HIND GUT DUPLICATION—DOUBLING OF COLON AND GENITAL URINARY TRACTS*

MARK M. RAVITCH, M.D.

NEW YORK, N. Y.

FROM THE DEPARTMENT OF SURGERY OF THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL, AND THE DEPARTMENT OF SURGERY OF THE MOUNT SINAI HOSPITAL, NEW YORK

THE OCCURRENCE OF supernumerary organs has always excited a lively interest in physicians and laymen alike. Some such phenomena, like supernumerary breasts, are relatively simply understood, and are more in the nature of atavisms than of malformations. There is a wide literature concerning doubling phenomena of the cephalic end of the embryo-varying from two-headed monsters to incomplete midline clefts with partial duplication of structures. These are ordinarily considered as examples of incomplete, single ovum twinning, but might equally well be taken as examples of incomplete fusion of two individuals.

Supernumerary viscera are not commonly found, although anomalous pulmonary lobes, for instance, are not rare, and instances are said to have been reported of duplication of the heart alone.

In considering duplication of the colon it is unfortunate that this appellation is in wide use to describe a cyst-like formation anywhere along the alimentary tract. Such cysts are usually intimately attached to the bowel from which they arise, generally have a muscular wall in common with this bowel, but usually do not communicate with the lumen of the bowel. Such cysts have been considered by Bremer to be derived from the persistence of isolated vacuoles formed at the time of the dissolution of the solid cord of epithelium filling the lumen of the embryonic bowel.

Even these simple enterocysts, with heavy muscular walls between them and the bowel, are not well explained by this mechanism. The observation of Lewis and Thyng of the occasional formation in the embryonic gut of intestinal diverticula, conceived to be pinched off at the neck subsequently, is not more satisfying. But neither of those theories can be held to apply at all to the lesion presently under discussion and usually referred to as a duplication of the colon. We are concerned with a lesion in which often the entire colon and a portion of the ileum as well is completely double, or even triple. In association with this anomaly one observes, with extraordinary frequency, doubling of the genitalia and of the bladder, exstrophy of the bladder, spina bifida, omphalocele, and other lesions.

Our interest was aroused by a boy of 4½ years of age, referred as suffering from megacolon of the Hirschsprung's type, with life-long distress from distention. When his problem was finally elucidated, he proved to have (Fig. 9) a duplication of the colon from the cecum to the bottom of the pelvis, and a double bladder with a urethra for either side. Resection of the supernumerary bowel, the left ureter and kidney obstructed by it, and the excision of the vesical septum converted him into a normal boy.[19] A careful search of the literature was made and a number of obscurely published instances were found, but others must certainly have been missed, and a few publications in Japanese, *etc.*, were not available. There appear to have been 20 other duplications of this magnitude, all but one (Kratzer, Dixon and Bargen) attributable to the same type of developmental

* Read before the Southern Surgical Association, Hollywood, Florida, December 9, 1952.

error. Each reported instance is epitomized in the legend below the respective drawing, and the salient points are tabulated in the chart. Excluding case 21 (Kratzer, Dixon and Bargen), but adding our own, there have been 12 females and eight males. In almost every case one colon or both had an inadequate proximal opening. (In every case the two or three colons communicated with the fecal stream proximally.) The extra colon was filled with feces and caused distress by its distention. In 15 of the 20 cases, the duplication involved the entire colon, and in five the terminal ileum was also double; in two cases the duplication extended up to the site of a Meckel's diverticulum. While it is difficult to be certain from the available data, it would appear that the lateral colon more frequently ended blindly, the more medial often had an external opening and gave the appearance of being the normal colon. The appendix was double in just half of the 20 cases. One adult patient with two appendices had acute appendicitis (Weber and Dixon). At operation a perfectly innocent second appendix was removed as well as the acutely inflamed appendix which had led to operation. The relation between the two or three colons varies strikingly from case to case and from one area in the bowel to another. Some patients are described as having a large appearing colon with a slender, scarcely visible longitudinal groove or furrow indicating the junction of the colons. In others the intestines are separate for considerable distances and adherent, if at all, only at a relatively slender interface. The septum between the lumina varies; in some cases it shows mucosa and submucosa on either side, and two complete muscular walls each with both circular and longitudinal muscular coats. In other instances only the two layers of circular muscle are present in the septum, the longitudinal muscle being absent in the septum.

The case of Bruni is included in this study because it appears to be an example of the condition under discussion, of a special type. In his patient, a man of 35, the rectum is described as "forked" with one anal opening at either side of the midline. The rest of the bowel is not mentioned, but this was an autopsy examination of a man dead of extraneous causes. However, the presence of two separate penes, two scrotal sacs and two bladders and two urethrae seems clearly to indicate that we are dealing with a partial doubling of the colon of the type common to the other cases under discussion.

The blood supply of the two colons (and in two instances, of the three colons) is a common one, and in most cases there has been but a single mesentery.

In almost every instance serious symptoms have been produced by the distention of either or both colons because of an inadequate external opening or a narrow fistulous communication with the genito urinary tract, or the complete absence of any external opening for one or both loops. In our case, and at least one other, the greatly distended feces-filled duplication compressed a ureter against the pelvic brim and produced a hydroureter.

It is difficult to be sure of the complete picture in each case because many of the cases were reported from the special viewpoint of the author's interest in supernumerary appendices, genito-urinary anomalies, or colon duplication *etc.*, and complete descriptions of the other organs and systems are often lacking.

In 12 of the 20 cases there is definite description of a major anomaly of the lower urinary tract. However, in several of the other cases the genito-urinary tract was apparently ignored, for no statement concerning it is to be found. In eight of the 12 there was a double bladder. This varied from a condition in which there were two separated bladders to one which is best described as a septate bladder. In this condition an external groove suggests the presence of a septum, and each ureter is found to enter its own half of the bladder. In most

instances, male or female, this resulted in two urethrae and two urethral meatuses, but there is one instance in which one side of the bladder failed to communicate externally.

