2. *Ease*.—No complicated apparatus is necessary—nothing, in fact, beyond the Thomas splint, three straight metal splints, strapping extensions, wool, and bandages.

3. *Freedom from Tragedies*.—In none of these cases were there any tragedies, such as stiffness of the knee, want of alignment, necrosis of bone, or non-union—occurrences which, unfortunately, are by no means unknown when skeletal traction is used.

4. *Results*.—A good result is almost certain to follow the intelligent use of this splint.

TABLE OF RESULTS

Name	Age	Result
Francis S.	3 days	$\frac{1}{2}$ inch lengthening
James C.	19 years	$\frac{1}{2}$ inch shortening
Martha I.	67 "	$\frac{1}{2}$ inch lengthening
Alexander C.	12 "	$\frac{1}{2}$ inch lengthening
Alan G.	1 year	$\frac{1}{2}$ inch lengthening
Winifred J.	6 years	$\frac{1}{2}$ inch shortening
Ruth H.	7 "	Equal length
Marie G.	3 "	$\frac{1}{2}$ inch lengthening
Wilfred F.	3 "	Equal length
Joseph C.	1 $\frac{1}{2}$ "	Equal length
Margaret B.	4 "	$\frac{1}{2}$ inch lengthening
Hilda A.	17 "	$\frac{1}{2}$ inch lengthening
Alice J.	7 "	$\frac{1}{2}$ inch shortening
John E.	22 "	Equal length
Richard B.	5 "	$\frac{1}{2}$ inch lengthening
Leslie B.	7 "	Equal length
Robert C.	7 "	$\frac{1}{2}$ inch lengthening
Thomas V.	61 "	$\frac{1}{2}$ inch lengthening
John L.	13 "	$\frac{3}{4}$ inch shortening
James T.	13 "	$\frac{3}{4}$ inch lengthening
William R.	59 "	Equal length
Joseph B.	12 "	$\frac{1}{2}$ inch shortening
Fred. N.	25 "	$\frac{1}{2}$ inch lengthening
Stanley C.	21 "	$\frac{1}{2}$ inch shortening
Cyril T.	1 year	$\frac{1}{2}$ inch lengthening
Marjorie P.	2 years	Equal length
Lucy W.	10 "	$\frac{1}{2}$ inch lengthening
Herbert W.	11 "	Equal length
Joseph W.	7 "	Equal length
Donald W.	7 "	Equal length
Thomas W.	4 "	Equal length
John U.	5 "	Equal length
Reginald T.	4 "	Equal length
Eeryl T.	6 "	$\frac{1}{2}$ inch lengthening
Henry S.	2 "	$\frac{1}{2}$ inch lengthening
Emma R.	3 "	Did not walk in calliper; $\frac{1}{2}$ inch shortening
John R.	8 "	$\frac{1}{2}$ inch lengthening
Alfred O.	7 "	Equal length
Norman N.	6 "	$\frac{1}{2}$ inch lengthening
John M.	7 "	$\frac{1}{2}$ inch lengthening
Stanley M.	3 "	Equal length
William M.	9 "	$\frac{1}{2}$ inch lengthening
George H.	5 "	Equal length
John H.	5 "	$\frac{1}{2}$ inch shortening
Pierce G.	8 "	$\frac{1}{2}$ inch lengthening
Audrey G.	1 year	Equal length
Brenda G.	2 years	$\frac{1}{2}$ inch lengthening
Thomas G.	6 "	Equal length
Ronald F.	7 "	$\frac{1}{2}$ inch lengthening
Patrick D.	7 "	1 inch lengthening
Stanley D.	5 "	$\frac{1}{2}$ inch shortening
Gladys C.	5 "	$\frac{1}{2}$ inch lengthening
Douglas C.	7 "	$\frac{1}{2}$ inch lengthening
Annie C.	4 "	Equal length
Bernard C.	7 "	$\frac{1}{2}$ inch lengthening
John B.	8 "	$\frac{3}{4}$ inch lengthening
Doreen B.	14 weeks	Equal length
Edwin B.	4 years	$\frac{3}{4}$ inch lengthening
Evelyn B.	7 "	Equal length
William B.	7 "	$\frac{1}{2}$ inch lengthening
Eleanor I.	13 "	$\frac{1}{2}$ inch lengthening. Did not walk in calliper; now $\frac{1}{2}$ inch shortening

