from a new infection with such remarkable rapidity after a few irrigations with potassium permanganate, the solution freely entering the lacunae and flushing them out.

It is advisable to stock at least a couple of these tubes, and a 22 F. and a 26 F. are useful sizes, but any size can be obtained. Other uses may be made of these tubes: for instance, the small inner tube may be made longer than the cannula to form a syringe, or a capillary syringe may be passed instead of the probe. A silk covered wire is used for electrolysis. On one occasion I used it as an écraseur by passing a fine steel wire doubled from the

distal end, thus forming a loop. The base of a wart which has been shaved off with the thinned end of a cannula, or a warty area, can also be cauterized in the distended urethra.

I have used this method of treating the lacunae constantly for five or six years and can thoroughly recommend it as a practical, efficient, and expeditious substitute for the probe and collapsible mount.

REFERENCES.

- ¹ Benjamin Bell, *System of Surgery*, vol. ii, second edition, 1785.
² *Ann. de mal. d'org. gén. urinaire*, Paris, 1903, xxi, 1601, p. 241.

OBSERVATIONS ON THE ILEO-CAECAL VALVE IN MAN.

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A PATIENT has recently come under my care in whom the ileo-caecal valve was visible on the surface. Exceptional opportunity was therefore afforded for observations on its behaviour.

The patient, a well nourished, intelligent man, aged 39, suffered from dysentery in Salonica in December, 1916. In September, 1917, caecostomy was performed at another hospital on account of chronic dysentery. The whole of the caecum prolapsed through the wound and turned inside out, and this condition has remained ever since. The large intestine has been irrigated regularly, and there is little or no discharge from it now. An operation to remedy the condition is contemplated shortly, probably

FIG. 1.—The ileo-caecal sphincter at rest.

excision of the caecum and ascending colon with the termination of the ileum, and end-to-end anastomosis of the ileum and transverse colon.

PRESENT CONDITION.

A mass of prolapsed bowel, about the size of a large orange, is seen over the right iliac fossa. It is covered with mucous membrane, which is the mucosa of the caecum turned inside out. At the upper end the orifice leading to the ascending colon can be found beneath a fold. There is no thickening or inflammation or ulceration. The thin wall of the caecum is spread out over coils of ileum, which are not themselves visible, but through the covering of caecum it can be seen that these coils of ileum are in incessant peristalsis; fasting or feeding they are never still.

THE ILEO-CAECAL VALVE.

In the centre of the protuberant mass the ileo-caecal valve is plainly visible all the time. In the somewhat similar case described by A. H. Rutherford¹ the valve could only be seen by drawing aside a fold of mucosa. Through the orifice all the motions pass and are collected in a receptacle. Nothing passes on into the ascending colon.

It is clear at a glance that the ileo-caecal valve should rather be regarded as a sphincter than a valve. It is oval in shape. There is a well marked ring of muscle surrounding it, slightly raised above the surface. Three or four puckers are visible radiating from the slit-like orifice. When the sphincter is contracted it is about three-quarters of an inch long. No folds of ileal mucosa are then visible. It grips the inserted finger.

When the patient is lying quiet in bed the sphincter remains closed, and nothing comes through for hours at a time. Occasionally there may be a little passed, but I have not seen it myself. When the patient is up and about there is rather more activity.

The effectual factor in bringing about activity is the taking of food by mouth. This never fails. Fluids or solids have the same effect, but especially a proper meal of solids. I have timed the reflex on various occasions. It may take place in one and a half minutes, or may be delayed for four minutes.

When activity commences the sphincter relaxes, the orifice lies patent, and may measure $1\frac{1}{2}$ in. across. Folds of ileal mucosa are exposed to view. Having relaxed, it does not contract again until activity ceases, in this respect differing from the pylorus.