In two instances there was an exstrophy

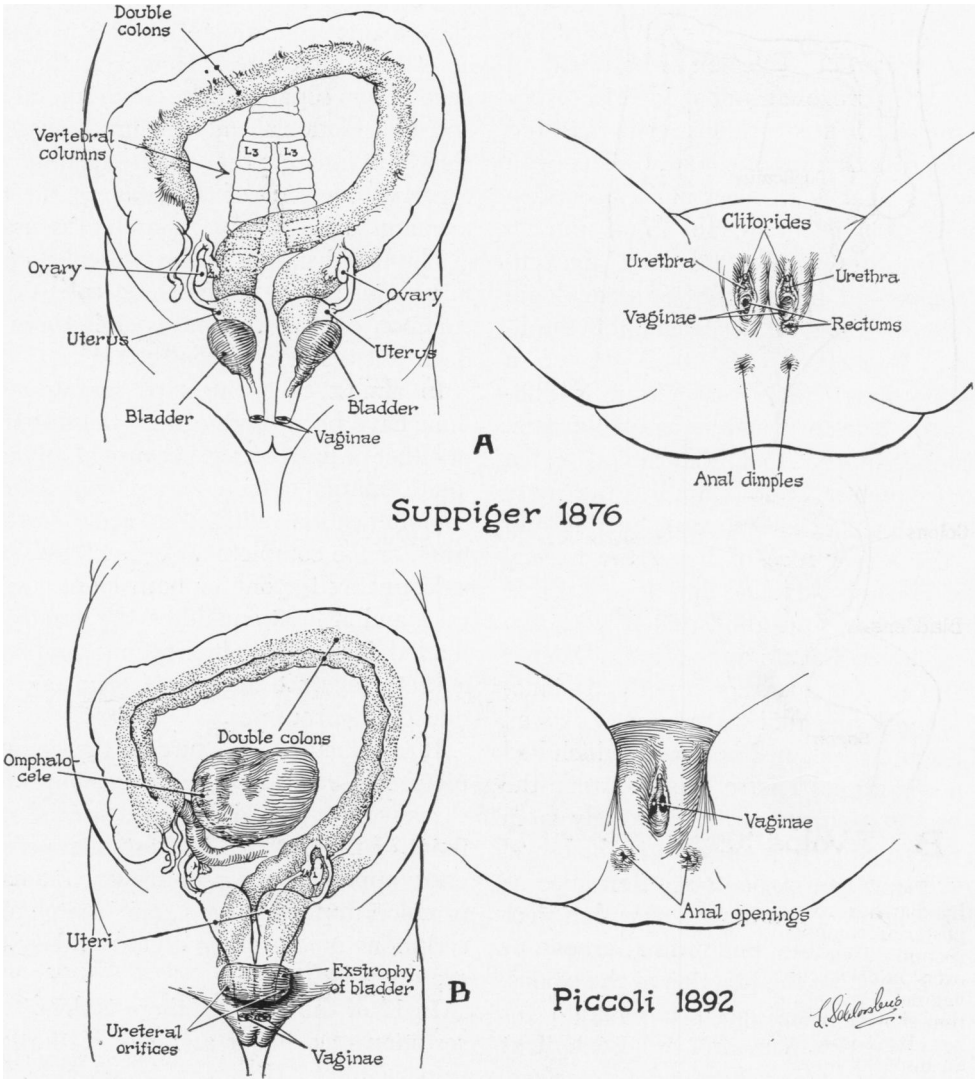

FIG. 1.—(A) Suppiger, 1876. Female seen at birth by Suppiger died of chronic partial intestinal obstruction 1¾ years later and was autopsied by Roth. There were two complete and parallel vulvae, two functioning anuses. Both urethrae discharged urine and each led to a separate bladder. Each bladder received one ureter. The vaginae were separate and there were two unicornuate uteri. The pelvis was divided in two by a sagittal, midline peritoneal fold. Both colons were completely double but there was only one ileo cecal valve and one appendix. The vertebral column was double from L_3 caudally.

(B) Piccoli, 1892. Female, twin, died at 24 hours of peritonitis following operation for omphalocele. There was a large omphalocele containing most of the umbilicus and a lobe of the liver and an exstrophy of the single bladder. There were two entirely separate unicornuate uteri. The two vaginae were in contact in the midline. All of the large bowel, including cecum and appendix, was double, one bowel anterior, one posterior, like an over and under shotgun. The rectums separated one centimeter from the anal skin and each went to its own lateral orifice at the level of the ischial tuberosity. Each large bowel had complete circular and longitudinal musculature.

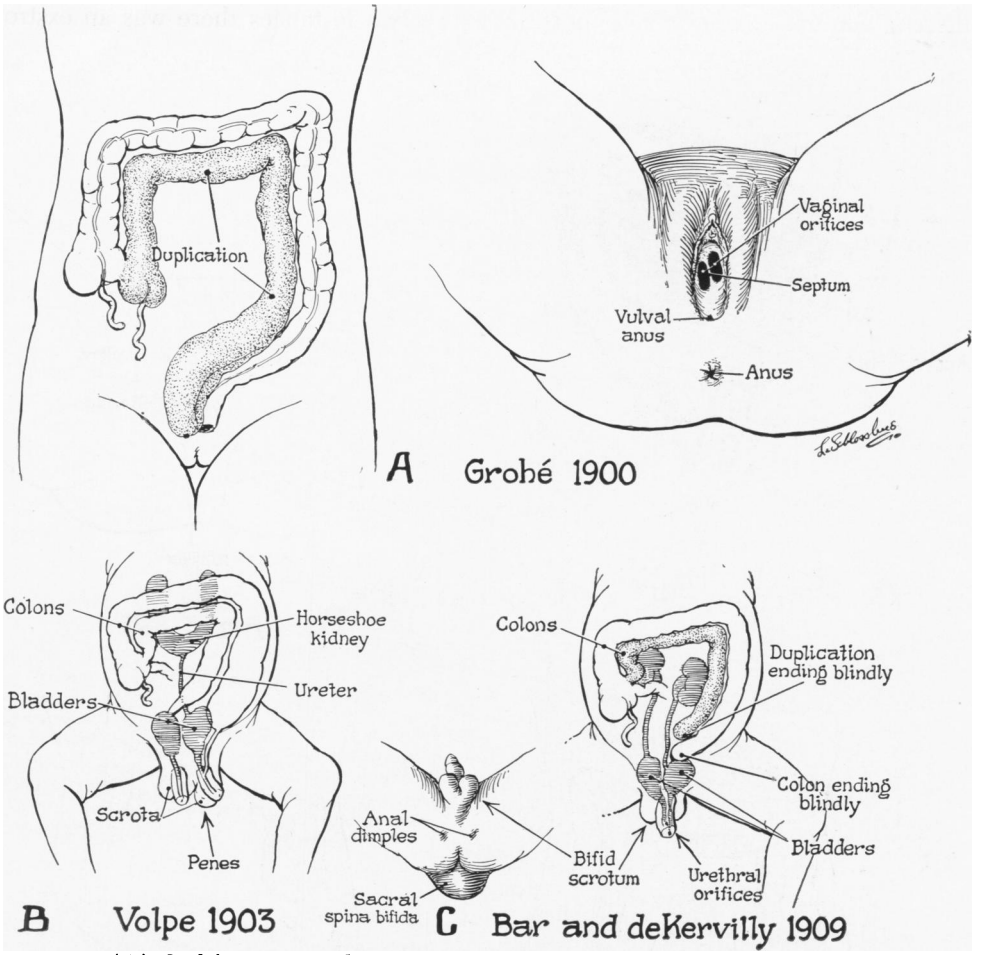

FIG. 2. (A) Grohé, 1900. Healthy female age 10 with periods of abdominal pain followed by diarrhea. Septate vagina, with two orifices, one normal anus, one feces stained orifice at posterior commissure, found to communicate with feces filled duplication anterior to normal rectum. Two ceca, two appendices, two complete distinct colons. Operation by Riedel, with excision of septum between two rectums, division of tissues between anal orifices. Excision of vaginal septum and reconstruction of perineum. Ultimately child was continent. Colonic septum showed double circular and longitudinal muscle.

