types of curves are known?

The American observers - Rehfuss, Bergeim and Hawk - as the result of Fractional Analysis after a Ewald Test Breakfast upon over a hundred healthy Medical students have recognised three types of Stomach as far as the Acid Curve is concerned.

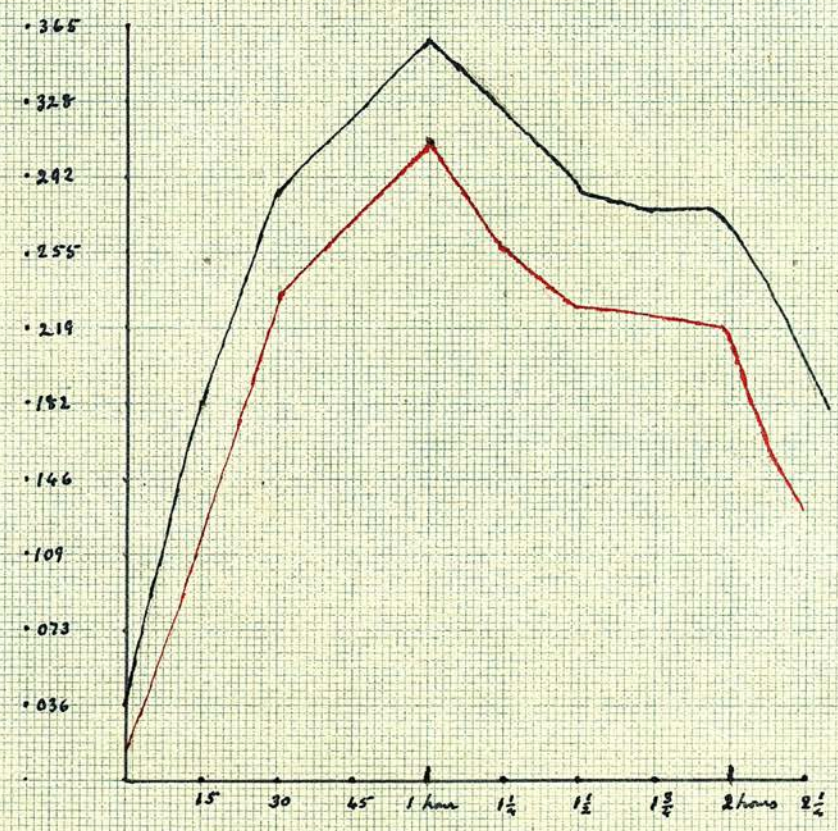
The technique they adopted was fortunately practically the same as that described above, which renders comparison of results simple.

The types they describe are as follows:-

I. The Isosecretory Type. This showed a steady rise, a High point of about .21, or 60 as estimated in cc $\frac{N}{10}$

Caustic Soda solution, which was usually sustained from half an hour to one hour and then a gradual decline/

0/0 HCl
Hypersecretory Type of Curve (after Rolfoss, Bergem and Stank)



Total acidity in blue. Free acidity in red

decline with total disappearance of food residues in 2 to 2½ hours. The Curve was usually steady and unbroken. The High point was usually rounded and not abrupt and was found in the neighbourhood of one hour.

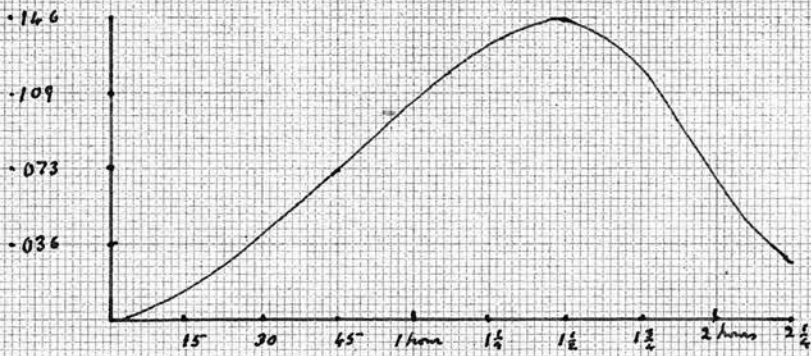
All the curves shown above belong to this class.

II. The Hypersecretory Type. Here a rapid response to stimuli was found, often a marked change in acidity of even the five minute samples (They collected samples at intervals of 5 minutes during the first quarter of an hour), a rapid increase in acidity, a high point from .25 to .36 or over, reached in one hour, either sustained or abrupt and a slow decline or none at all in the usual time. It was found that food left the stomach in the normal time - from 2 to 2½ hours - but even after the passage of all food material there was often encountered an outpouring of pure Gastric juice for half an hour, one hour or even several hours.

This, they called "a continued digestion secretion" because "it occurred in normal symptomless persons" in contradistinction to Hypersecretion.

III./

o/o HCl Hyposecretory Type of Curve (after Stephens, Bergheim and Hawks)



Total acidity alone shown in this chart.

III. The Hyposecretory Type is similar to the First (the Isosecretory) but there is usually a slower ascent, slower response to stimuli and a High point from .14 to .18 usually at $1\frac{1}{2}$ or $1\frac{3}{4}$ hours after the completion of the meal.

Digestion was usually completed in $2\frac{1}{2}$ hours. They found that this type was least frequently encountered.

Rehfuss and his colleagues found that a particular person always showed identically the same type of curve although on different occasions the exact figures might not be obtained. Furthermore the same type was shown whether the stimulus were an Ewald meal, water or meat.

In a later communication Rehfuss states that in 45% of his normal curves he found a total acidity exceeding .36.

So there are large numbers of normal persons who present the figures of "Hyperacidity" as estimated by the test meal and suffer no inconvenience.

Kemp notes the same fact.

X-RAY EXAMINATION IN HOSPITAL.

As we have at our disposal a means of actually observing the stomach in action during digestion most Gastric cases are given a Bismuth meal and then X-rayed.

The Routine procedure here is to give the meal early in the morning to a fasting stomach and then examine the abdomen under the X-rays six hours later to see how far the contents have travelled in that time. If the Caecum be filled and the Stomach empty we are content to say the motility is normal. But surely six hours is a long time and besides the stomach may during that time act in an unequal fashion. It may and as we shall see does not always in disease expel its contents with regularity. It may act violently for a time and then slow down. It may at the start make no response and do nothing for a prolonged period and then later waken up to great activity, and yet from the six hour test it is classed as being of good motor power.

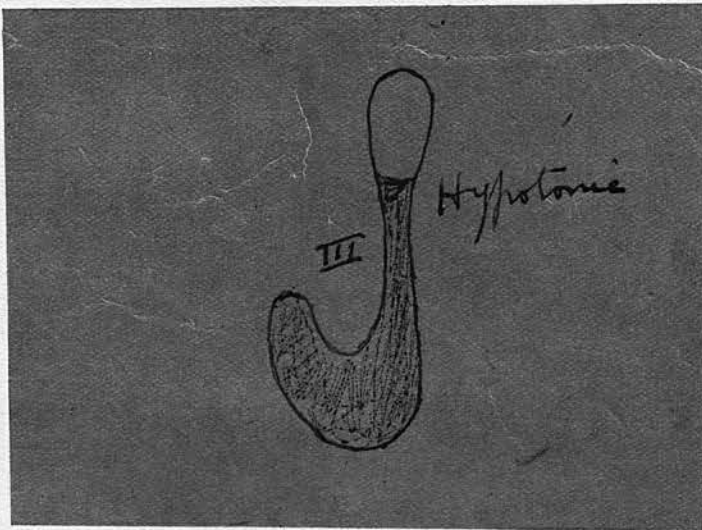
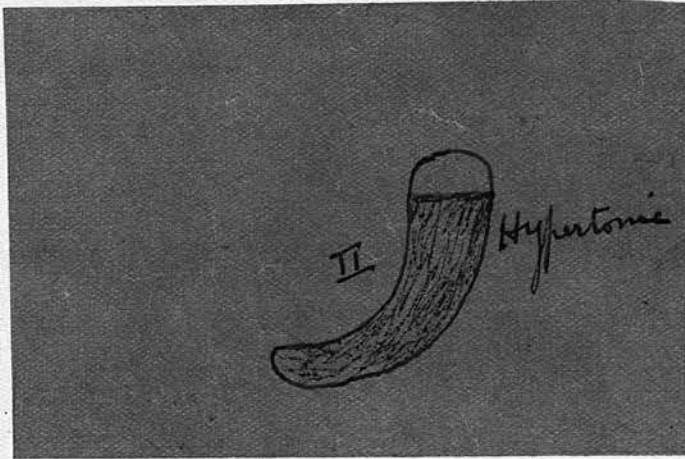
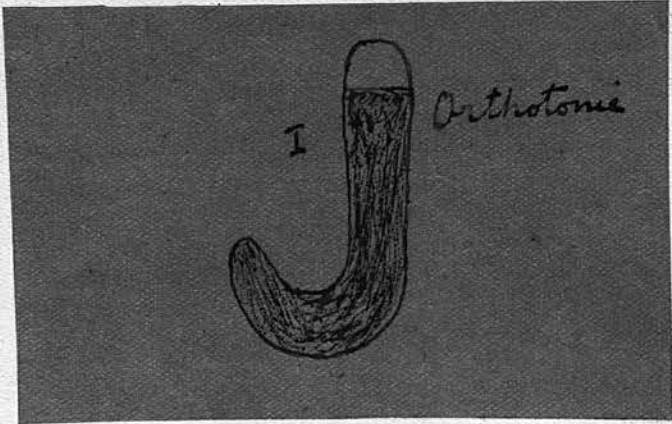
It is true that at the Screen the Roentgenologist gives a second meal and can therefore detect confirmation and muscular tone.

But how long does he watch the stomach? Only for
a/

a few seconds and if he sees no spasm or niche we have learned very little which can aid us. Nevertheless from observation of thousands of cases Roentgenologists have learned to recognise various common types of conformation and have also detected certain peculiarities of motility which accompany these.

Still as in the case of estimating acidity a closer inspection is now seen to be necessary and a more prolonged watch kept upon actual peristaltic movement while the patient is under the screen. The Roentgenologist too has recognised the fallacy of simply observing a single phase and building up a diagnosis upon such a slender foundation.

I am very much indebted to Dr Hope Fowler, at the Royal Infirmary, Edinburgh, for his instruction upon this point, and the opportunities he afforded for studying the cases that follow.



NORMAL TYPES OF STOMACH CLASSIFIED ACCORDING TO CON-
FORMATION SHOWN UNDER THE X-RAYS AFTER A BISMUTH MEAL.

Carmen and Miller recognise three types as occurring in persons presenting no Gastric symptoms.

These are.-

(1) The J shaped, Orthotonic or Fish Hook type. This is the commonest type. Its form is adequately expressed by its name. Its position is vertical or slightly oblique. Its form is tubular and the air sac above is rounded or dome-shaped.

(2) The Hypertonic or Steer Horn type. This also is described by its name. It tends to lie obliquely and to taper towards the Pylorus. Its position is higher in the abdominal cavity and in consequence more of it is covered by the ribs. The air sac is flattened. Carmen and Miller say that it is commoner in the broad-chested type of individual.

(3) The Hypotonic Type. In this form we have the suggestion of loss of tone in the walls. There is an appearance of drag upon the upper portion. The contents have sunk more to the lower pole which is well below the Pyloric end, and there is a broadening/

broadening of the most dependent part, with a narrowing above.

The Air sac is more elongated and bladderlike.

Carmen and Miller mention the tendency of Hyper-tonus to be associated with well marked peristalsis and state that the increase of peristaltic vigour by "hyperacidity" has often been noted.

So we would expect high acidity and vigorous peristalsis in cases of Steer-horn stomach or Type No.2. Hurst has drawn attention to the frequent association of this type with Duodenal Ulcer.

With regard to Hypotonus there is agreement of the above named Radiologists and Dr Hurst that this is a common accompaniment of Gastric Ulcer.

It would appear from these statements that a certain number of normal persons have stomachs the conformation of which is associated with Gastric or Intestinal disease under certain conditions.

THE RELATION OF THE VARIOUS TYPES OF ACIDITY CURVES
TO TYPES OF STOMACH CONFORMATION AND PERISTALSIS.

In the healthy individual can it be definitely asserted that a certain conformation of Stomach is associated with a special type of Curve?

From what has been quoted one would expect that the Steer Horn Stomach would be associated with the Hypersecretory type of Curve.

Two of the following cases seem to bear that inference.

Later investigations by Dr Hurst communicated to me by Dr Hope Fowler, tend to show that there is only one normal type of Stomach conformation, viz. the J shaped or Orthotonic.

Further, that the number of peristaltic movements per minute determines into which of the three categories of acidity the stomach falls, viz. Isosecretory, Hypersecretory or Hyposecretory.

Dr Hurst maintains that the Steer Horn type is an abnormality, the outcome of prolonged and abnormal spasm. Certainly we see the J shaped stomach when under/

under the influence of spasm, taking on an appearance which closely resembles the Steer-Horn, both in shape and position.

It is a routine practice in hospital for X-Ray photographic plates to be sent up to the Wards with a report from the Radiologist. One plate only represents the Stomach in cases where motility is declared to be good, as no residue is found after six hours. This plate represents the Stomach after receipt of a Bismuth meal at the Screen. It illustrates the initial phase of digestion.

This is not the phase illustrated by the Test Meal reading. Therefore it is only one more piece of isolated information. It sheds just as much light as the other, unless an organic deformity is depicted on it.

Can it be maintained that this is a logical procedure? But unless the Physician himself watches the screen, he has to depend upon the radiologist's verbal report with one reproduction of a single phase of a changing cycle. Dr Hope Fowler informs me that cinematographic records have been taken of Gastric and Intestinal peristalsis. This appears to be the only pictorial method of illustrating the physical changes/

changes represented by the Acidity Curve. It is however a very costly method.

Only prolonged observation of the Stomach under the fluorescent Screen will throw light upon much that is at present obscure.

The following cases were studied in the Wards of the Edinburgh Royal Infirmary under the charge of Professor Meakins. They were not selected in any way apart from the fact that each presented symptoms of Gastric disorder.

CASE I. Miss C. R. age 29, envelope gummer.

Complaint. Sickness and pain in the stomach.

History. A year ago sickness commenced after the midday meal, coming on about one hour later and being confined to the afternoon. It lasted for several hours.

About 3 weeks before admission vomiting began. It did not occur every day. It was always preceded by pain which it relieved. The pain which was felt in the Epigastrium always followed the midday meal. It sometimes recurred in the evening but passed off.

The pain and sickness steadily increased and led to her having to give up work.

Two days before admission she had a severe attack of pain and vomiting. The next night she vomited reddish black material. She has been losing flesh and getting paler.

General/

General Appearance.

Physique fairly good. There is a general appearance of flabbiness. Mucous membranes are somewhat pallid. Lying on her back with one pillow under the head she is fairly comfortable.

Alimentary System. Teeth in fairly good condition.

Tongue moist and coated with white fur.

Abdomen. Anterior wall moves slightly with respiration. There is tenderness on pressure at a point in the middle line about half way between the Umbilicus and Xiphisternum. Also some slight tenderness just above the pubes. No skin hyperaesthesia.

