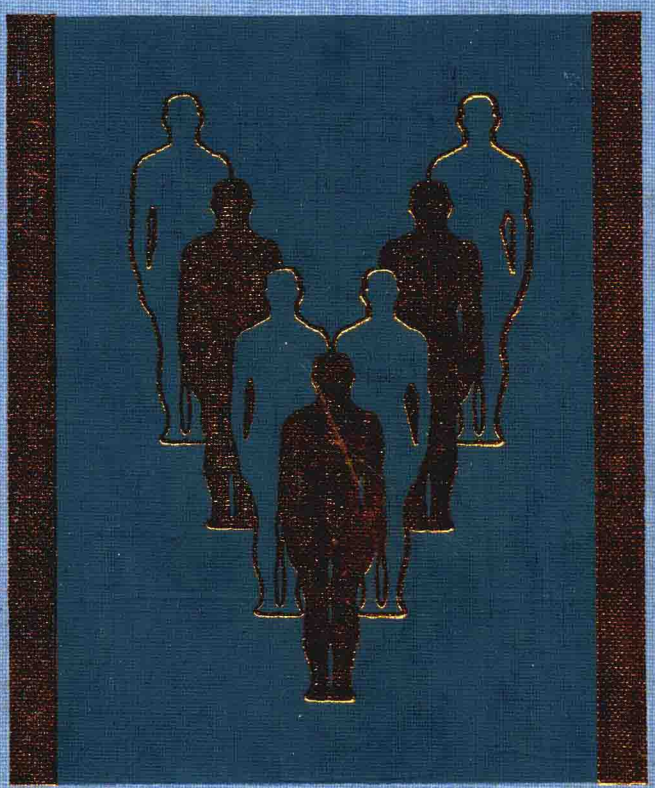
SECOND EDITION

ATLAS OF ULTRASONOGRAPHIC ARTIFACTS AND VARIANTS



ROGER C. SANDERS

Atlas of Ultrasonographic Artifacts and Variants

Second Edition

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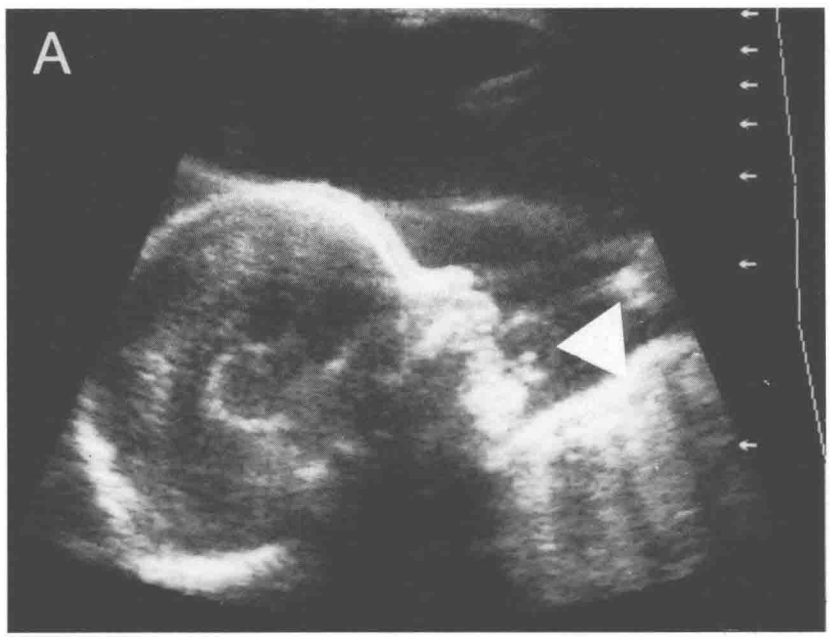

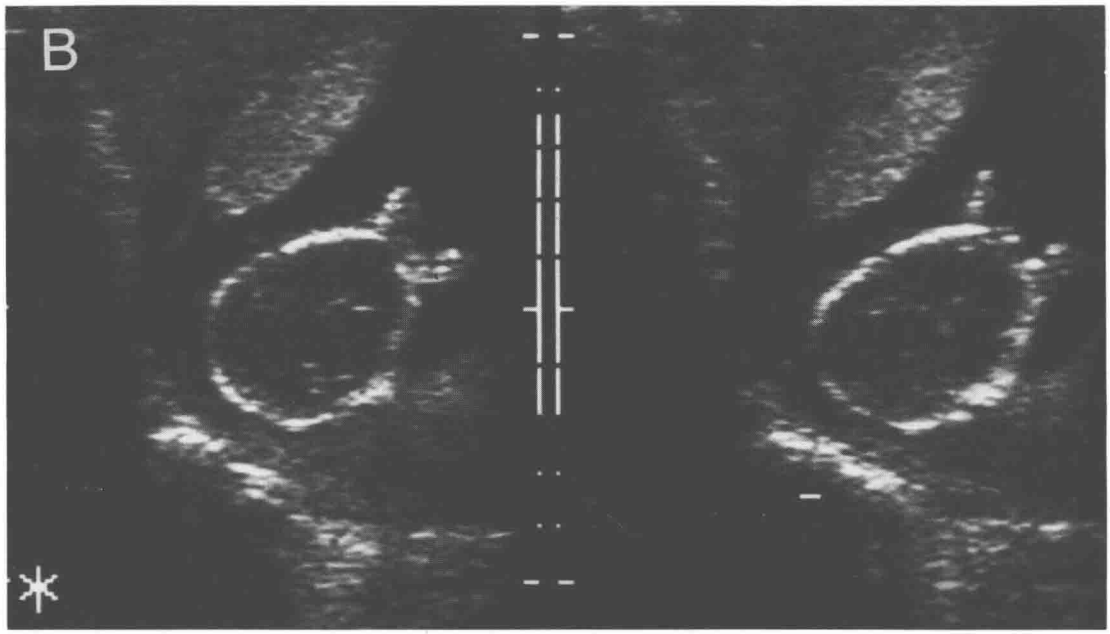

A, profile view of a fetus apparently blowing bubbles. The "bubbles" represent the umbilical vein. The cord lies alongside the mouth. **B,** "devil." The fetal arms appear as two horns coming off the fetal head.

Preface to the Second Edition

I am delighted that the first edition of the *Atlas of Ultrasonographic Artifacts and Variants* was well received. A number of sonologists sent to me examples of artifacts or anatomical variants not included in the first edition which have been added to this edition. Margaret Furness of Adelside, Australia, has been particularly helpful.

This edition of the book has been expanded by approximately 50%. The increase in size has been particularly great in the area of obstetrics, although significant material also has been added in other areas, notably the prostate and gynecological ultrasound. Doppler has created a number of variants, some of which are covered in this book. With additional experience no doubt many more Doppler variants will be seen and I expect this to be a much larger area in the next edition. I hope that sonologists will continue to send in unusual appearances for my preparation of the next edition.

ROGER SANDERS, M.D.