A NOTE ON PROTO-DUODENITIS*

BY

J. S. KELLETT SMITH, F.R.C.S., D.M.R.E.

AND

ARTHUR TOM, M.R.C.S., L.R.C.P.

(With Special Plate)

Anatomically the duodenum is described as being divided into four parts: (1) a superior portion, from the pylorus to the neck of the gall-bladder; (2) a descending portion, lying in front of the medial border of the right kidney and passing from the neck of the gall-bladder to the upper border of the fourth lumbar vertebra; (3) a horizontal portion, passing across the vertebral column from right to left, in front of the large vessels; (4) an ascending portion, running upwards in front of the abdominal aorta to the upper border of the second lumbar vertebra, where it turns abruptly forwards in the duodeno-jejunal flexure to become continuous with the jejunum.

These parts have varying relation to the peritoneum, in such manner that, disregarding exact detail, the condition is thus summed up in the words of a well-known textbook: "The superior part of the duodenum is somewhat movable, but the rest is practically fixed, and is bound down to neighbouring viscera and the posterior abdominal wall." This statement is misleading, like many other statements which seem to live for ever in the textbooks. By no means is the greater length of the duodenum always "practically fixed" and "bound down"; it would not function if it were. The truth is that the extraperitoneal areolar tissue attaching the gut to its related viscera varies greatly in density, so that in some cases the gut is as tightly fixed as is compatible with its function, whilst in others the attachment may be so loose that, as A. J. Walton records, there is sometimes no difficulty in even lifting the duodenum out of an abdominal incision. Certainly there is no difficulty in many cases in the way of the duodenum becoming ptosed, any more than there is in preventing a kidney from dropping below its average position. Finally, the duodenum may even have a mesentery, this being the persistence of a developmental stage in man but the normal state in some animals.

ANATOMY AND PHYSIOLOGY OF "PROTO-DUODENUM"

There is one part of the duodenum, however, where fixation is more constant and especially secured. The duodeno-jejunal flexure is supported and fixed by the muscle of Treitz (musculus suspensorius duodeni), a strong band of striped and unstriped muscle and elastic tendon which arises from the right crus of the diaphragm, and is inserted into the posterior aspect of the duodeno-jejunal junction and into the root of the great mesentery. We regard this fixation by the muscle of Treitz as a most important anatomical fact, for when the duodenum and jejunum become ptosed their junction is held up by this muscle of Treitz in such manner that the gut may become angulated by the downward drag on either side, thus forming a partial obstruction to the free onward flow of duodenal contents, and creating, as we believe, the conditions favourable to the development of one type of proto-duodenitis.

The use of the word proto-duodenitis suggests a method of dividing the duodenum into "proto-" and "meta-" duodenum which will appeal to the clinician as more useful than the old anatomical divisions. Between the

* Read at a meeting of the Gloucestershire Branch of the British Medical Association.