(B) Volpe, 1903. Male infant, dead of intestinal obstruction at 29 days of age. There was an imperforate anus. There were two distinct penises each with its urethra. Urine flowed only from the left kidney, feces from both. There was a single ileum, cecum and appendix, but two complete, discrete and not adherent colons. The outer colon ended in a sinus to the left urethra and was hugely distended with feces. The right bladder received the more medial colon through an ample opening. There was one horseshoe shaped kidney, its single ureter passing to the left bladder, the two bladders being quite separate each with its urethra and corresponding penis.

(C) Bar and de Kervilly, 1909. Male dead at 14 days despite colostomy for imperforate anus. Ileum entered double colon, with cecum and appendix only in lateral one. The medial colon ended blindly at the level of the sigmoid. The lateral colon ended blindly against the bladder. The two intestines were closely fused and the septum contained circular muscle but no longitudinal muscle. There was a blind anal dimple on each side of the midline. There was a bifid scrotum, one penis, with two urethral orifices, one at end of glans, one on ventral surface of penis. There were two separate bladders each with its own ureter and urethra. A meningocele protruded through an extensive spina bifida.

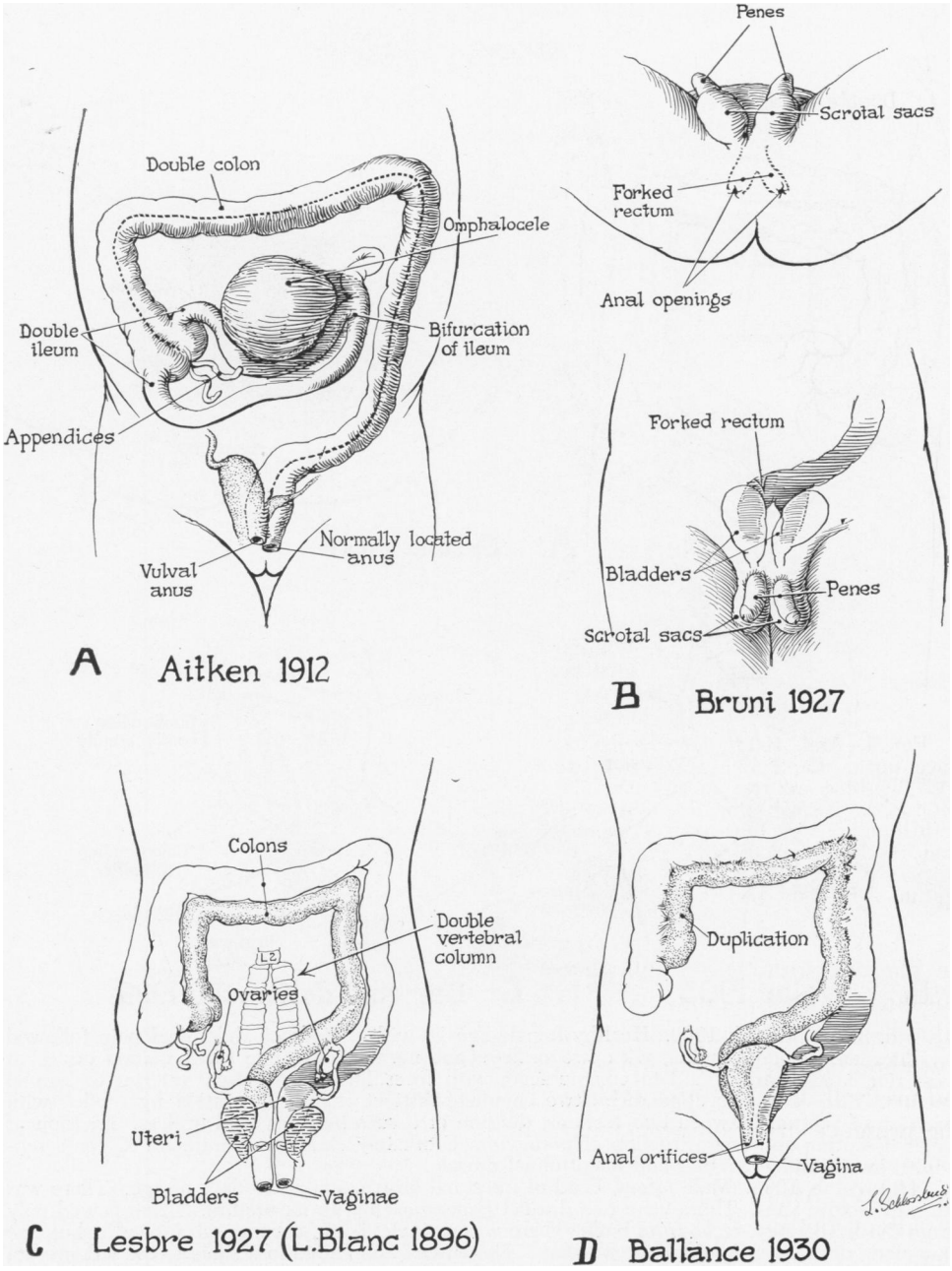

FIG. 3.—(A) A. B. Aitken, 1912. Female infant died 24 hours after birth, with a large omphalocele, untreated. The terminal ileum was bifurcated and the cecum and entire colon was double barreled. There were two appendices. One rectum emptied into a normal anus, the other into a vulvar anus in front of the posterior commissure. The uterus was unicornuate, the left horn being rudimentary. The colonic septum proximally was composed of mucosa and submucosa alone. Distally there were also two layers of circular muscle and a rare trace of longitudinal muscle.

(B) Bruni, 1927. This man died of extraneous causes at the age of 35. The anatomical description is incomplete. Although it appears that only the rectum and anus were double, the association with double bladder and urethra, and double penis (each penis being "hemicylindrical") and two scrotal sacs, all suggest that this patient represents a variation of double colon and doubling of the genital and lower urinary tracts differing only in degree from the other cases, and probably caused by the same mechanism.

Legend continued on opposite page.