Preface to the First Edition

Diagnostic ultrasound is a rewarding field for the imaging artist because the creation of a quality picture requires an ability to think in a 3-dimensional fashion from 2-dimensional views. One has to obtain views that will convey fragmented information in a comprehensible fashion. An ability to create an image out of a series of partial glimpses of underlying anatomy seen through overlying bowel or gas is necessary. This difficulty in the creation of a permanent record is at once a challenge and a reward. It makes the performance of the study as important as the interpretation of the image. A sonogenic series gives a feeling of satisfaction to the sonologist and sonographer that is much greater than that achieved by the x-ray technician in computed tomography or conventional x-ray imaging.

Nevertheless, the challenge involved often introduces more artifacts into the image than occurs in other imaging areas. There are three main causes of normal variants seen with ultrasound. As in other imaging fields, there are numerous anatomical variants related to the difference between the fat and the thin, the tall and the short, and the way the internal organs relate to one another. To a greater extent than in other imaging fields, there are variants related to the way in which sound, as opposed to x-ray, interacts with tissues. It is inevitable that there will be reverberation and slice thickness artifacts that cannot be eliminated even by the most optimal technique. Finally, there are artifacts related to the way in which the procedure was performed. These artifacts were probably seen to a greater extent with static scanning, which is now merely an accessory aid to real-time and is essentially obsolete as a primary imaging procedure. Nevertheless, artifacts related to technique are seen with real-time and a competent operator can reduce the number of apparent variants seen in the course of a normal day's work very considerably by selectively avoiding taking images that he or she knows are related to a technical problem. Some internal abdominal structures are particularly prone to create normal variants; these are structures that change with time. There are numerous different variants related to the contents of bowel such as gas, fecal material, or fluid. The pelvic organs change over the course of the menstrual cycle, giving rise to different appearances that can be interpreted as pathology rather than a variant of the menstrual cycle.

Some normal variants are iatrogenic in origin. The insertion of sutures and catheters has led to appearances that can be mistaken for pathology; a number of such variants are cataloged in this book but the list is by no means comprehensive.

This is a first attempt at defining the many normal variants that can be seen with ultrasound and I hope that readers of the book will inform me of any additional normal variants that they see that can be added to future editions. I believe that ultrasound represents *the* field in which a work of this type is necessary for good practice.

I am grateful to authors who have given me permission to reprint unusual variants in this book that I've not seen in my practice. Anna Nussbaum, M.D., and Nancy Smith Miner, R.D., M.S., have been good enough to check for errors; I'm truly grateful to them for all of their suggestions. All of the members of my team—be they "Roger's Angels" (Irma Wheelock, Nancy Smith Miner, Mimi Maggio, Susan Jeremiah Collini, Cheryl Wilson, Pat Kaplan, Mary McGrath); or physicians Ulrike Hamper, Rita Bass, Dean Gain, Wolfgang Dahnert—have contributed to the book. I am particularly grateful to my secretary, Joan Mosmiller, who can type almost as fast as I can talk, for putting up with version after version of this book (and all my other books).

ROGER C. SANDERS, M.D.

Contents

1

Obstetrics

• FIRST TRIMESTER •

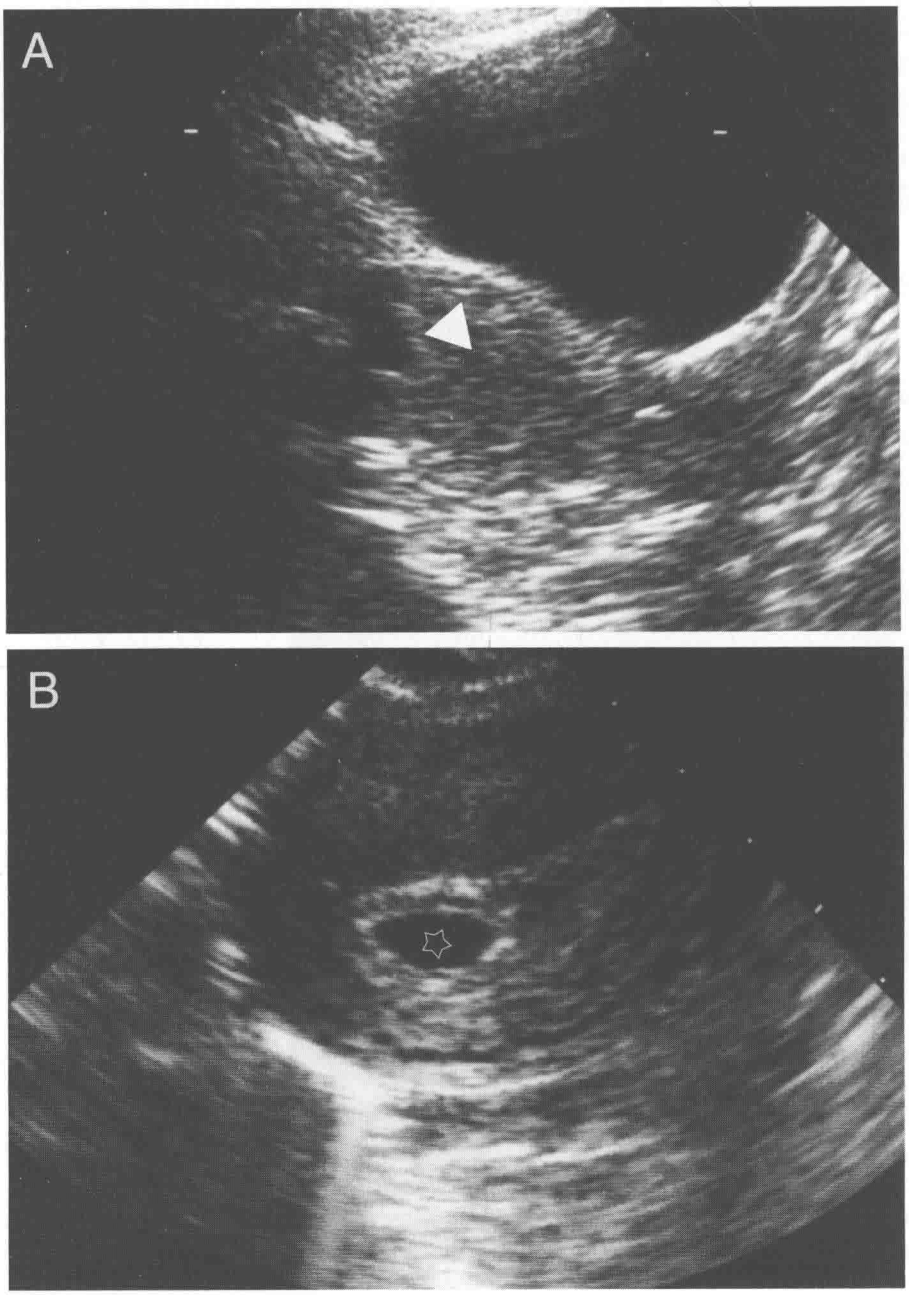

Fig 1–1.—A, transabdominal sagittal section shows a sac at the fundus that appears to have a single outline and that has an appearance suggestive of a decidual cast related to an ectopic pregnancy *(arrowhead).* **B,** an endovaginal view shows an early gestational sac enclosed within a normal decidual reaction (*). A sac with a single outline is most likely a decidual cast, but there are exceptions, such as this case. A double outline to a gestational sac is good evidence that there is a normal intrauterine pregnancy, but this also is not an infallible sign. Occasionally, a blood clot within a decidual cast can create an apparent double outline.

