OBSERVATIONS ON SOME ANOMALIES OF THE COLON

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Treves (1885), Rothman, Bruckner and Zetena (1934) have reported a high incidence of ascending and descending mesocolons. Since their investigations were carried out at operation or necropsy, some of their cases could have been caused by laxity of the peritoneum due to manipulation. In embalmed cadavers, Wolfer, Beaton and Anson (1942) found that only 6.4% of their cases had complete ascending mesocolons. However, radiological studies by Moller (1926), Kantor (1934), Oppenheimer and Saleeby (1939) revealed that most of the anomalies of the large gut have been confined to the sigmoid colon. Although anomalies of the colon are of clinical and surgical interest their aetiology has not yet been satisfactorily explained. The main purpose of the present paper is an attempt to provide a satisfactory explanation for most of the common anomalies met with in the colon by correlating the study of anomalous adult material with anatomical variations of the colon in the foetus.

MATERIAL AND METHODS

Observations were made on 45 dissection room cadavers over a period of 2 years. All the cadavers were unclaimed bodies of those who had died of known causes in Singapore hospitals. They were embalmed by perfusion with formalin for routine dissection by 2nd year medical students. Drawings were made and photographs taken with the colon in situ and then repeated with some portions lifted up to illustrate more clearly the presence of the variation.

The large intestines of 4 full-term foetuses and 13 other foetuses ranging from 2½ months to 6½ months gestation periods were also studied. The full term foetuses were fixed by perfusion with 15% formol saline and the others by immersion in 15% formalin.

OBSERVATIONS

45 adult cadavers were studied and 8 (Table I) showed some variations of the colon.

From the Table below, it can be seen that, they were all male, Chinese between the ages of 48 years and 79 years. Except for the case with carcinoma of the stomach, the remainder did not have any gastro-intestinal signs or symptoms, during their terminal illnesses.

TABLE I

DETAILS OF CASES

Case No.	Sex	Race	Age	Cause of Death
1a	Male	Chinese	76 years	Respiratory failure, bronchopneumonia.
2a	Male	Chinese	86 years	Congestive heart failure. Advanced bilateral pulmonary tuberculosis. Cor. pulmonale and emphysema.
3a	Male	Chinese	60 years	Respiratory failure, emphysema, chronic bronchitis.
4a	Male	Chinese	79 years	Bronchopneumonia, pulmonary tuberculosis, malnutrition.
5a	Male	Chinese	72 years	Carcinoma of stomach.
6a	Male	Chinese	74 years	Cerebral thrombosis.
7a	Male	Chinese	61 years	Cor. pulmonale with bilateral emphysema.
8a	Male	Chinese	48 years	Cor. pulmonale with emphysema.

The variations can be classified under the following headings:—

Group I — Presence of complete ascending and descending mesocolon—Case 1a.

Group II — Double hepatic flexure—Case 2a.

Group III — An extension of the sigmoid colon into the abdominal cavity —Cases 2a, 3a, 4a, 5a and 6a.

Group IV — Displacement of the sigmoid colon towards the right side—Cases 7a and 8a.

Group I

Presence of complete ascending and descending mesocolon—Case 1a

Case 1a had a complete ascending mesocolon which at its widest point was 6 cm. and a complete descending mesocolon, 7 cm. at its widest point was also present.

Group II

Double hepatic flexure—Case 2a

In addition to an elongation of the sigmoid colon, Case 2a also had a double hepatic flexure. This was produced by the formation of a loop downwards at the commencement of the transverse colon. This loop was 31 cm. long.

