

## VISCOSITY OF SOLUTIONS OF PLASTEIN AND HETERO-ALBUMOSE.

Plastein		Hetero-albumose	
Hrs.	Viscosity	Hrs.	Viscosity
½	160.7	½	166.7
2½	156.5	1¾	161.6
8	156.0	8	154.8
20	156.3	18	150.7
—	—	30	146.9
—	—	42	146.8
52	156.1		

## VISCOSITY OF VARIOUS PROTEIN SOLUTIONS.

Fibrin		Casein		Gliadin		Glutein		Edestin	
Hrs.	Viscosity	Hrs.	Viscosity	Hrs.	Viscosity	Hrs.	Viscosity	Hrs.	Viscosity
—	—	¼	266.8	—	—	—	—	—	—
—	—	—	—	—	—	—	—	2	175.9
4	223.1	5	178.0	—	—	—	—	3	169.1
8½	179.2	—	—	8½	181.4	9	247.8	10½	153.0
23	158.3	18	163.3	24	165.1	26	226.1	28	146.3
54	151.3	52	154.6	47	155.5	—	—	53	143.1

The viscosity determinations were made at the Laboratory of the U. S. Fish Commission, Woods Holl, Mass.

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### The action of bile and some of its constituents upon intestinal peristalsis and the circulation.

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In their experiments with a Vella fistula, Fubini and Luzzati found that a pea, fastened to a thread, passed along the bowel more quickly when ten to fifteen minutes previously they had injected two grams of bile. C. Eckhard,<sup>1</sup> of Giessen, also studied the influence of the bile upon the peristaltic movement of the small intestine.

Eckhard experimented upon rabbits. He used a sodium chloride bath and studied the movements of the intestine *in situ* after opening the abdomen. After the injection into the duodenum of one cubic centimeter of bile of the rabbit the duodenum remained for ten minutes in absolute rest. He injected three c.c. of bile of rabbit, calf and sheep in different parts of the small intestine with the

<sup>1</sup> Eckhard: *Centralblatt für Physiologie*, 1889, p. 49.

same result, the intestine remaining quiet fifteen to twenty minutes. If, however, the intestine remained for some time in the salt solution, it became more sensitive to the irritant. With the injection of large quantities of bile there was more frequently than before little wave-like movements, although Eckhard does not feel sure that this was the result of the bile injected.

Drs. Hallion and Netter<sup>1</sup> have studied the influence of bile on the peristalsis of the intestine. They operated on dogs curarized or narcotized by chloralose or by morphine and chloral. By a small button hole in the small (mainly in the duodenum) intestine they introduced a balloon which was connected with a water manometer by means of rubber tubing. The balloon was flexible rubber and mounted upon a metal tube perforated by a large number of lateral openings, which prevented bends of the balloon upon itself. The water manometer was connected with a Marey tambour which inscribed the movements. After the balloon was inserted the abdomen was closed by a suture and the movements registered for more than an hour, so that subsequent curves produced by the bile could be closely compared. The bile was injected either into the blood or into the intestine. Ox bile was used, concentrated by desiccation at a low temperature, but subsequently when used diluted to its original volume by water. Then 10 c.c. of bile was injected into the rectum. At the end of four minutes repeated movements of defecation ensued, followed by an irregular rhythm for eight minutes. The intravenous injection of bile (3-7 c.c.) was by the saphenous vein. There was produced a marked diminution of peristalsis and a relaxation of tonus in the small intestine. Immediately afterwards the contractions and the tonus considerably increased. Bile put in contact with the intestinal mucous membrane exercises a local excito-motor effect upon the small intestine. Intravenously it produces the same effect, a result that is due, in part at least, to an augmented secretion of bile by the liver, induced by the cholagogue influences of the injected bile.

Dr. Albert Schüpbach,<sup>2</sup> working in the Hallerianum under Professor Asher, has studied the effect of bile on the movements of

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<sup>1</sup> Hallion and Netter; *Comptes Rendus de Biologie*, 1907, pp. 182 and 254.

<sup>2</sup> Schüpbach; *Zeitschrift für Biologie*, xxx, pp. 1-41.

the small intestine. Dr. Schüpbach made experiments with a Vella fistula in two dogs; also upon the rabbit's large intestine *in situ*, and by the Magnus method with the isolated intestine of the cat and also upon the rectum in dogs.