First there comes through a spit or two of gas and bubbles, then follows a gush of liquid orange or brown-coloured faecal matter. This continues to come through in

FIG. 2.—The ileo-caecal sphincter relaxed after taking food.

gushes of about $\frac{1}{2}$ oz. at a time at intervals of half a minute, more or less. This goes on whilst food is being taken, and for a variable time, usually about an hour afterwards, unless the food consisted only of a biscuit or glass of milk, in which case the orifice ceases to discharge after twenty minutes or so. Articles of undigested food, such as currants, take about six hours coming through from mouth to ileo-caecal valve.

SPECIAL OBSERVATIONS.

Secretion of Succus Entericus.—On one occasion, just after taking food, the first gush to come through was not faecal, but consisted of a drachm or two of clear watery fluid. It seemed as if the swallowing of food had provoked a reflex secretion of succus entericus, and that on this particular occasion there happened to be no faecal matter in the terminal inches of the ileum, so that the succus entericus came through in a pure state. In ordinary it would be mixed with faeces.

Acid and Alkali Reflexes.—It is well known that the pylorus is controlled by the acidity or alkalinity of the contents of the duodenum. I applied acid solutions, and on another occasion alkaline solutions, to the caecal mucosa near the orifice, both when it was active and when it was quiescent. Neither acid nor alkali had any obvious effect in hindering or stimulating the activity of the ileo-caecal sphincter. This point, as far as I know, has not been investigated before, but the result is not surprising. The conditions of activity of the pylorus and the ileo-caecal sphincter are quite different.

Bismuth Skiagraphy.—Not much information could be obtained by this means. The stomach was viewed with the fluorescent screen, and behaved normally. After four hours a small trace of the bismuth meal remained in the stomach, but most of it was in the pelvic coils of the ileum. On one occasion an attempt was made to determine whether irritation of the caecal wall had any reflex effect in delaying the emptying of the stomach. A clip was applied to the caecal mucosa near the valve, and left on; at the same time a bismuth meal was given. It was found impossible to keep the clip applied; the peristaltic movements of the ileum underneath repeatedly threw it off. The stomach emptied in the normal time.

Influence of Local Stimulation on the Activity of the Ileo-caecal Sphincter.—It was not possible, by stimulation of the mucous membrane of the caecum to start efflux. On the other hand, I repeatedly found that pinching up a fold of caecum near the orifice, when it was in full activity after a meal, delayed the outflow and made the jets less frequent, though it did not check them altogether. This is of considerable importance, as bearing on the question whether chronic inflammation in the ileo-caecal region, as for instance chronic appendicitis, can delay the passage of bowel contents through the sphincter.

Influence of Enemata.—In Rutherford's case, enemata given per rectum stirred up more activity in the ileum than in the colon. In the present observation, enemata and colon wash-outs did not provoke activity of the ileum or discharge of ileal contents.

Plugging the Orifice.—In Rutherford's case inserting a finger into the sphincter caused pain and spasm. My patient, on the other hand, wore a plug in the hole for some time before he came to me, without inconvenience. It was used, so he said, to control the efflux, but needless to say, it failed to do so.

REFERENCES.

- ¹ A. H. Rutherford, *The Ileo-caecal Valve*, 1914.

RENAL EFFICIENCY TESTS IN NEPHRITIS AND THE REACTION OF THE URINE.*

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THE functions of the kidney include three that are equally important—the excretion of the nitrogenous end-products of metabolism, the regulation of the osmotic tension of the blood by the removal of a fluid of higher or lower tension as the case may be, and lastly, the regulation of the reaction of the blood. The efficiency of the kidney in nephritis in regard to the first two of these functions has been studied by many; in regard to the last, only, so far as I know, by Henderson and Palmer. They collected the daily urine of large numbers of nephritic subjects, and found that it tended to be more acid than that of other subjects.