pylorus and the duodenal papilla the gut presents characteristics which serve to distinguish it almost as a separate organ. "It has a distinct embryological origin, being derived from the fore-gut, whereas the rest of the duodenum, which it is proposed to call the meta-duodenum, belongs to the mid-gut. It has a blood supply through the artery of the fore-gut, the coeliac axis, and not through the artery of the mid-gut, the superior mesenteric, which supplies the rest of the duodenum. . . . It has no valvulae conniventes as occur in the meta-duodenum, and possesses special glands which are only met here, the Brunnerian glands." (Cawadias, *Diseases of the Intestines*.) Brunner's glands require especial attention. They occur as a dense layer of acino-tubular glands in the submucosa of the proto-duodenum, rapidly diminishing in number below the duodenal papilla. Altogether they form such a substantial collection that some writers have alluded to them as the "Brunnerian secretory organ," and yet little is known about them. Two books on physiology do not even mention Brunner's glands, others mainly dismiss them as being similar in structure and function to the pyloric glands of the stomach. One reason for our lack of knowledge is that the cells of these glands are extremely fragile, and their histological study in animals after death is a matter of difficulty. This may have a bearing upon the fact that the region of the gut in which they occur, the proto-duodenum, is a very susceptible and tender part of the intestinal canal. It seems, however, to be pretty well agreed that they secrete enterokinase, erepsin, some other less important enzymes, and a hormone which is a gastric stimulant. On this last point Margaret M. Murray says, in a paper in the *Journal of Physiology* (1930, lxi, 48): "(1) The response of the gastric mucosa to intravenous injections of extracts of different parts of the duodenum has been investigated. (2) The results show that when that part of the duodenum which contains Brunner's glands is used, the secretion by the stomach is greater, more HCl and pepsin being produced. When parts that do not contain Brunner's glands are used the effect is insignificant in almost every case." In view of Murray's experiments it seems to us a possible explanation of a disputed point that a pathological irritation of Brunner's glands may, by increasing this gastric hormone, overstimulate the secretions of the stomach and so give rise to the hunger sensations which are frequent in proto-duodenitis and other duodenal complaints.

TWO TYPES OF PROTO-DUODENITIS

The cases of proto-duodenitis dealt with in this paper are those in which the symptoms were suggestive of duodenal ulcer, but in which there was no positive evidence on the clinical side, and in which x-ray examination revealed no ulcer crater, but only tenderness of the duodenum to palpation under the screen. They may be divided into two classes: (1) those with gastro-enteroptosis, and (2) those with the viscera in normal position.

Those with gastro-enteroptosis are found most often in females, since the condition occurs chiefly in that sex. In a series of 111 cases analysed by Bedingfield there were only fifteen males to ninety-six females. On screen examination, with the patient in the erect posture, the pylorus is seen in low position—generally somewhere about the level of the base of the sacrum. The duodenal cap is large and gives the impression of "ballooning out" at each filling, a rather characteristic appearance already suggestive of some partial block to free onward flow. The outline of the cap is even, but this part of the gut is definitely tender to palpation. Occasionally one is fortunate enough to show the whole length of the duodenum on one film, this in itself being evidence of

partial duodenal stasis caused by angulation at the duodeno-jejunal flexure. We are able to show two perfect examples of this in films taken by one of us (J. S. K. S.) (see Special Plate), in each of which the angulation of the gut where it is held up by the muscle of Treitz is a very striking feature.

We now come to the question, "Why should these cases develop a proto-duodenitis?" It has been shown (G. M. Smith, *Journal of Medical Research*, 1914, xxx, 147) that the mucous membrane about the pylorus is not irritated by weak HCl alone, nor by bile alone, but that a mixture of acid and bile acts as a definite irritant. Following on this we suggest that, when, in a case of gastro-enteroptosis, there is sufficient angulation at the duodeno-jejunal flexure to interfere with the free flow of duodenal contents there is back pressure enough to allow the bile to mix with the acid chyme in the proto-duodenum, and that this mixture of bile and acid acts as an irritant to the mucous membrane and produces a proto-duodenitis.

Next come those cases in which the position of the viscera is normal, and in which back pressure in the duodenum is not a factor. If we look upon the causes of proto-duodenitis in them as falling into the same category as those of duodenal ulcer, we find ourselves at once in a much disputed field. Rehfuß quotes references for fifty-six different causes in the production of gastro-duodenal ulcers. We do not wish to discuss these various causes or to add to their number, but there is one point we desire to emphasize—namely, that 95 per cent. of chronic duodenal ulcers, and therefore of the antecedent conditions of duodenitis, occur in that part of the duodenum where Brunner's glands are thickest. This seems to be more than coincidence.

