She left the hospital in excellent health on October 12th, weighing 9 st. 13 lb.

I did not see the patient again until August 26th, 1908. She then told me that she had remained quite well until a month previously, when she began again to suffer from pain in the epigastrium bearing no relation to food. On passing a tube in the early morning the stomach was found empty. After a test meal 40 c.cm. of gastric contents were drawn off, containing a good deal of mucus and some blood.

Total chlorides	...	...	...	0.430
Free HCl	...	...	...	0.032
Protein HCl	...	...	...	0.317
Mineral HCl	...	...	...	0.080
No lactic acid.				

In view of the recurrence of hyperacidity and the presence of blood in the stomach I feared the recurrence of ulceration. When the patient left the hospital I had advised her never to take meat again, a warning which she had disregarded. I again cautioned her as to her diet, and prescribed bismuth and alkalis. The patient so strongly objected to the use of the stomach tube, and was so alarmed at the sight of blood in the gastric contents that she discontinued attendance for some months, so I lost sight of her again, although I heard indirectly that she was better.

In February, 1909, I saw her again. She was then much better although occasionally she suffered from attacks of pain, usually coming on during the night, accompanied by an acid taste in the mouth, and not bearing any relation to food. Her weight was 10 st. 12 lb. There was no tenderness of the abdomen, the abdominal scar remained soundly healed, and the patient looked in excellent health. On bismuth and hydrocyanic acid she quickly lost her pain, and I believe that if only she would be more careful in her diet, she would remain well.

In a few of the recorded cases the total acidity of the gastric contents was estimated before operation, and in still fewer the amount of free hydrochloric acid, as estimated by Topfer's method, is noted. The estimation of free HCl by this method, however, is very inaccurate, and the amount of total acidity includes both organic and inorganic acids. The important point, it appears to me, is the amount of free hydrochloric acid present in the gastric contents, and this is well illustrated in the case just related. On admission into the hospital for the second time, the free HCl in the gastric contents was 0.072 per cent., more than three times the normal amount. The percentage of free HCl in the fluid escaping from the jejunal fistula—that is, in the jejunal contents—was 0.044, or more than double the amount normally present in the stomach. This observation appears to me of considerable significance with regard to the etiology of jejunal ulcer. Here we had evidence of the presence of a fluid rich in free HCl in a portion of intestine normally unused to the presence of acid contents. That under such circumstances ulceration should ensue is not surprising. The analysis of the gastric contents after a week on milk diet showed a very different state of affairs. The percentage of free HCl was then only 0.018, or just about normal, and the percentage of free HCl in the jejunal contents had diminished from 0.044 to 0.004. From these analyses we may, I think, draw the following inferences:

1. That the presence of an ulcer in the jejunum was connected with the large percentage of free hydrochloric acid present in the jejunal contents.

2. That as the high percentage of free hydrochloric acid in the gastric contents rapidly diminished to a normal amount on a milk diet, the excess of free hydrochloric acid in this case was probably due to errors in diet.

3. That the bile and pancreatic juices in the jejunum usually neutralize the free hydrochloric acid which escapes from the stomach. When, however, free hydrochloric acid reaches the jejunum in great excess, the alkaline juices are insufficient to neutralize all the free hydrochloric acid present.

Incidentally I may point out that although after a week on a milk diet the amount of free HCl had diminished by nearly two-thirds, the total acidity had diminished only from 85 to 80. This illustrates how little information Topfer's method gives us as to the amount of inorganic acids present in the gastric contents.

ASE II.—Anterior Gastro-jejunostomy (May, 1899) for Pyloric Stenosis supposed to be Malignant: Recurrence of Pain Five Years later: Seven Years later Separation of Adhesions round Jejunum: Good Health until March, 1908: Death in September, 1908.

Anterior gastro-jejunostomy by means of a Murphy's button was performed by the late Mr. Walsham in May, 1899, on a man aged 69 years suffering from pyloric stenosis, which was thought to be malignant. He remained well for nearly five years, but

then began to suffer constant pain after food. He was sent to see me by Dr. Howard Distin, who thought that the pain was due to the irritation of the Murphy button, which, so far as was known, had never been passed. The patient's weight was 8 st. 6 lb., a gain of 3 st. since the operation. The stomach was somewhat dilated, and just above the level of the umbilicus there was a rounded induration in the left rectus muscle.