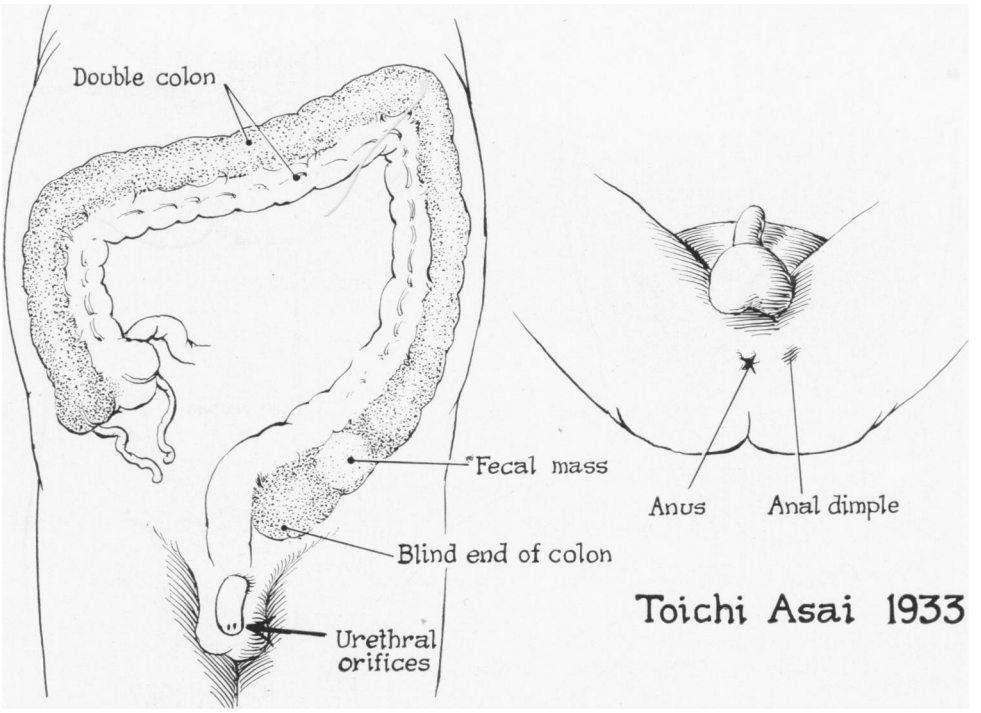

FIG. 4.—Asai, 1933. A male child one year old, had suffered with obstinate constipation since birth. Laparotomy disclosed two parallel colons intimately attached to each other, with two ceca and two appendices. The descending colon and rectum lying more to the right entered the normal anus. The one more on the left ended blindly in the pelvis and was filled with liquid feces. There was a pigmented dimple 4 cm. to the left of the anus and 5 mm. from the blind end of the colon. There were 2 urinary meatuses. The left could be sounded only for 3 cm.; the bladder is not mentioned. A transrectal incision was made in the colonic septum. The child died of pneumonia.

of the bladder without a duplication. In one instance, (Ombredanne[17]) a female with double external genitalia, there was an open urethral meatus in the right vulva and a blind urethral dimple in the left, suggesting the presence of a double bladder. No reference is made to the bladder in the report. Finally, Asai[4] reported two urethrae in his patient, but made no mention of the bladder.

In 13 of the 20 cases there is a definite description of anomalies of the genital tract and in five, the evidence is good that the genital tract was thought to be normal. Of the thirteen with genital anomalies, nine were females and four were males. There was considerable variation in the extent of the anomaly. One patient (Gray[9]) had no external genitalia, and only two rudimentary tubes and ovaries for internal genitalia. On the other hand there are several instances, (Suppiger,[20] Lesbre-Blanc,[15] Ombredanne,[17] Aitken[2]) of complete doubling of the external genitalia, labia, clitoris, va-

FIG. 3. (C) Lesbre, 1927 (L. Blanc, 1896). Blanc's original report was not found. The patient was a woman who had lived in good health. She had a complete double colon with two anuses, side by side beneath her double external genitalia. She had two vaginae, two uteri, and two bladders. The vertebral column was double caudal to L_2.

(D) Ballance, 1930. Ten-year-old female with several unsuccessful attempts at repair of double rectovaginal fistulae at the lower end of the posterior vaginal wall with imperforate anus. Colostomy preliminary to another attempt demonstrated doubling of the colon after repair of the recto-vaginal fistulae. Colostomy spurs were excised and the bowel anastomosed.

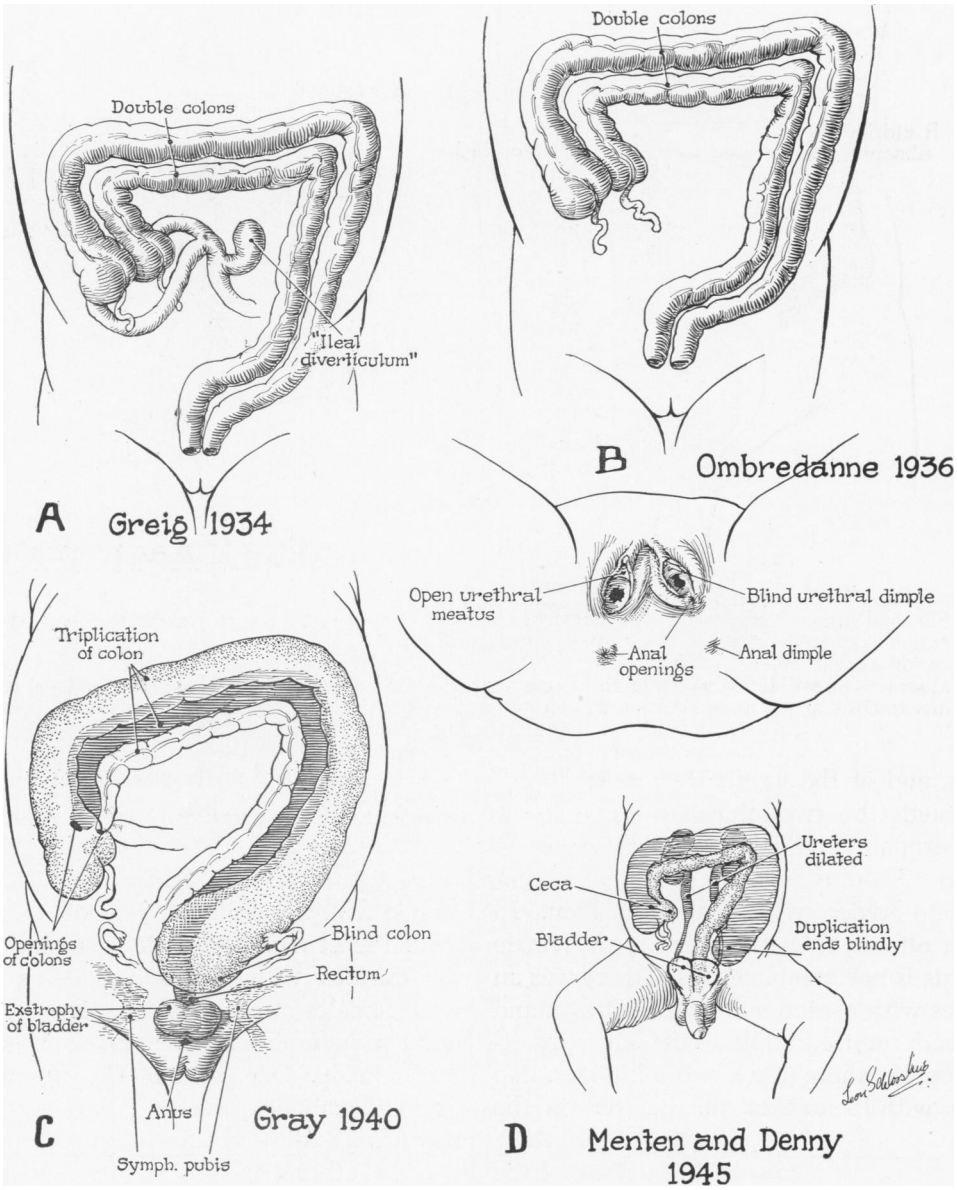

FIG. 5.—(A) Greig, 1934. A female infant dead at 10 weeks. Greig's interest centered chiefly in the double appendix and the remainder of the description is cursory. "Among other malformations, the bowel was in duplicate distal to the ileal diverticulum. There were two ceca and each cecum had its vermiform process."

