when using the antecubital vein as a point of injection and the difficulty in interpretation of results obtained.[10]

A significant correlation of femoral-arterial chemoreceptor time with rectal temperature suggests that in the tissues which contribute blood to this long extent of intraäbdominal and intrathoracic vein, the volume of blood flow is reduced in direct proportion to the decrease in internal (rectal) body temperature, while in the case of the arm and head this is not true. It has been suggested that this correlation may be an expression of Van't Hoff's Law.[11, 12]

Summary. Pulmonary circulation time is prolonged in humans whose internal temperature is reduced toward 85°F when exposed to low environmental temperatures. It is suggested that diminished output of the right heart is a large factor. Correlations between fall in rectal temperature and prolongation in circulation time exist only when the femoral vein is the site of injection. Shivering shortens circulation time or minimizes prolongation due to hypothermia.

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Reflex Inhibition of Bile Flow and Intestinal Motility Mediated Through Decentralized Celiac Plexus.

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The celiac ganglia are anatomically and functionally related to the splanchnic nerves. The peripheral links in splanchnic efferent conduction pathways are made up of celiac ganglion cells. Splanchnic nerve components, however, are not the only nerve fibers which terminate in the celiac ganglia. In a recent experimental anatomical study, terminal branches of axons have been demonstrated in preparations of the celiac ganglia of the cat in which all the splanchnic nerve fibers which enter these ganglia had undergone degeneration, following bilateral section of the splanchnic nerves. Intact nerve fibers also have been demonstrated in sections of the distal segments of divided mesenteric nerves arising from the celiac plexus, after the fibers separated from their cells of origin had undergone degeneration.[1] These findings support the assumption that axons of

[10] Stead, E. A., Jr., and Kunkel, F., *Am. J. Med. Sc.*, 1939, **198**, 49.

[11] Ring, G. C., *Am. J. Physiol.*, 1939, **125**, 244.

[12] Bruhn, J. M., *Am. J. Physiol.*, 1940, **129**, 322.

[1] Kuntz, A., *J. Comp. Neur.*, 1938, **69**, 1.

enteric origin enter the celiac ganglia. If such fibers effect synaptic contacts with celiac ganglion cells, they might constitute the afferent limbs of reflex arcs with central connections in the celiac ganglia. The present investigation has been undertaken to test the hypothesis that reflex reactions can be mediated through the celiac plexus in the absence of intact nerve fiber connections with the central nervous system.

Methods. The experiments have been carried out on cats under nembutal anesthesia. The splanchnic and vagus nerves were divided bilaterally and the intestine transected in the lower portion of the jejunum. In one series of experiments, the common bile duct was cannulated and the drops of bile recorded. After the rate of flow was established, mesenteric nerves were stimulated either by means of a faradic current or distention of the ileum and colon. In another series, a balloon was placed in the proximal segment of the intestine and a kymographic record taken of the intestinal motility. While this segment was undergoing spontaneous contractions, mesenteric nerves to the distal segment of the intestine were stimulated either faradically or by means of distention of the ileum and colon.

Results. Inhibition of bile flow (Table I). In a series of control experiments carried out on cats with intact splanchnic and vagus nerves. distention of the ileum and colon and faradic stimulation of mesenteric nerves resulted in inhibition of the flow of bile. These

TABLE I.

Effects of Distention of Ileum and Colon and of Faradic Stimulation of Mesenteric Nerves on Rate of Bile Flow Before and After Bilateral Section of Splanchnic and Vagus Nerves.

	Control					After section of splanchnic and vagus nerves				
		Distention of ileum and colon		Faradic stimulation of mesenteric nerves			Distention of ileum and colon		Faradic stimulation of mesenteric nerves	
Cat No.	Bile flow drops per hr*	Flow drops per hr*	% change	Flow drops per hr*	% change	Bile flow drops per hr*	Flow drops per hr*	% change	Flow drops per hr*	% change
1	54.5			42.7	—21	80			40	—50
2	34.2			20	—41	28.5			13.3	—53
3	18.7			15	—19	27.9			7.8	—71
4	60	36.3	—39			42.7	25	—41	13.1	—71
5						42.7	30.7	—28	26	—39
6						32.4			25	—23
7						33.3			16	—52
8						29.2			18.7	—35
9						42.7	26	—40		
10						18.1	9.8	—45		

*Calculated on basis of five drop-intervals.

results are in general agreement with those of experiments carried out on dogs by Goldman and Ivy.[2] The same stimulation also resulted in inhibition of the flow of bile following bilateral section of the splanchnic and vagus nerves and transection of the jejunum.

Distention of the ileum and colon, by filling with air under moderate pressure, resulted in inhibition of the bile flow in all of 4 cats with decentralized celiac plexus and transected jejunum. The flow was reduced 28 to 45% during the periods of observation, or an average of 38.5%. Faradic stimulation of mesenteric nerves to the ileum resulted in inhibition of the bile flow in all of nine cats prepared in the same manner. The flow was reduced 23 to 71% during the periods of observation, or an average of 50%. A 1% solution of nicotine applied to the decentralized celiac ganglia effectively abolished the inhibitory response. In all of these experiments stimulation was maintained for 5 minutes. The period of observation covered the time interval required for the elimination of 5 drops of bile after the initiation of stimulation.