SUGGESTED EXPLANATION

In attempting an explanation, the first thing that strikes one is the general agreement of research workers as to the great fragility of Brunner's glands, shown by the difficulty of their histological study. Cawadias remarked this when investigating the toxic action of the blood serum of nephritic individuals. Again, early last year F. Pescatori thought it worth while to publish (*Italian Archives of Surgery*) a description of three cases in which a hyperplasia of Brunner's glands took place, with inflammatory fibrosis fixing the mucous membrane to the muscular wall of the gut, and consequent ulceration from the fact that "the mucosa at these spots remained exposed to more direct friction against which the normal protection of the mucosa did not exist." Certainly this layer of the delicate Brunner's glands would appear to render the proto-duodenum a vulnerable tract peculiarly susceptible to inflammatory changes.

The second explanation that occurs to one is from the analogy of the reaction of other glands to certain toxins. We know that certain substances affect certain organs of the body during the process of excretion. Iodides may inflame the nasal mucous membrane; bromides, the sweat glands; mercury, the salivary glands; arsenic, by whatever channel it may have been introduced, is eliminated into the stomach, and if it is present in poisonous quantity, produces characteristic erosions and ulcerations of the mucosa (Professor A. J. Clark). We suggest that certain toxins may pick out Brunner's glands and irritate them during excretion, producing a proto-duodenitis which may proceed to ulceration. Especially do we suspect the pyridine bases and other products of tobacco smoking. The definitely greater incidence of proto-duodenitis in smokers may thus be explained. (One of us has had the opportunity of watching a case in which duodenal pain and tenderness to palpation under the screen would always quickly follow indulgence in cigars.)

This suggested excretory function of Brunner's glands is not entirely an original line of thought. In 1842 Curling, describing duodenal ulceration after burns, expressed a belief that "the duodenal glands of Brunner sympathized and compensated for the suppression of the exhalation from the skin by an increased activity." This, he theorized, "leads to an irritation which causes inflammation and ulceration." However, the role of Brunner's glands suggested by us remains in effect still a virgin field for investigation. There appears as yet to be no experimental evidence of any excretory function of these glands, and research on this point might throw much light upon the contentious field of proto-duodenitis and duodenal ulcer.

SUMMARY

1. The proto-duodenum is an especially vulnerable part of the intestinal tract owing to the presence of the fragile Brunner's glands.
2. In cases of gastro-enteroptosis, where there is angulation at the duodeno-jejunal flexure sufficient to cause partial block, an inflammatory reaction may be produced by the presence of an irritant bile and acid mixture in the proto-duodenum.
3. Brunner's glands may become inflamed during the excretion of certain toxins.

DISORDERED REGULATION OF TRAFFIC IN THE GUT

BY

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(With Special Plate)

This paper discusses a definite class of patients who exhibit chronic abdominal pain intermittently. These patients are plentiful, and their pains are due to various parts of the gut contracting against the opposition of sphincters which should regulate the traffic, but fail to do so by their inability to relax properly (achalasia, incorrectly called spasm). The symptoms are extremely varied, depending on the sphincter or sphincters in fault. Hence this disorder is so protean that it is hardly looked upon as a clinical entity, and often evades recognition. It is a motor neurosis very similar to asthma, and not really indigestion, for the food is completely though painfully digested.

TRAFFIC ANALOGY EXPLAINED

It is my purpose to attempt a simplification of this unwieldy subject so that it may be unified and applied in general practice. Hence it must be presented as a simple and portable working conception. Thus the sphincters will be compared with traffic "robots" which get stuck at red. The traffic is then obstructed and pain results.