Group III

Extension of the sigmoid colon into the abdominal cavity—Cases 2a, 3a, 4a, 5a and 6a

In Cases 2a, 3a and 4a the sigmoid colon commenced in the usual manner, the first part being related to the left pelvic wall. The second part formed a loop which extended into the abdominal cavity. In Cases 2a, 4a and 5a the loop extended into the hypogastrium to come into contact with coils of the ileum. In Case 3a, the apex of the loop was tucked under the transverse mesocolon on the left side. This loop was 34 cm., 39 cm. and 31 cm. long in Cases 2a, 3a and 4a respectively. The entire length of the sigmoid colon was 41 cm. in Case 2a, 52 cm. in Case 3a and 36 cm. in Case 4a. In Case 5a the sigmoid colon began at the pelvic inlet, on the left side and continued above the pelvic brim to the right side for a distance of 10 cm. It then passed into the pelvis, related to the right pelvic wall. Its total length was 15 cm. In Case 6a, the sigmoid colon commenced at the pelvic brim on the left side and passed upwards along the posterior abdominal wall on the left side forming a loop, the apex of which almost reached the splenic flexure, resulting in a second splenic flexure. The descending segment of this loop passed downwards and medially into the pelvis to continue with the rest of the sigmoid colon. The total length of the sigmoid colon was 37 cm. The posterior surface of the loop was attached to the posterior abdominal wall so that it was immobile. This patient had carcinoma of the stomach and a laparotomy and gastrojejunostomy were done. There was no mention of an elongated loop of colon in the operation findings. From the position of this extra loop, there is a possibility that it could have resulted from a mobile sigmoid colon becoming fused to the posterior abdominal wall due to post-operative adhesions.

Group IV

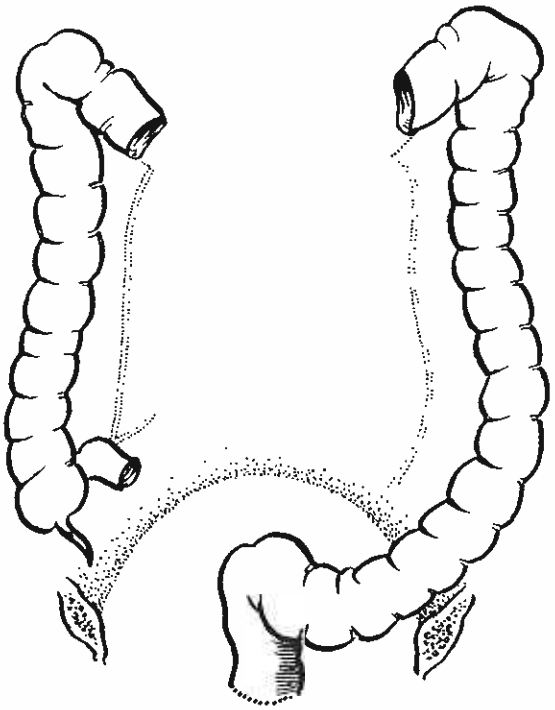
Displacement of the sigmoid colon towards the right side—Cases 7a and 8a

Case 7a—In this case the descending colon had shifted across the midline towards the right side as it was descending along the posterior abdominal wall. The sigmoid colon began at the pelvic inlet on the right side and it was a mirror image of the normal condition with its mesentery attached to the right pelvic wall. The total length of the sigmoid colon was 32 cm.

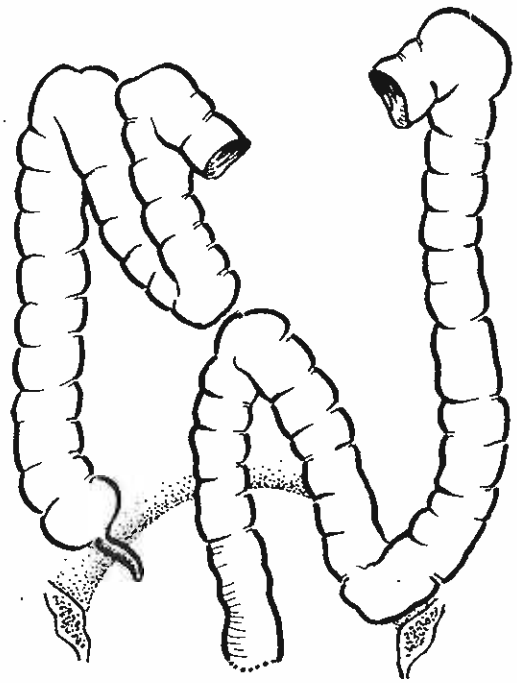
Case 8a—The sigmoid colon commenced at the iliac crest on the left side and turned horizontally towards the right iliac crest. The length of this horizontal section was 23 cm. and it had a small mesocolon attached across the posterior part of the pelvic brim. From the right iliac crest the sigmoid colon then looped upwards along the posterior abdominal wall lateral to the ascending colon. The length of this loop was 28 cm. and its apex almost reached the liver. The rest of the sigmoid colon continued from the right side of the pelvic inlet and was related to the right pelvic wall. The total length of the sigmoid colon was 79 cm.