Under medical treatment the patient improved and remained well until the beginning of 1906, when he began to suffer severe pain in the left side, with occasional attacks of vomiting. I saw him again in July. He looked thinner and more careworn than when I last saw him, and he had lost 2 st. 4 lb. In the left rectus muscle was a tender nodular swelling about the size of a small Tangerine orange. A test meal showed the presence of free hydrochloric acid, a trace of lactic acid. An x-ray photograph did not show the presence of a button in the stomach.

Operation.

On July 20th I reopened the abdomen. There were adhesions at the pyloric end of the stomach. The pylorus was markedly stenosed, but all trace of the former tumour had disappeared. The anastomosed loop of jejunum was firmly fixed to the anterior abdominal wall for a distance of 2 in. There was considerable induration of the jejunal wall as if there existed, or had existed, an ulcer of the jejunum which had resulted in the adhesion of the jejunum to the abdominal wall. The separation of these adhesions would have involved an extensive operation, which I did not think justifiable in view of the patient's age. The other adhesions were divided, and the abdominal wound sewn up.

After-History.

The patient remained well until March, 1908, when his appetite began to fail. He suffered no pain, but he vomited occasionally. I saw him again in July. The stomach was then considerably dilated, and there was marked stomach splash. It was evident that the stomach was not emptying itself properly. With occasional lavage he improved for a time, but later his strength gradually failed, and he died in September, 1908.

Through the courtesy of Dr. Distin I was able to examine the abdominal viscera. On opening the abdomen an interesting state of things was found. The stomach was enormously dilated and flabby. High up towards the cardiac end the button could be plainly felt loose in the cavity of the stomach. The anterior wall of the stomach had been drawn downwards and backwards, so that the site of the anastomosis was posterior rather than anterior. Although an anterior operation with a long loop had been performed, the length of the afferent limb from the ligament of Treitz to the junction with the stomach now measured 4 in. only, and it emerged from under the colon near the splenic flexure. Until a careful examination had been made it was difficult to believe that an anterior and not a posterior operation had been performed. The stomach was distended with formalin and examined at a later date. When the stomach was opened I found that the anastomotic opening was much contracted and admitted only the tip of the little finger, and was surrounded with a considerable amount of indurated tissue. In the jejunum just below the anastomosis the mucous membrane was puckered as if the site of an old ulcer, and microscopical examination showed old chronic inflammation. The pylorus was indurated and almost completely stenosed, so that its lumen was diminished to the size of a cedar pencil.

This case bears out a view I expressed some years ago—that, after the anterior operation, the afferent limb, although at the time of operation it is drawn up round the colon, becomes later displaced outwards so that it emerges from under the colon at or near the splenic flexure. Nature thus appears to protect the afferent loop from the influence of the excursions of the movable part of the transverse colon.

REPORT CXV.

THE CARBON MONOXIDE METHOD OF DETERMINING THE TOTAL OXYGEN CAPACITY AND THE BLOOD VOLUME IN ANIMALS:

WITH SOME EXPERIMENTS ON ANAEMIA AND TRANSFUSION.

BY

A. E. BOYCOTT, and C. G. DOUGLAS,
M.D., B.Ch.Oxon. M.B., B.Ch.Oxon.

[FROM THE PATHOLOGICAL LABORATORY, GUY'S HOSPITAL.]

THE carbonic oxide method of determining the total oxygen capacity and the blood volume described by Haldane and Lorrain Smith¹ has been applied to experiments on rabbits. Using the apparatus previously described by Douglas,² we find that this can be done with a considerable degree of accuracy.