I started some years ago in Toronto the investigation of the nephritic kidney in the performance of this function, but the work was interrupted before much more had been done than to employ for taking the reaction a double titration method, using methyl orange and phenolphthalein. In a solution of sodium phosphate, if all the phosphate is acid phosphate, methyl orange turns pink; if any of it is dibasic this indicator is yellow; when it is all dibasic, and not before, phenolphthalein turns pink. In a solution of mixed phosphates, therefore, by titrating on the one hand with methyl orange and N/10 acid the amount of the dibasic phosphate present is determined, and on the other with phenolphthalein and N/10 soda, the amount of acid phosphate present is determined, and the ratio of the amounts used in the two titrations gives the ratio in which the two phosphates are present. This ratio varies with the reaction, and the reaction of the phosphate mixture may be given as so much per cent. acid or so much per cent. alkali, according to the results of the titration. The reaction of the urine practically always lies between these two points, the

turning points of methyl orange and phenolphthalein respectively. And since the principal constituents of the urine that determine its reaction are the phosphates, the reaction of the urine may be expressed in the same way as that of a pure phosphate solution, in acidity or alkalinity per cent.

In 1916 an exceptional opportunity for prosecuting inquiry into this subject occurred when the nephritis cases of the 3rd Northern General Hospital were collected together in a branch hospital and entrusted to me. The method of testing the condition of the kidney, which I used during two and a half years at this hospital, was what is well known as a water test. The patients, kept in bed, received at 8 a.m. 500 c.cm. of water to drink, but had no food or drink otherwise from supper the night before till noon. Urine was collected, measured in six fractions, from 11 to 7 and then at 8, 9, 10, 11 a.m. and 12 noon; in each the reaction was determined by the method described. It soon became apparent, from the study of perfectly normal subjects under the same conditions, that a large number of the cases still undergoing treatment for nephritis reacted to this test exactly as the normal organism, while others did not. The normal subject produces during the night a urine that is acid, as does also the nephritic subject, but in the morning the reaction in the normal subject swings strongly over to the alkaline side. This more alkaline reaction persists generally to the last specimen collected.

In nephritic patients often the acid reaction persists throughout the test. Normally, of course, too, the urine, scanty during the night, becomes very abundant after drinking water. It is well known that in nephritis diuresis often cannot be produced by drinking water. When there is no diuresis there is frequently not any change in the reaction either, and cases of this kind occurring early in the series studied, suggested naturally that the change in reaction constant in the normal subject undergoing the water test was merely that which, as was shown by Rüdel in 1892, accompanies any diuresis. But tests done on the normal subject and similar in all respects except that the amount of water taken was reduced to 250 or to 100 c.cm. and that consequently the diuresis was proportionately reduced, showed that nevertheless the change in reaction persisted in the same degree as when diuresis was well marked; results are given in Table I that were obtained in this way.

TABLE I.—Normal Subjects.

(Three tests done on the same normal subject.)

	Diuresis, c.cm. per hr.		Alkalinity per cent.	
	Before.	Maximum After.	At Night.	Maximum (at 10 or 11 a.m.).
I. 500 c.cm. ...	40	285	20	91
II. 250 c.cm. ...	27	116	23	85
III. 100 c.cm. ...	37	88	20	89

Precisely similar results were obtained from three tests done on another normal subject, the conditions observed being in all respects the same as in the water tests done on nephritic patients, except as to the amount of water taken in the experiments numbered II and III in Table I.

With more experience of the reaction to the test in nephritic patients it soon became apparent that in them, too, the phenomena occurred separately and were independent of one another. For, in the first place, the matutinal alkaline tide was undiminished in many cases in which the drinking of 500 c.cm. of water produced little or no diuresis, and, secondly, a considerable number of cases were observed in which the diuretic response was normal or but little impaired, while the alkaline tide was missed altogether.

The study of nephritic patients in this way, therefore, brought to light three abnormal types of response—one in which there was little or no diuresis but a normal alkaline tide (Groups III and IV, Table II), one in which there was a diuretic reaction but no alkaline tide (Group V in Table II), and a third in which neither the one nor the other of these phenomena was present in a normal degree (Group VI in Table II).

* Communicated to the Association of Physicians at the annual meeting, July 11th, 1919.