Percussion showed the lower border of the stomach about the level of the umbilicus. The note did not extend to Right across the mid-line. The note was somewhat flat above the pubes but elsewhere resonant.

The other systems presented nothing of note.

Progress. The day after admission the patient had severe pain followed by vomiting when she brought^{up} copious blackish material which gave a blood reaction and had a total acidity of .11 with no free acid.

Blood was also found in the stools.

Complete rest in bed, gentle evacuation of the bowels and normal saline per rectum gave great relief.

Slowly small doses of milk and lime water were increased until on the 4th day she was able to take two ounces every hour.

All pain ceased and blood disappeared from the stools.

When some time after she was taking Benger's food and milk pudding without any discomfort, a test meal was given in the afternoon. It was not considered desirable to impose the usual night's fast.

She was kept on her back however, and only turned her head to get rid of any saliva that might accumulate in her mouth when the tube was passed.

The tube was passed with the greatest gentleness and no discomfort was experienced by her then or during the performance of the test. At the end of the test, when the tube was withdrawn, she said she had no pain.

The Curves shows.-

- (1) a very slow and weak response.
- (2) a High point of .11 retarded, occurring at $1\frac{1}{2}$ hours, which is sustained for $\frac{1}{4}$ hour.
- (3) a gradual decline.
- (4)/

Case I Curve before Sippy diet treatment



Total acidity in blue. Free acidity in red.

(4) An increase of combined acid in the fall.

The test was stopped at $2\frac{1}{4}$ hours as it was becoming difficult to aspirate material and it was felt to be dangerous to employ much force in the suction.

There was still a considerable quantity of food in the last sample however.

No coffee grounds were observed in the aspirated material.

The general characteristics of this curve are those of atony.

There is the slow rise, the low acme and the slow evacuation evidenced both by the increase of combined acidity and the fact that a considerable quantity of food was present in the last sample withdrawn.

It may appear surprising that a case of Gastric ulcer should give such a low curve.

Evidence is accumulating however that this is not such a rare circumstance.

Moynihan states he found low acidity in about a quarter of his cases and normal acidity in about 41%.

Emerson quotes Ewald to the effect that "hyperacidity" is present in but about half the cases.

Rehfuss found "hyperacidity" in 42% of his ulcer cases.

However this patient was on a milk diet at the time/

time and Paterson has shown that a milk diet lowers acidity. Moreover it has to be recalled that the patient had suffered from several considerable haematemeses and was in an anaemic condition in consequence.

Kemp and others have noted the association of lowered acidity with secondary anaemias.

Had the usual clinical test been relied on here, the acidity would have been reckoned at a considerably lower figure than it actually reached.

Owing to her condition no X-Ray examination could be made at this stage.

The patient was placed upon the Modified Sippy treatment described by Dr A. F. Hurst in a recent lecture.

The essence of this treatment is the constant keeping of the Stomach contents alkaline, the restriction of HCl output by Belladonna or Olive Oil given alternately before meals, and where necessary the aspirating of hypersecreted acid juice at night.

The diet itself is Milk and Cream $\frac{3}{4}$ V to which is added Sodium citrate gr.X and Magnesia oxide gr.X in emulsion. Between all feeds which are given hourly from 8 a.m. to 8 p.m., Calcium Carbonate gr.X and/

g/100cc

.328

.292

.255

.219

.182

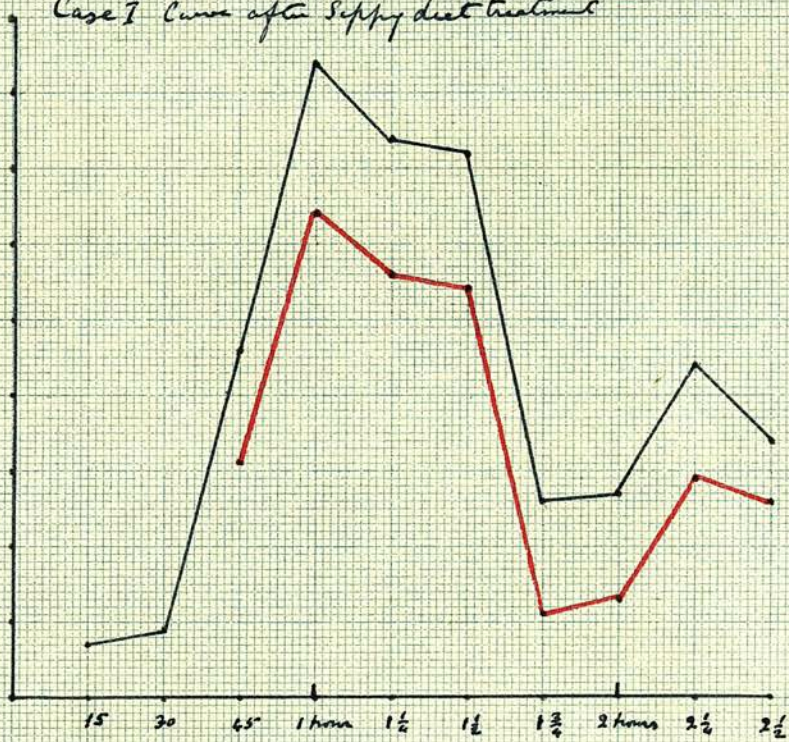
.146

.109

.073

.036

Case I Curve after Sippy diet treatment



Total acidity in blue. Free acidity in red

and Bismuth Carbonate 3 μ are given suspended in a little water.

This careful diet and medication which make a severe demand upon the nursing staff, is continued till the patient is free of all pain and other symptoms for three weeks. Then the diet is rapidly raised to an ordinary scale.

This patient rapidly improved and put on some weight.

More than a month after she had been put on this treatment, when she was going about freely and declaring herself perfectly well, a second test meal was administered.

This time the test meal was given in the morning after a night's fast.

The Curve now presented shows a marked difference. A slow response in the first three quarters of an hour is succeeded by a sharp ascent to a High point of .3 at the end of the first hour. The apex is abrupt and the Decline follows at once, slowly to begin with, then becoming rapid with disappearance of food in 2 hours.

A small rise from a slight late secretion of Gastric juice follows.

This curve betokens a return to heightened secretory vigour and improved Stomach motility.

It/



It does not conform to any normal type shown. There is still a want of responsiveness to stimuli at the beginning and in comparison with this sluggishness the steep ascent which follows seems out of proportion.

The X-Ray examination showed normal motility within the first six hours.

The 2nd Bismuth meal (given at the screen) displayed at first a normal J shaped stomach which as it was watched lost its firm contour and gave the outline of the Hypotonic-type with sinking of the meal to the lower pole.

This is the type now generally associated with Gastric Ulcer.

CASE II. Mrs I. McK. age 39, occupation - House-
:hold duties.

Complaint. Pain in the Stomach.

History of abdominal pain dates from the age of 21 when it used to come on suddenly and last for about 20 minutes to one hour and then gradually pass off.

This pain which is epigastric in situation has troubled her at long intervals since then, but recently it has been becoming more severe and more frequent.

The present attack commenced about a fortnight before admission.

The pain has recurred during the past fortnight every day and night, with perhaps only an hour's interval elapsing between attacks. It comes on fairly suddenly, reaches its height within a quarter of an hour, lasts at its worst for about 10 to 15 minutes and then dies away. Starting in the middle line it spreads round to both sides. The patient then has the sensation of a tight band round her waist. Where the tightness is felt she experiences the feeling of being jagged with needles. The area of the band is about 3 inches broad.

The most severe pain is in the epigastrium however, and here it feels as if there were a knife in her.

There/

There is no associated sickness and she does not vomit but if she makes herself do so she gets relief.

She does not think the pain is connected with the taking of food. Coming on during the night it wakens her in great agony. Occasionally she has pains which shoot downwards in the thighs, but these are not severe. There is no difficulty in walking in the dark. No skin paraesthesia.

The epigastric pain, when severe, seems to spread to the throat and gums, giving the sensation of toothache.

As a rule she has an excellent appetite and is frequently hungry soon after a small meal such as tea. When pain is present, however, her appetite goes. She always takes laxative medicine to keep the bowels regular.

Her surroundings are good and her work is not heavy.

Previous Illness. Indigestion since she was 17 years of age. But she says the pains from this are entirely different from those described above.

Family History. Patient had a miscarriage 10 years ago and has no children.

Nothing else to note.

General/

General Appearance. She is a somewhat emaciated woman with an anxious expression.

The skin is somewhat bronzed, especially over the right side of the forehead. The hands are thin and the interossei wasted.

Nervous System. No Rombergism. No clonus. Some increase in the knee and wrist jerks. Otherwise normal.

Respiratory System. Chest barrel-shaped with prominent sternum and poor expansion. A number of brown spots on the back. Nothing else to note.

Circulatory System - normal.

Urine - normal.

Alimentary System - Teeth artificial. Tongue moist and coated with white fur and somewhat tremulous.

Abdomen flat, moves partly with respiration.

There is epigastric tenderness and the muscles here are held rather rigid. Palpation is difficult on this account.

A large area of skin Hyperaesthesia exists over the/

the Epigastrium, extending from the Xiphisternum to an inch above the umbilicus, circular in shape and of the size of an ordinary saucer.

The stomach note reaches to about the level of the umbilicus. The rest of the abdomen is resonant. The Liver and Spleen are normal.

Pathological Report. Wassermann Blood reaction - doubtful negative. (a trace of fixation in the 4 dose tube).

Progress. The patient received Potas. Bromid. gr.XX and Chloral Hydrate gr.X at night to enable her to sleep.

Sod. Bicarb. gr.XX was given to relieve stomach pain. S. & W. Enemata were employed to open the bowels. The stools were dark in colour but blood was not noted.

On examining the spine some tenderness was elicited over the 3rd, 4th and 9th and 10th Dorsal spines.

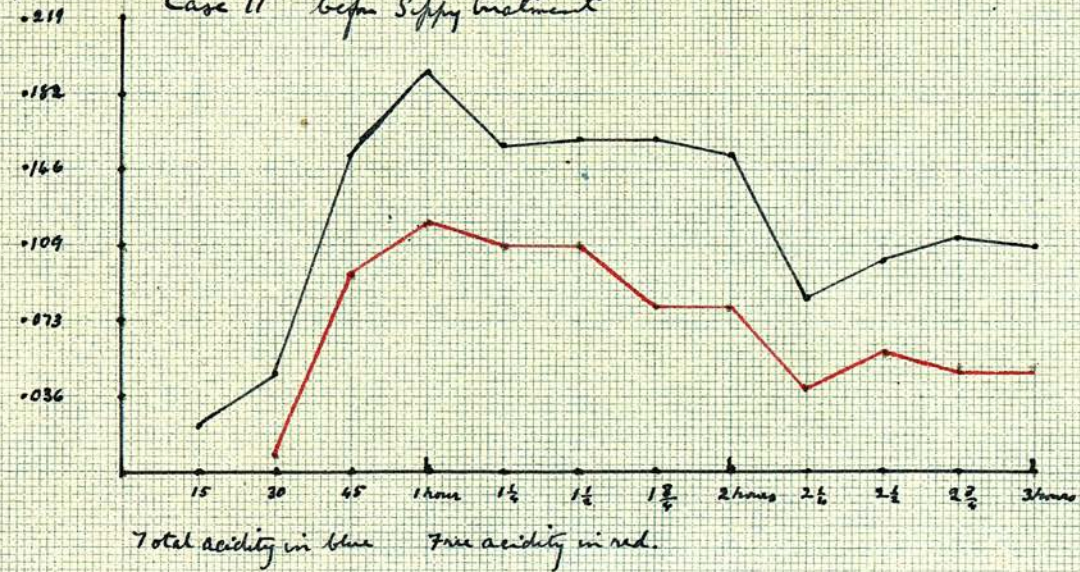
A Test Meal was given after the patient had been in hospital five days.

The Curve obtained is interesting not only on account of its curious form but also because the test meal either precipitated or happened to be followed by one of the attacks of pain.

The Ascent shows a moderate response at first which becomes more marked and reaches the High point of/

% HCl

Case II before Sippy treatment



of .19 in one hour.

The summit is abrupt but the general height is sustained for 1 hour.

The Decline lasts only for a quarter of an hour and is followed by a late rise which is slightly descending again at 3 hours when the test was stopped, the greater part of the Meal having gone.

During the steep portion of the Ascent and at the acme, severe pain was present. This might have been due to severe spasm of the Pylorus.

The flatness of the Curve and the increase in the combined acidity are very noticeable and point to some stasis of food in the stomach which does not excite the outpouring of more acid but allows of greater combination and perhaps the consequent relief of pain.

At all events as the pain dies off the free acid is seen to fall markedly.

The secondary rise which is slight, is probably due to a slight late secretion.

The patient herself was under the impression that as samples were drawn off the pain diminished.

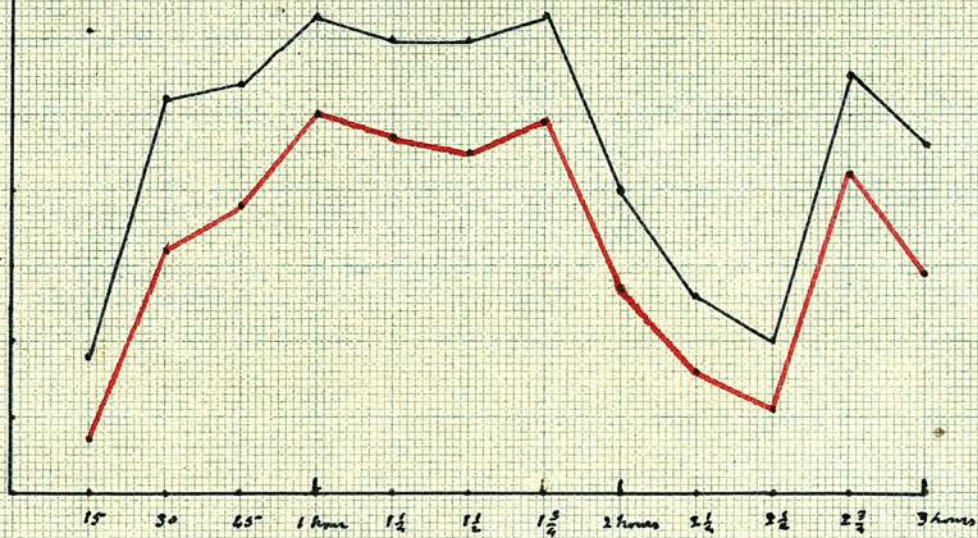
Owing to the X-Ray department being under repair no Bismuth Meal was given.

Shortly after this the patient was placed upon
the/

% HCl
.255

Case II Curve after Sippy treatment

.214
.182
.146
.109
.073
.036



Total acidity in blue. Free acidity in red.

the Sippy Diet. From the very first dose of Olive oil all pain and hyperaesthesia vanished.

She slept well and lost her anxious look.

On the first night after the treatment was commenced aspiration of the stomach contents was performed and 65 cc. of fluid withdrawn. This gave a total acidity of .16 with free acid .07.

Next night 70 cc. were withdrawn and the patient received Atropine injections at night to check this slight hypersecretion.

So rapidly did she improve that she was getting 2 oz. Minced Beef daily in 8 days from the start.

A fortnight later the feeds were reduced to six times daily and the patient allowed up.

In less than a month she was on convalescent diet.

