TABLE IV.
Effect of Immersion in Sea Water on Antifouling Efficacy of a Paint-Sulfonate Mixture. Panels exposed at Corona del Mar for six weeks beginning October 17, 1944.

Material	Time for 10% ABH coverage, days	Avg coverage		Maximum No.		
		ABH	Bryozoans	Bryozoans	Tubeworms	Barnacles
Black asphalt paint	6	24	0	44	6	16
Same + 30% T-333	5	37	0	0	0	0
Same + 30% T-333, soaked 2 hr in sea water	14	23	0	1	0	0
Same + 50% T-333, soaked 2 hr	42+	5	0	0	0	0

interface between such a mixture and sea water has a negative charge, and that this may be important in its antifouling properties.

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Effect of Drugs on Gastric Motility Following Vagotomy.

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During the past 4 years, reports by Dragstedt,[1] Grimson,[2] Moore[3] and their associates have renewed interest in vagotomy for the management of patients with peptic ulcer. Although prompt relief from symptoms and healing of ulcer usually follow vagus resection, adverse complaints may develop because of reduced gastric peristalsis with retention or delayed emptying of stomach contents. Investigation of this retention phenomenon led to studies of gastric motility and tone as shown by variations of intragastric pressure in rabbits and in patients before and after vagotomy and after drugs.

Methods. Experiments were performed on rabbits after bilateral cervical vagotomy using local anesthesia and frequently inserting tracheotomy tubes. Intragastric pressures were recorded graphically by water manometers connected through small catheters to stomach balloons inflated with 30 to 50 cc of air. Drugs were administered hypodermically 30 minutes to 2 hours after vagotomy. Records of gastric motility and of resting intragastric pressure or "tone" were made for periods of 2 hours or longer. Experiments were also performed in rabbits one day to 8 months after transthoracic vagotomy done through a left thoracotomy wound. Studies on patients were obtained before and at intervals after transthoracic vagotomy for peptic ulcer. The balloons used in patients were inflated by 300 cc of air and pressures

1 Dragstedt, L. R., and Schafer, P. W., *Surgery*, 1945, **17**, 742; Dragstedt, L. R., *Ann. Surg.*, 1945, **122**, 973; Thornton, T. F., Jr., Storer, E. H., and Dragstedt, L. R., *J. A. M. A.*, 1946, **130**, 764.

2 Grimson, K. S., Taylor, H. M., Trent, J. C., Wilson, D. A., and Hill, H. C., *South. Med. J.*, 1946, **39**, 460.

3 Moore, F. D., Chapman, W. P., Schulz, M. D., and Jones, C. M., *N. Eng. J. Med.*, 1946, **234**, 241.

TABLE I.
Effects of Drugs in Rabbits.

Drug	No. animals	No. injections	Contractions	Tone
Pilocarpine	4	4	+++	+++
Physostigmine	4	5	±	0
Pituitrin	4	4	±	+
Priscol	4	8	0	+
Histamine	4	6	+	+
Neostigmine	4	7	+	++
Mecholyl	6	14	+	++
Doryl	9	17	+++	++++
Urecholine	4	7	+	+++

\+ = 0 to 2 cm
++ = 2 to 3 cm
+++ = 3 to 4 cm
++++ = over 4 cm

TABLE II.
Effect of Drugs in Patients.

Drug	No. tests	Dose and route	Onset, min	Contractions	Tone
		Preoperative			
Neostigmine	6	0.5-1.5 mg subq.	—	0	0
Doryl	3	.15-.25 " "	—	0	0
Mecholyl	4	0.2 g orally	—	0	0
Urecholine	3	10 mg U.T.	10	+	0
		Postoperative			
Priscol	3	10-30 mg subq.	—	0	0
Histamine	3	0.8 " "	—	0	0
Neostigmine	19	0.5-2.0 " "	—	0	0
Mecholyl	2	10 " "	2-5	+	0
"	8	0.2 g orally	—	0	0
Doryl	4	2.0 mg U.T.	60	++	+
Urecholine	5	1.0-2.5 mg subq.	2-5	+++	++
"	15	10-50 mg U.T.	120	+	+

\+ = 0 to 2 cm
++ = 2 to 3 cm
+++ = 3 to 4 cm
++++ = over 4 cm
U.T. = Under Tongue.

were recorded by a bromoform manometer. Drugs employed in patients were administered hypodermically, swallowed, or allowed to dissolve under the tongue.