1. In a series of experiments, we have withdrawn from or added to the circulating blood of a rabbit a quantity of

blood of known oxygen capacity, as determined by the haemoglobinometer, with the following results:

C.cm. O ₂ Capacity Before.	C.cm. O ₂ Capacity Removed or Added.	C.cm. O ₂ Capacity After.		
		Calculated.	Found.	Difference.
15.9	- 5.7	10.2	10.0	- 0.2
26.7	- 6.6	20.1	18.6	- 1.5
16.8	- 6.9	9.9	10.4	+ 0.5
21.5	- 5.95	15.55	15.4	- 0.15
13.0	- 4.8	8.2	8.7	+ 0.5
21.3	+ 6.1	27.4	27.8	+ 0.4
22.5	+ 6.5	29.0	28.5	- 0.5
26.0	+ 7.05	33.05	32.5	- 0.55

2. In another series we compared the total oxygen capacity as found by this method with that calculated colorimetrically by bleeding the animal to death, washing out the vessels, and subsequently mincing and extracting the tissues (Welcker's method). The results were not

Total Oxygen Capacity.		Difference per Cent.
CO Method.	Welcker's Method.	
21.0	19.4	+ 8
17.8	14.8	+ 20
16.1	14.7	+ 10
24.7	21.3	+ 16
23.3	23.3	± 0
26.05	30.55	- 15
21.0	21.1	- 0.5
		+ 5.5

altogether satisfactory; the CO method appears to give results somewhat too high, but we have not been able to make out the reason.

3. In three animals we studied the sequence of events following a single severe haemorrhage. The chief points

Weight.	Total O ₂ Capacity Before Bleeding.	Amount bled.		Days till Original O ₂ Capacity was Regenerated.	Ultimate O ₂ Capacity Reached.	In Days After Bleeding.
		C.cm. Blood.	C.cm. O ₂ Capacity.			
I. 2,180 ...	16.1	41.5	5.7	27	19.5	53
II. 2,450 ...	15.9	48.0	6.9	19	20.4	55
III. 2,170 ...	13.4	44.5	4.8	27	17.6	49

which arise are: (1) In the days immediately following the haemorrhage the blood volume may be considerably increased over the normal; (2) the percentage oxygen capacity (haemoglobinometer readings) is a very uncertain index of the rate and degree of regeneration; (3) over-regeneration occurs; (4) the rate of regeneration may be quantitatively followed day by day in the intact animal; over the whole period of regeneration it varies from 0.18 to 0.36 c.cm. O₂ capacity (0.13 to 0.27 gram haemoglobin) per day, sometimes being as great as 0.41 c.cm. (0.31 gram) per day.

4. In other three animals we followed the effects of repeated haemorrhage. We did not obtain any permanent dilution of the blood, as was found by Lorrain Smith in human cases of haemorrhagic anaemia.³ The chief points of interest are the large amounts of blood which may be removed with impunity and the rapid regeneration which occurs. At some points this reached the high figure of 2.2 c.cm. O₂ capacity (1.65 grams haemoglobin) per day.

Weight.	Total Oxygen Capacity.		Amount bled.		C.cm. Oxygen Capacity Regenerated.	
	Before Bleeding.	After Bleeding.	C.cm. O ₂ Capacity.	In Days.	C.cm. O ₂ Capacity.	C.cm. per Day.
I. 2,420...	16.2	18.5	49.9	47	52.2	0.870
II. 3,010...	18.6	26.0	28.9	23	36.3	0.527
III. 3,575...	26.65	23.5	23.8	6	20.65	0.941

5. Aniline poisoning is not altogether suitable for study by this method since the blood becomes yellow and muddy. We found, however, that the apparent anaemia as judged by the haemoglobinometer is greater than the real loss of haemoglobin owing to a marked increase in the volume of the blood.

Date.	Weight.	Total O ₂ Capacity.	Percentage O ₂ Capacity.	Volume of Blood c.cm.	Treatment.
March 26	3,120	19.5	12.0	163	
" 28	3,250	21.2	10.9	195	
" 30	3,020	20.9	13.2	158	0.2 c.cm. aniline daily from Mar. 30th to April 4th.
April 2	2,970	17.5	12.8	137	
" 4	3,000	19.6	11.2	175	2.0 c.cm. aniline April 6th.
" 8	2,980	12.4	5.7	217	
" 10	2,900	10.1	2.8	360	
" 13	2,820	10.5	3.8	276	
" 16	2,670	13.2	5.1	260	
" 24	2,450	10.6	6.5	163	
March 29	2,680	19.8	11.3	175	

The total O₂ capacity was actually halved, while the haemoglobin readings fell from 65 on the human scale to 15 instead of 32.