She had gained nearly two stone in weight and looked quite another woman a month from the commencement of treatment when a second test meal was given.

The second Curve shows a prompt response with the greater part of the Ascent in the first half hour.

A High point of .22 is reached in one hour.

The height is sustained for $\frac{3}{4}$ hour.

The Decline is steady and rapid until the stomach is empty in $2\frac{1}{2}$ hours.

A secondary rise apparently due to a late secretion of Gastric juice follows.

At/

At this time the patient said she felt her stomach empty and as if it were full of wind.

Throughout no pain was experienced.

The two acidities run very parallel courses throughout and mucus was not present in any marked amount.

The stomach has apparently improved in muscular tone and secretory vigour, and persistent spasm appears to be a less marked feature. The combined acidity, as evidenced by the interval between the Curves, is here no longer so great after the High point is reached. The Chyme appears to escape more easily than before. The acidity is higher than before Treatment and the late hypersecretion or continued secretion is greater after the passage of food, although the patient is no longer the victim of pain.

The Curve, except for its height, resembles the Hypersecretory type of Rehfuss..

Much has been written upon "Hyperacidity" as a distinct pathological entity, and this patient displayed the classical symptoms. Her pain was relieved by food so that she thought that it had no relation to it. It was present at fasting periods such as the night. She had an excellent appetite but was losing flesh as the pain became severe and/

and she was probably afraid to eat. She had a certain degree of hypersecretion but not so marked as another case to be shown, and the alkaline treatment she received plus the antidotes to secretion, gave complete relief.

The striking point, as shown by her curves, is that with the relief she attained a higher acidity than before. In spite of this higher acidity she has less stasis although more is to be expected theoretically.

Writers on this subject have tried to explain the cause of the pain.

Langdon Brown suggests that "excessive" acidity provokes excessive contraction of the Pylorus and thus increases pain.' 'Spasm by keeping chyme in contact with the Pyloric glands stimulates secretion of acid.' A vicious circle is thus established.

Edkins and Maydell appear to have proved the existence of a Pyloric Hormone or Gastric secretin which stimulates the continued flow of free HCl from the Cardiac glands after the Psychological flow begins to wear off.

Cannon has shown that acidity of the Chyme causes relaxation of the Pyloric sphincter and Serdjukon showed that the Pylorus remains firmly closed so long as/
as/

as the Duodenal contents are acid.

These facts appear to give colour to Langdon Brown's hypothesis. Our difficulty is that we do not know what is "excessive" acidity. Apparently an increased acidity did not prove "excessive" in this case. Nor are the higher figures excessive as compared with many of Rehfuss's normal curves.

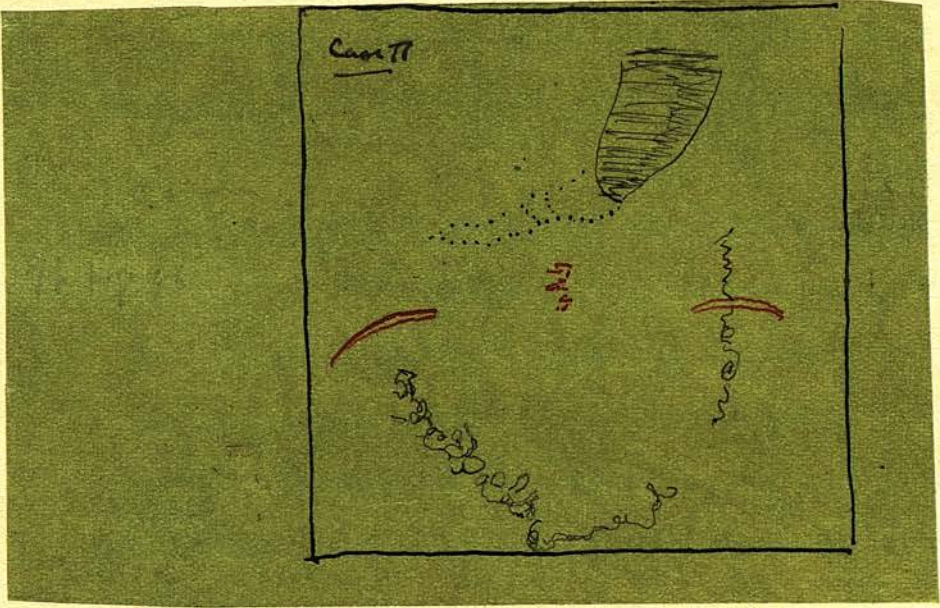
Symptoms do not depend, it seems, upon the High acid content of the Chyme.

In one case Friedman relieved the pain of ulcer by administering Hydrochloric acid.

Osler and McCrae in their "System of Medicine" state that "while a patient is under treatment for hyperacidity and the acidity can be reduced, the reduction is not permanent; and while the patient may be free of all symptoms of hyperacidity (after treatment) an excess of acid secretion still exists. This points to the fact that our treatment is only effectual in reducing the Gastric hyperaesthesia and not the acidity."

The patient was X-Rayed after the second curve was taken. Six hours after the first Bismuth meal, all the Bismuth was in the Caecum showing good motility.

A second meal given at the screen showed a Hypertonic/



Hypertonic stomach of the Steer-Horn type, which commenced to empty at once into the Duodenum.

Peristalsis also commenced in the Caecum and Transverse Colon.

While watching, a spasm of the Pyloric end of the Stomach commenced, which endured, was photographed and still found persisting when the patient was screened again.

She however was unconscious of any pain.

This patient then still shows marked spasm and a higher acidity. Why is she no longer hyperaesthetic?

It would seem that the general constitutional condition has something to do with it.

Mackenzie and other observers have noted that a stimulus incapable of causing pain or even a conscious sensation in health is quite able to do so in debilitated states.

Considering how often High acid figures are encountered in normal persons and how often symptoms of "Hyperacidity" are found in persons whose acidity is within 'normal' limits, should this term be retained in the nomenclature?

Does it not indicate a hasty and unwarranted conclusion from superficial observations?

CASE III. Mrs M. N. aged 35 years, Occupation -
Household duties.

Complaint. Nausea and Discomfort in the
Right side of Abdomen.

History. dates back two years when
fainting turns commenced at the menstrual periods
which compelled patient to take temporarily to bed.
Seventeen months ago Influenza aggravated the condition.

Shortness of breath, even without exertion, and
throbbing of her Heart caused discomfort. At night
oedema of the ankles was present but this disappeared
by the morning.

The appetite is good, but a feeling of exhaustion
and emptiness in the stomach comes on about 2 hours
before meals. Flatulence is troublesome. Vague pains
used to shoot from the left hypochondrium to the
shoulder blade, but these disappeared 3 weeks before
admission.

A year ago after a sharp shooting pain in the
Right thigh - only one spasm - she felt a lump in the
right side (which turned out to be a movable Kidney).
Lately she has been losing weight.

Previous Illness. Those of childhood - Pleurisy 9
years ago after the birth of a child.

Family History. Good. No miscarriages. Has had six children.

General Appearance. Thin and pale. Anaemic. Slight oedema of ankles.

Circulatory System. Marked pulsation of abdominal aorta. Venous pulsation in neck and episternal notch.

Soft systolic bruits in Mitral and Pulmonary areas.

Pulse 80, regular. Poor volume. Vessel wall normal.

Respiratory and Nervous Systems and urine present nothing of note.

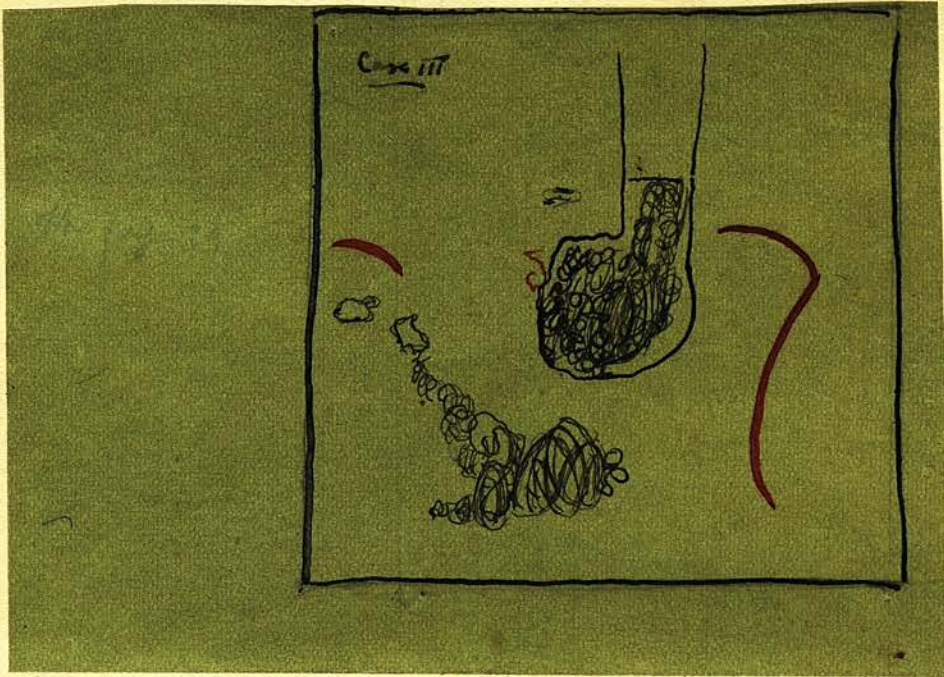
Alimentary System.

Abdomen - slight movement on respiration. Prominent umbilicus. Walls thin and intestinal movements can be seen.

No skin hyperaesthesia but tenderness over an area 2" x 1½" just above the umbilicus. No definite rigidity.

Liver and Spleen normal. The lower end of the Right kidney is palpable.

Stomach. - Gurgling on palpation. The note extends "below/



% HCl

.166

Case III Curve on Admission

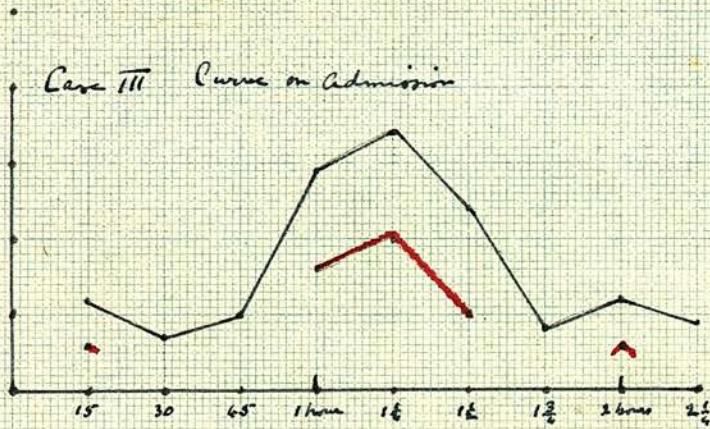
.109

.073

.036

15 30 45 1 hour 1 1/2 2 1/2 3 hours 2 1/2

Total acidity in blue. Free acidity in red.



1" below umbilicus and $1\frac{1}{2}$ " to the right of it. On dilatation with air the outline stands out a little below the umbilicus.

X-Ray Examination - Motility appeared to be fair.

A 2nd Bismuth meal revealed a lengthened and Atonic stomach with expanded lower pole wall below the umbilicus and ^{the} Iliac crests.

Progress. The patient was kept in bed and placed on a convalescent diet. The bowels were opened as required by aperients and enemata.

Some time after admission a test meal was given.

The Curve shows an immediate normal response which fails, however, during the next half hour and then a steady ascent to a rounded High point of .12 at $1\frac{1}{4}$ hours. There is a steady decline during the next half hour followed by a slight rise and fall as the stomach emptied itself.

The Curve is like a weak Isosecretory. It is however broken at the start and finish. It suggests loss of tone and some irritability. The Free and Total acidities maintain a close parallelism throughout.

The patient remained in bed and received Iron tonics and Malt Extract with regular aperient treatment until she was fitted with an abdominal belt.

After/

% HCl

•255

Case III Curve after treatment

•219

•182

•146

•109

•073

•036

15

30

45

1 hour

1 1/2

1 1/2

1 3/4

2 hours

2 1/4

2 1/2

Total acidity in blue. Free acidity in red.



After this she was allowed up and greatly improved. Before she left hospital she had gained weight and had a better colour.

After she had been out for some time, wearing her belt, living her ordinary life and receiving no medical treatment except Easton's Syrup, she returned to report herself and a second test meal was given.

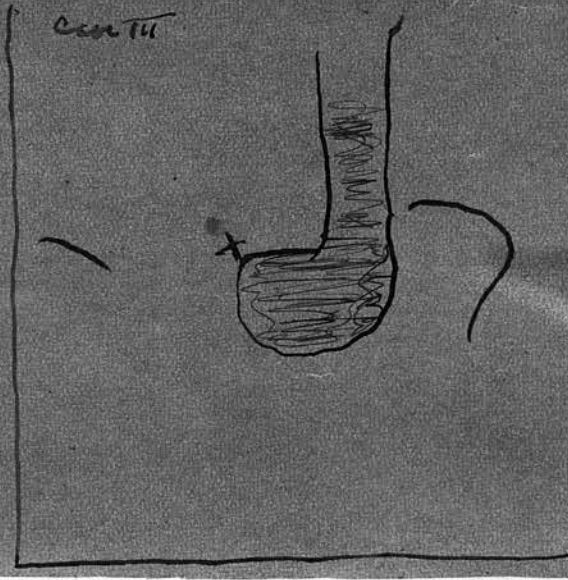
The Curve now obtained shows:-

- (1) a weak response at first, mucus being present in the samples for the first $\frac{3}{4}$ hour.
- (2) A sharp ascent to a High point of .22 reached in one hour.
- (3) A gentle and steady decline unbroken save for a slight rise at 2 hours when the stomach was almost empty of food.

During the last half hour of the test, which was discontinued just under $2\frac{1}{2}$ hours, the specimens collected were viscid and tinged green. Gmelin's test applied in the ordinary way failed to give the Bile reaction in this (as in many other cases) but according to Hutchison and Rainy the test may fail even with 5% Bile.

A comparison of the two curves shows an initial sluggishness in both, but there appears better secretory response in the second. The process of digestion/

centu



digestion, though slow in beginning, once it has done so appears to proceed in a perfectly normal manner without stasis.

The results of treatment seem to be excellent considering the chronicity of the condition (Visceroptosis) and the shortness of time which has elapsed since it was commenced.

An X-Ray Examination made the following day (the patient of course wearing her abdominal belt as she always did when out of bed) showed the lower pole of the stomach higher than before, and a great improvement in tone as judged by the outline. The organ was now more tubular throughout and bore a closer resemblance to the normal J shape.

The patient stated at this time that she no longer had any gastric discomfort.

CASE IV. M. R. aged 44 years, occupation moulder.

Complaint. "Pains across the stomach" and Vomiting.

The History begins 8 years ago with pain in the epigastrium, coming on about 2 hours after food, and vomiting. Food relieved the pain. Vomiting sometimes occurred as often as 2 or 3 times a day.

Large quantities of fluid were brought up. "Coffee grounds" were never seen and the fluid was described as clear, with a very sour taste.

For days he would be quite free from vomiting.

Flatulence was very troublesome both in stomach and bowels.