(B) Ombredanne, 1936. A two-year-old infant brought to the hospital because of a double vulva and double anus. The two vulvae were complete. The right anal opening was in the normal relation to the right vulva. On the left at the corresponding point there was an anal dimple with a functioning anal orifice at the fourchette. There was an open urethral meatus on the right, a blind urethral dimple on the left. Sphincter contractions were seen around the right anus and left anal dimple. The double colons and ceca were demonstrated radiographically. Status of bladder and of uterus not known.

Legend continued on opposite page.

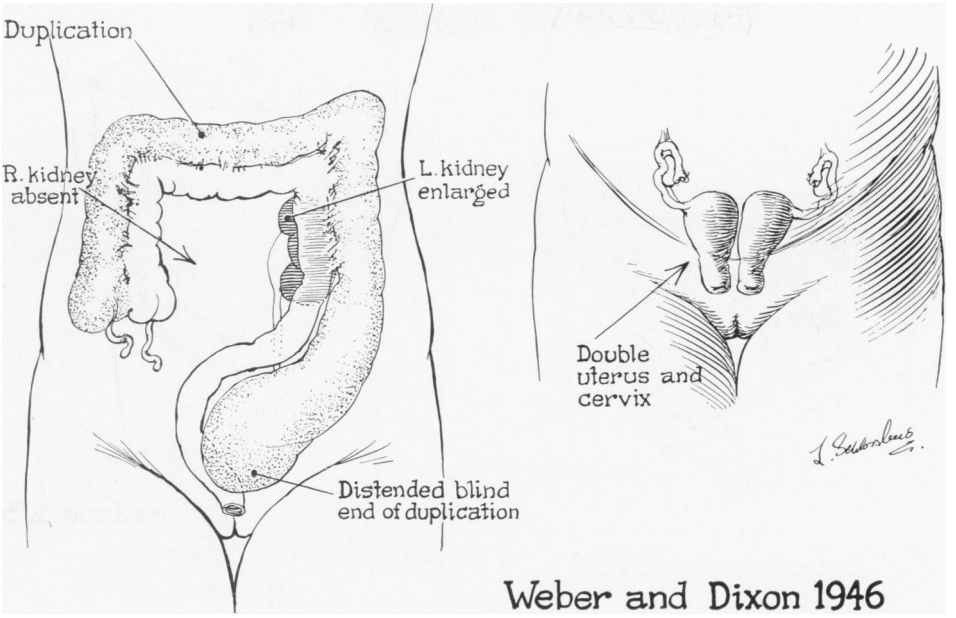

FIG. 6.—Weber and Dixon, 1946. Female, age 27, complaining of cramps and distention. She had appendicitis and one inflamed and one normal appendix were removed. The duplication appeared lateral to the normal colon (and in transverse colon, superior). The duplication ended blindly in the pelvis. There was a double uterus and the right kidney was absent. Operation, with resection of a portion of both descending and sigmoid colons and anastomosis of the ends after excision of the spurs.

gina, and of the internal genitalia as well, although the two uteri are found to be unicornuate and each tube to have one ovary. There is only one instance of a mere septate vagina without further abnormalities, although in that case (Grohé[11]) the uterus is not mentioned. There were three males with genital anomalies (other than a second urethra and meatus.) In one (Volpe[21]) there were two separate penes, each with its urethra, and two scrota. This infant died of intestinal obstruction at 29 days of age. In another (Bar and de Kervilly[6]) there was but one penis, with two urethrae, one from each bladder, opening one at the end of the glans and one on the ventral surface of the penis. However, the scrotum was entirely bifid. In the third case (Bruni[7]) there were two separate, fully formed penes "half cylindrical" in shape, and two separate scrotal sacs. This patient died of unrelated causes at the age of 35,

FIG. 5. (C) Gray, 1940. Female, dead at age of 9 months, of constipation and diarrhea. There was a complete exstrophy of the bladder. There were no external genitalia. The anus, discharging feces, was a little more anterior than usual. There was a wide separation of the symphysis pubis. There was one ileo cecal valve and one appendix; there were three closely and intimately attached colons, two of them opening off the normal appearing cecum of the third. The outer of the three colons ended blindly in the pelvis and was enormously distended. The middle colon led to the anus and the third, and most medial colon entered the second one in the region of the rectum. There were two tubes and ovaries and a rudimentary uterus. Each colon was wrapped in its own circular muscle and all three were wrapped in one sheath of longitudinal muscle.

(D) Menten and Denny, 1945. Male, age 4 months, died of distention and fecal impaction with diagnosis of Hirschsprung's disease. The entire large intestine was double. There were two ceca and two appendices. One colon ended blindly in the region of the rectum. The bladder was divided into two by a midline septum. The urethra and penis are not mentioned. The colonic septum showed all components in duplicity. The ureters were dilated by pressure of the distended fecal sac against pelvic wall.