In the dogs with Vella fistula he made experiments with a ball of sealing wax, with a thread attached to a little weight. The bile was injected into the intestine. He also found that psychic irritations by holding ham near the nose of the animal excited increased peristalsis. When the bile was injected he noted how fast the ball moved in the intestine. The bile was mixed with physiological salt solution, or with milk, or with water. He also used the Magnus method of excised intestine.

He concludes that bile in the dog either has no special influence upon the small intestine in normal conditions or in many of the cases has an inhibitory effect. In the case of the implantation of the gall bladder into a Vella fistula, the gall of the dog had no special effect upon the peristalsis of the small intestine. In a state of hunger and at different hours after taking nourishment, the action of the bile was indifferent or a weak inhibition of peristalsis ensued.

In rabbits under ether and morphine, with the small intestine *in situ*, the bile acted in an inhibitory manner. The excised cat's intestine was inhibited by bile. The large intestine of the rabbit *in situ* had its peristalsis increased by bile. When through an injection of gall the large intestine had increased peristalsis, the small intestine remained quiet. Bile injected into the rectum of the dog called out defecation.

*Our experiments* were made upon etherized rabbits and cats. They were thirty-eight in number. We used two methods in the study of intestinal peristalsis. The first one was that of Magnus on the excised intestine in a modified Ringer solution with oxygen bubbling through it. The other was the insertion of a rubber balloon into about the middle of the jejunum in the small intestine and in the ascending colon of the large intestine. This was connected with the delicate piston recorder of Dr. Schlayer, of Tübingen. The bile used was that of cats and of rabbits.

*Effect of bile on small intestine.* — With the method of Magnus small and large doses locally applied decreased peristalsis. In one

case, a cat, there was with one eighth of a drop an increase of tonus and a slight augmentation of peristalsis. In the balloon method, bile given per jugular or injected into the lumen of the intestinal part experimented upon decreased peristalsis. In the rabbit, with one eighth of a drop by the Magnus method a temporary, well marked inhibition of peristalsis was seen with a decrease of extent of peristalsis. In a cat by the balloon method, one half a drop per jugular increased peristalsis. In a rabbit, one quarter of a drop by the jugular produced an increased peristalsis with the balloon method.

*Effect of bile on the large intestine.* — The effect of bile on the large intestine by the Magnus method was to decrease tonus and peristalsis of the intestine. In rabbits there was occasionally, after a  $\frac{1}{16}$  to a  $\frac{1}{32}$  of a drop of bile by the Magnus method, greatly increased peristalsis. In the balloon method, bile in the cat per jugular in doses of a drop, decreased tonus and peristalsis at first, and afterwards greatly increased them.

*Effect of glycocholic acid upon the small intestine.* — In the cat, by the balloon method, three quarters of a grain of glycocholic acid per jugular increased the tonus and the extent of the peristaltic movements. In other cats, one half grain of glycocholic acid decreased peristalsis, using the balloon method and injecting the acid per jugular.

In the rabbit,  $\frac{1}{32}$  of a grain of glycocholic acid by the Magnus method greatly decreased the tonus and peristalsis.

*Effect of glycocholic acid upon the large intestine.* — In the rabbit, glycocholic acid by the balloon method in one half grain doses per jugular decreased peristalsis. In a rabbit and a cat it increased peristalsis producing quite large waves.

*Effect of taurocholic acid on the small intestine.* — In the cat, one half grain of taurocholic acid greatly increased peristalsis by the Magnus method. In the rabbit there was a momentary increase of tonus by the Magnus method.

In the rabbit, with  $\frac{1}{16}$  to  $\frac{1}{2}$  grain of taurocholic acid there was with the Magnus method a great decrease of tonus and peristalsis.

In the balloon method,  $\frac{1}{4}$  of a grain of taurocholic acid per jugular in the cat increased peristalsis after a temporary decrease.