6. In a case of marked anaemia associated with suppuration, which arose fortuitously in a rabbit which was in hand, we found a marked instance of chlorotic anaemia associated with some loss of total haemoglobin.

Date.	Weight.	Total O ₂ Capacity c.cm.	Percentage O ₂ Capacity c.cm.	Blood Volume c.cm.	Remarks.
May 14	3,200	23.0	12.0	192	
" 22	3,080	23.2	12.95	179	
June 2	3,070	19.5	9.25	210	
" 4	3,000	18.8	9.6	196	
" 11	2,880	18.9	7.6	248	
" 12	2,850	17.3	6.5	266	Obviously ill.
" 13	2,740	15.3	6.7	228	
" 15	2,820	13.6	4.9	277	
" 18	2,620	13.5	3.05	443	Died June 18-19.

The blood volume here was more than doubled, and the haemoglobin fell to 16, though in proportion to the real loss in total haemoglobin it should not have fallen below 39.

7. In three animals we made a series of observations on the fate of rabbits' citrated blood transfused into rabbits. In this series on the whole the haemoglobinometer gives a fairly accurate measure of the total haemoglobin, though we met with some marked exceptions in detail. The chief points ascertained are (1) an accurate measure of the rate of disappearance of transfused blood; (2) the fact that a second transfusion disappears much more quickly than the first. The details of this are still occupying our attention. We may say here, however, that there are no external signs of haemolysis, and the serum is not haemolytic to rabbits' red cells.

Weight of Animal.	Total O ₂ Capacity before Transfusion.	First Transfusion.			Second Transfusion.			Third Transfusion.		
		Amount Transfused.		Normal reached in Days.	Amount Transfused.		Normal reached in Days.	Amount Transfused.		Normal reached in Days.
		C.cm. Blood.	C.cm. O ₂ Capacity.		C.cm. Blood.	C.cm. O ₂ Capacity.		C.cm. Blood.	C.cm. O ₂ Capacity.	
3,750	21.9	52	6.5	8	61	8.01	4	60	5.4	2
3,600	25.9	56	7.05	16	80	9.2	5	70	9.3	7
2,600	21.8	51	6.1	12	63	6.6	5	—	—	—

8. Incidentally we have obtained a number of measurements of the total oxygen capacity and blood volume in normal rabbits, which may be summarized as follows:

	Body Weight, Grams.	Percentage Oxygen Capacity	Total Oxygen Capacity	Blood Volume.	Per 100 Grams c.cm. Blood.	Body Weight, c.cm. Oxygen Capacity
Average of 3 males	2,490	14.2	19.5	138	5.51	0.780
Average of 12 females	3,115	13.0	21.7	170	5.44	0.697
Maximum..	4,040	16.8	28.7	337	8.6	0.97
Minimum..	2,090	8.5	12.0	84	3.8	0.53

9. The chief results of immediate practical import are three in number. In the first place, the general accuracy of the Haldane-Lorrain Smith method is fully established. In the second place, we have found several examples (after haemorrhage, aniline poisoning, spontaneous anaemia) in which the degree of anaemia indicated by the haemoglobinometer is more profound than the actual deficiency of haemoglobin existing at the time—cases, in short, in which the pathological condition is, as it is in chlorosis, in part a dilution rather than a defect of blood. Thirdly, it is shown that transfusion, if practised as a therapeutic measure, can only be done once on the same individual with much prospect of benefit; the second and subsequent lots of transfused red corpuscles are disposed of so quickly by the recipient that they cannot be of much use.

REFERENCES.

¹ *Journal of Physiology*, vol. xxv, 1900, p. 331. ² *Ibid.*, vol. xxxiii, 1906, p. 493; and vol. xxxiv, 1906, p. 210. ³ *Trans. Path. Soc.*, vol. li, 1900, p. 328.

Memoranda :

MEDICAL, SURGICAL, OBSTETRICAL.

TREATMENT OF GONORRHOEA BY ALLOSAN.

