mass ligatures—a more difficult and tedious and less secure way than that of ligating them in segments. The plan of bringing the uterus entirely outside adopted in my first case has the advantage of exposing everything fully to view, whilst equally with the plan of removing the uterus cervix first, directly downwards, it avoids the risk of septic infection of the peritoneum. It can only be done when the broad ligaments are elastic and free from any trace of past cellulitis, and when the uterus is not much enlarged. It is not mentioned by any writer on this subject as possible, nor in any account of operations which I have seen is it mentioned, except that Staudé has published some cases in which, without the anterior wound being made at all, the fundus was retroverted through the posterior one, the cervix being thus not antverted, as usual, and then, lastly, the anterior wound was made.

In order to avoid injury to the ureters, their exact distance from the cervix must be borne in mind. This is the merest fraction under half an inch. They are nearest the cervix, quite at the lowest part of the broad ligaments, and higher up three-quarters of an inch from the side of the uterus. This space is very small. It can be made a trifle larger by firmly grasping the broad ligament between the finger and thumb, when the ureter being of firmer structure than the surrounding parts escapes or is squeezed outwards a little. But we have to cut our coat according to the cloth, and it is absolutely necessary for the lowest ligature to be not further from the cervix than five-sixteenths of an inch. The uterus being now removed, we must sponge out the vagina and get an idea of the position and appearance of the wound. The left index is to be passed in to pull down the peritoneum anteriorly and posteriorly. The anterior is most important. With an Emmet's long needle-holder, and one of his needles, which, however, should be made an inch and a quarter in length, and curved slightly (to be had of Mayer and Meltzer, Bond-street, Leeds), a strong catgut suture is to be passed through the edge of the vaginal wall on the extreme right of the wound; then in order through the posterior flap of peritoneum, through two pieces of broad ligament stump (at opposite edges, so that they may not lie superimposed in the wound), through the anterior flap of peritoneum, and lastly through the anterior vaginal wall. These sutures should pass through the stumps at the further side of the constricting silk ligatures, so that when the wound is closed the latter are extra-peritoneal. Two similar catgut sutures at each side of the supra-vaginal wound are sufficient to bring it together and to fasten the pedicles in the wound. A drainage tube should be placed centrally, and fixed to the posterior vaginal wall low down by a suture. It can easily be removed by cutting this suture, without any disturbance or exposure of the wound. The ends of the catgut sutures which bring together the supra-vaginal wound should be cut short, but those of the silk constricting ligatures on the stumps should be left an inch and a half long and lying loosely in the vagina. These will come away in about a fortnight. The vagina, and especially the wound, should now be dusted lightly with iodoform, and the vagina plugged loosely with iodoform gauze. The drainage tube should be cut off so that the end is well within the vagina, lest air should enter the peritoneum. The end of the tube is to be packed round with absorbent wool. One advantage of leaving the silk ligatures on the pedicles so long is that in the event of secondary hæmorrhage the end of each pedicle could be examined separately by sight and any bleeding vessel taken up.

Much attention has been given by writers on this operation to the two questions of whether the peritoneum should be included in the sutures closing the vaginal wound, and whether a drainage tube should be used. A conclusion on these points can hardly be helped by elaborate statistics, for our knowledge of peritoneal wounds is quite sufficient from other sources to teach us that the peritoneum flaps should be brought down and included in the wound; but the result of statistics proves this almost foregone conclusion. There are other ways of doing this, as by using a continuous suture, which is said to be more quickly done, but I think this would seal up the parts rather too firmly. A little capillary exudation should be allowed.

There have been many modifications of the operation, which seem to me should be condemned. Such as removal of the cervix at the commencement of the operation, the use of mass ligatures either as temporary or permanent means of arresting hæmorrhage from the broad ligament, relying upon pressure forceps instead of ligatures for the same purpose, the use of elastic ligatures, putting ligatures on the

broad ligaments with the uterus *in situ*, unnecessary ligating the vaginal roof before incising it, and especially leaving the vaginal and peritoneal wounds unclosed. On the other hand, the plan of bisecting the uterus and removing one half first, which has been followed by Müller of Vienna, Zweifel, and by Alexander Simpson of Edinburgh is a modification worth bearing in mind.

In conclusion, my object in this paper has been to try to work out the minute details of this operation, choosing from the various plans which have been previously followed those parts of each which seem most likely to conduce to success. It seems not improbable that the mortality may be considerably reduced. If it is properly done, there seems to me very little for the patient to die from, for the peritoneum can be guarded from sepsis by the methods I have indicated, and hæmorrhage can also be with great certainty prevented. Moreover, if the pedicles are treated extra-peritoneally and peritoneal surfaces everywhere lie together in the wound, it will be shut off almost at once from the general peritoneal cavity. By far the greatest number of these operations have been done on the Continent, and especially in Germany; but this arises from their being done unnecessarily, when supra-vaginal amputation would have given equal security with much less risk. For instance, out of nineteen cases of Fritsch's, sixteen were cancer of the cervix and only three of cancer of the cervix with enlargement of the body. The same proportion holds good with most German operators. In this country the operation has been performed comparatively seldom; but it has been generally confined to suitable cases—viz., cancer of the body or of the neck at its upper part. In Yorkshire it has, I believe, only been done four times, and the two cases related were the only successful ones; but I say this open to correction.