Results. After bilateral cervical vagotomy all animals died usually within 24 hours and had pulmonary edema and pneumonia.

During the first several hours after operation, however, cessation of fluctuations in intragastric pressure and slight depressions of the resting tone occurred. Drugs were administered to 43 animals during this period of quiescence and some effected restoration of motility (Table I). The choline derivatives and pilocarpine produced strongest contractions and greatest increase of tone. Thirty rabbits survived transthoracic vagotomy 4 days or longer. Cessation of fluctuations of intragastric pressure and decrease of tone occurred during the first 12 to 48 hours. Thereafter hypermotility developed spontaneously and persisted in animals followed 8 months. Contraction waves were persistent, rapid, and regular with an amplitude 4 to 6 times greater than that before vagotomy. These movements were not effective, since gastric dilatation and retention occurred and was seen later at abdominal exploration. Gastric ulcers developed in several of these rabbits.

In patients after vagotomy fluctuations of intragastric pressure were low or absent and tone little changed or increased. Histamine, 2 benzyl-4, 5 imadazoline hydrochloride (Priscol) and Neostigmine produced no change of tone or return or contractions (Table II). Acetyl-beta-methyl-choline chloride (Mecholyl) subcutaneously produced a slight return of contractions. Mecholyl bromide orally had no effect, and carbamylcholine

chloride (Doryl) orally resulted in a slight increase of tone with good contractions. Urethane of beta-methyl-choline chloride (Urecholine), injected subcutaneously, raised the tone baseline and produced excellent contractions lasting as long as 4 hours. Administered orally, Urecholine stimulated fair contractions. The effect appeared slowly, but was prolonged.

Conclusions. Death of rabbits one or 2 days after cervical vagotomy occurred as reported by Short[4] and others. During the first several hours after operation the animals seemed in good condition and stomach motility ceased. Levin[5] has described this as "shock." Motility recovered later and persisted as described by Opuls,[6] Auer[7] and others. Van Yzeren[8] noted chronic gastric ulcers in rabbits after vagotomy and this has been confirmed by others and by us.

In man gastric contractions were markedly depressed after vagotomy even though resting intragastric pressure increased slightly. These effects persisted. Ulcers healed or became quiescent. This difference in the effect of vagotomy, that is, healing of ulcer in man and development of ulcer in rabbits might be associated with decreased motility in man and increased or continued motility in rabbits.

Of the drugs studied (Table I) most restored motility or tone during the first hours after vagotomy in rabbits. In patients Urecholine was the most effective. Starr and Ferguson[9] first reported the clinical use of Urecholine. Machella *et al.*[10] described its effect in patients after vagotomy. Our observations confirm theirs but indicate also that some effect was obtained from Mecholyl and Doryl. Urecholine and Doryl have proved effective in overcoming gastric retention in patients treated by vagotomy providing scar tissue obstruction of the outlet of the stomach does not exist.

4 Short, R. H. D., *J. Path. and Bact.*, 1944, **56**, 355.

5 Levin, P. M., *J. Pharm. and Exp. Therap.*, 1938, **62**, 449.

6 Opuls, W., *J. Exp. Med.*, 1906, **8**, 181.

7 Auer, J., *Am. J. Physiol.*, 1909, **25**, 334.

8 Van Yzeren, *Z. f. klin. Med.*, 1901, **43**, 181.

9 Starr, I., and Ferguson, L. K., *Am. J. Med. Sc.*, 1940, **200**, 372.

10 Machella, T. E., Hodges, H. H., and Lorber, S. H., *Gastroenterology*, 1947, **8**, 36.

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Nutrition of Trout: Studies with Practical Diets.*

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Introduction. Both in anatomy and habit the trout appears to be a carnivore. In hatchery practice it was early established that these fish can live and grow to maturity on diets of animal origin.[1] Liver has been shown to be an adequate ration in itself and any modification of the ration has been related to attempts to replace liver with less expensive organs and animal products. Plant materials have been thought to have little promise. Embody[2] was unable to raise trout on a mixture of animal and plant materials. Subsequently he made proximate analyses of the stomach contents of fish raised under

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1 McCay, C. M., Bing, F. C., and Dilley, W. S., *Trans. Am. Fish Soc.*, 1927, **57**, 240.

2 Embody, G. C., *Trans. Am. Fish Soc.*, 1918, **48**, 26.

3 Embody, G. C., and Gordon, M., *Trans. Am. Fish Soc.*, 1924, **54**, 185.