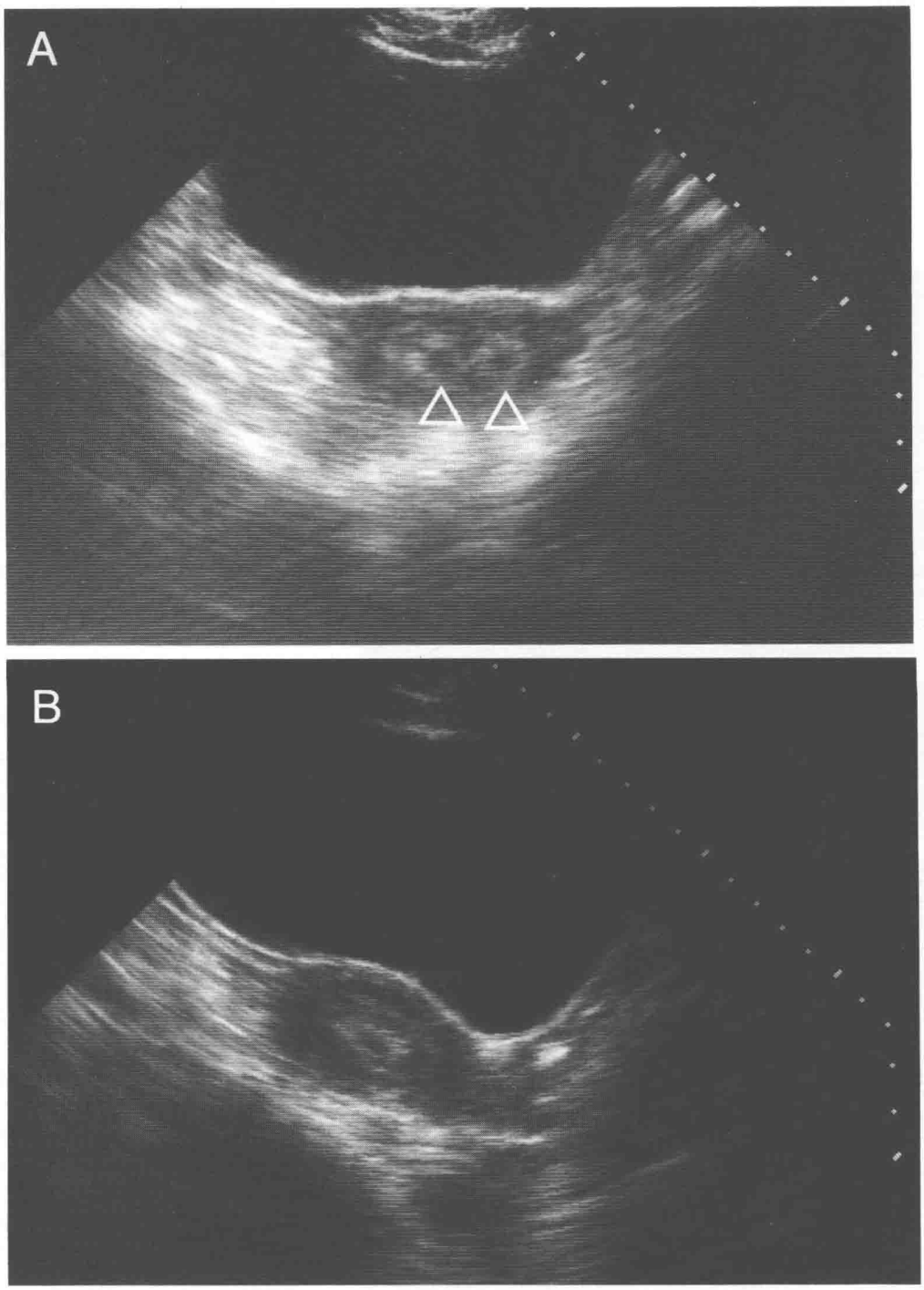

Fig 1–2.—A, apparent twin pregnancy with two small gestational sacs within the uterus *(arrowheads).* **B,** longitudinal view showing a single sac within the uterus. The apparent double sac is an artifact related to acoustic refraction through the rectus muscles. It is unusual to see this artifact, common with a linear array transducer, with a sector scan view. The system used here is a phased array, which can create such an image if the transducer is placed in the midline. Views from an oblique aspect showed a single sac. (See Fig 1-165 for an explanation of how this artifact is created.)

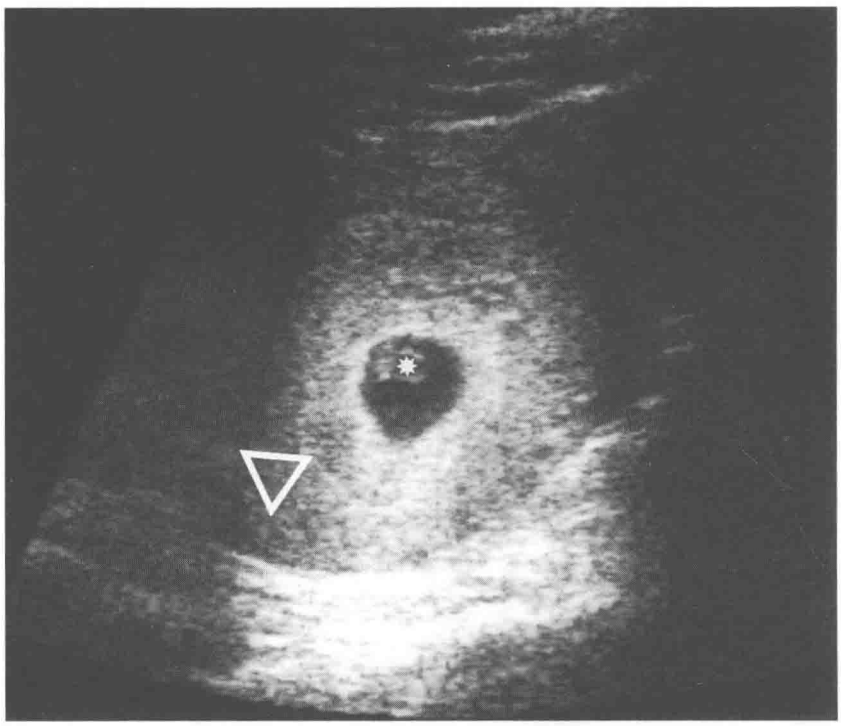

Fig 1–3.—Early gestational sac seen on endovaginal views. Note the yolk sac (*) and fetal pole. The trophoblastic reaction *(arrowhead)* is more exuberant than usual. This is a normal variant.