COMPARATIVE EXPERIMENTS BETWEEN THE ACTION OF PAPAIN (FINKLER) AND PEPSINE.

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PAPAIN (Finkler) is a ferment which is manufactured according to my specification from the plant called *Carica papaya*. It is an albuminous body, which under certain conditions can change albumen into peptone. The conditions which produce this change are very different from those under which pepsine and pancreatine produce the same effect. In order to demonstrate the effect of papain I shall indicate various experiments made by myself which will give an exact insight into the conditions of the effect and also a comparison of the effect of pepsine. For these comparative trials I used a pepsine of known best quality, most of the commercial pepsines being decidedly weaker than the one I used.

I. HAS PAPAIN REALLY A DIGESTING PROPERTY?

Experiment 1.—(a) Five grammes raw minced meat, 50 c.c. water, 5 c.c. of a 1 per cent. papain solution (1 gramme in 100 c.c. water). This mixture was put into the oven and kept for twenty-one hours at 38° Centigrade; it was then filtered. The filtered portion contains the albuminous substance of the meat turned into peptone, which is *not* precipitated by nitric acid, nor by ferrocyankalium or acetic acid; it is precipitated by tannic acid. The xanthoprotein and biuret reactions are well shown. The non-peptonised residue of the meat weighs when dried 0.1 gramme; therefore 90 per cent. of the solid portion of the meat has been dissolved in water. Of the albuminous substances of the meat, 87 per cent. were peptonised—which shows a very energetic degree of digestion. (b) For comparison, 5 grammes raw minced meat, 55 c.c. hydrochloric acid (0.2 per cent.), and 5 c.c. of a 1 per cent. pepsine solution were treated as above. After twenty-one hours, 70.6 per cent. of the albuminous substance of the meat was peptonised.

Experiment 2.—(a) Five grammes meat, 50 c.c. water, 0.5 c.c. of a 1 per cent. papain solution. After forty hours the non-peptonised residue of the meat weighed 0.19 gramme; of the albumen of the meat 77.7 per cent. was peptonised. (b) Five grammes meat, 50 c.c. hydrochloric acid (0.2 per cent.), 0.5 c.c. of a 1 per cent. pepsine solution. After forty hours the non-peptonised residue weighed 0.19 gramme; of the albumen of the meat 77.7 per cent. was peptonised.

Experiment 3.—(a) Ten grammes meat, 20 c.c. water, 1.5 c.c. of a 1 per cent. papain solution. After thirty-six hours, 73.5 per cent. of the albumen of the meat was changed into true peptone. (b) Ten grammes meat, 20 c.c. hydrochloric acid (0.2 per cent.), 1.5 c.c. of a 1 per cent. pepsine solution. After thirty-six hours, 18.0 per cent. of the albumen of the meat was changed into true peptone.

Résumé of the Three Experiments.

Ferment.	Digested albumen of the meat.	Time.	Proportion of the quantity of ferment to the meat.	Proportion of the quantity of the meat to the liquid.
Papain (Exp. 1) ...	87.0 %	21 hrs.	1 : 100	1 : 10
" (" 2) ...	77.7 %	40 "	1 : 1000	1 : 10
" (" 3) ...	73.5 %	36 "	1 : 600	1 : 2
Pepsine (" 1) ...	70.6 %	21 "	1 : 100	1 : 10
" (" 2) ...	77.7 %	40 "	1 : 1000	1 : 10
" (" 3) ...	18.0 %	36 "	1 : 600	1 : 2

Papain therefore shows a more energetic peptonising power than pepsine, and especially so when the proportion of the liquid to the albumen is small—i.e., in the proportion of concentration in which food generally exists in the stomach and intestines. The great variability in the quality of commercial pepsine (some of which will, under the most favourable circumstances, not peptonise more than 20 per cent. of the albumen of the meat) gives papain (Finkler) also the preference, as it is always made of one uniform quality.

The peptonising of hard-boiled egg (egg boiled five minutes and rubbed down) is demonstrated by the following experiments, which were made in an oven at 38° Centigrade.

Experiment 4.—(a) Five grammes albumen, 50 c.c. water, 5 c.c. of a 1 per cent. papain solution. After sixty hours in an oven small residue—peptonised 95 per cent. (b) Five grammes albumen, 50 c.c. hydrochloric acid (0.2 per cent.), 5 c.c. of a 1 per cent. pepsine solution. After eighteen hours all peptonised = 100 per cent.

Experiment 5.—(a) Five grammes albumen, 50 c.c. water, 0.5 c.c. of a 1 per cent. papain solution. After sixty hours all peptonised = 100 per cent. (b) Five grammes albumen, 50 c.c. hydrochloric acid (0.2 per cent.) 0.5 c.c. of a 1 per cent. pepsine solution. After eighteen hours all peptonised = 100 per cent.