SANTALOL preparations have been widely used for the treatment of gonorrhoea; indeed, of the liquid esters of this drug there is no lack, but only recently has a santalol preparation in a solid form been put upon the market under the name of "allosan," which is the allophanic ester of santalol, and has the formula $\text{NH}_2 \text{ CO NH CO OC}_{15} \text{H}_{25}$. It is a white powder of a mild aromatic odour, tasteless, and non-irritating to the mucous membranes of the mouth and oesophagus; it is split up in the intestine, where it does not produce any irritative effect, the separation of santalol beginning after about two hours. A suitable dose is 15 grains three times daily, although in some cases I have given 20, and even 30, grains thrice daily without any harmful effect. I do not wish to claim that allosan is different in its action to santalol, the medicinal active component of East Indian sandalwood oil. It is not, of course, a substitute for the local treatment of gonorrhoea with or without complications, but it is a valuable adjuvant to local treatment. Its action seems to be to diminish the secretion and relieve the irritation in acute uncomplicated as well as complicated cases (cystitis colli posterior urethritis).

The following are brief notes of some cases in which this drug was used:

Mr. J., aged 20, complained of burning pain on passing water, and inability to sleep owing to painful erections; there was a

thick yellowish discharge and painful enlargement of the right testicle; this condition had lasted for ten days without medical treatment. Allosan 15 grains was prescribed in powder three times daily, while locally the orchitis was treated with belladonna and glycerine. In ten days the discharge was practically gone, only a thin, watery, scanty discharge occurring early in the morning; after another four days' treatment the discharge had entirely disappeared and the chordee had ceased. In this case I was satisfied with allosan and glycerine of belladonna, and no injections were given. The patient returned in three weeks and reported that he was quite free from any further symptoms or signs.

Mr. S., aged 28, complained of severe scalding during micturition; a thick discharge had been present for a fortnight; he had been under medical treatment without appreciable relief. Allosan 30 grains was ordered as powder four times daily. In four days the discharge was much thinner, he passed water with considerably less pain, and slept better. The treatment was continued for another five days, when the discharge was watery and scalding pain during urination had nearly gone. The treatment with allosan was continued for another ten days, with injections of protargol 2 per cent., and at the end of this time the patient was quite well.

I have selected these two cases as typical examples of gonorrhoea. I have now treated about 30 cases of gonorrhoeal infection in man with allosan, and the result has been uniformly successful. In the majority of cases towards the end I have, of course, used injections; but that does not diminish the value of the good results obtained by the allosan treatment in the early stage of the infection.

JOHN R. O'BRIEN, M.D., F.R.C.S.Irel.

North Kensington, W.

LACTIC ACID BACILLI IN THE TREATMENT OF MELANCHOLIA.

FORD ROBERTSON, whose recent brilliant researches in association with McCrae in regard to the etiology of general paralysis of the insane have created so much discussion, assigns to toxæmic states a large value in the causation of melancholia. (As a curious recapitulation of the dogmas concerning "black bile" of olden times may be noted the modern ideas of toxins.) Maudsley, Clouston, and many others have noted the invariable concomitance between disordered conditions of the alimentary canal and melancholic states. The latter, it is true, are frequently looked upon as causes, the former as effects. But, for the sake of argument, let us assume a contrary hypothesis.

Last summer it was stated in the BRITISH MEDICAL JOURNAL that the lactic acid bacilli or their product soured milk, or tablets containing the bacilli, had been tried in such conditions as chronic diarrhoea, catarrhal diarrhoea, constipation, etc., and their method of operation was not empirical, but was based on the hostile influence of the lactic acid bacilli on the other organismal denizens of the intestine. The results were gratifying. It occurred to me that, this inimical action having been proved, the lactic bacilli or their products might well have a beneficial effect in melancholia, the reasoning leading to this conclusion being as stated above. In discussing the matter with Dr. David Hunter, of the West Ham Borough Asylum, I found that the same idea had occurred to him.

Having tried the treatment by tablets containing the bacilli and by prepared milk, I have observed such improvement in the cases as to warrant a short note on the subject. In one case in particular the result has been marked—an example of hypochondriacal melancholia exhibiting such typical symptoms as would have marked him inevitably for inclusion in his categories by Burton: "His soul abhorred all meat. Like Job, he cursed his stars. He was weary of the sun, and yet afraid to die;