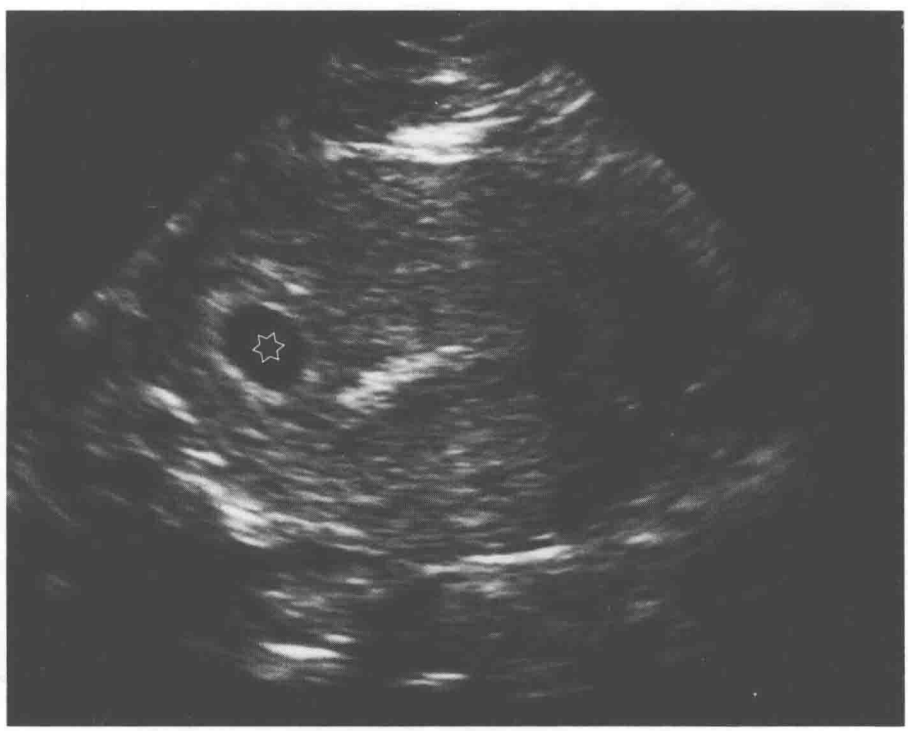

Fig 1–4.—Transverse view of the fundus of the uterus showing an eccentrically placed but normal gestational sac (*). This type of sac position raises the question of cornual or interstitial pregnancy. A portion of myometrium should lie lateral to the sac. If no myometrium is present, an interstitial pregnancy becomes more likely. A bicornuate uterus can also give rise to an eccentric position of the gestational sac; there is a split endometrial cavity with a second decidual reaction in the opposite horn. Fibroids may displace the sac into a lateral position. The fibroid should be visible. In this instance, later ultrasound studies showed a normal position of the sac.

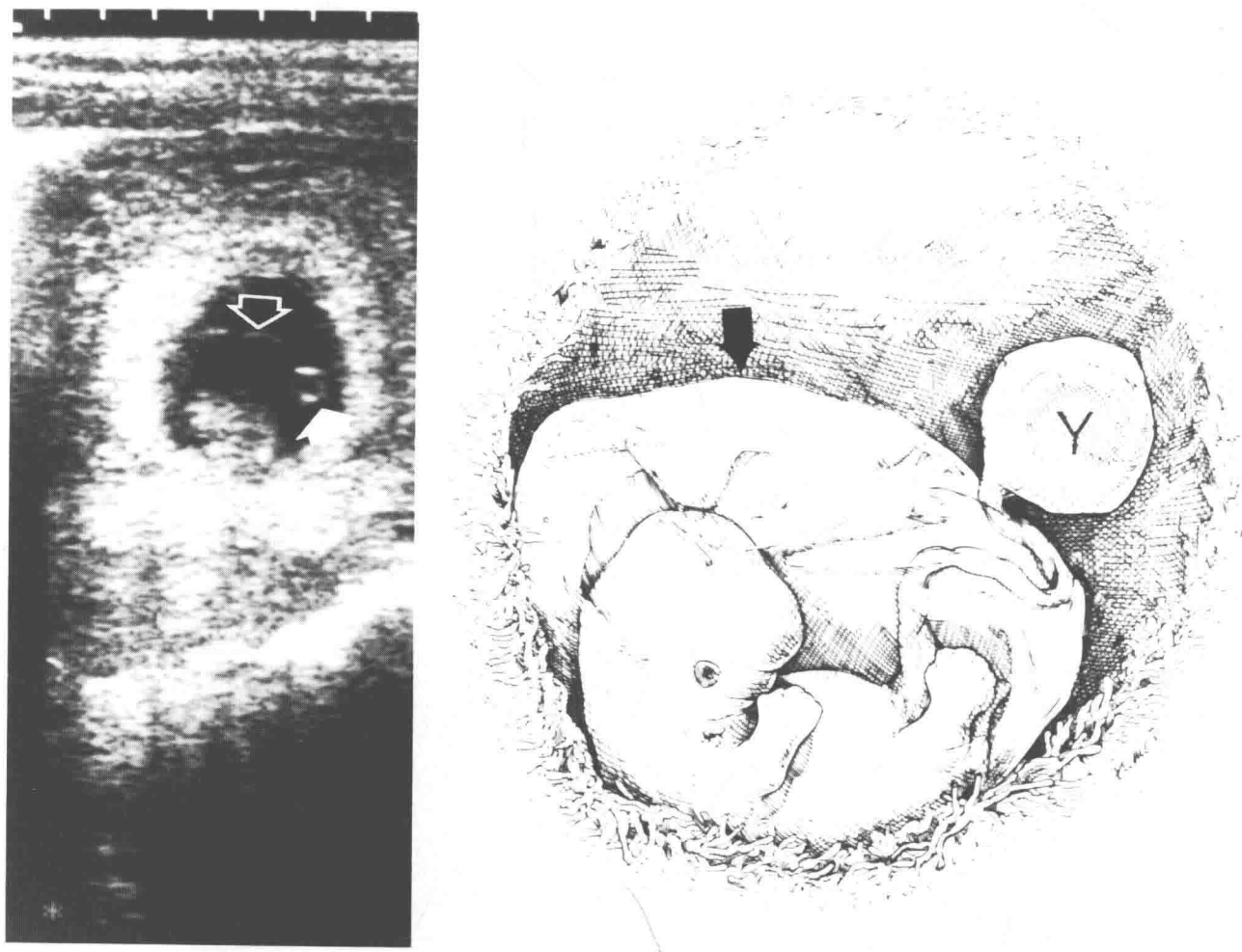

Fig 1–5.—Left, normal amniotic sac membrane *(open arrow)* in the first trimester. Note the yolk sac *(closed arrow)* that lies outside the amniotic sac. **Right,** the usual site of the amniotic sac membrane *(arrow)* at this stage of pregnancy with the yolk sac *(Y)* in the standard location.

