STUDIES of digestive function in the different segments of the equine digestive tract have been limited in number. Because of the relatively rapid rate of passage of digesta through the equine tract (Alexander, 1946; Alexander and Benzie, 1951) the contribution of the microflora of the large intestine to the nutrition of the host is of fundamental interest. The development of techniques which allow permanent fistulation of different segments of the digestive tract (Alexander and Donald, 1949; Jasper and Cupps, 1950; Alexander, 1952; Hayes, Little and Mitchell, 1964; Teeter, Nelson and Stillions, 1968) offers the possibility of measuring digestibility in the different segments of the equine tract. Modifications of previously described techniques have been used to produce multiple-fistulated horses with access at the origin of and near the termination of the great colon.

Materials and Methods

Permanent fistulae were established in the sacculation at the origin of the right ventral colon and in the right dorsal colon just prior to its termination in the small colon (figure 1). The fistulae were installed in simultaneous operations. In each case fistulation was accomplished by a two-stage procedure as developed by Linerode (1967). The appropriate portions of the intestinal wall first were sutured to the incised abdominal muscles and to the skin, and adhesions at these points encouraged. During the second stage, which followed the first by approximately 14 days, the cannulae were installed.

During the first stage the horses were maintained in left lateral recumbency under general anesthesia effected by an initial quieting dose of 100 mg. of Promazine followed by 1 gm. of Sodium Thiymyl per 113 kg. of body weight. An incision approximately 13 cm. long was made through the skin, the obliquus abdominus externus and the peristomeum, exposing the lateral surface of the 16th rib. The exposed section of rib terminated approximately 10 cm. above the costo-chondral junction. The peristomeum was carefully peeled off both the external and internal surfaces of the exposed rib, and approximately 6.5 cm. of the rib was resected by means of obstetrical wire (figure 2). Upon removal of the rib segment, the internal surface of the costal periostomeum was incised on a dorso-ventral plane, and the two parts, thus formed, were retracted into the adjacent intercostal spaces.

At this point in the operation, a second incision was made through the center of the right para lumbar fossa beginning at the lateral edge of the longissimus dorsi and extending ventrally for approximately 15 cm. This incision was made through the skin, the fascia and underlying obliquus abdominus muscles and the peritoneum as described by Alexander and Donald (1949) and Teeter et al. (1968). The operator then inserted his left arm into the peritoneal cavity to the point of the 16th rib, and, with his left hand in apposition to the rib incision, carefully incised the peritoneum to expose the lateral surface of the right dorsal colon (figure 3). The dorsal colon was then presented to the rib incision, two Allis forceps were affixed to its surface and a small pouch was pulled to the outside. This pouch was anchored at its base by suturing (00 catgut) to the peritoneum, to the periosteum and obliquus abdominis muscles, and to the subcutaneous tissues in a circle approximately 8 cm. in diameter surrounding the fistula opening. The entire area was generously dusted with an antibacterial powder (Neomycin-sulfanilamide) to discourage infection and to encourage the development of adhesions. The skin incision was then closed...
over the pouch with a row of interrupted mattress sutures (Vetafil, Special) (figure 4).

The lateral surface of the sacculations forming the origin of the ventral colon was then pulled to the surface of the posterior incision and anchored to the peritoneum, the muscles and the subcutaneous tissues, and the incision closed by the methods just described.

Both incisions were allowed approximately 2 weeks for healing and for the formation of dependable adhesions prior to insertion of cannulae. During the second stage of the operation, permanent fistulae were formed into the right ventral and the right dorsal colon using local anesthesia (2% procaine infused subcutaneously around the sites). Stab incisions were made and the incisions enlarged to the diameters of the cannula to be inserted. A plexiglass cannula, 32 mm. in diameter, was inserted into the dorsal colon by means of the special tool shown in figure 5. The essential parts of the insertion tool consisted of a threaded steel rod with two no. 2 rubber stoppers arranged on it so that they could be placed inside the cannula and expanded to grip its inner surface. A cross-sectional view of the dorsal colon cannula in place is shown in figure 6. A soft plastic cannula, 60 mm. in diameter (Yarns and Putnam, 1962), was inserted manually into the ventral colon. The incised surfaces of the fistulae were dusted with nitrofurazone, and care was taken to adjust the cannulae as needed to allow for post-operative swelling and to prevent leakage of digesta.

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*Vetafil Bengen, Special, 1.1 mm., S. Jackson, 7801 Woodmont Ave., Washington, D. C.*

*Furacin, Soluble Powder, Veterinary, Eaton Laboratories, Norwich, N. Y.*
Parenteral administration of antibiotic was maintained for 5 days after each stage of the operation.

Discussion

Ventral Colon Fistulation. The ventral colon fistula was placed adjacent to the cecocolic orifice to provide access to the ventral colon, as well as to the cecum through the adjacent orifice. Cecal collections have been taken routinely with comparatively little difficulty, though it has been necessary to place the collection tube into the body of the cecum manually. Conversely, collections of digesta from the ventral colon by means of the fistula at the origin have not been successful. The finding is in agreement with the radiological studies of Alexander and Benzie (1951) which indicated that digesta remains in this portion of the tract for a comparatively short time. It should be noted, however, that the ventral colon fistulae have been maintained with comparatively little difficulty for more than a year, and they have been less subject to digesta leakage than similar fistulae located on the cecal side of the ceco-colic orifice.

Dorsal Colon Fistulation. The dorsal colon fistula was located at the 16th rib and at approximately the widest diameter of the dorsal colon. This point was chosen to provide access for digesta sampling as near as possible to the terminus of the great colon. An earlier attempt to provide this access by fistulation of the small colon near its origin through the left para lumbar fossa proved unsuccessful due to the strong peristalsis obtaining in that segment of the tract. Digesta samples from the right dorsal colon have been relatively easy to collect except in cases where the horses have been on limited intakes of diets low in fiber content. In these cases, the greatest difficulty has been experienced with the nocturnal collections. The fistulae have been easily maintained despite their rather exposed location, and digesta leakage from them has been almost nil.

Summary

Surgical procedures for multiple fistulation of the equine large intestine were described. The use of such fistulated horses for digestion studies and problems encountered in fistulation of these and other sites were discussed.
Figure 4. Cross sectional view of dorsal colon fistula site at completion of first stage of operation.

Figure 5. Components of dorsal colon cannula attached to cannula insertion tool.
Figure 6. Cross sectional view of completed dorsal colon fistula.

Literature Cited

Alexander, F. 1946. The rate of passage of food residues through the digestive tract of the horse. J. Comp. Path. 56:266.