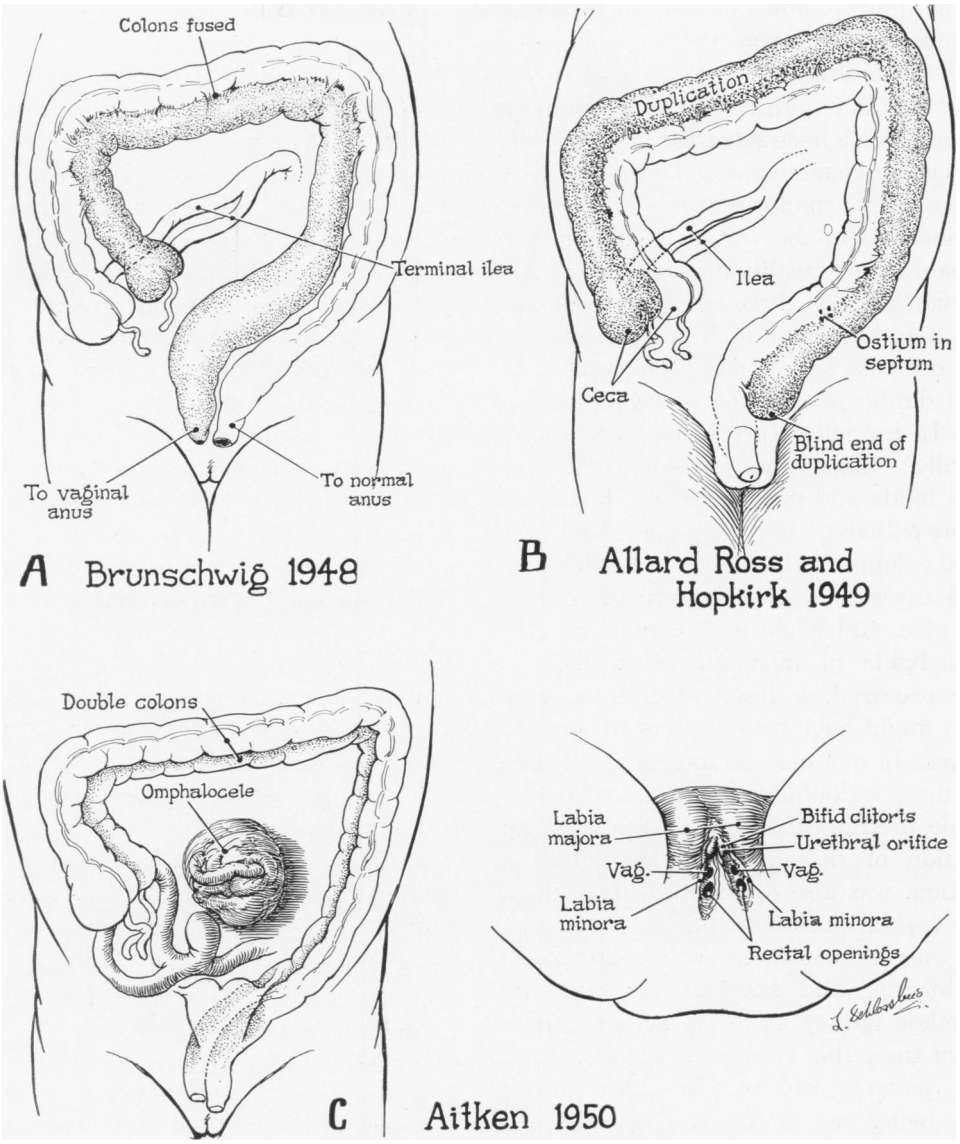

FIG. 7.—(A) Brunschwig, 1948. Seven-year-old female with abdominal distention. One normal anus, one vaginal anus. Normal uterus, tubes and ovaries. Two separate terminal ilea for ten inches above ceca. Two appendices. The two complete colons appeared fused. A lateral anastomosis was performed between the two sigmoids, and the sigmoid leading to the vaginal fistula divided below the anastomosis (leaving an intestinal sac to discharge mucus into the vagina).

(B) Allard, Ross and Hopkirk, 1949. This was a 4½-year-old male with constipation and diarrhea since birth. There were two complete colons, closely attached to each other. The terminal ileum bifurcated and led to the two ceca, each with its appendix. The outer colon ended blindly in the pelvis. A stercoraceous ulcer had established an opening between the *cul de sac* of the duplication and the urethra. This fistula was closed, all of both colons were resected down to the sigmoid, the septum crushed distally and the bowel anastomosed with an ileosigmoidostomy. The bladder was not mentioned.

(C) John Aitken, 1950. Newborn female with large omphalocele. Double external genital apparatus with recto vaginal fistula on each side, discharging meconium. Omphalocele successfully repaired. Ileum double from beyond Meckel's diverticulum. There were two ceca, two appendices, two complete double colons intimately attached, and a bicornuate uterus. There was no mention of the bladder. Only one urethra, at root of bifid clitoris. Definitive operation was not undertaken.

and nothing is known of the functioning of these penes. However, double penis occurs much more often in the absence of double colon than in its presence, and a number of instances have been recorded in which each penis was an effective sexual organ and both were used for micturition.

Anomalies of the vertebral column were probably more readily missed than visceral anomalies, yet in three cases there are positive descriptions of such anomalies.

In one case (Suppiger) there was a complete duplication of the vertebral column from L_3 caudally. In another (Bar and de Kervilly) there was an extensive sacral spina bifida and meningocele. The case of Lesbre & Blanc,[15] like Suppiger's, had a vertebral column doubled below L_3. However, in 14 cases there is no information about the spine, and while it is obvious no gross spina bifida or meningocele is likely to have occurred, a lesser degree of spina bifida might have been present in some instances. In one case (Suppiger's) not only was there a double colon, double bladder, double urethra, and complete parallel duplication of the genitalia, the pelvis, in addition, was also divided into two halves by a sagittal peritoneal fold.

In one of the patients with exstrophy of the bladder and another with a single, horseshoe kidney with one ureter, separation of the pubic symphysis was described. Four patients had omphaloceles; one of these being one of the patients with exstrophy of the bladder.

Ten of the 20 patients died as a result of the anomalies presented. Two with omphaloceles died of peritonitis, the others died either of unrelieved intestinal obstruction or after operation. In all, ten patients were operated upon. One infant (Bar and de Kervilly[6]) died after a neonatal colostomy, one died of pneumonia on the seventh day after operation, at the age of one year (Asai[4]), and one (Leon-Diaz[14]) died after too extensive an operation at the age of seven weeks. Bar and de Kervilly merely performed a colostomy to relieve the obstruction caused by the absence of an outlet for either colon. Asai performed an exploratory laparotomy and then a trans rectal incision of the septum between the two rectums, one of which ended in a normal anus, the other blindly at a perineal dimple.

Dr. Francisco Leon-Diaz of the Hospital Infantil, Mexico, D. F., has graciously permitted us to describe his hitherto unreported patient. Leon-Diaz's patient was a new-born male with an omphalocele, a double bladder (the right ending blindly, the left communicating with the single urethra), two complete colons and a triple descending colon. One colon ended in the left bladder, the other two were blind. At a first operation he performed a colostomy at the level of the triplication, excised the septum between the two bladders, and repaired the exomphalos. Encouraged by the great success of these measures, he resected all of the colon and anastomosed the ileum to the anus seven weeks later. This bold procedure proved to be more than the baby could support.

There are seven patients living after operation, six of them more or less well, while one (Aitken[2]) had an omphalocele repaired but the visceral anomalies were not disturbed. The first successful operation was by Riedel, in Grohés (1900) case. Riedel found two ceca, two appendices, two distinct colons, one ending in a normal anus and one at the vaginal commissure. The bladder was normal; there was a septate vagina, the uterus was not described. He transformed the double rectum into a single rectum by excision of the septum connecting the two anal openings into one, excising the vaginal septum and reconstructing the perineum. The child was well and continent at the age of ten years.