OBSERVATIONS IN THE FOETUSES

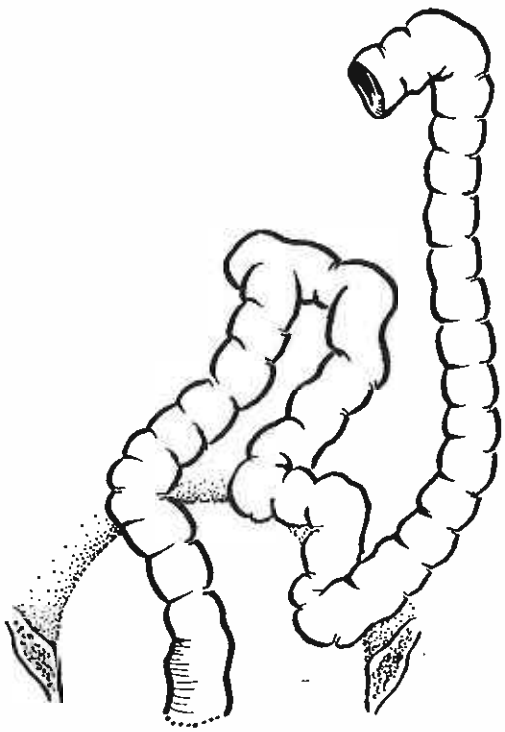
Seventeen foetuses with C. R. lengths of 45 mm., 70 mm., 85 mm., 116 mm., 140 mm., 147 mm., 152 mm., 172 mm., 176 mm., 180 mm., 190 mm., 216 mm., 355 mm., including 4 full term specimens with birth weights of 5 lb. 8 ozs., 6 lbs. 3 ozs., 7 lbs. 8 ozs. and 8 lbs. were studied. In the 45 mm., 70 mm. and 85 mm. foetuses, the midgut loop has returned into the abdominal cavity, but fixation to the posterior abdominal wall has not yet taken