Inhibition of intestinal motility (Fig. 1). In the series of experiments in which the effects of distention of the ileum and colon and faradic stimulation of mesenteric nerves on the motility of the proximal segment of the intestine, following decentralization of the celiac plexus and transection of the intestine, were recorded kymographically, many trials yielded no positive results, *i. e.*, the stimulation resulted in no change in the kymographic record. In some experiments, the stimulation employed resulted in inhibition of the intestinal contractions. Rhythmic segmental contractions seemed to be inhibited more readily than peristaltic contractions. In the

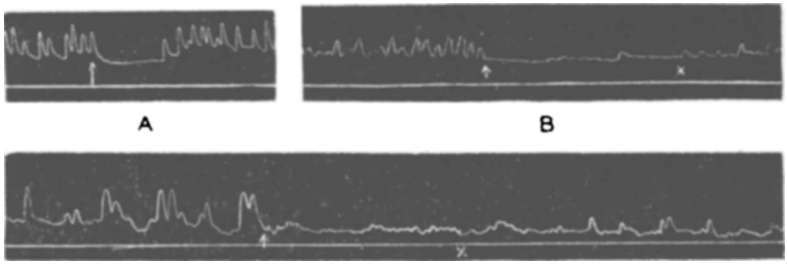

FIG. 1.

Kymographic records showing inhibition of motility in the proximal segment of the intestine following bilateral section of the splanchnic and vagus nerves and transection of the jejunum, elicited by (A) faradic stimulation of mesenteric nerves to the ileum and (B and C) distention of the ileum and colon. Initiation of stimulation is marked by an arrow; its discontinuance by X.

[2] Goldman, L., and Ivy, A. C., *Ann. Surg.*, 1939, **110**, 755.

animals in which inhibition of intestinal motility was elicited, this could be accomplished only a few times. After inhibition had been elicited once or oftener, the same stimulation in additional trials usually resulted in no change in the kymographic record.

The record in Fig. 1A shows complete inhibition of rhythmic contractions in the proximal segment of the intestine for a brief interval, elicited by faradic stimulation of mesenteric nerves to the distal segment of the small intestine. In this instance contractions were resumed before stimulation of the mesenteric nerves ceased. The record in Fig. 1B shows inhibition of segmental contractions; the one in Fig. 1C, inhibition of peristaltic contractions, in the proximal segment of the intestine, elicited by distention of the distal segment, including ileum and colon, by filling with air under moderate pressure. In both instances, inhibition was nearly complete for several minutes, after which motility was resumed and gradually increased. The inhibitory effect of the stimulation remained apparent for several minutes after the 5-minute interval during which the distention was maintained.

Discussion. The inhibitory responses in the biliary system and the proximal segment of the intestine described in the present paper exhibit the essential properties of reflex reactions. They undoubtedly involve conduction pathways through the celiac plexus. They could not be influenced by centers in the central nervous system, since all connections of the celiac plexus with the central nervous system were interrupted. Complete division of the splanchnic and vagus nerves was verified in every animal used. They could not be mediated through the enteric plexuses, since the intestine was transected and the stimulation was applied distal to the section. The anatomical findings cited above support the assumption that the celiac ganglia may include reflex connections, but conclusive physiological data supporting this assumption have not been forthcoming. Warkentin and Ivy[3] have demonstrated that enterogastric regurgitation in response to acid irritation of a Thiry fistula of the duodenum in the dog may be mediated through the celiac plexus under certain experimental conditions in some cases. In their experiments, however, regurgitation was materially reduced after vagus section; consequently, they do not regard their findings as unequivocal evidence that the celiac ganglia constitute a true reflex center.

In view of the anatomical evidence that nerve fibers of enteric origin enter the celiac ganglia, the inhibitory responses described

[3] Warkentin, J., and Ivy, A. C., personal communication.

in the present paper in animals with the celiac plexus decentralized and the intestine transected, can be explained most satisfactorily as true reflex reactions. Abolition of these responses by application of a nicotine solution to the decentralized celiac ganglia also supports the assumption that the neural mechanisms employed include synaptic connections in these ganglia.

By what mechanism the flow of bile is inhibited has not been determined. Vasomotor reactions in the liver undoubtedly play a rôle in this response. The formation of bile, according to Tanturi and Ivy,[4] is influenced by intrahepatic vascular pressure. In their experiments, stimulation of the sympathetic nerves to the liver resulted in decreased bile formation, probably due to vascular or mechanical changes. True inhibitory secretory nerves to the liver have not been demonstrated. Inhibition of intestinal motility, as demonstrated in our experiments, probably is effected by impulses reaching the intestinal musculature through its sympathetic innervation

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Effect of Sulfanilamide and Sulfapyridine on the Avian Malarias.*

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The effect of sulfanilamide and sulfapyridine on some of the bacterial infections has been so striking that these drugs have been tried on many others, including some of the malarias, both of man and of animals. The results obtained have been of considerable interest, and not the less so because they have varied a great deal with the species. Coggeshall,[1] for example, found that sulfanilamide was effective in eradicating *Plasmodium knowlesi* infection in monkeys, but was apparently without any action on *Plasmodium inui* in the same host. He suggested that the difference might be due to the much more rapid metabolism of the former species. This seems probable in view of the generally accepted idea that sulfanilamide is effective because oxidation products are formed from it which destroy catalase, and hence interfere with the metabolic activities of the cell.

[4] Tanturi, C. A., and Ivy, A. C., *Am. J. Physiol.*, 1938, **121**, 61.

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[1] Coggeshall, L. T., *J. Exp. Med.*, 1940, **71**, 13.