Ballance[5] in 1930 performed a simple anastomosis between the two transverse colons. There was a duplication of the colon beginning at the cecum and each colon had its own anal orifice to either side

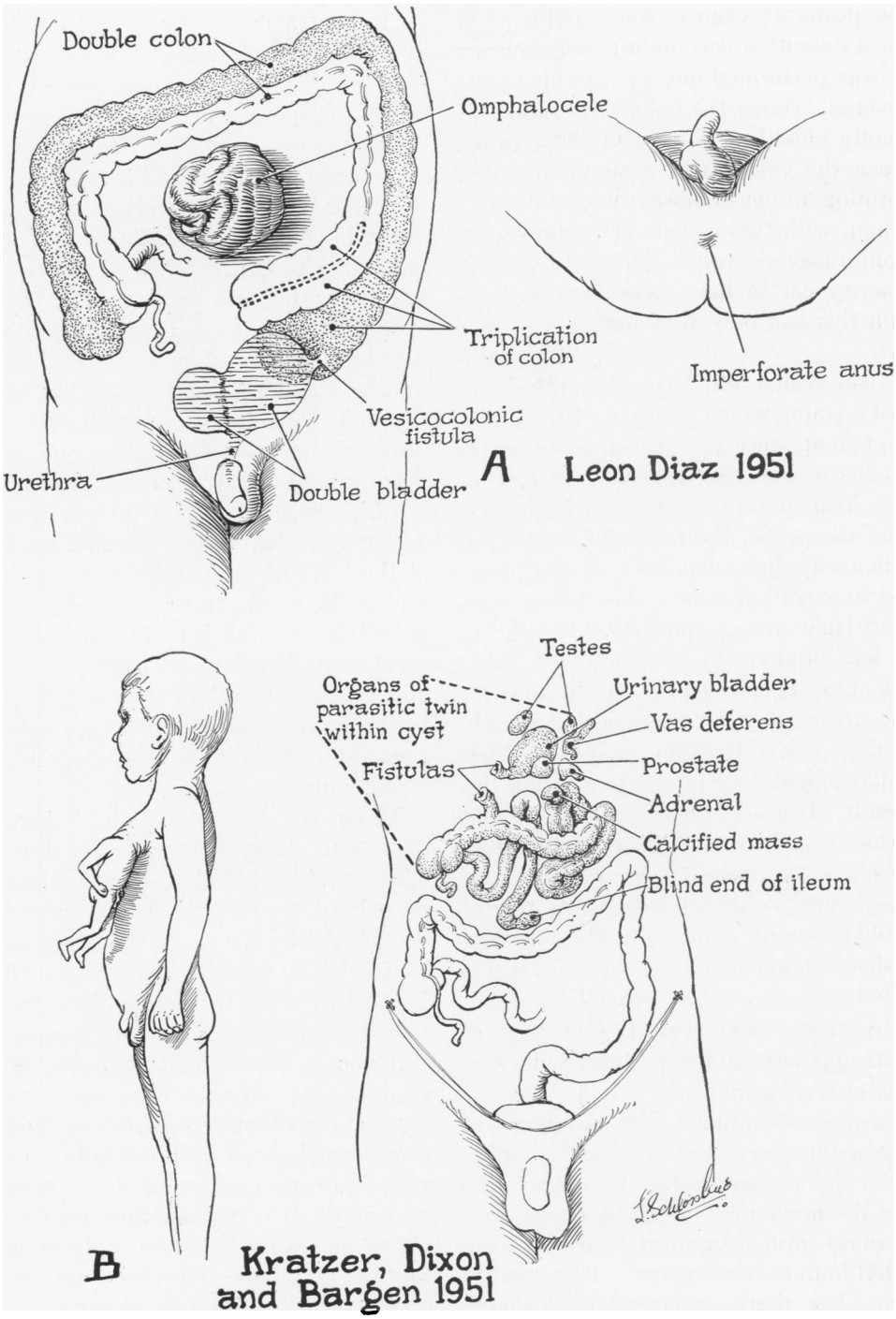

FIG. 8.—(A) Leon-Diaz, 1951. Newborn male with a small omphalocele and an imperforate anus. Duplication of the ascending and transverse colons and triplication of the descending colon. Only one appendix. Bladder completely divided by septum. Each side received corresponding ureter but only the left had a urethra, the right being blind. Two of the descending colons ended blindly. The third emptied into the left bladder. First operation—colostomy, repair of omphalocele, excision of vesical septum. Second operation, total colectomy, ileoanal anastomosis, with subsequent exitus.

Legend continued on opposite page.

of the posterior vaginal wall. Before the perineal operation was undertaken, a colostomy was performed and the double colon discovered. When the colostomy was subsequently closed, a portion of the septum between the colons was excised, in effect performing an anastomosis. This child was left then, with two colons, anastomosed in the mid transverse colon. The recto-vaginal fistulae appear to have been repaired, although this can only be inferred from the report.

In 1946 Weber and Dixon[22] reported the case of a young woman with one ileum, two caeca, two appendices (history of acute appendicitis in one, resection of both appendices). The lateral colon ended blindly just beyond the pelvic peritoneal floor and was tremendously distended. The medial colon ended in a normal anus. This patient also had no right kidney, and a twice normal sized left kidney; the bladder is not mentioned. Dixon performed a partial resection of the descending and sigmoid colons, excised the spurs of the resulting colostomies, as Ballance had done, and anastomosed the two ends. This left the pelvic end of the duplication still blind, but able to overflow relatively easily into the functioning sigmoid. Brunschwig,[8] in 1948, in a seven-year-old girl with normal genitalia who was admitted for great distension with an abdominal mass, found two separate terminal ilea, ten inches above the two ceca, each with its appendix and two complete colons. The lateral colon led to a normal anus the medial one to a vaginal anus. Brunschwig performed a lateral anastomosis between the two sigmoid colons and transected and closed the medial one (leading to the vaginal anus) just beyond this anastomosis. This left both colons emptying well into one rectum, but there remained a relatively large colonic sac discharging mucus into the vagina through the original fistula.

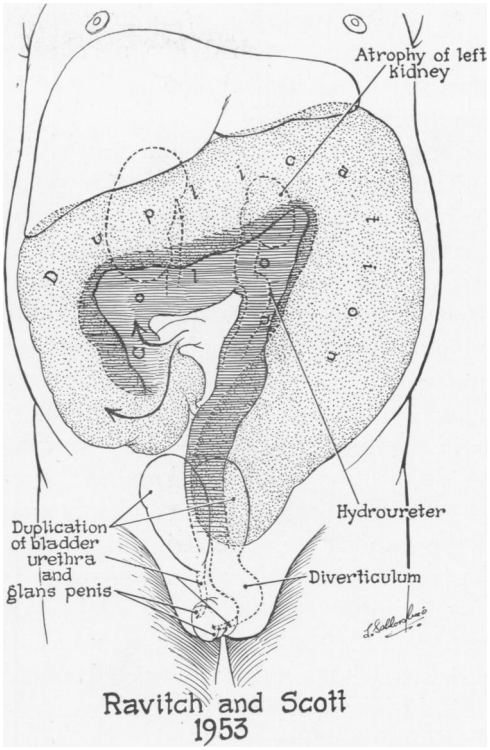

FIG. 9.—Ravitch and Scott, 1953. A four and a half year old boy with life long constipation and distention and urinary dribbling. There was a complete duplication of the colon. The lateral colon ending blindly in the pelvis. The bladder and urethrae were double. The left ureter was obstructed by the distended blind colon. The proximal duplicated colon both transverse colons and the distal duplicated colon were resected and the bowel anastomosed. The vesical septum was excised and the left vesical neck closed, and the left ureter and kidney excised. The child is well and normal three years later.