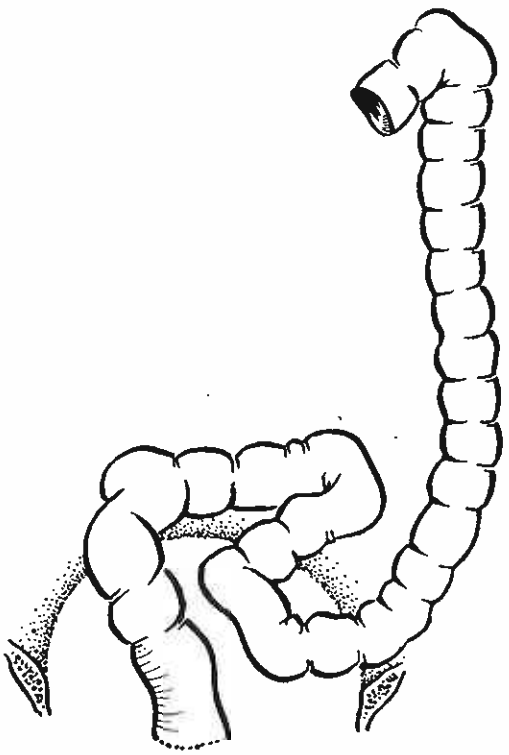
1a



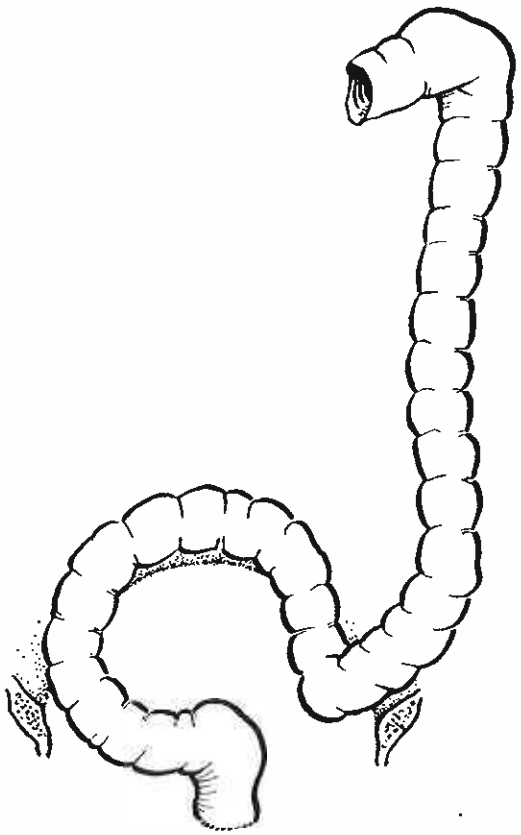
2a



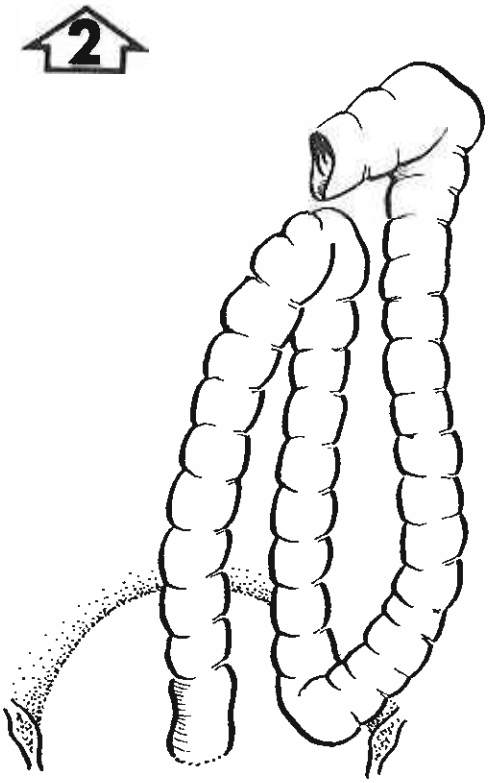
3a



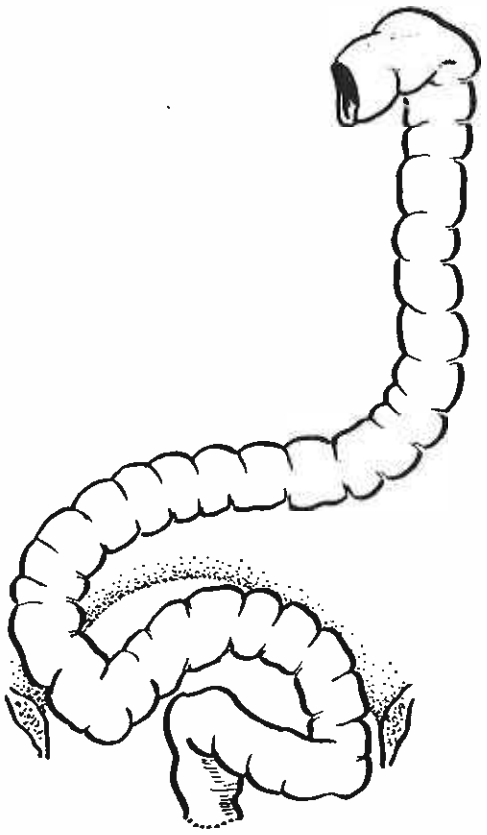
4a



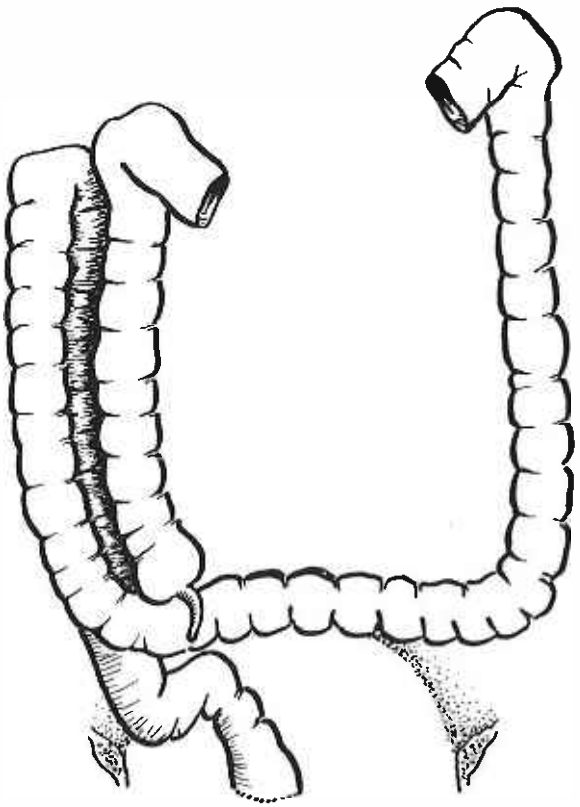
5a



6a

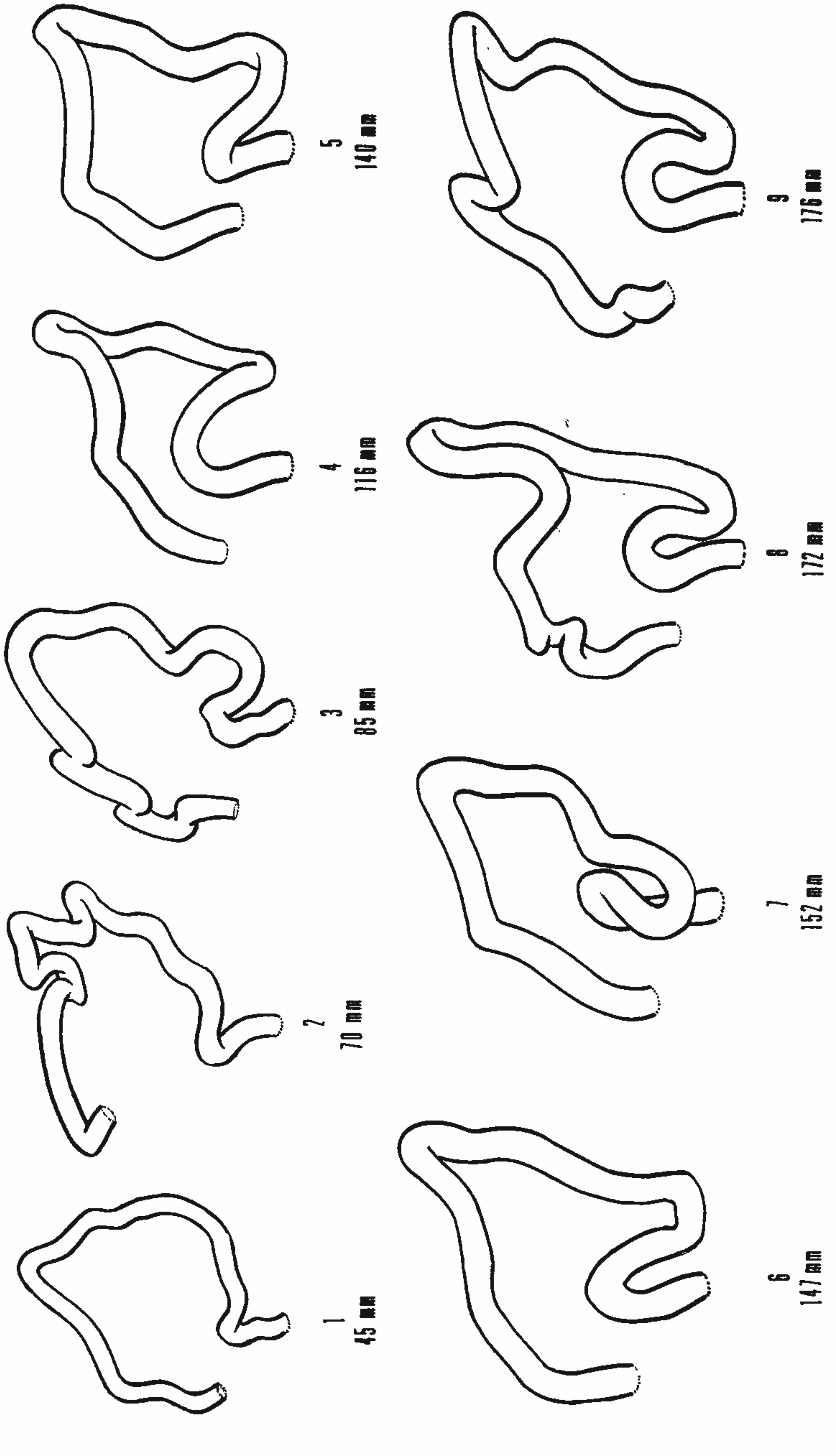


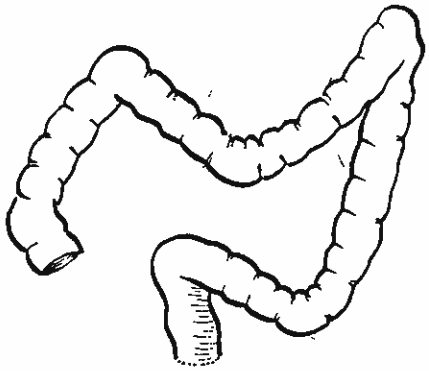
7a -



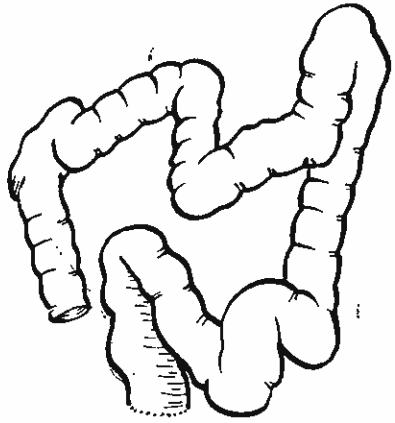
8a

3

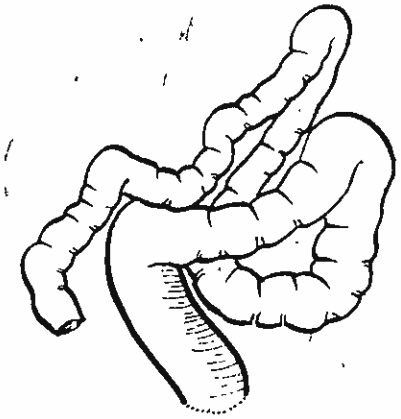

1
45 mm
2
70 mm
3
85 mm
4
116 mm
5
140 mm
6
147 mm
7
152 mm
8
172 mm
9
176 mm



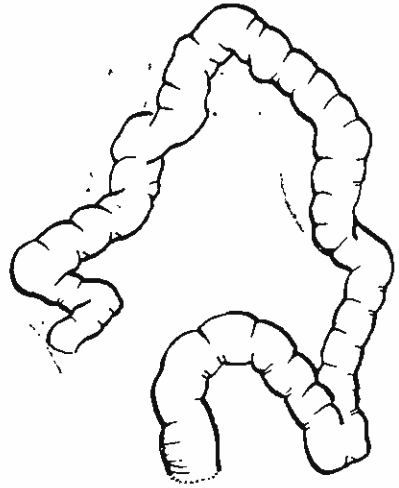
10
180 mm



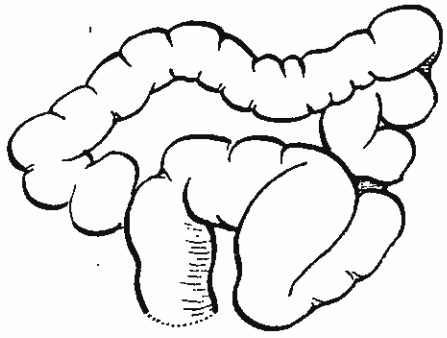
11
190 mm



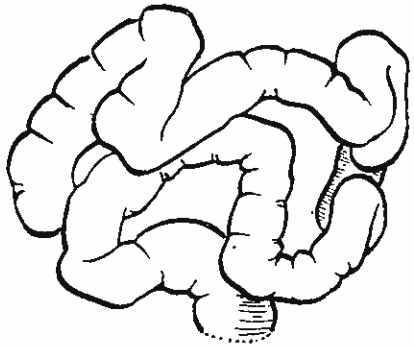
12
216 mm



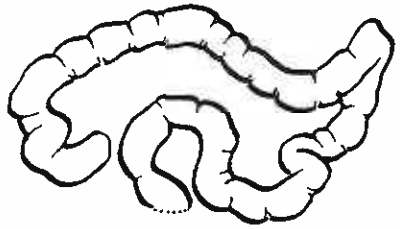
13
355 mm



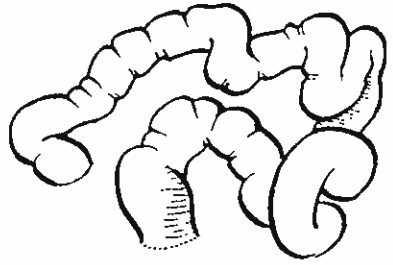
14
5 lb 8 oz



15
6 lb 3 oz



16
7 lb 8 oz



17
8 lb

place. The large intestine consists of one large mobile loop with a mesocolon along its whole extent. A small kink at the lower end of the descending colon