EXPERIMENT I. <i>Cat.</i>				EXPERIMENT 2. <i>Cat.</i>				EXPERIMENT 3. <i>Rabbit.</i>			
<i>Bile on blood pressure.</i>				<i>Taurocholic acid on blood pressure.</i>				<i>Glycocholic acid on blood pressure.</i>			
Time P. M.	Bile.	Rate 15 sec.	Height, mm. Hg.	Time P. M.	Taurocholic acid.	Rate 15 sec.	Height, mm. Hg.	Time P. M.	Glycocholic acid.	Rate 15 sec.	Height, mm. Hg.
2.00.00		45	158	2.00.00		45	132	3.00		45	118
2.01	¼ gtt.	45	156	2.00.15	¼ grain	43	130	3.00.40	½ grain	42	115
2.02		43	100	2.02		42	132	3.01		46	115
2.08		43	156	2.05		44	132	3.02		46	110
2.10		45	150	2.10		44	134	3.06		47	110
2.10.30	¼ gtt.	46	154	2.11		43	134	3.08		45	108
2.12		46	156	2.11.20	¼ grain	45	124	3.08.10	¼ grain	46	110
2.18		48	160	2.12		43	132	3.08.30		42	108
2.20		47	160	2.15		40	130	3.09		42	108
2.20.10	½ gtt.	49	158	2.20		42	130	3.14		42	108
2.22		50	160	2.21		40	132	3.16		42	108
2.27		50, clot.	158	2.21.20	½ grain	44	112	3.16.30	¼ grain	42	106
2.35		56	144	2.22		43	116	3.17		43	110
2.35.30	1 gtt.	54	142	2.25		43	130	3.21		43	114
2.37		57	150	2.30		41	130	3.23		44	90
2.43		64	142	2.31		40	126	3.23.30	½ grain	42	110
2.45		56	140	2.31.10	½ grain	47	104	3.24		30	96
2.45.10		54	128	2.32		45	120	3.26		47	104
2.47	2 gtt.	55	138	2.35		40	124	3.28		44	108
2.53		57	128	2.40		40	122	3.30		45	96
2.55		64	130	2.41		40	124	3.30.15	½ grain	31	84
2.55.10	2 gtt.	68	110	2.41.30	½ grain	43	100	3.31		34	104
2.57		56	124	2.42		42	118	3.35		48	64
3.03		56	124	2.45		42	124	3.37		40	80
3.05		55	122	2.50		39	120	3.37.30			
3.05.10	4 gtt.	58	80	2.52		35	116	3.38			
3.07		58	104	2.57		35	114	3.38.30			
				3.02		35	113				
				3.07		35	114				

*Effect of taurocholic acid on the large intestine.*—By the Magnus method,  $\frac{1}{2}$  grain of taurocholic acid decreased peristalsis and the tonus of the large intestine. In the rabbit,  $\frac{1}{4}$  to  $\frac{1}{2}$  grain of taurocholic acid by the Magnus method greatly decreased the tonus and peristalsis.

There is no doubt that either with the excised intestine or with the balloon method, where the nerves of the intestine are attached, that bile from  $\frac{1}{8}$  of a drop up to 4 c.c. primarily inhibits peristalsis and afterwards may or may not increase peristalsis. The taurocholic and glycocholic acids have the same action as the bile itself. The experiments upon the pulse-rate and arterial tension show that bile after a few doses reduces the tension and the heart beat. Taurocholic acid reduces the heart beat and the blood pressure. Glycocholic acid reduces the blood pressure, but did not materially alter the pulse-rate.

From an examination of our results it is apparent that bile has contradictory effects upon the small and large intestine. It is evident that with either the Magnus method or the balloon method results are antagonistic. Dr. Schüpbach believes that this may in part be explained by a psychic reaction on the intestine in his experiments. It will not, however, explain the contradictory effect in the case of the excised intestine. In 1884, in a paper on intestinal peristalsis, Ott called the ganglia in the intestine intestino-motor and intestino-inhibitory. It is probable that these ganglia have a varying antagonistic effect, and as one or the other is in the ascendant we have an increase or a decrease of peristalsis by the bile. It is evident that the circulatory changes did not have any part in the changes in intestinal peristalsis.

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### **The uric acid excretion of normal men.**

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The purpose of the investigation was to observe the course of the excretion of uric acid in normal men living on an ordinary mixed diet. Each subject was allowed to select his own diet and