Heartburn and waterbrash were also present.

At night he was frequently wakened by pain which he used to control by taking Baking Soda.

Army diet aggravated his condition during the War and apparently an exploratory operation was undertaken owing to the severity of his symptoms. Though he continued to suffer for some months after, later on he had freedom from his complaint for a year. Since then he has steadily become worse. Appetite is good. As he has defective teeth he has probably bolted his food. He is constipated and thinks he has /

has lost weight of late.

He was a heavy smoker and also chewed tobacco.
Is a moderate drinker. Never had venereal disease.

Previous Illness. Typhoid fever 20 years ago.

Family History - Good.

General Appearance - a well built man with a healthy complexion, spare but not emaciated and not anaemic.

Alimentary System. Teeth nearly all false. Tongue clean and moist.

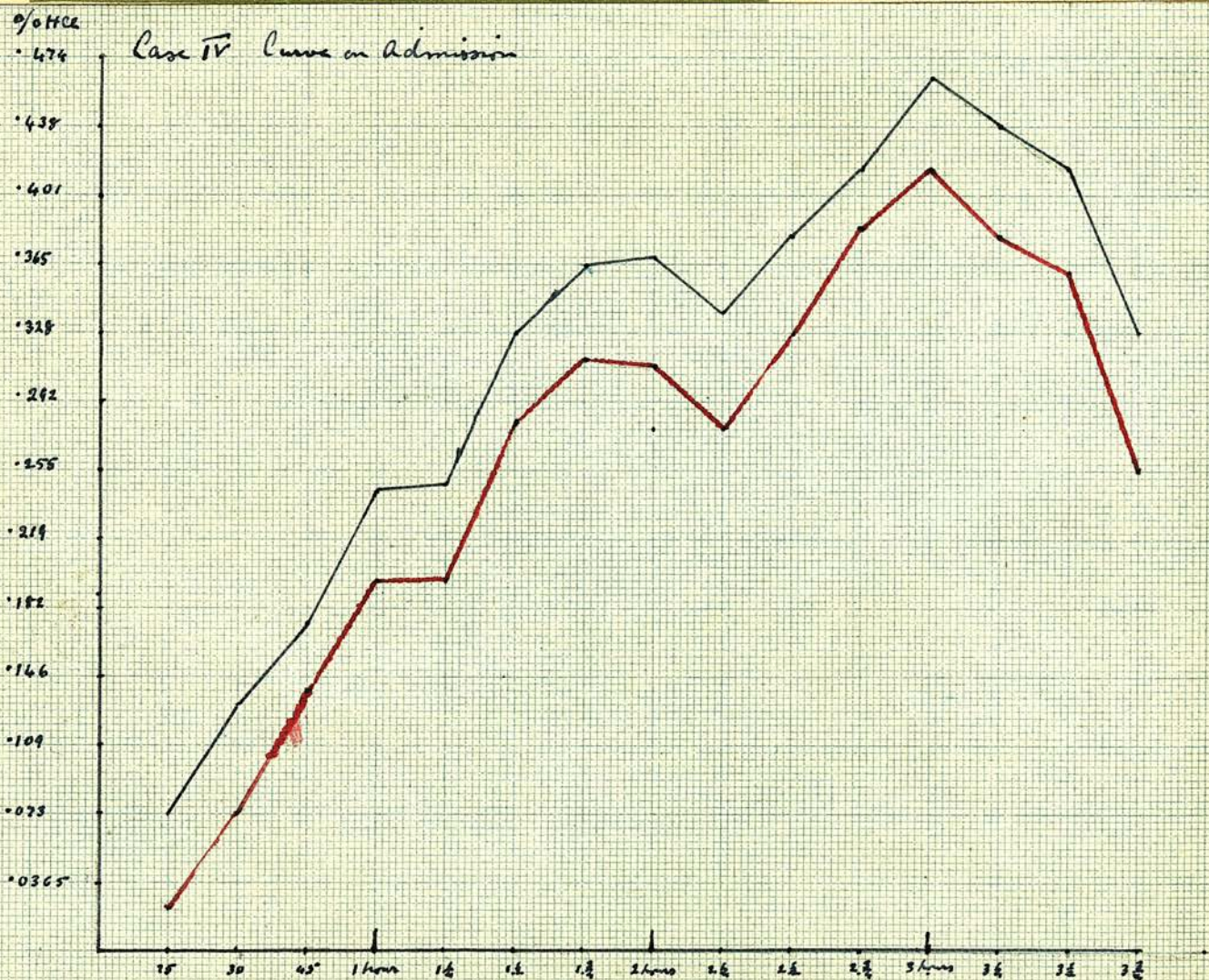
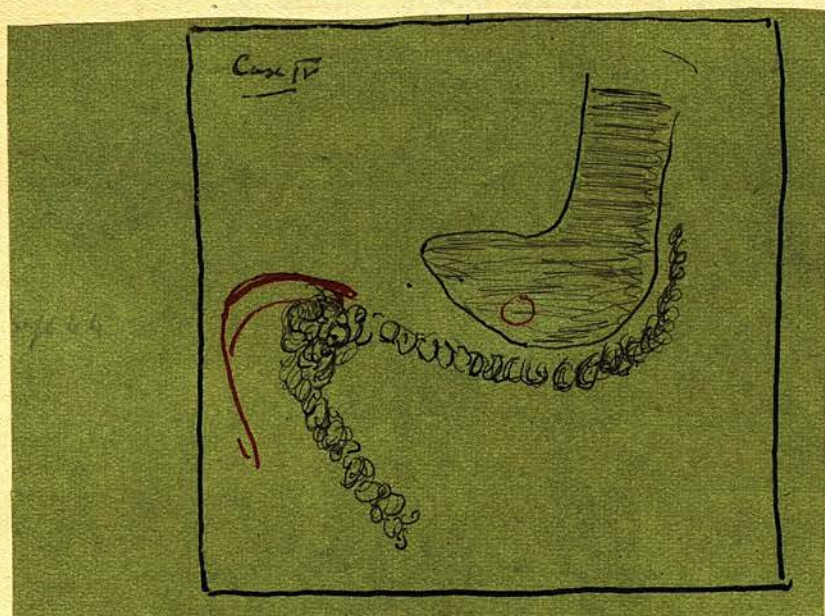
Abdomen moves all over on respiration. A healthy scar to right of umbilicus extending upwards for 4" (operation scar).

Some resistance but no tenderness in the epigastrium.
Skin reflex active, at upper part of abdomen especially.

The Stomach note reaches level of umbilicus and extends to the right.

No skin hyperaesthesia on abdomen but there is a small oval patch of hyperaesthesia at the inner border of the left scapula with its centre opposite the 7th Dorsal Spine. No tenderness over the spines.

Apart from some exaggeration of the arm and leg reflexes and some lateral nystagmus, there is nothing to note in other systems.



Progress. He vomited once or twice after admission. There was pain followed by nausea, both of which were relieved by vomiting.

X-Ray Report. The meal reached and filled the Caecum to the flexure like a typical Hyperchlorhydric or duodenal ulcer.

2nd meal showed no evidence of a stoma, the pylorus functioning normally.

Peristalsis slight and Duodenal cap flattened or imperfect.

Meal well supported throughout examination. Considerable spasticity of the Colon. This stomach approaches the Steer-Horn type.

On Light Diet and alkalies the Patient improved and went out of hospital. A month later he reported again, apparently as bad as ever.

A test meal was therefore given and the following Curve obtained.

There is an immediate steady and pronounced rise during the 1st hour, a more gradual rise during the second hour, and after a slight fall a further ascent to a High point of .46 at three hours.

The Decline at first gentle becomes more rapid to $3\frac{3}{4}$ hours when the test was discontinued.

All/

All through fluid was withdrawn with ease.

The patient felt no discomfort. This is noteworthy as both acidities reach a high figure and run a close and parallel course. Indeed he said he had some pain before he swallowed the test meal but this relieved pain.

Another point of interest is that at one hour the acidity is not very marked. It only slightly exceeds the limits of what is generally considered normal by many, but not all writers. The total acidity was then $.24\%$ HCl and some test-books give $.25$ as an upper limit.

The actual height reached at 3 hours is nearly double this figure.

From the course of the curve and the watery samples collected, the conclusion is reached that this is a case of Hypersecretion plus pylorospasm.

At the end of each hour there seems to be an attempt at a decline which only succeeds at the third hour.

The patient was readmitted to Hospital and this time placed upon the modified Sippy Diet.

At 11 p.m. every night the stomach was evacuated and considerable quantities of fluid withdrawn, e.g. 380 cc, 580 cc, 250 cc. and later small amounts such as 120 cc.

Examination/

0/0402

.255

.219

.182

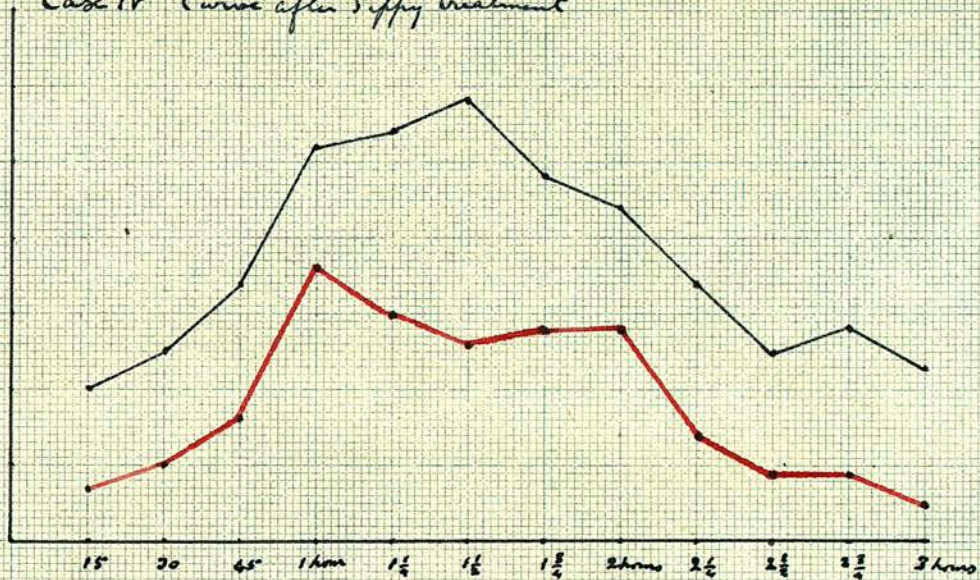
.166

.109

.073

.036

Case IV Curve after Sippy treatment



Total acidity in blue. Free acidity in red.

Examination of this fluid showed total acidity .2, Free .021, Total acidity .18% all combined and so on.

Atropine injections^{were} given but had later to be discontinued owing to eye trouble. However the patient made uninterrupted progress, remaining free from all pain and gastric distress and sleeping well at night. The dietary was steadily though gradually increased, 1 egg being added after 9 days, a week later 1 oz. chopped beef per day; later the milk feeds were increased in quantity and reduced in frequency, and 2 oz. chopped beef given per day, with a little bread and the medicines given thrice daily.

Then he was allowed up and continued to improve.

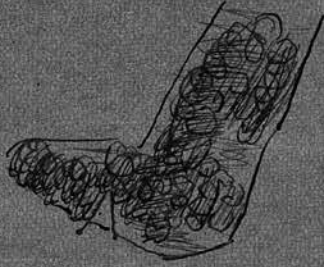
After a month he said he felt perfectly well so far as his digestion was concerned, and a second test meal was given.

The Second Curve shows:-

- (1) good initial response with a steady ascent during the first hour, then a slower rise to a High point of .21 in $1\frac{1}{2}$ hours.
- (2) A steady decline during the next hour followed by a slight rise and fall.

The food had practically disappeared in $2\frac{1}{4}$ hours from the samples, to be succeeded by bile as suspected from the green tinge which showed itself.

Case IV



The Free Acid reached its height in one hour.

There is a noticeable increase in the combined acidity after the first hour, which contrasts markedly with the interval between the Total and Free acids in the first curve.

A curious feature was the occurrence of Hiccough at the end of the 1st hour and again about the second hour. This was followed by an increase in the combined acidity. It is difficult to say whether there was any connection between these occurrences.

There was no discomfort felt by the patient. Samples were obtained easily as before.

The curve shows a great improvement in the lessened irritability of the stomach, as evidenced by the lowered and accelerated High point and the more unbroken outline.

The question arises: had this patient an organic lesion which was cured or alleviated by the Alkaline dietary and rest in bed?

An X-Ray examination showed "a normal J shaped stomach with improvement in form and tone".

No hypermotility was observed nor were any residues seen before the 2nd Bismuth Meal.

CASE V. Mrs B. R. aged 61 years, occupation -
household duties.

Complaint. "Indigestion" for the past year.

History. A year ago the patient began to be troubled with "indigestion pains" in the stomach, flatulence and sickness.

The pain used to last 2 or 3 hours, was not very severe and was vague in its localisation. She said Beef Steak was the article of diet which chiefly brought it on. It would occur about 2 or 3 hours after a meal. As it died off "regurgitation" often took place, Occasionally heartburn would waken her at night.

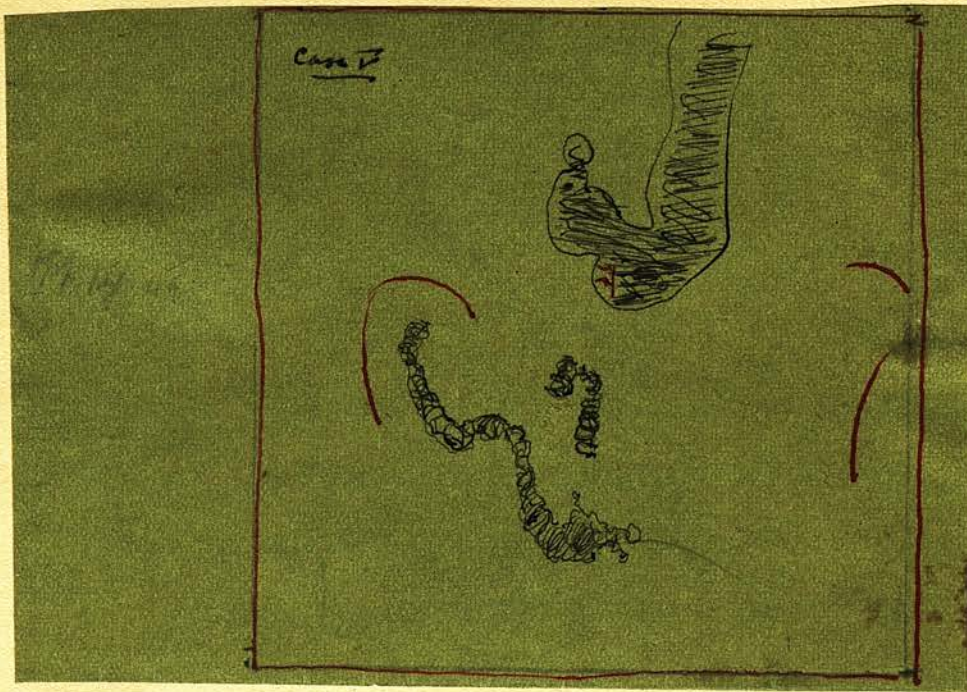
The appetite is good. No diarrhoea . No history of jaundice.