appears to demarcate the site of the future sigmoid colon in the 45 mm. foetus. This kink has become more pronounced in the 70 mm. and 85 mm. foetuses.

In the remaining foetuses fixation of the ascending and descending colon to the posterior abdominal wall has already taken place. In all cases the sigmoid colon extends into the abdominal cavity, and this abdominal part of the pelvic colon shows great range of variation in length and disposition. Some of the patterns present in the foetuses could be compared with the variations occurring in the adult.

DISCUSSION

Most text books of Embryology (Keibel and Mall, 1912; Hamilton, Boyd and Mossman, 1957; Arey, 1965 and Patten, 1968) have not given an adequate account of the development of the sigmoid colon. Our observations in the 17 human foetuses indicate that in the 45 mm. stage there is already a trace of the sigmoid colon as indicated by a small flexure at the lower end of the descending colon. Moreover, there is also a mesentery for both the ascending and descending colon. The formation of the sigmoid colon is clearly seen in the 116 mm. stage. From this stage onwards the elongation of the sigmoid colon appears to proceed at different speeds in different foetuses culminating in the establishment of various patterns which could be discerned during foetal life. Some foetuses e.g., 7, 11, 12, 14 and 15 appear to show an excessive elongation of the sigmoid colon and it is possible that a persistence of this condition could later give rise to a similar elongation of the colon in the adult. Whatever may be the cause of the elongated sigmoid colon during foetal life it is clear that all the anomalies met with in this part of the gut in our dissecting room cadavers have a similarity to the foetal pattern. Thus the presence of complete ascending and descending mesocolon in Case 1a of Group I of the adults is explicable on the basis of a persistence of the foetal condition seen in the 45 mm., 70 mm. and 85 mm. foetuses. The 5 cases of Group III in the adult which show an extension of the sigmoid colon into the abdominal cavity correspond to the pattern seen in most foetuses. The pattern in Case 4a clearly resembles foetus No. 14 while that of Case 6a somewhat resembles the condition seen in the full-term foetuses, except that the flexures of the colon in the foetuses are not as acute as the one seen in Case 6a. Therefore the findings in Group III of the adults are explicable on the basis of a persistence of the foetal condition as explained previously. The 2 cases of right sided sigmoid colons of Group IV in the adult can also be compared to the displacement of the sigmoid colon to the right side seen in the 3 foetuses 11, 12 and 15 of the present series. Moreover, from our observations in foetuses (11, 12, 15 and 17) the adult cases with double hepatic and double splenic flexures could also have been developmental in origin.