Allard, Ross and Hopkirk[3] in 1949, reported the case of a five-year-old boy with an almost identical situation. The medial colon entered the normal anus and the more lateral one ended in a recto urethral fistula which was probably secondary to ulceration by a fecalith. In a series of operations most

FIG. 8. (B) Kratzer, Dixon and Bargen, 1951. This condition was reported as duplication of the colon and is therefore included in the present report, although it is the result of an entirely different mechanism. In the first operation the external portion of the parasite was amputated, and in the second the encysted viscera of the parasite were removed from the epigastrium and thorax of the host.

of the colon was removed, the remaining colonic septum crushed like a colostomy spur, the fistula closed and an ileo rectostomy performed.

The patient of Ravitch and Scott,[19] who had one appendix, two caeca, two colons, the lateral one ending blindly in the pelvis, a completely divided septate bladder and two urethrae, was left essentially normal after operation. One caecum and right colon and a portion of the other caecum were preserved as a capacious right colon. Both colons were resected to the sigmoid. Below this point the free portion of the duplication was excised and in the septal portion only the mucosa and submucosa of the duplication were stripped away and the two colon ends then anastomosed. The vesical septum was excised, the left hydroureter and atrophic kidney removed, the obstructed left urethra transected and the vesical neck repaired. The child has normal bowel and bladder function.

The twenty-first case, that reported by Kratzer, Dixon and Bargen,[13] is literally an example of duplication of the colon, but certainly by an entirely different mechanism. In this instance a parasitic monster was attached to the epigastrium of the host by its own short trunk. Most of the viscera of the monster occurred in a cyst in the abdomen of the host. This contained an entire colon with an appendix, a good deal of small intestine and various portions of the genito-urinary tract. The monster was amputated and the encysted viscera excised. With the exception of this case, included principally because there was in actuality a second colon, the other instances all seem to fit a general pattern.

It is hard to see how else doubling of the colon, doubling of the genito-urinary apparatus and doubling in varying degrees of the sacral or lumbo sacral spine can be explained than as a form of partial twinning, or as incomplete fusion of two individuals. The production of partial double monsters may occur either at the caudal or cephalic ends of the embryo. Care must obviously be taken in translating observations in experimental amphibian embryology[12] to the interpretation of abnormalities in mammals. However, it is interesting that it has been found relatively simple to produce cephalic partial twinning by constricting ova with a fine thread, but impossible thus far to produce caudal duplication in this fashion. On the other hand, by fusion of two early amphibian embryos, it has been possible to produce monsters which are double in some respects and single in others. Such a mechanism might conceivably explain the occurrence of a normal vertebral column in these patients in the presence of double colon and double bladder and genitalia. So perfect a doubling of two or three systems as some of these instances present implies a precise doubling of the caudal end of the embryo at an extremely early stage—probably within the first two weeks of embryonic life.

Although there is a difference in origin from that of the enteric cyst type of duplication, the principals of treatment are relatively similar. Symptoms are usually caused by distention of a channel which has inadequate or absent outlet. The close association of the two colons, as in the commoner enteric cysts, usually precludes dissection and resection of the supernumerary colon itself. It may be drained into the colon which is to be left, or its free portion may be cut away and the mucosa and submucosa of the second colon stripped away from the septum. The frequent association of urinary tract anomalies requires investigation of both upper and lower urinary tracts. As far back as 1900, Riedel demonstrated that a well conceived comprehensive operative attack could relieve the symptoms caused by the anomaly. Despite the seeming complexity of the associated malformations in most cases, one can reasonably expect operation today to effect a restitution to normal function of the intestinal and genito-urinary tracts.

BIBLIOGRAPHY

1 Aitken, A. B.: Case of Doubling of the Great Intestine. Glasgow Medical Journal, **78:** 431, 1912.

2 Aitken, J.: A Case of Colon and Ileum Duplex. J. Brit. J. Surg., **37:** 349, 1950.

3 Allard, C. A., D. E. Ross and J. F. Hopkirk: Complete Duplication of Large Bowel Treated by Subtotal Colectomy. Ann. Surg., **130:** 249, 1949.

4 Asai, T.: Duplication Totale du Gros Intestin. Arch. f. Jap. Chir., **10:** 592, 1933.

5 Ballance, Sir Hamilton: Double Colon. Proc. Roy. Soc. Med., **23:** 1570, 1930.

6 Bar, P., and M. De Kervilly: Gros Intestin Duplex chez un Enfant Nouveau Ne L'Obsterique, **2:** 81, 1909.

7 Bruni, C.: Seltene Anomalie der Urogenital Organe, Doppelter Penis. Ztsd. f. Urologie, **21:** 193, 1927.

8 Brunschwig, A., H. W. Dargeon and W. A. Russell: Duplication of the Entire Colon and Lower Ileum with Termination of One Colon into a Vaginal Anus. Surgery, **24:** 1010, 1948.

9 Gray, A. W.: Triplication of the Large Intestine. Arch. of Path., **30:** 1215, 1940.

10 Greig, D. M.: Processus Vermiformis Duplex. Edinburg Med. J., **41:** 277, 1934.

11 Grohé, B.: Duplicitas Intestini Crassi Cum Utero et Vagina Dupl. Deutsche Zeitschrift fur Chirurgie, **57:** 425, 1900.

12 Huxley, J. S., and G. R. DeBeer: The Elements of Experimental Embryology, Cambridge University Press, 1934.

13 Kratzer, G. L., C. F. Dixon and J. A. Bargen: Duplication of the Entire Colon and Terminal Part of the Ileum Associated with Parasitic Twin. Proceedings of Mayo Clinic, **26:** 15, Jan., 1951.

14 Leon-Diaz, Francisco (Mexico, D. F.): Personal Communication with Photographs and Complete Record.

15 Lesbre, F. X.: Vigot Freres. Traité de Tératologie, 1927.

16 Menten, M. L., and H. E. Denny: Duplication of the Vermiform Appendix, the Large Intestine and the Urinary Bladder. Arch. Path., **40:** 345, 1945.

17 Ombredanne, L.: Une Fillette Splanchnodyme. Memoires de L'Academie de Chirurgie, **62:** 747, 1936.

18 Piccoli, G.: Anomalia (un) di Sviluppo Fetale. Progresso Med., **6:** 32, 1892.

19 Ravitch, Mark M., and W. W. Scott: Duplication of the Entire Colon, Bladder and Urethra. Surgery. In Press.

20 Suppiger, J.: Bildungs Fehler der Weiblichen Beckenorgane, Correspondenz-Blatt fur Schweizer Aerzte, **6:** 418, 1876.

21 Volpe, Mazzini: Dell 'asta Doppia. Il Policlin, **10:** 46, 1903.

22 Weber, H. M., and C. F. Dixon: Duplication of Entire Large Intestine (Colon Duplex.) Am. J. of Roentgenology, **55:** 319, 1946.