Slightly short of breath on exertion.

Previous Illness. Lumbago at times for many years.
Nothing else of importance.

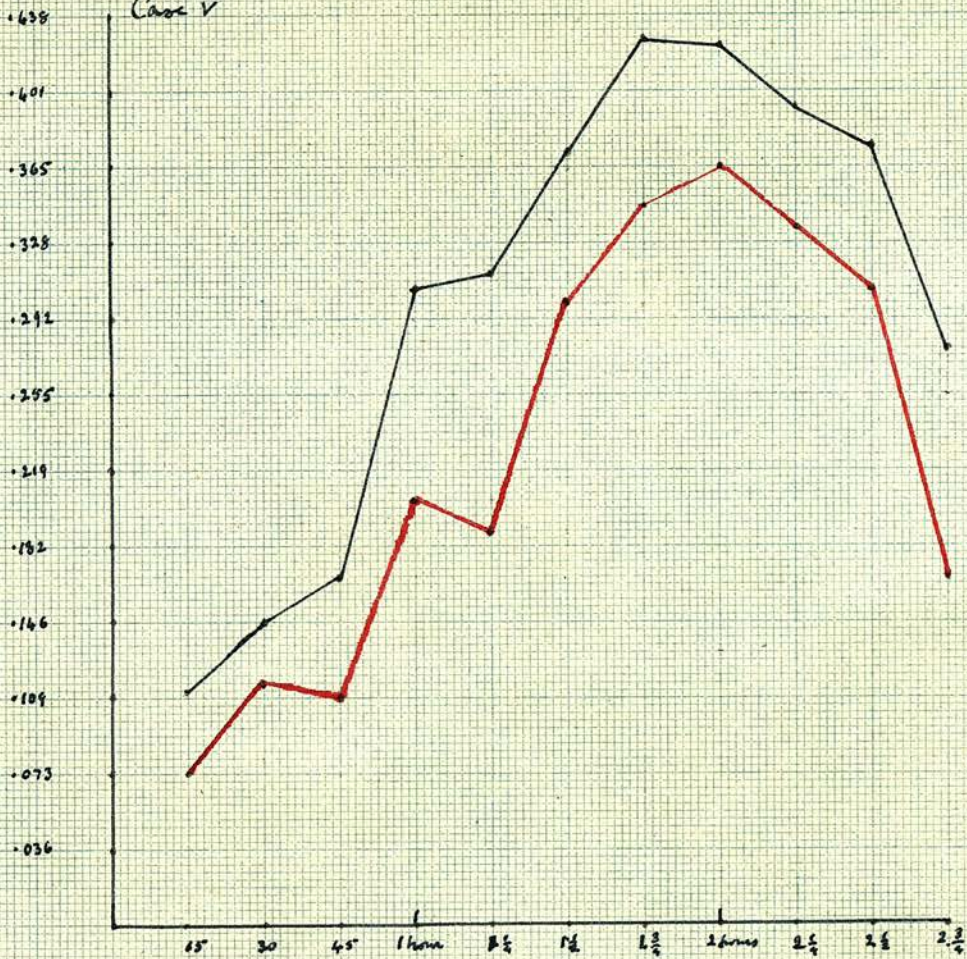
Family History. Seven children alive and well.
2 miscarriages and 2 stillbirths -
these latter were the first births.

General Appearance. Well coloured. No anaemia.
No oedema.



% HCl

Case V



Total acidity in blue. Free acidity in red.

Apart from marked venous pulsation in the neck, there was nothing to note in the Circulatory, Respiratory or Nervous systems.

Alimentary System. Tongue clean and moist. Teeth all artificial.

Abdomen - Nothing abnormal apart from slight resistance in the Right Hypochondrium.

Examination of the stools for occult blood proved negative.

Report of X-Ray Examination. 1st Meal. Trace in tail of Caecum. Big last coil of Ilium, typical Ileal Stasis appearance.

2nd meal. Hypertonic, hyperperistaltic but regularly rhythmic J shaped stomach of vertical type. A reflex cause was suspected.

The Curve taken shortly after admission shows a sharp initial response which becomes more gentle for half an hour. Then a very rapid rise which reaches its apex of .42 in $1\frac{3}{4}$ hours. The summit is rounded, and the Decline, at first gradual, becomes steeper to the end of the test in $2\frac{3}{4}$ hours when it was exceedingly difficult/

difficult to aspirate material from the stomach (which was probably nearly empty by this time). All through it was difficult to obtain samples, which were thick and viscid, - a marked contrast to the preceding case.

No pain was experienced by the patient during the test.

The course of the Curve with its broken outline in Ascent suggests pyloric spasm which probably also accounts for the two intervals where the combined acidity becomes increased.

Pyloric spasm and exaggerated peristalsis probably account for the High figures obtained, and possibly also for the difficulty in withdrawing the contents.

Progress. Light diet and rest in bed gave relief and as no symptoms presented themselves the patient at her own request was discharged. Gallstones were suspected as a possible cause of the reflex stomach symptoms.

CASE VI. Mrs T. aged 25. Housewife.

Complaint. Vomiting of large quantities of fluid at intervals and a feeling of fulness in stomach.

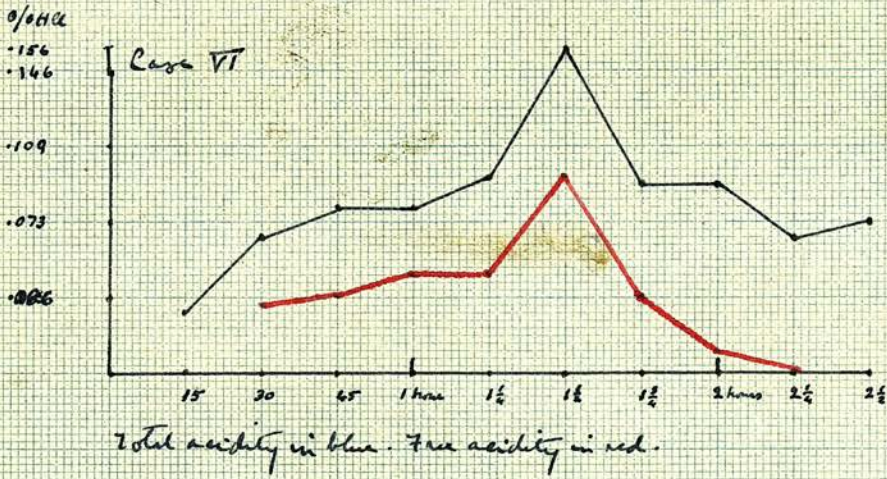
The History dates from a period in France when she commenced to have symptoms of pain which was relieved by food and also by vomiting. This was in 1918. Treatment at home gave relief.

In 1919 the symptoms recurred with haematemesis. On this occasion Jaundice made its appearance. Again treatment was temporarily successful. But in 1920 the condition became so intolerable than an exploratory operation was undertaken and a duodenal ulcer discovered. Gastro-enterostomy was performed. Shortly after the operation the patient commenced to suffer from periodical attacks of vomiting following an increasing feeling of fulness after meals and also from loss of appetite. Vomiting relieved her symptoms for a time.

She noticed that after lying for some time on her left side, gurgling took place and she obtained relief from the feeling of distension.

Appearance/





Appearance on Admission. The patient is moderately well nourished and has fair colour. There is some distension of the Abdomen below the umbilicus and splashing can be elicited. The abdomen is lax and there is no marked tenderness.

By syphonage through an oesophageal tube two pints of frothy yellowish material were obtained some hours after a meal. This material showed under the microscope undigested particles of meat and general debris with some red blood cells. The material was not faecal in character. Its chemical reaction was acid. There was no free Hydrochloric or Lactic acid.

An X-Ray examination showed a stomach dilatated and prolapsed into the Pelvis.

Both the Pylorus and the new Stoma were seen to function but there was stasis in the bowel owing to a kink in the Jejunum beyond the new stoma.

Regurgitation was seen to occur through the stoma.

The Curve obtained in this case shows a weak response and a slow ascent to a retarded High point of .15% HCl at $1\frac{1}{2}$ hours, which is abrupt. The decline is very gradual.

The greater part of the meal had passed out in 2 hours but food residues were still present in the last two samples in which a greenish yellow colour suggestive of regurgitated Bile showed itself.

There is an increase in the Combined Acidity of the specimens collected in the last $\frac{3}{4}$ hour which finally becomes complete as if stasis were occurring or the Free Acid were being combined with Duodenal fluid. No Lactic acid was detected. A good deal of mucus was found throughout.

The retarded high point and the general lowness of the Curve point to an atonic condition which is confirmed by the X-Ray appearances and the clinical findings.

It has been shown by Willcox that Gastro-jejunostomy lowers acidity and some surgeons regard this operation as the only regular way of applying alkaline medication to the stomach. As Langdon Brown suggests, the effect of it may be due to the absence or diminution of the food stimulus at the Pylorus (which normally excites the production of Gastric Hormone) and also partly to regurgitation from the Small Intestine.

Further History. At operation by Sir Harold Stiles it was found that the Jejunum was enormously dilated as far as the Anastomosis and narrowed at that point.

This accounts for the stasis and the regurgitation of fluid through the new stoma.

The Gastro-enterostomy was undone and the patient left hospital feeling well.

CASE VII. Miss C. C. aged 45 years. Occupation -
Household duties.

Complaint. Pain in left hypochondrium,
of many months duration and becoming progressively
worse.

History of Illness. This is somewhat
difficult to follow as the patient is very garrulous
and introspective. But apparently it dates from
7 months before admission when she felt a pain in her
left side while walking along the street. It made
her sick and she had to stand still. She cannot stand
for any time without becoming sick. There is a
dragging feeling at the left side and she complains
vaguely of a feeling of indigestion. The appetite
is fickle and she has heartburn and waterbrash.
Sleeplessness has bothered her for about three months.
Many indefinite symptoms are complained of, such as
tingling in the legs, a feeling as if there were
"a stick" in her throat, palpitation after food.
She has been losing weight and is obviously irritable
and discontented.

Previous Illness. Measles in childhood and rheumatism
(a condition of Rheumatoid Arthritis
which is quite marked, but upon
which she lays no stress.)

State on Admission. Rheumatoid Arthritis affecting both hands and forearms with more or less ankylosis and wasting of muscle. Shoulders slightly affected. Left knee swollen and deformed. There is twitching of the eyelids and trembling of the lips. Everything tastes of garlic. She complains of dull headache "without actual pain".

Nervous System. Slight nystagmus. Knee jerks exaggerated. Achilles jerk present. Abdominal Reflex absent.

Alimentary System. Tongue large, tremulous and slightly furred. Slight degree of pyorrhoea though teeth are in good condition.

Abdomen. - Rounded and well covered. Wall flaccid except for some slight rigidity in right hypochondrium where there is no tenderness. Descending Colon palpable.

Stomach note reaches below umbilicus and to right.

Nothing else to note in any of the systems.

A test meal was given two days after admission. The patient was very nervous over swallowing the tube at/

Case VI
no 1

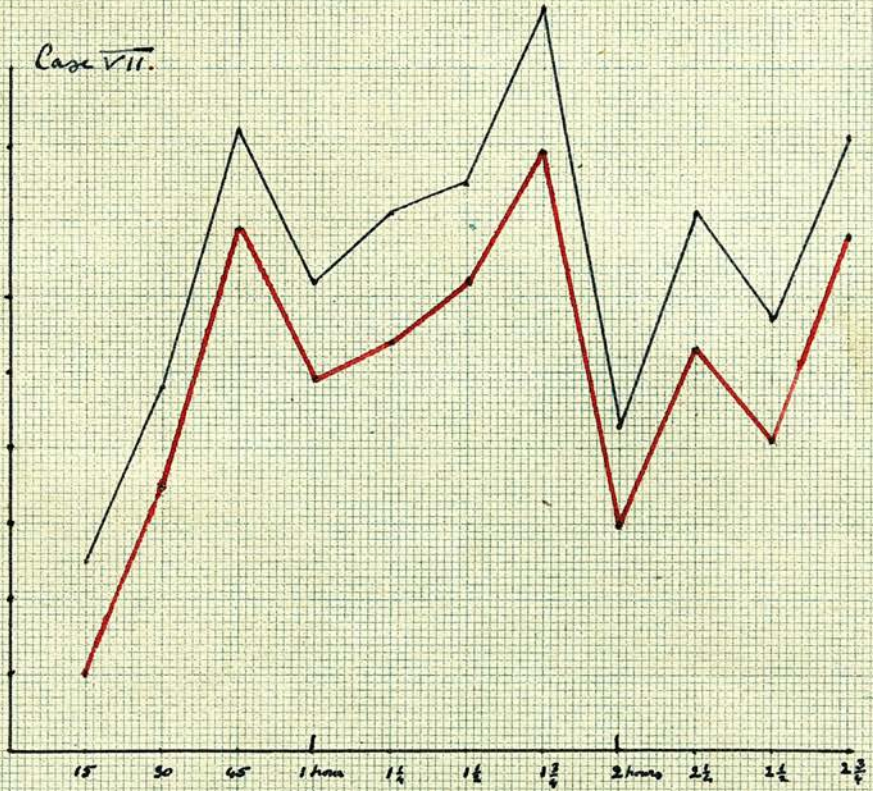


Case VII
no 2



% HCl
 .328
 .292
 .255
 .219
 .182
 .146
 .109
 .073
 .036

Case VII.



Total acidity in blue. Free acidity in red.

at first. All through the examination she complained of being tired but had no pain.

The Curve shows an immediate sharp response with a rapid ascent during the first $\frac{3}{4}$ hour. A slight fall at this point gives way to a second rise at first gradual and then abrupt to a High point of .35% at the end of $1\frac{3}{4}$ hours. A swift decline is followed by a zig-zag course which has reached .29% when the test was stopped at $2\frac{3}{4}$ hours, as the patient was tired and fluid hard to aspirate. At this point there was considerably less food present in the samples. All through a fair amount of mucus was observed.

The marked jerkiness of this curve points to recurring Gastrosplasm and this may explain the difficulty frequently encountered of withdrawing specimens. The rapid ascent and the height of the curve point to great irritability. It is to be observed that the ordinary clinical meal in this case would not reveal very much.

An X-Ray examination next day showed no residue in the stomach after the 1st meal.

The 2nd meal displayed a marked "Hourglass" stomach which persisted while being watched, then photographed and watched on the screen again.

She was screened again on the following day, however, when the normal outline was seen and the Hourglass condition proved to be merely a Gastrosplasm in a normal J shaped stomach.

In Case No. II we saw an instance of marked spasm of the Pyloric end of the stomach, where the interval between the Total and Free acidities became widened, possibly owing to retention of the contents without an accompanying stimulation of the Pyloric membrane on account of the contraction of the lumen at that point.

Here we find spasm of the body of the stomach and retention of food above and below the contraction, with the result that acidity rises without any marked increase in combined acid.

The curve appears to confirm the History and the X-Ray appearances, and to point to nervous irritability.

CASE VIII. Mrs M. McL. aged 32 years. Occupation
Housework.

Complaint. "Vomiting of Blood".

History. Five weeks before admission
the patient who is pregnant (3 months) vomited a
little bright red blood which came up easily. The
evening before she had felt choked up from the chest
to the throat.