Variations of the colon are of clinical and surgical interest, as elongated loops of sigmoid colon have been associated with symptoms of constipation, gas and abdominal discomfort (Moller, 1926; Kantor, 1934). Occurrence of tenderness and pain in the right lower quadrant of the abdomen has also given rise to a higher incidence of appendicectomy (Kantor, 1934). Pain according to him is caused by spasm proximal to the point of redundance. The symptoms may suggest gastric ulcer, heart disease, carcinoma of the colon, gall-bladder disease, chronic obstruction of the bowel in addition to appendicitis (Moller, 1926; Kantor, 1934) and in diagnosing these conditions the possibility of a redundant colon should be kept in mind.

Elongation and displacement of the sigmoid colon to the right side have been observed in radiological studies by Moller (1926) Kantor (1934) and Oppenheimer and Saleeby (1939). According to the latter two authors this could result from adhesions due to pelvic inflammatory disease and typhoid. That this may not necessarily be the case, and that they may be developmental in origin, is shown by correlating the anomalous findings in the adult to the patterns seen in the foetus. Such a concept is indeed in accord with anomalies occurring elsewhere in the gastrointestinal system (Kanagasuntheram, 1957, 1960).

Displacement of the sigmoid colon to the right could result in it being mistaken for the caecum in appendicectomy and volvulus involving it could be confused with volvulus of the ascending colon and caecum. The presence of an ascending mesocolon as in Case 1a could predispose to volvulus of the ascending colon and caecum. It has also been known to give rise to symptoms due to traction on the superior mesenteric artery, second part of the duodenum, gall-bladder, pyloric end of the stomach and right kidney (McConnel and Hardman, 1923).

Redundancy of the sigmoid colon is the commonest cause of volvulus of the large bowel. In

North Iran 85% of large bowel obstruction is said to be due to this redundancy (Scott, 1965). From our observations the underlying cause for this condition is probably congenital and not as currently believed, due to the high residue diet giving rise to constipation and redundancy of the sigmoid colon.

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REFERENCES

1. Arey, L.B. (1965): "Developmental Anatomy." W.B. Saunders Co. Philadelphia & London.
2. Hamilton, Boyd & Mossman (1957): "Human Embryology." W. Heffer & Sons Ltd., Cambridge, England.
3. Kanagasuntheram, R. (1957): "Development of the human lesser sac." J. Anat., 2: 188.
4. Kanagasuntheram, R. (1960): "Some observations on the development of the human duodenum." J. Anat, 94, (2): 231.
5. Kantor, J.L. (1934): "Anomalies of the colon, their roentgen diagnosis and clinical significance." Radiol., 23: 651.
6. Keibel & Mall (1912): "Human Embryology." Lippincott, Philadelphia & London.
7. McConnel, A.A. & Hardman, T.G. (1923): "Abnormalities of fixation of the ascending colon." The relation of symptoms to anatomical findings. Brit. J. Surg., 10: 532.
8. Moller, P.F. (1926): "The redundant colon." Acta Radiol, 6: 432.
9. Oppenheimer, A. and Saleeby, G.W. (1939): "Roentgenologic studies of the rectum and sigmoid." Surg. Gynae. Obst., 69: 83.
10. Patten, B.M. (1968): "Human Embryology." McGraw Hill, New York.
11. Scott, G.W. (1965): "Volvulus of the sigmoid flexure." Dis. colon and rectum, 8: 30.
12. Treves, F. (1885): "The anatomy of the intestinal canal and peritoneum in Man." Brit. Med. Jour., 1: 415, 470, 527.
13. Wolfer, J.A., Beaton, L.E. and Anson, B.J. (1942): "Volvulus of the caecum. Anatomical factors in its etiology." Report of a case. Surg. Gynae. Obst., 74: 882.