Experiment 6.—(a) Five grammes albumen, 10 c.c. water, 0.5 c.c. of a 1 per cent. papain solution. After forty-five hours peptonised 80 per cent. (b) Five grammes albumen, 10 c.c. hydrochloric acid (0.2 per cent.), 0.5 c.c. of a 1 per cent. pepsine solution. After forty-five hours peptonised 40 per cent.

Experiment 7.—(a) Ten grammes albumen, 20 c.c. of a 1 per cent. papain solution. After fourteen hours all albumen is dissolved. *Reactions:*—1. Boiling only produces a slight precipitate. 2. Xanthoprotein reaction succeeds very well. 3. Biuret reaction also shows very nice pink (rosy red). 4. Acetic acid and ferrocyankalium give slight precipitate; the albumen is therefore all peptonised = 100 per cent. (b) Ten grammes albumen, 20 c.c. of a 1 per cent. solution pepsine in 0.2 per cent. hydrochloric acid. Albumen dissolves slowly after forty-five hours; only 50 per cent. of the albumen is peptonised.

Résumé of the Four Experiments.

Ferment.	Albumen peptonised.	Time.	Proportion of quantity of ferment to albumen.	Proportion of the albumen to liquid.
Papain (Exp. 4) ...	95.0 %	60 hrs.	1 : 100	1 : 10
" (" 5) ...	100.0 %	60 "	1 : 1000	1 : 10
" (" 6) ...	80.0 %	45 "	1 : 1000	1 : 2
" (" 7) ...	100.0 %	14 "	1 : 50	1 : 2
Pepsine (" 4) ...	100.0 %	18 "	1 : 100	1 : 10
" (" 5) ...	100.0 %	18 "	1 : 1000	1 : 10
" (" 6) ...	40.0 %	45 "	1 : 1000	1 : 2
" (" 7) ...	50.0 %	45 "	1 : 50	1 : 2

Result.—Hard-boiled egg is better digested by pepsine if the quantity of liquid be large in proportion. As soon, how-

ever, as a more concentrated mixture is employed, the superiority of papain is at once evident.

II. WHAT EFFECT CAN BE OBTAINED BY PAPAIN IN THE HUMAN BODY?

a. Concentration of the solution is of first importance.—It is impossible to create in the stomach and intestines such amount of liquid as would be favourable to the effect of pepsine; the conditions, therefore, are very much in favour of papain.

b. Importance of the reaction.—Pepsine acts in the stomach but not in the intestines, as in the latter the reaction is neutral or alkaline. Papain has little effect in the stomach, as the reaction there is acid; when, however, the stomach is neutral or alkaline papain will peptonise, while pepsine will be useless. The degree of acid reaction in the stomach varies greatly, especially in the case of a stomach out of order, in which case the reaction can be so highly acid or alkaline that pepsine would be of no value at all. In the treatment of stomach catarrhs we will, moreover, find that as a general rule the contents of the viscus have been rendered artificially neutral or alkaline by the administration of remedies, so that in these cases pepsine will have absolutely no effect. Papain, on the contrary, will act energetically.

c. Regarding the time available for the digestive ferment to act in the body.—In the case of pepsine this is necessarily very short, as the action ceases when the food enters the alkaline reaction of the intestines. In the case of papain, which can act well in alkaline reaction, the time is practically unlimited, as it continues acting on the food during the whole time it remains in the body.

For all these reasons the conditions for the effect in the human body are far more in favour of papain than of pepsine, and especially as under existing circumstances (high degree of concentration) papain has been shown to act much more energetically; it is only too clear that the preference should be given to papain as a digestive ferment for the treatment of dyspepsia. Besides for dyspepsia, the papain is of great importance in the treatment of diphtheria. Its effective power consists in the circumstance that no free acid need be present in the application, and further, that the moisture of the diphtheritic membranes is quite sufficient to allow the ferment to dissolve the solidified substances of the membranes. No other ferment has so far been able to obtain these results. It is on this account that many competent experimentalists and specialists have lately made observations as to these points. From all these circumstances there is no doubt that in papain we have a ferment which has a great future before it, and it is for this reason that I have made a special study of the manner of preparing the papain. I have had the satisfaction of obtaining the most favourable results from its use in the treatment of disease.

Bonn.

NOTES ON AN OUTBREAK OF BERI-BERI ON THE CHINESE TRANSPORT SHIP TOO NAN, STATIONED AT NEWCASTLE-UPON-TYNE.

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THE world-wide reputation of Sir Wm. G. Armstrong and Co. as gunmakers draws from time to time the gunboats of many of the nations to the Tyne. Italians, Spaniards, Chilians, Indians, and others have in their turn visited us, and whilst in most their advent and departure have been apparently a source of pleasure to all concerned, such has not always been the case. About eighteen months ago an Indian gunboat arrived in the Tyne in the cold season of the year, and within a very short time several of the sailors died apparently from cold, but the chief symptom of whose illness, it should be remembered, was hæmaturia. None of these cases were seen by the writers of this article. Two months ago the Chinese Government sent over in their transport ship the *Too Nan* 640 sailors to man two new gunboats built on the Tyne. This was not the first