She took her usual food that day and had no pain.

Three days later she vomited blood twice, first
bright red and then dark blood.

The next evening the choking sensation recurred
and a clammy sweat, but no vomiting.

In the morning she vomited but no blood appeared.

Some of the motions were very black at this time.

She had some treatment for her condition later,
and though sick in the mornings did not vomit till a
week before admission when a little dark blood again
came up. She took her food after these attacks
and pain, if present, was negligible.

Previous Illness. Was a delicate child with the usual
children's diseases. Had Influenza
and Pleurisy a year ago.

Seven/

Seven years ago she vomited blood and had a cough after the birth of a child. Has ailed continuously since the birth of her last baby.

Family History. Has had 7 children - two dead (broncho-pneumonia) - no miscarriages.

Surroundings - fairly satisfactory. Works pretty hard but is well fed.

General Appearance. Lies comfortably in bed. Pale. No jaundice or cyanosis. Some oedema over tibiae.

Respiratory and Circulatory systems present nothing of note.

Genito-urinary System Frequency of micturition which was present before pregnancy.

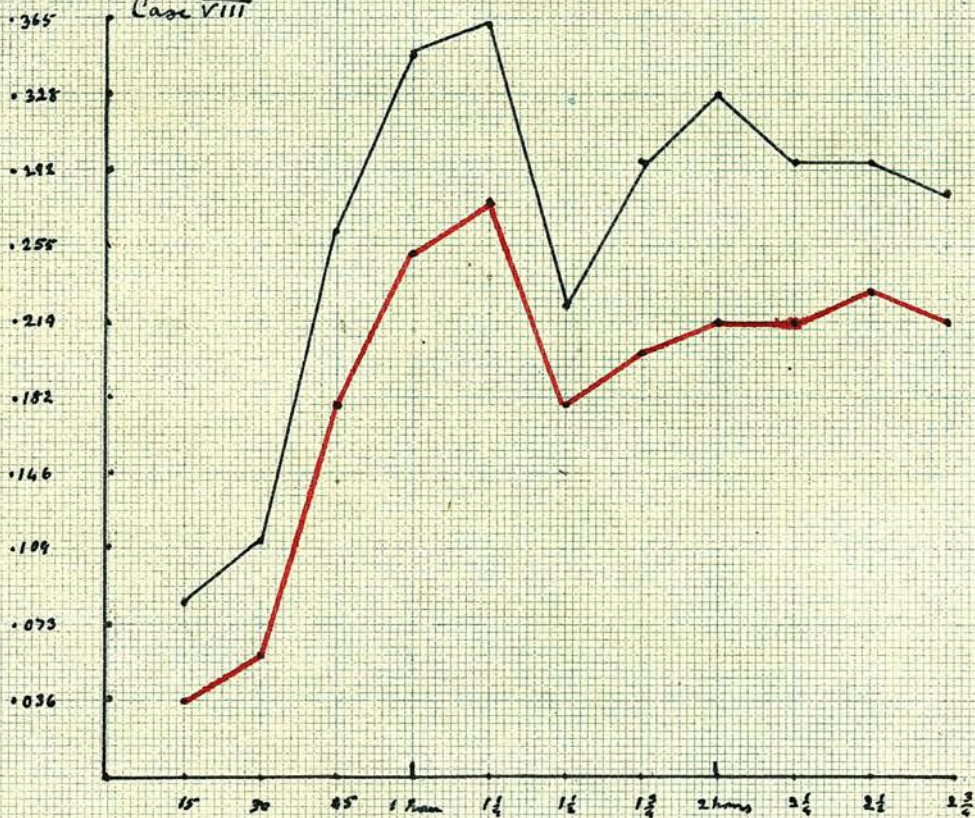
Urine - Normal.

Alimentary System. Appetite good. No pain after food. Bowels regular. Tongue moist, slightly furred in middle. Teeth dirty and gums bleed rather easily.

Abdomen - moves freely. Muscles lax. There is an area of Cutaneous Hyperaesthesia in Epigastric and Hypochondriac regions.

%HCl

Case VIII



Total acidity in blue. Free acidity in red.

Tenderness on deep palpation 1" to right of Navel and much tenderness 2" below Xiphisternum.

Some tenderness in right Iliac fossa and some thickening felt. Occult blood in faeces doubtful.

Nervous System - Normal.

Progress. No symptoms of active stomach trouble showed themselves so a test meal was given some days after admission.

No discomfort was experienced by her and specimens were collected with ease.

The Curve shows a moderate response at first which in half an hour has become very active, the Ascent being rapid and reaching a high point of .36 in $1\frac{1}{4}$ hours. The Decline is steep at first but, after a secondary sharp rise, becomes very gradual. At $2\frac{1}{2}$ hours the stomach was practically empty of food, the last specimen containing only a little clear gastric juice, from continued secretion.

There is a noticeable interval between the curves at 2 hours, when a good deal of mucus was observed. No occult blood was found.

The motility of the stomach appears normal.

On the whole it is difficult to class this curve as abnormal. It bears a marked resemblance to the/

Case VIII



①
Pinnaculi

the Normal Hypersecretory type of Rehfuss, except that the initial response is moderate and the High point a little retarded. This may be due to some loss of tone.

The X-Ray examination next day revealed a "somewhat atonic stomach with feeble peristalsis". There was however good movement to terminal Ileum and Caecum in the six hours, and no residue left after the 1st meal.

The patient was tried with the Sippy diet but she could not stand it, and after being put on convalescent diet she showed no symptoms of Gastric ulcer or other stomach trouble. Some days after, she was allowed to leave hospital. It appears that her trouble was due to pregnancy.

CASE IX. J. R. aged 27 years, occupation barber.

Complaint. Pain in the pit of the Stomach.
and headache.

History. Two and a half years ago the patient had Trench fever and commenced to suffer from 'pain in the stomach on the right side' after food. Food would regurgitate into the mouth at these times.

It was however about a year before admission that more severe discomfort occurred. Headaches followed, at first, immediately after food, later, at any time. Pain would come on half an hour to one hour after meals, especially if potatoes were eaten. Starchy and milk foods caused the worst pain, while meat and chicken agreed well with him. Fat Bacon had no ill effect.

This pain would last for about one hour. It felt like a weight and it did not shoot in any direction.

He never vomited. The pain was relieved by lying down, especially if he lay on his left side. Turning on his right side aggravated it.

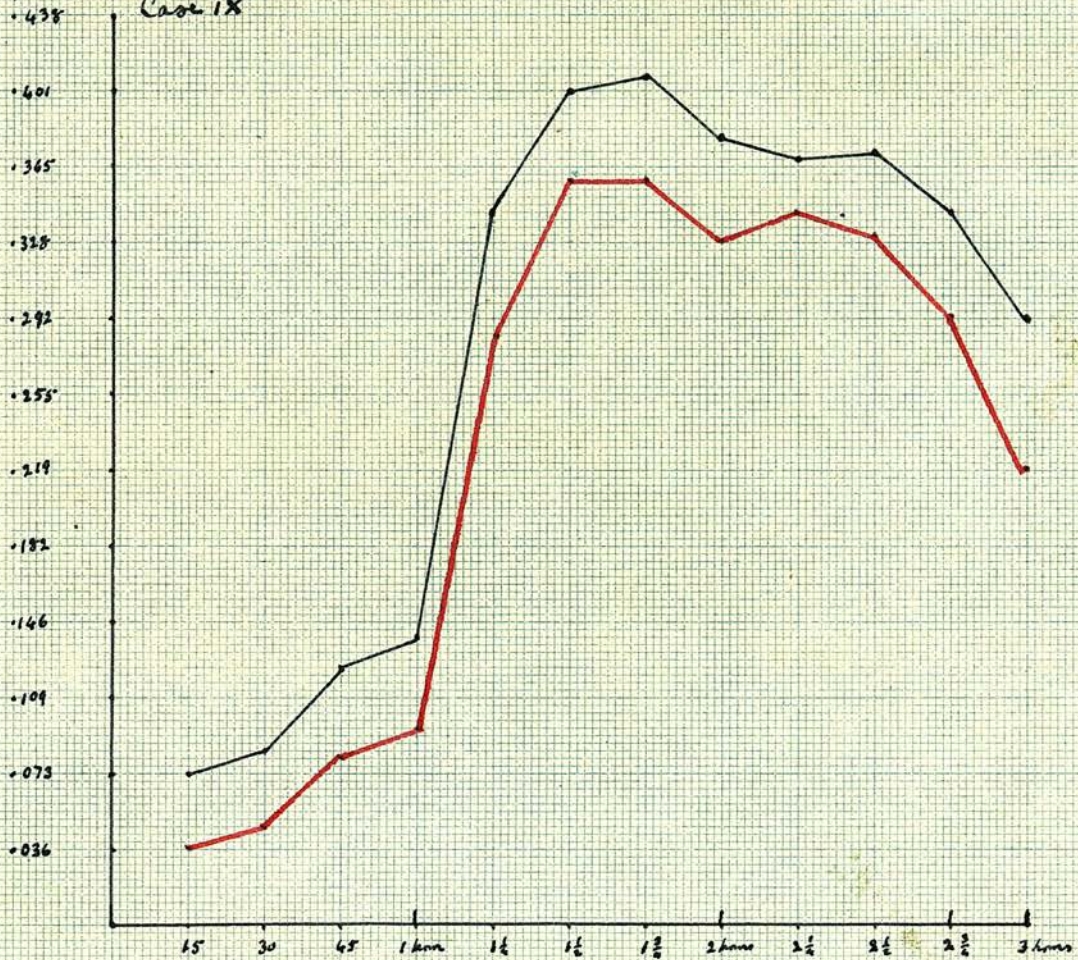
He says, on being asked, that very occasionally he has been wakened from sleep by the pain in his stomach.

Baking Soda taken before food gave relief.

If/

% HCl

Case IX



Total acidity in blue. Free acidity in red.

If he is hungry - no food for 5 hours - he has a dragging pain in the Epigastrium.

He is always constipated. He has never noticed that the stools were markedly dark in colour.

He has been losing weight.

State on Admission. He is rather pale and thin, but not anaemic, judging from the mucous membranes.

The tongue is fairly clean.

The Abdomen. - is not rigid, but there is a tender spot about one inch above and to the right of the Navel.

There is some tenderness in the Right Hypochondrium.

There is no tenderness elsewhere.

There is no skin hyperaesthesia.

An ordinary clinical test meal gave Total acidity .08, Free - nil.

A few days after, a Fractional Analysis was done and the Curve shows a fair immediate response, but thereafter for one hour the rise is extremely gradual.

Suddenly, however, a steep Ascent occurs which after slowing down reaches the High point of .4 in $1\frac{3}{4}$ hours.

The Decline from the rounded summit is gradual and/

Case IX



and has fallen to 29 at 3 hours when the test was discontinued.

Blood first appeared in the samples at $1\frac{1}{2}$ hours from the start, and Coffee grounds continued to appear in small amounts to the end.

There was no pain. All the samples were very fluid and easily withdrawn. Mucus was never a marked feature.

In the last two samples, and especially the last, there was a considerable quantity of food particles.

This curve shows sluggishness at first and then hyperexcitability of secretion. Motility during the 3 hours appears to have been poor, the stomach not being empty by the end of that time.

The X-Ray picture shows an atonic stomach in which all the meal has fallen to the lower pole, though the 1st meal had reached the transverse colon in six hours.

The stomach is not at all prolapsed as the position X of the umbilicus shows.

Progress. The patient has no pain while lying in bed. He is on a light diet and Rhubarb and Soda powders.

As/

As the point arose for discussion, whether the X-Ray picture was merely the appearance of the stomach when the bismuth meal entered it and not the conformation one would find during the later phases of digestion, a bismuth meal was given $1\frac{1}{2}$ hours before screening.

It was hoped in this way to see the stomach outline at the period of highest acidity.

Dr Hope Fowler had previously screened this patient repeatedly, and tried to change the outline by giving more bismuth. A tubular outline never appeared, and he doubted the success of such an attempt as has been mentioned. His doubts were justified.

For when the patient was examined between $1\frac{1}{2}$ and 2 hours after the meal, the same outline was seen though more scanty in extent. For the meal had nearly all left the stomach and we had simply what looked like a small basin substituted for the larger one delineated above.

The case is interesting from its history, which covers a long period and yet seems vague from a diagnostic point of view.

Carbohydrates are specially incriminated.

Yet a test meal in which the carbohydrate element bulks largely, is borne with absolute comfort.

The/

The appearance of blood during the performance of the Fractional test, and at a period of high acidity and active peristalsis, might suggest the presence of ulcer.

The Radiologist considers that there might be ulceration of the Duodenum from the active peristalsis seen lower down in the alimentary tract.

It is however stated by Rehfuss that Duodenal Ulcer produces an acceleration of the High Point.

In this case it is distinctly retarded.

Further, the Atonic outline is admitted by the Radiologist to be a possible outcome of pyloric obstruction and if the ulcer - if ulcer be present - were situated at the Pylorus, the late appearance of blood might be explained.

Then again the pain is early in its onset and the patient denies the occurrence of Melaena.

It is interesting to contrast the slow evacuation of the stomach during the Test Meal with its more rapid treatment of the Bismuth.

The posture of the patient - lying on his left side - in affording relief from pain, is also worth noting.

CASE X. Mrs J. B. aged 42 years, occupation -
household duties.

Complaint. Pain in the stomach.

History. A haemorrhage from the stomach suddenly occurred about 8 months previous to admission without any pain. No discomfort occurred till pain began to follow the taking of food (about an hour after) some two months ago. This pain would last for about half an hour and then die away. It felt like a band round her waist, and it shot from the epigastrium round the right side to the back.

All sorts of food brought it on, no one kind more than another.

It was relieved by Magnesia and Baking Soda.

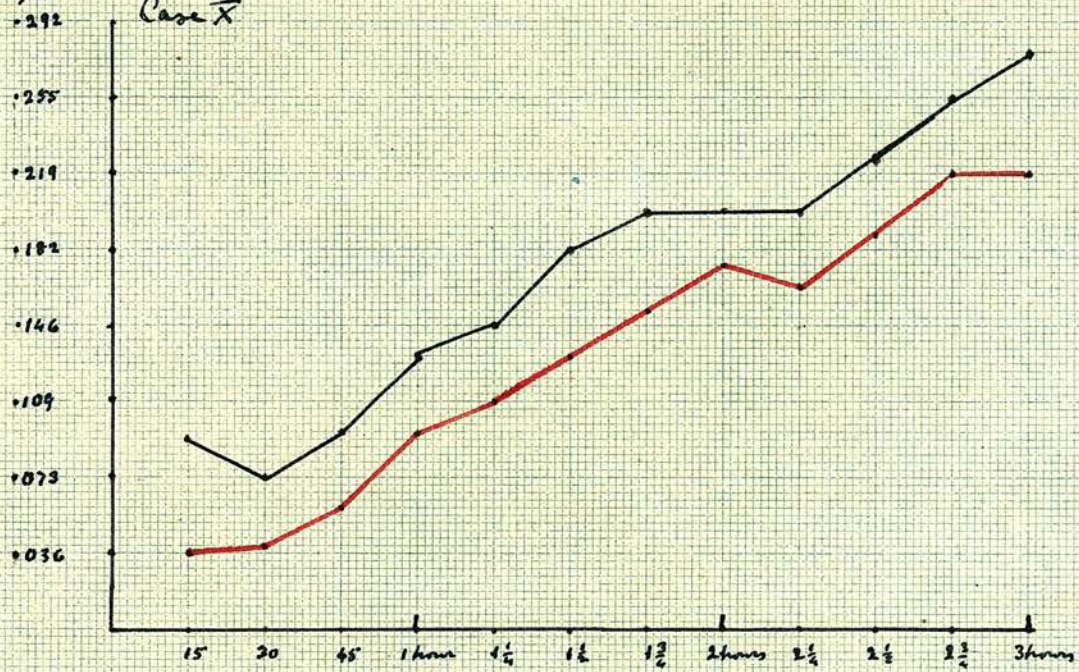
Two weeks ago vomiting first began and it relieved her.