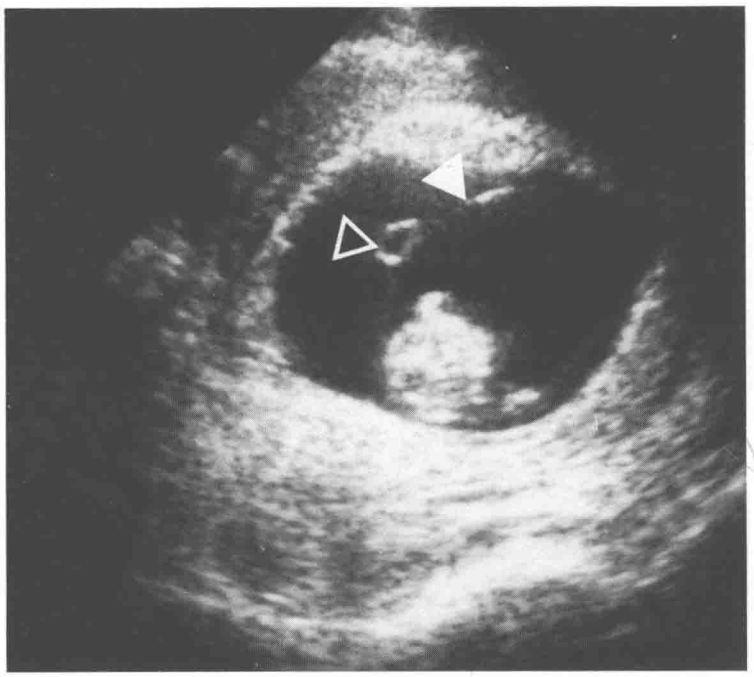

Fig 1–6.—The complete amniotic sac membrane can be seen *(closed arrowhead)*. The amniotic sac appears relatively small in comparison to the extracoelomic space. A small amniotic sac does not appear to have any clinical consequences. *Open arrowhead* = yolk sac.

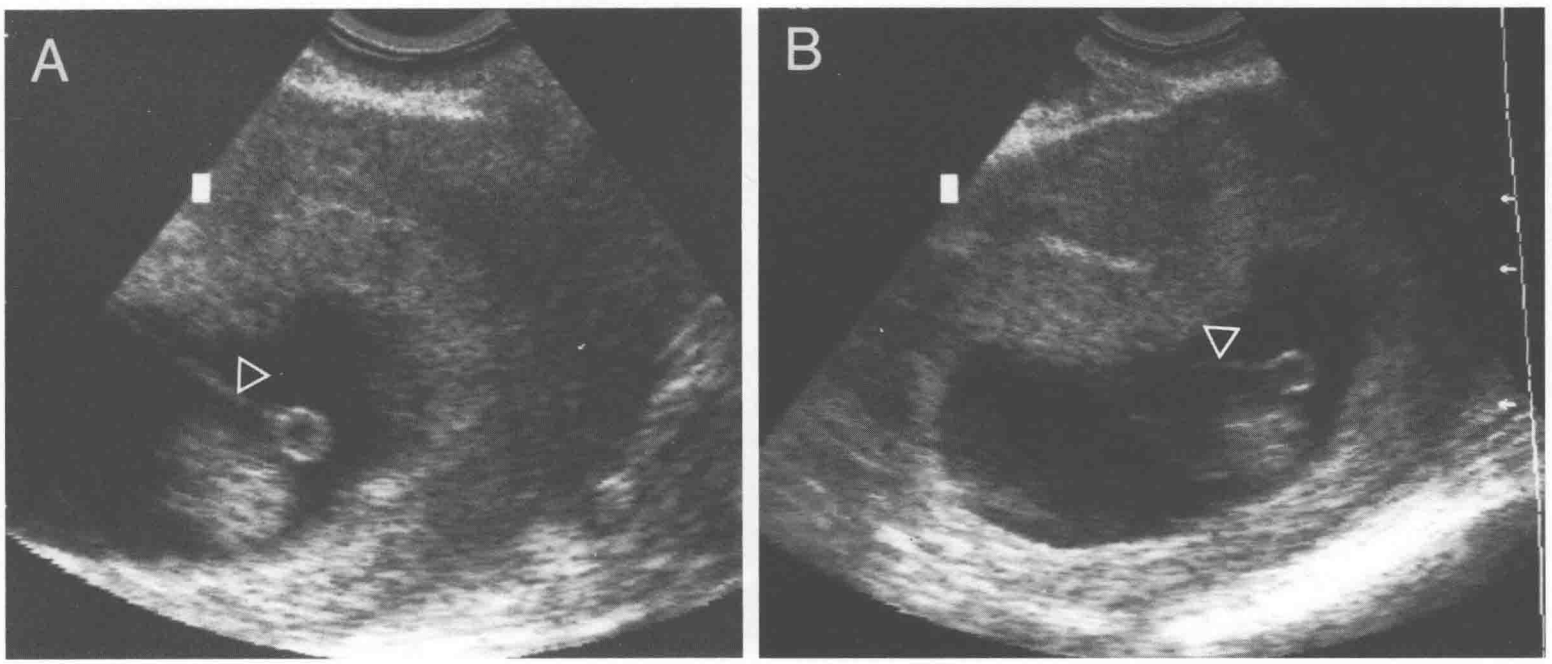

Fig 1–7.—**A** and **B,** vitelline duct *(arrowheads)* supplying yolk sac. The small tubular structure supplying the yolk sac is not the amniotic membrane, which could be seen separately (Barzilai et al., 1989). The vitelline duct atrophies when the yolk sac disappears.

Fig 1–8.—A membrane can be seen posterior to the back of the fetus *(arrowhead)*. This membrane represents an unfused amniotic membrane. It could be mistaken for nuchal thickening related to Down's syndrome.

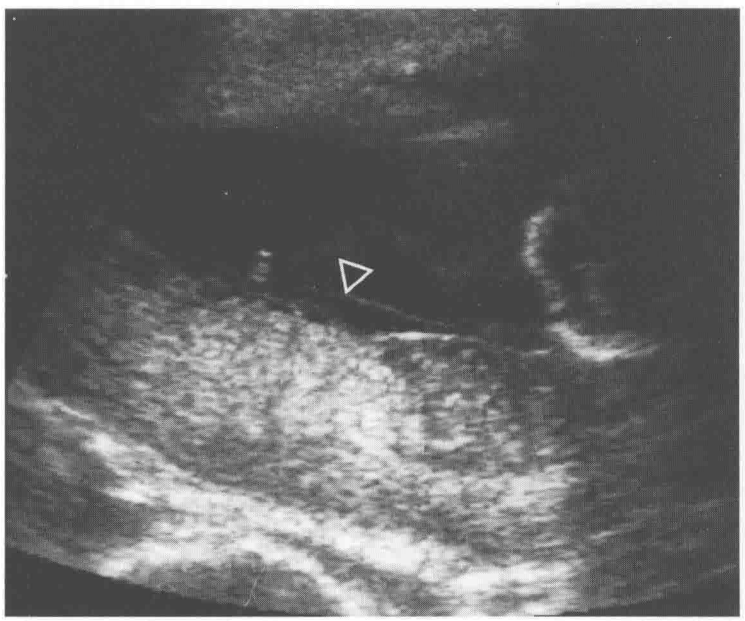

Fig 1–9.—Unfused amniotic membrane *(arrowhead)*. The small linear membrane along the posterior aspect of the uterus adjacent to the placenta is an unfused amniotic membrane at 17 weeks of gestation. Normally, the amniotic membrane fuses with the chorionic membrane at about 12 weeks'.