The normal regulation of traffic in the food canal from mouth to anus is automatic, but its nervous mechanism is extremely complex. At over half a dozen strategic points robots have been erected to ensure the necessary delay and maintain a one-way traffic. The supervision of this intricate control would be very wearing to the central nervous system. It is therefore deputed to scattered groups of humbler, tireless, sympathetic nerve cells, which act as non-commissioned officers. Just as our robots have red and green lights worked by separate wires, so the traffic in the gut is regulated by two separate and opposing nervous wirings—the vagus and the sympathetic acting in balanced opposition. The sympathetic closes the sphincter robots at red and inhibits peristalsis in the tube. The

vagus opens the sphincter to green and stimulates peristalsis. Moreover, there must be intelligent co-ordination between various sphincters. So much for the normal traffic regulation. Before we consider the painful symptoms of disordered regulation of the traffic we must clear the ground by three generalizations, which I think are broadly true:

1. Nervous indigestion is either secretory or motor (or both).
2. Secretory indigestion causes malnutrition rather than pain.
3. Motor "indigestion" causes pain due to tension in part of the tube contracting against obstruction (usually sphincteric). In chronic abdomens it is the main cause of pain, and it forms the chief topic of this paper.

It is important to recognize the rather definite class of patient subject to these stuck robots. Usually these patients are of the anxious, idealistic type, striving to do their best intelligently. Very commonly they have had migraine from about 20 to 40 years of age, and as, in the natural course, the migraine passed off so the traffic pains came on—a sensory (? vasomotor) neurosis in the head being replaced by a motor neurosis in the belly. Both come on in attacks with intervals of good health, both seem to have a toxic-metabolic cause, but both also demand a nervous temperament. Often there is a history of asthma in the family, and that will define the type to the experienced doctor. In many patients creases on the forehead betray the frequency with which their brows are corrugated and reveal their anxious temperaments.

DERANGEMENT OF "ROBOTS" IN THE GUT

At last we are in some shape to study the five chief robots individually:

The first robot is in the upper end of the gullet and it rarely goes wrong. In a middle-aged woman, dysphagia for solids and bilateral throat pains give this diagnosis—confirmed by skiagram. (Plate.) On the screen it was most interesting to watch the movements of the spindle-shaped bolus of barium paste—about 2 inches in length. Each effort to swallow dragged it down an inch or two, but then it sprang back as if suspended on an elastic thread. I have also seen this "spasm" come on a few days before death.

The second robot is at the lower end of the gullet. Food is felt to stick at the lower end of the sternum. There is no pain: indeed, the patient may be unaware of the achalasia. There is no actual spasm, except rarely and late; and the weight of 6 or 8 inches of food, or of a mercury-loaded tube, is sufficient to force this robot. The latter is usually curative, and operation is rarely needed. Generally the patients become very thin and miserable. An oesophagitis may develop from dilatation and decomposing food. G. W. Rake has demonstrated degeneration of Auerbach's plexus in this disease. (Is not this the first neurosis to be manifested to the microscope?) This "cardiospasm" is said to be relieved by tickling the back of the throat, because the robot is relaxed reflexly before vomiting. Water-brash, or the "vomiting" of small quantities of non-acid food, is diagnostic of obstruction at this point. If the robot relaxes too readily to green there may be eructations or heartburn. If the nervous mechanism of eructation is disorganized one finds air-gulping, in which, despite noisy and protracted efforts, more air is swallowed than is eructated.

The third robot is the pylorus. If it sticks at red we get hunger-pains, appearing two hours after food, and relieved by food or alkalis. Duodenal ulcer, gall-stones, or chronic appendix, etc., are often the reflex cause of this "spasm" pain, which indicates operation. It is important, however, to realize that hunger-pain may frequently be an idiopathic neurosis, and thus not call for

W. J. EASTWOOD: FRACTURES OF SHAFT OF FEMUR

FIG. 1.—Man, aged 67 years. Compound fracture of femur. Before reduction.

FIG. 2.—Same patient as in Fig. 1. X-ray taken after 4 weeks of treatment by the Thomas method. Note increase in length.

FIG. 3.—Boy, aged 1 year. X-ray taken 6 weeks after fracture, showing increase in length.

J. S. KELLETT SMITH AND ARTHUR TOM: PROTO-DUODENITIS

X-ray photographs showing angulation of duodeno-jejunal flexure.