She has sometimes been wakened from sleep by the occurrence of the pain at night.

State on Admission. Though the patient has, it appears, lost about $1\frac{1}{2}$ stone weight in the last year, she by no means looks thin nor has she an anxious expression. She sleeps pretty well. Her bowels are regular and she is not markedly anaemic.

% HCl

Case X



Total acidity in blue. Free acidity in red.

Abdomen. Moves fairly freely and is not rigid anywhere. There is no skin hyperaesthesia.

Tenderness on pressure can be elicited in the Epigastrium at a point in the mid line rather nearer the Navel than the Xiphisternum.

There is also tenderness in the Right Iliac fossa where she sometimes feels pain.

There is nothing to note about the mouth.

No occult blood has been found in the stools.

During the past two years she has only menstruated once, and she has not been pregnant.

A Gynaecological examination discovered nothing of importance.

On Fractional Analysis being done some days later the following Curve was obtained.-

A normal immediate response is followed by a gradual rise to .27 which was the Highest point reached when the test was stopped at the end of three hours.

The constant rise without any dip (except a slight one in Free acidity) is very remarkable. It is not equal throughout, e.g. at two hours there is a period of half an hour when it remains level; but it is very steady. At no point does the combined acidity exceed .05, and it is more often .03.

No/

Case X



No pain was experienced and no Blood appeared.

Samples were not easily withdrawn at first and a good deal of food then appeared, which later only showed itself in the mushed state.

There was a fair amount of mucus throughout.

By two and a half hours most of the meal had passed and the last two samples were largely clear gastric juice.

The stomach motility appears to have been good but its secretory reaction is sluggish. There is, further, evidence of continued secretion of acid after the passage of the food.

The X-Rays showed good passage of the meal to the Caecum and pelvic colon and an elongated stomach below the umbilicus with the bulk of the meal in the lower pole, but a considerable remnant at the Cardiac end, i.e. There is some hourglass contraction, real or spastic, and some atony.

Thurston Holland in the Medical Annual 1920, describes a visceroptotic condition in which there is dropping of the lower curvature with a consequent

U shape of the upper border of the stomach, and the X-Ray appearance suggests this in the case under review.

Progress./

Progress. This patient has improved remarkably upon a modified Sippy diet. She has put on weight, sleeps well and feels perfectly comfortable after two weeks treatment.

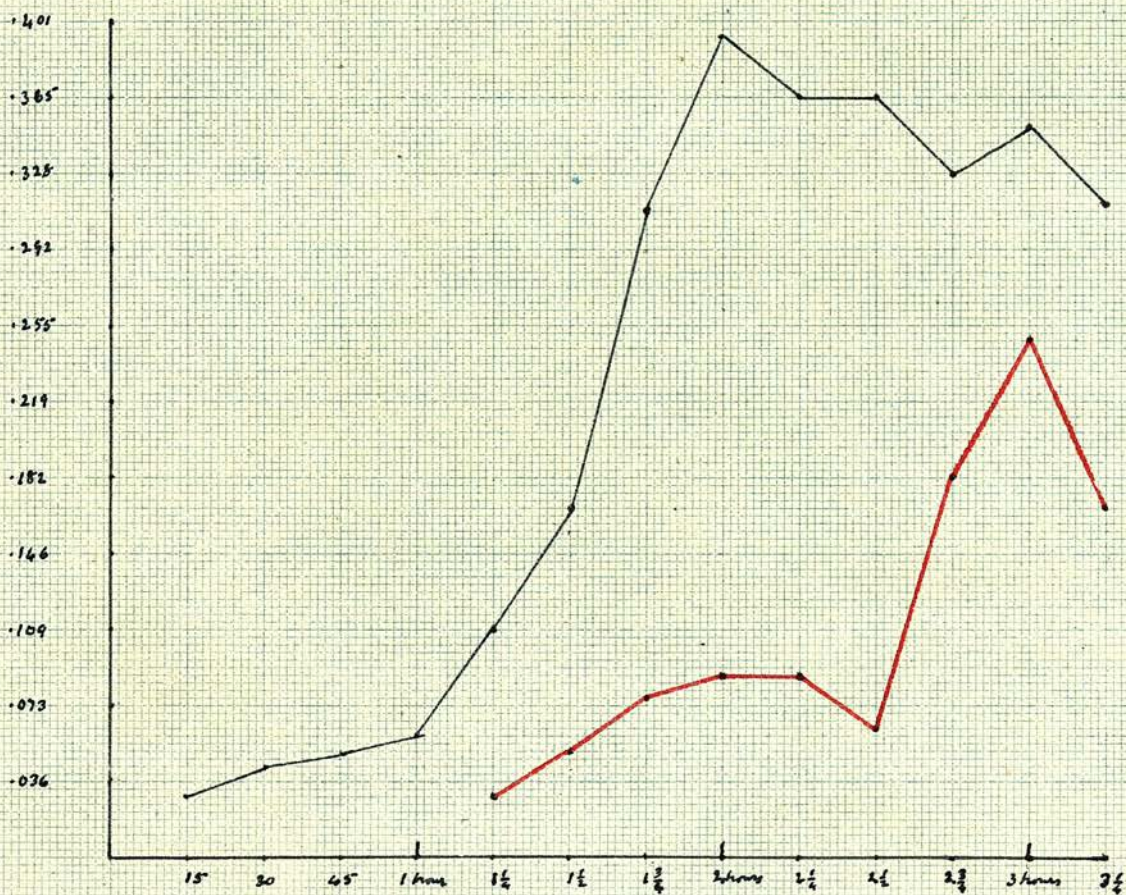
Regurgitation of Bile has been noted in one of the normal curves and in some of the Curves of cases of Gastric disorder. It always occurred at the end of digestion and in my cases could only be suspected by the colour as the Bile reaction was not given in the ordinary way by Gmelin's test. It was associated with an increase in combined acidity and the Free Acid frequently disappeared.

In some of the cases it was suspected that not only Stasis but also a probable Regurgitation of Intestinal Fluid had occurred during the course of digestion from the great divergence of the Free and the Total acidity curves. In this connection it is noteworthy that Dr Hope Fowler states that he has seen, in a cinematographic representation, the back flow of fluid through the Pylorus during the process of digestion.

So the suspicion appears to have some basis in fact.

These points are only mentioned here as requiring more thorough investigation.

Acidity Curve after Protein Test meal No 7



Total acidity in blue. Free acidity in red.

Protein Test Meals in healthy subjects.

In order to see how the stomach responds to a meal containing a comparatively large amount of Protein, a test meal consisting of a slice of bread buttered and made into a sandwich with about 30 gms. of chopped Beef was administered with 300 cc. of milk to the same subject from whom the first normal curve was obtained after a test breakfast.

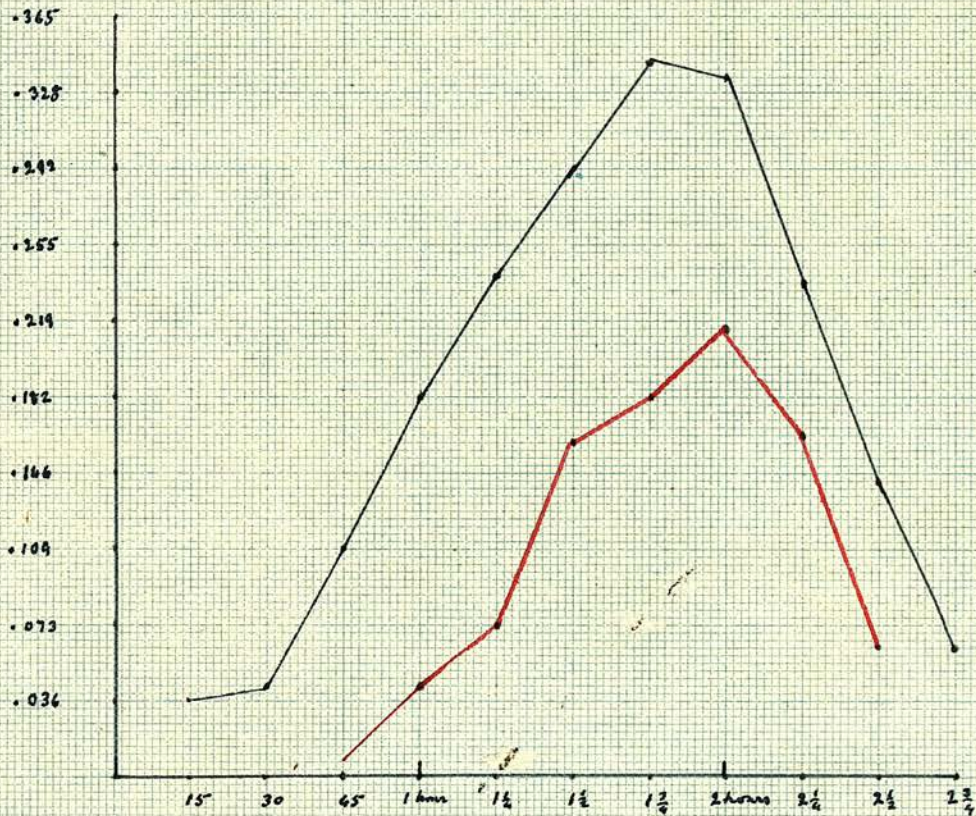
He had had an attack of fever but was now well and declared his digestion good.

The meal was given about 1.30 in the afternoon, the ordinary breakfast having been taken earlier in the day.

The Curve shows a very slow rise in the Total Acidity for the first hour. Then commences a rapid Ascent to a high point of .39% reached by the end of the second hour. From this it falls very gently.

The Free acidity appearing after an hour, first slowly rises for an hour, sinks a little and then steeply rises to reach its maximum of .24 by the end of three hours. After this it falls with the Total acidity. The Test was stopped at $3\frac{1}{4}$ hours, at which time there still remained a good deal of food in the stomach, as judged by the samples.

Acidity Curve after Protein Test meal. No 11



Total acidity in blue. Free acidity in red.

The next test was made on the Medical man from whom the second normal curve from a Ewald test breakfast was taken.

He also had taken his usual breakfast and received a Protein test lunch about the same time in the afternoon as the foregoing. As has been remarked before, this subject leads a very active life. Unfortunately the Test lunches were not the same in the two cases. Owing to a misunderstanding he received two thin slices of buttered bread with 30 gms. of chopped beef and 300 cc. of milk. So there may have been more bread in the meal and also more butter although his slices were thinner.

The Curve in this case shows at first a slow rise in the Total Acidity which after half an hour becomes a steady rapid ascent to a high point of .34 in $1\frac{3}{4}$ hrs. After this the Decline at first slight, becomes equally rapid to the end of the Test in $2\frac{3}{4}$ hours when the stomach appeared to be nearly empty as regards food, and it was difficult to aspirate fluid.

Free Acid shows a trace at $\frac{3}{4}$ hour from the end of the meal and rises in three phases, of which the middle one is the steepest, to its height in 2 hours. Then it falls away parallel with the Total Acidity curve.

The motility of the stomach appeared greater in this case.

In both of these curves the acidity is all combined at the start and Free Acid is late in appearing as compared with the Curves drawn after a Ewald test breakfast. In one case none is seen in the first hour, and in the other a trace is found in $\frac{3}{4}$ hour.

Another point is the more rapid rise in Total Acidity as compared with Free. In other words combined acid increases in amount from the point of appearance of the Free Acid until the Free acid approaches its maximum, at which point the Total Acidity Curve and the Free Acidity Curve approximate to one another and both begin to fall.

The Third subject was also a young Medical man of about the same age, also leading a healthy active life.

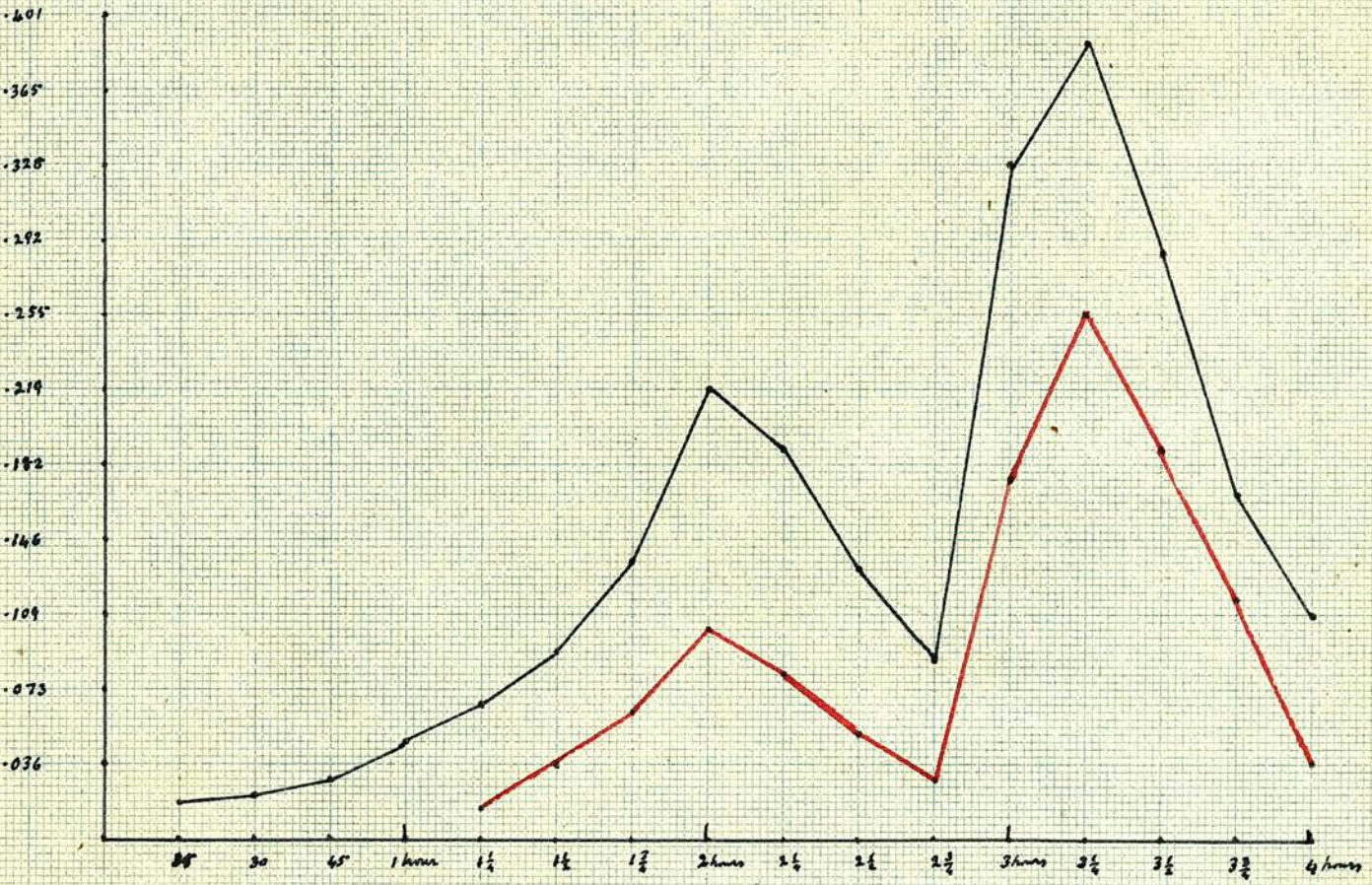
He received the same meal as the last, also in the afternoon.