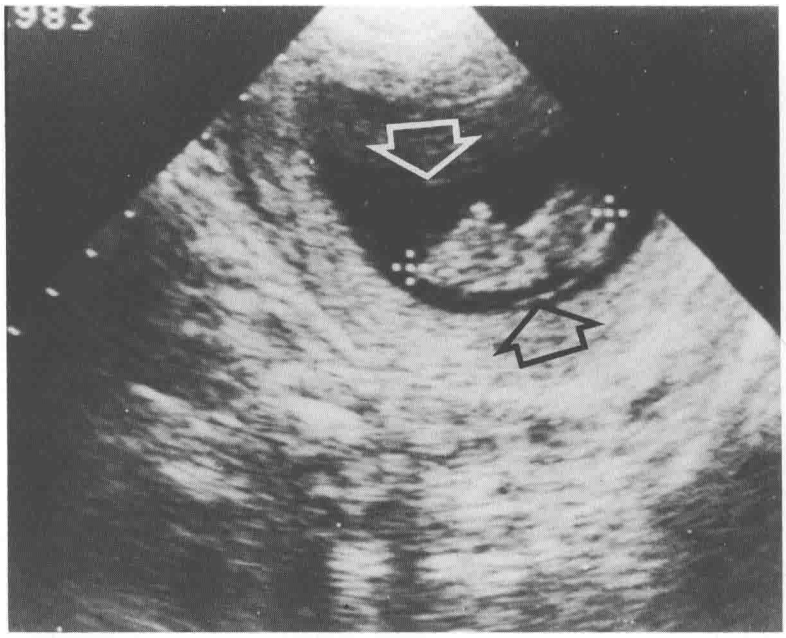

Fig 1–10.—Amniotic sac membrane *(arrows)* in the first trimester. A space between the amniotic and chorionic membranes is a common finding in the first trimester; fusion may normally occur as late as the early part of the second trimester (Kaufman et al., 1984). The amniotic membrane can be confused with an area of nuchal thickening.

Fig 1–11.—Normal gestational sac with yolk sac *(arrow)* seen separate from the fetus *(F)* (Sauerbrei et al., 1980; Crooij et al., 1982).

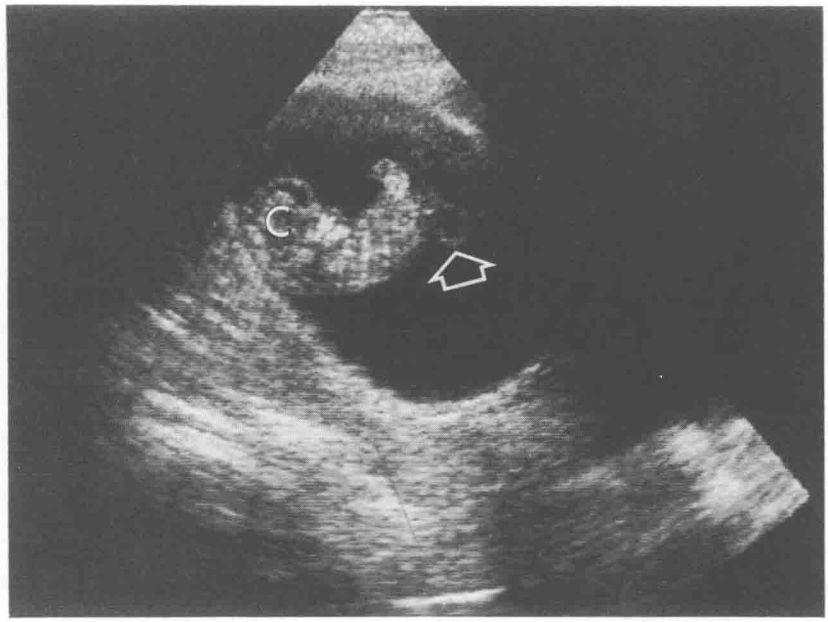

Fig 1–12.—Normal gestational sac with yolk sac *(arrow)* adjacent to the fetus. The yolk sac might be included in a crown rump length measurement. *C* = fetal head.