This subject had a very sensitive pharynx, as a result of which he brought up about a third of the meal in attempting to swallow the tube. He however managed to get it down.

Like the first Curve, his curve for an hour is that of Total acidity all combined.

The/

Acidity Curve after Protein Test meal no. 111



Total acidity in blue. Free acidity in red.

The Ascent is very gradual up to the end of two hours. Then it falls for $\frac{3}{4}$ hour and finally reaches its maximum half an hour later. It attains its acme of .39 in $3\frac{1}{4}$ hours.

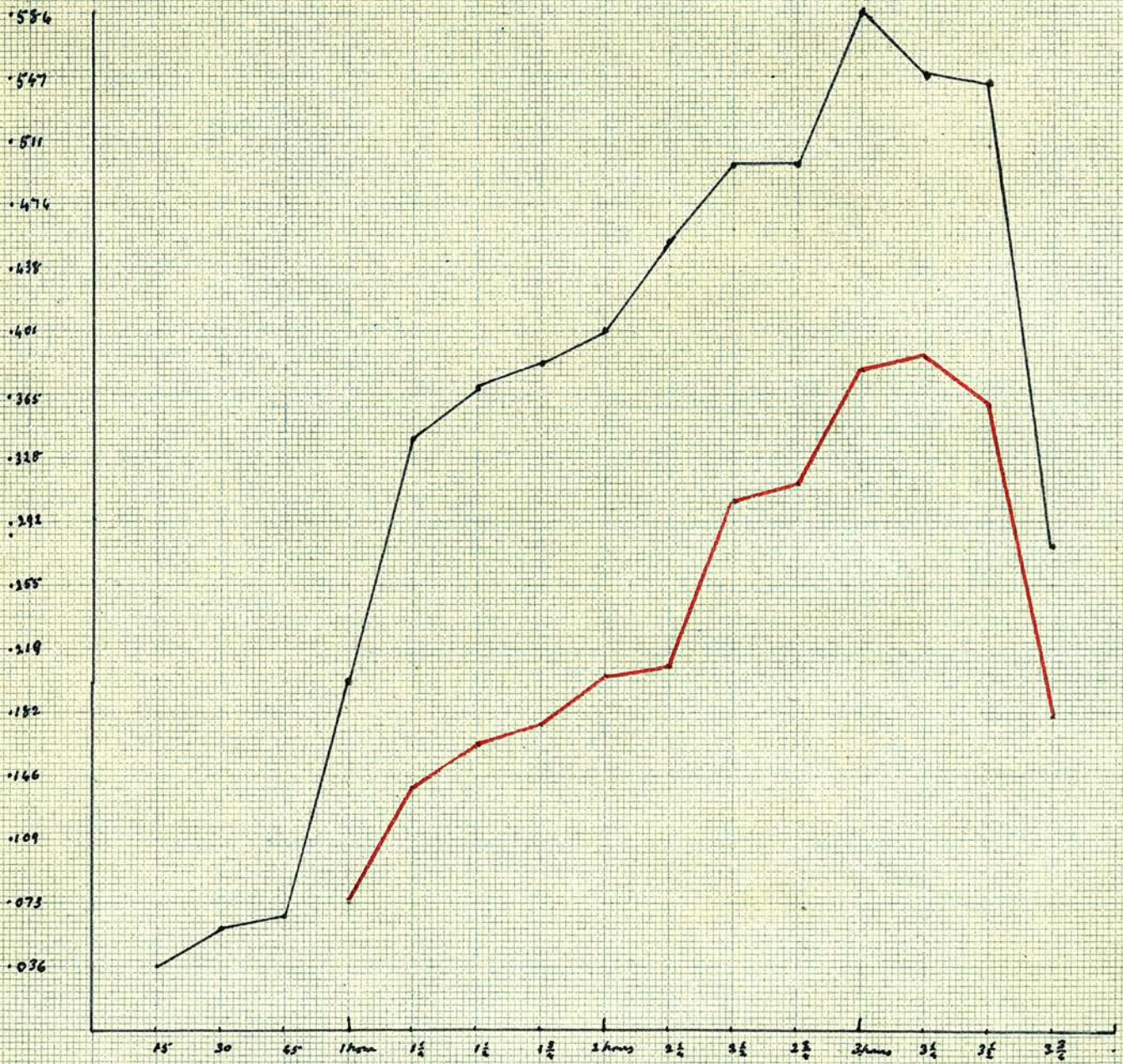
The Decline is steady and rapid.

Free acidity first seen in $1\frac{1}{2}$ hours, follows very closely the course of the Total Acid, rising and falling and finally reaching its acme at $3\frac{1}{4}$ hours also, when it falls in a parallel course with the other.

The fall in the interval between 2 and 3 hours is very interesting. The subject was almost asleep at the point when both acidities reach their lowest, and it was then noticed that he had been very drowsy after the 2nd hour. As if in addition to less acid secretion, the stomach peristalsis had quietened down: there was a noticeable absence of food particles during the period of this intermediate fall as compared with what was found when he wakened up and took an interest in the test, when the acidities both flew up to their maxima. It may be that drowsiness suspended at least partially the process of digestion. Certainly it is unlikely that swallowing of saliva was the cause as the dip is too pronounced for this.

The last two specimens were practically devoid of/

Acidity Curve after Protein Test meal No. 11



Total acidity in blue. Free acidity in red.

of food particles, the stomach having apparently emptied itself in $3\frac{1}{4}$ hours. If the unexpected dip be left out of account the same divergence of Free and Total Curves is seen, most markedly before the Free acidity approaches its height.

The Fourth Test was made on a convalescent patient who was leaving hospital the next day.

She was a younger subject - 17 years.

The meal was the same as the two last, but it was given as a breakfast after a night's fast.

The Curve shows the Total Acidity all combined for the first three quarters of an hour while the rise is very gradual. Then the Ascent becomes very rapid for half an hour. Then it continues but in a gentler fashion at unequal rates till it finally attains a height of .58 in three hours.

The Decline, slow at first, develops into a precipitous fall till the test was stopped at $3\frac{3}{4}$ hours, at which time all food had gone and only gastric juice was aspirated.

The Free Acidity appears by the end of the 1st hour, ascends in a much more leisurely fashion but also at unequal rates to its maximum at $3\frac{1}{4}$ hours. Then it falls parallel with the Total Acid to which it is approximating.

Here/

Here also we see the wide interval between the two at its greatest, just before the Free Acid approaches its height.

The marked feature of these four curves is the high degree of Combined Acidity which prevents the parallelism seen in the Test Breakfast Curves.

Also it is to be noted how late in all of them the Free acidity attains its maximum.

In one it reaches its height in two hours, but in all the others it takes from 3 to $3\frac{1}{4}$ hours to do so.

From the first two curves which can be compared with the first two normal curves shown after a test breakfast (the subjects being the same) it is seen how high a figure is reached by both acidities, practically double as regards the Free.

In the last curve shown the great height attained is possibly due to the subject's having had a night's rest before the meal was given.

These points are of interest with regard to the symptoms complained of by patients suffering from Gastric and Duodenal disorders.

The prescribing of a protein diet has long been held to be a necessary measure in the treatment of
so/

so-called "Hyper-acidity". The physician recognised that the pain of his patient was relieved by giving such articles even as raw meat juice.

This is known to excite the flow of gastric juice even more violently than does cooked meat. Pavlow has shown this. But the above protein tests were carried out with cooked meat and we have seen how high a Free Acidity is eventually evolved. How then, can the alleviation of pain be explained under such a dietary?

It was held that relief was due to the combination of protein with the free Hydrochloric acid. Such a combination certainly occurs. It has been shown that both acidities are kept very low for at least one hour, Free acid hardly appearing during that period at all. We have seen, however, that so-called "Hyperacidity" may be treated successfully by the Sippy diet and relief obtained in spite of increased acidity. Therefore high acidity is apparently not the cause of pain.

Were it not so we should have reason to look for severe pain some 2 or 3 hours after a protein meal when the Free acid is at its height. But is this the experience of the physician?

If/

If one be entitled to generalise from what has been shown in two of the normal subjects, viz. that Free Acidity after Protein food is twice as great as Free acidity after Carbohydrates, to what a height must it rise in these persons whose acidity after a Test Breakfast is regarded as far exceeding "Normal" limits.

Yet these are the patients to whom proteins are recommended for the relief of their pain!

The Curves of Acidity traced after a Protein meal, in fact, simply offer another argument against the views held as to the cause of pain and its alleviation in "hyperacidity".

Do the Curves of Acidity after Protein test meals offer any clue to the late pain complained of in cases of Duodenal Ulcer?

How often do such cases give a history of pain occurring at 2 or 3 hours after food.

Moynihan suggested that this symptom might be due to some change in the quality of the chyme at this period.

The advocates of high acidity as a cause of pain would no doubt say that in the Curves we have a direct/

direct explanation. The average chief meal of the day contains a large amount of Protein in the form of meat and therefore as Free acid attains its height late in such cases, the pain will naturally follow at a corresponding period.

Mackenzie has given ground for belief that the pains of the abdominal hollow viscera are due to severe spasmodic contraction.

But what causes the violent spasm and pain?

Apparently not the high acidity.

May not, however, the presence of a late high degree of Free acidity betoken the concomitant presence of a large amount of Peptone in the Chyme?

Peptone is an end product of Gastric digestion and the indication that digestion has reached this final stage may be the setting free of acid no longer required.

One of the cases shown above stated that her pain usually followed a meal in which Beef Steak was an ingredient, and that it followed after an interval of about 2 hours. Her stomach even after a Bismuth meal showed great motor irritability and the Radiologist suspected a reflex cause. The amount of Peptone produced after such a meal as she mentioned might be sufficiently great to stimulate painful contractions.

In/

In Luciani's Physiology it is stated that one observer found that the presence of Peptone elicited motor activity in the stomach.

The hypothesis is merely put forward as one which seems worthy of further consideration.

SUMMARY OF CONCLUSIONS.

1. The fallacy of the ordinary Clinical Test to find the High Point of Gastric Acidity, as this test is founded upon an arbitrary rule, which neglects the variations in secretory response in the normal stomach and its deviations in disease.
2. The conspicuous limitations of the X-Ray method of taking a single plate to determine the actual motility of the Stomach in health or disease.
3. It is possible to recognise constant hypersecretion and late continued secretion only by a study of the whole cycle of digestion.
4. The employment of the Fractional method of Gastro-analysis combined with close observation of the Fluorescent screen affords the best, and perhaps the only, means at present in use of determining the type of stomach and its alteration of function in health or disease.

5./

5. "Hyperacidity" is seen to be a misnomer and the present theories regarding it require revision. The views underlying the treatment of the condition also appear to want reconsideration in view of the facts elicited by Protein test meals.
6. Alkaline medication, if not very prolonged, appears in many cases to raise the capacity of the Stomach for acid secretion, which is, presumably, the contrary of what is intended by those who prescribe it.

It has been shown above that false assumptions have been allowed to dictate our method of clinical investigation as to the acidity of the Stomach in disease.

Further it is clear that high acidity does not indicate a condition of disease.

But because high acidity has been regarded as Pathological, a treatment of Stomach pain and indigestion has been evolved which in some way alleviates the condition.

It is evident however that though the end has been attained the means whereby it is attained are other than has hitherto been believed. This has been shown in two of the foregoing cases. We have in/

in fact blindly reached our goal - a phenomenon only too common in medical practice.

It has been impossible in the time at one's disposal to do more than touch on the fringe of a large subject - how large one did not realise at the outset.

But even from these very incomplete investigations one fact emerges very clearly, viz. that for too long Physicians have been content to accept a plausible theory in place of solid fact.

Even where the treatment founded upon a hypothesis is successful it is evident that this does not necessarily justify the hypothesis; and it seems a just inference that were the real etiology of a condition known the results of treatment would be still more brilliant.

Further, it is a humiliating thought for the Physician to realise that much of what he knows with regard to the Stomach in Disease he owes to his colleague the Surgeon.

The appearance of the Surgeon upon the scene at all is in itself a confession of the failure of Medicine.

Every sound physician must look forward to a time when his diagnosis will be sufficiently early and/
and/

and his treatment sufficiently thorough to dispense with Surgery.

This, however, can only be attained by more careful research and the rescuing of this branch of Medicine from the chaos in which it lies at present.

B I B L I O G R A P H Y.

1. W.B. Cannon. "The Mechanical Factors of Digestion".
2. Fractional Study of Gastric Digestion in A.M.A. Journal, Sept. 12th, 1914, by Martin E. Rehfuss, Olaf Bergeim and P.B. Hawk.
3. "Possibilities of Fractional Gastro-Analysis" by Martin E. Rehfuss, M.D., Philadelphia. Journ. A.M.A. 1918, Vol.LXXI, p.1534.
4. Bayliss. "Principles of General Physiology" pp.344, 373, 712.
5. Starling "Principles of Human Physiology" 3rd Edition, p.744.
6. Osler and McCrae "A system of Medicine" Vol.V. p.118.
7. Carmen and Miller "Roentgen Diagnosis of the Alimentary Canal".
8. Dr A. F. Hurst "New Views on the Pathology, Diagnosis and Treatment of Gastric and Duodenal Ulcer", B.M.J. April 24th, 1920.
9. Kemp "Diseases of the Stomach, Intestines and Pancreas".
10. Langdon Brown "Physiological Principles in Treatment".

11. Sahli - "Diagnostic Methods".
 12. Emerson "Clinical Diagnosis".
 13. Hutchison and Rainy "Clinical Methods".
 14. Peterson. Proc. Roy. Soc. Med. Vol.II, pt.3
(Surg. Sect.)
 15. Report of 88th Meeting of the Brit. Med. Assoc.
B.M.J. July 24, 1920.
 16. Mackenzie "Symptoms and their Interpretation".
 17. Friedman "Callous Ulcer of the Stomach"
(causes of Gastric pain)
The Medical Clinics of North America,
May, 1920.
 18. Purves Stewart "The Diagnosis of Nervous Diseases"
(Chap. XXIV Disorders of Sleep)
 19. Quain's "Dictionary of Medicine" (Temperaments)
 20. Willcox. Quart. Journ. of Medicine, 1909,
Vol. II, p.93.
-