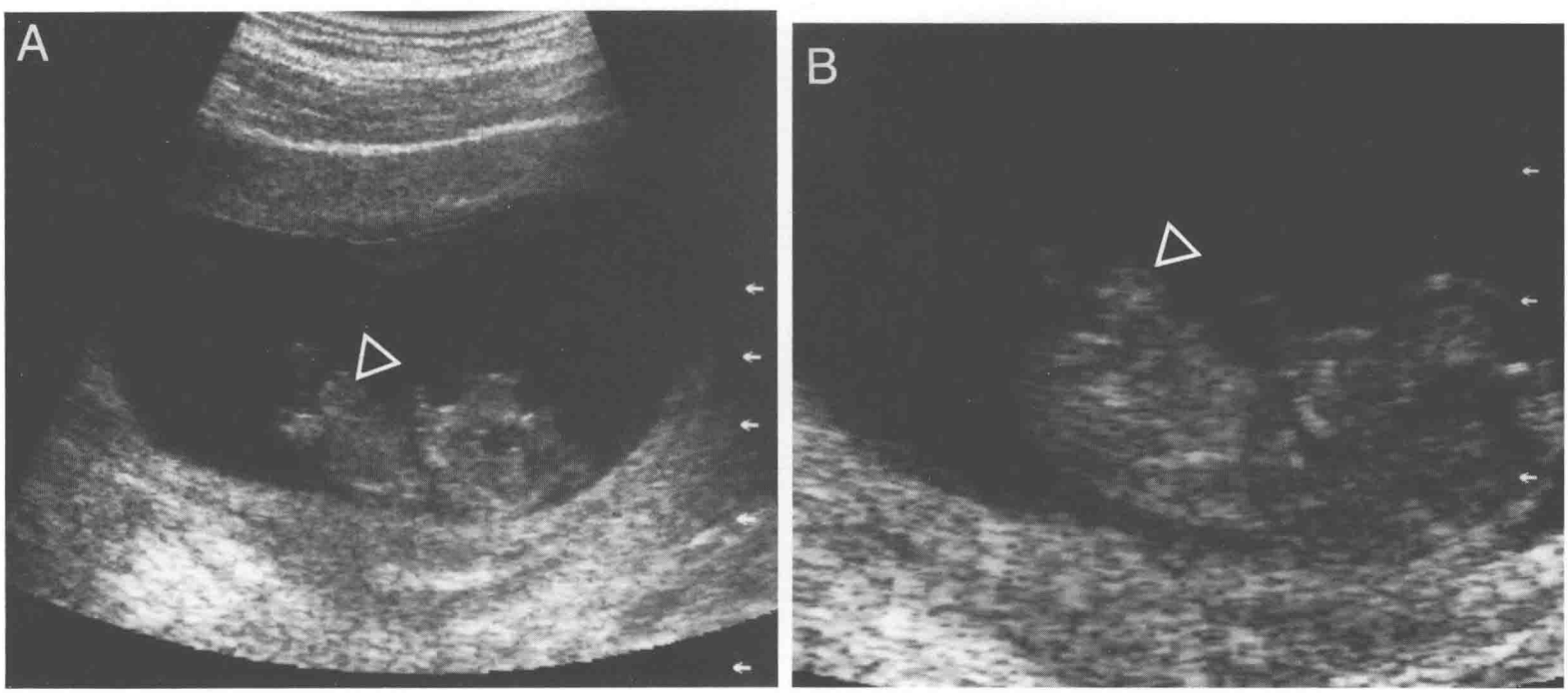

Fig 1–13.—**A** and **B,** midgut herniation. Between 7 and 10 weeks', the small bowel may rotate outside the fetal abdomen and form a mass anterior to the fetus *(arrowheads)*. This "pseudo-omphalocele" is composed only of bowel. The gut should return within the fetal abdomen by 10 weeks (Cyr et al., 1986; Timor-Tritsch et al., 1989).

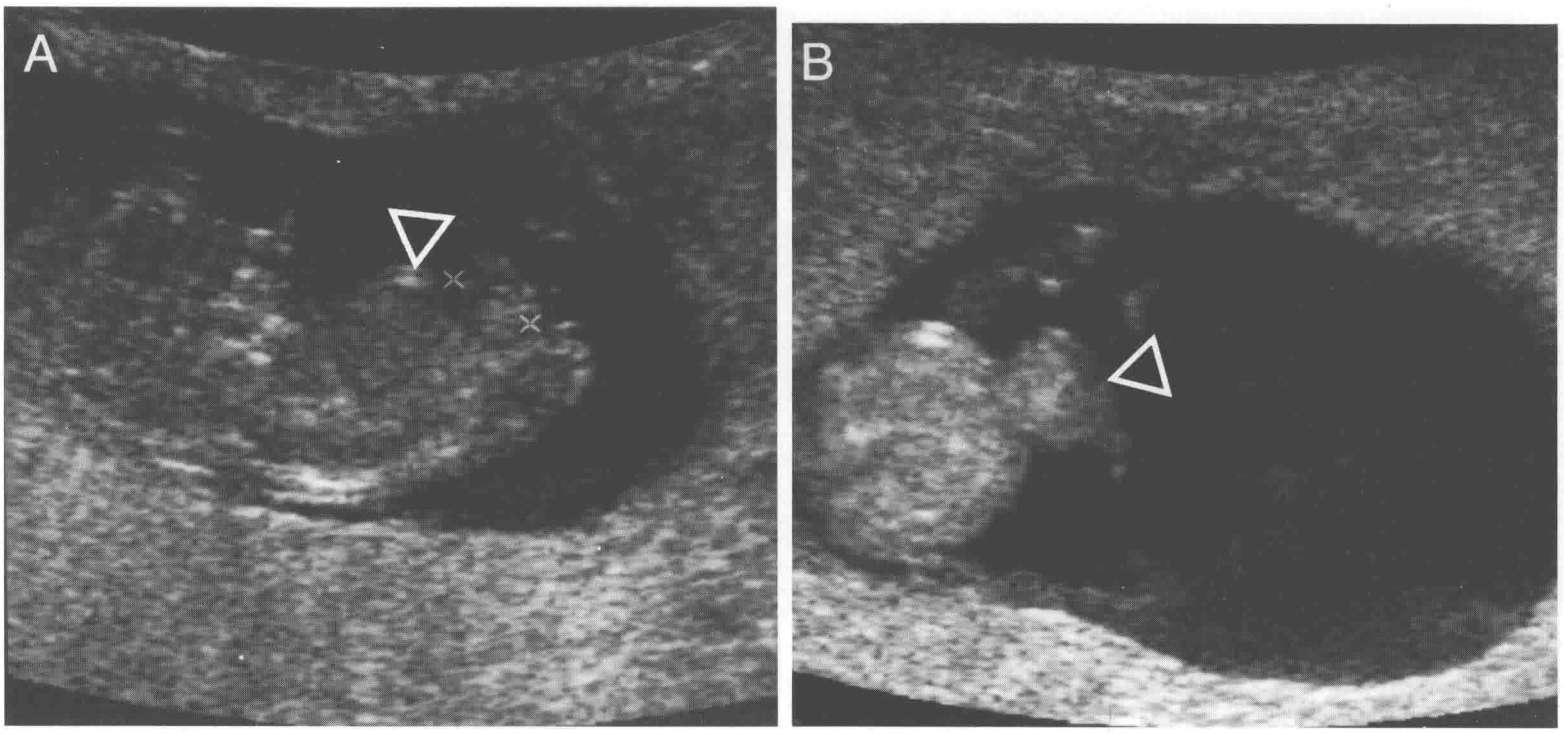

Fig 1–14.—A and **B,** another example of a midgut herniation *(arrowheads).* No liver should lie within the "pseudo-omphalocele." If liver is present, a diagnosis of a true omphalocele should be suggested (Gray et al., 1989).

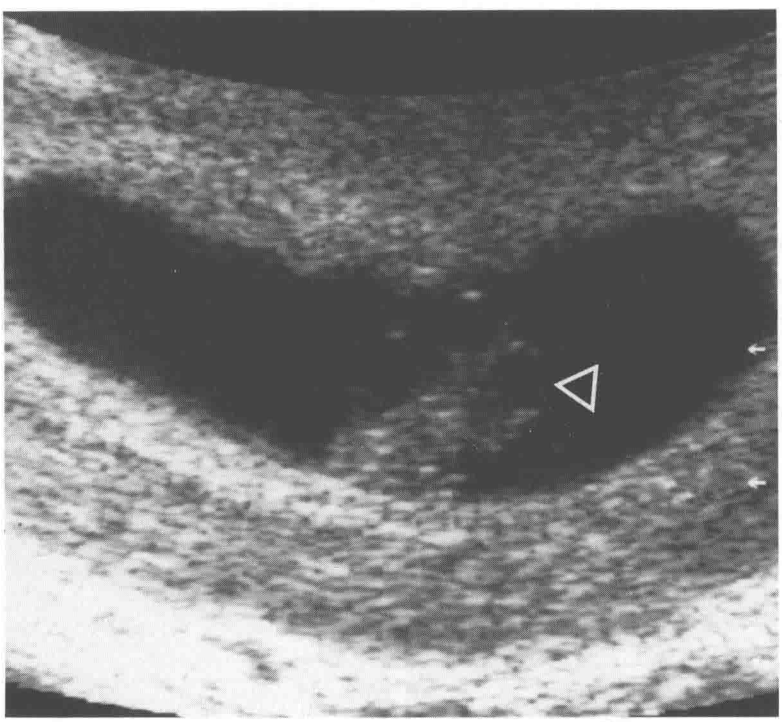

Fig 1–15.—Cystic structure in first trimester cranium. A cyst *(arrowhead)* is seen at the posterior aspect of the fetal head between 8 and 11 weeks'. It represents the telencephalon, a primitive intracranial ventricle. This cystic structure will become the fourth ventricle later (Timor-Tritsch and Rottem, 1991).

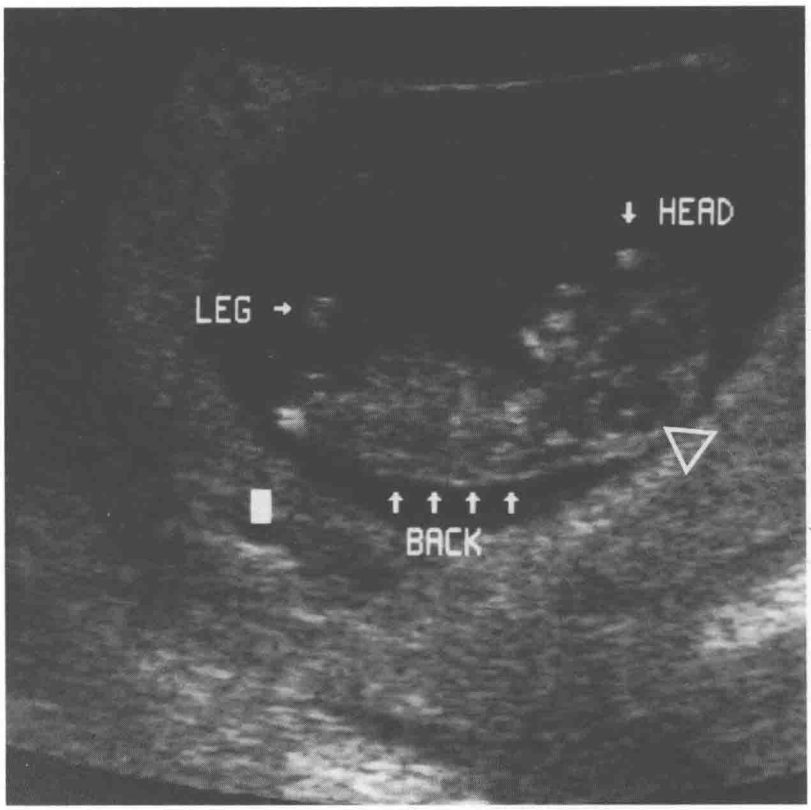

Fig 1–16.—Twelve-week fetus showing the telencephalon *(arrowhead)*, which is smaller than the one in the fetus in Figure 1–15. At this stage, the telencephalon is decreasing in size.

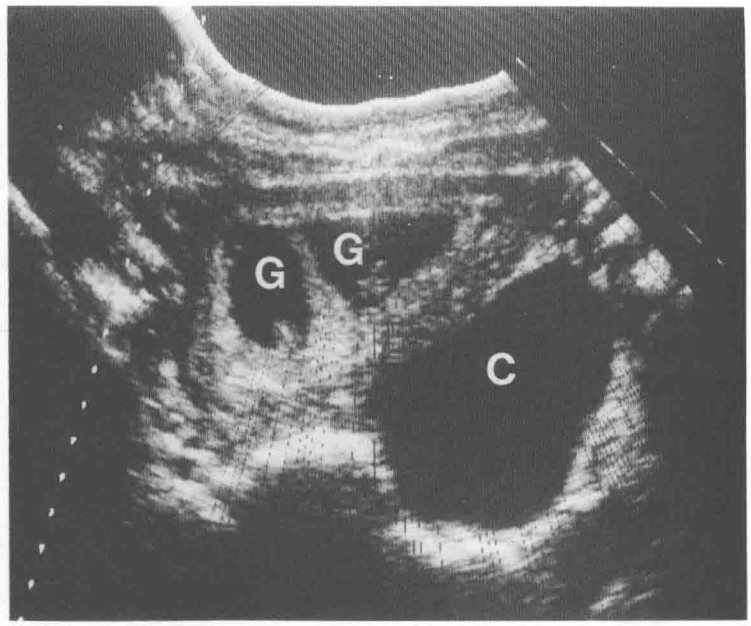

Fig 1–17.—Transverse view of a uterus containing two gestational sacs *(G)* with a twin pregnancy. A large corpus luteum cyst *(C)* is present in the left adnexa. It disappeared on subsequent sonograms.

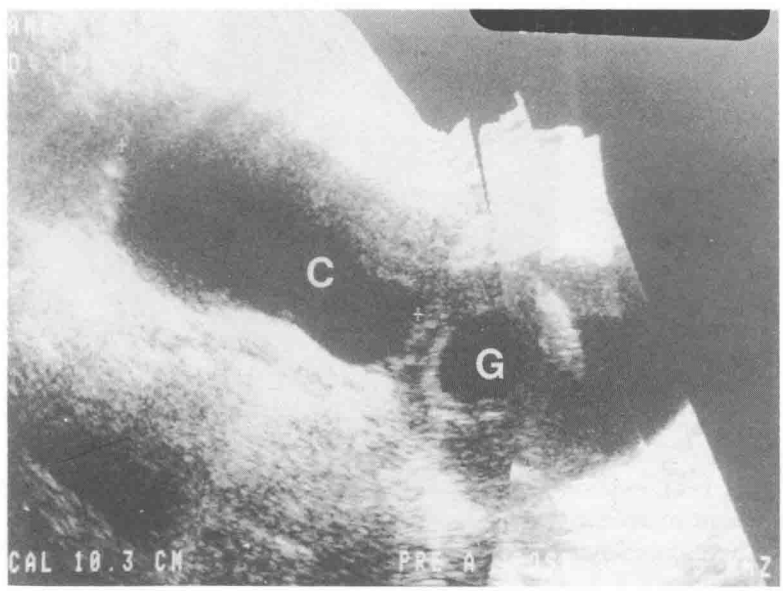

Fig 1–18.—Very large corpus lutein cyst *(C)* (10 cm in length) in association with an early gestational sac *(G)*. This is the largest confirmed corpus lutein cyst of which I am aware. Note the internal echoes in the anterior part of the cyst and in the bladder because of reverberations. The anterior abdominal wall appears very echogenic as a result of excessive near gain.