

**SYNOPSIS OF
OBSTETRICS**

EUGENE C. SANDBERG

TENTH EDITION

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EUGENE C. SANDBERG, M.D.

Associate Professor of Gynecology and Obstetrics,
Stanford University School of Medicine,
Stanford, California



TENTH EDITION

with 287 illustrations

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SYNOPSIS OF OBSTETRICS

For
Kristin and Kerk
and
Bob Hacha

Preface

The tenth edition initiates the third generation of authorship of this abbreviated text. *Synopsis of Obstetrics* was created in 1940 and nurtured through its first three editions by Dr. Jennings C. Litzenberg, Professor of Obstetrics and Gynecology at the University of Minnesota School of Medicine. Thereafter, responsibility for the book was assumed by Dr. Charles E. McLennan who developed the six editions that were published between 1952 and 1974. Throughout this interval, Dr. McLennan was Professor and Chairman of the Department of Gynecology and Obstetrics at the Stanford University School of Medicine. It was my pleasure to be his associate during the majority of those years and to share in the formation of the last two editions. It is now my privilege to perpetuate the scholastic effort of these two fine academicians.

In the tenth edition the concepts established by the previous authors have been maintained and their format only modestly varied. The book is a condensed version of the large standard texts and is designed to provide a synoptic introduction to the field of obstetrics for those desiring generalized obstetric information. It is broad in its coverage, compressed in its exposition. Theoretical and controversial aspects are minimized, and the dogma expressed has been selected as representing a reasonable mean in obstetric opinion and practice today.

In the past five years the audience for condensed texts has enlarged substantially. Because of the recent and profound accentuation of new information, medical schools have been called on to condense subjects to their *core* elements. Medical students are spending shorter periods of time in more numerous subject areas in the attempt to broaden their clinical exposure. Paramedical personnel (physician's assistants, nurse practitioners, midwives, etc.) are

increasing rapidly in number and need different quantities and types of obstetric information. All these individuals can benefit from synoptic coverage; few require detailed texts. It is anticipated that those who develop a keener interest in this science and a need for more extensive information will graduate to the use of the periodicals and the more sophisticated books that abound within the specialty.

As with any new edition, numerous revisions and deletions have been made in the effort to modernize the text. The subject areas and the sequence of their presentation remain much the same. The previous practice of omitting bibliographic references has been perpetuated on the continuing assumption that the typical reader of a synopsis has little time, and generally little enthusiasm, for pursuing the details found in original sources.

The major changes are expansionary. A large number of new drawings and illustrations has been added. The chapters relating to maternal disorders have been enlarged in keeping with the increased interest in *high-risk* maternal problems. The principal additions, however, concern the fetus. In the last decade progressively greater attention has been devoted to the physiologic, genetic, maturational, growth, and oxygenational status of this member of the pregnancy. In the four years since the last edition, new methods of assessment of intrauterine fetal health have been developed, and older methods have been more broadly applied. These have been described in expanded sections, as well as in new chapters, on fetal and environmental assessment, and prematurity. It is in the area of *fetal medicine* that the greatest advances are anticipated in the next four years.

I am grateful to Alice Baker and Halcyon Cowles for several new drawings, to Dr. Howard Cann for reviewing the sections related to genetics, and, most specifically, to Lillie Melton for her indefatigable and meticulous preparation of the repeatedly revised typescript for this edition.

Eugene C. Sandberg

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CHAPTER 1

Ovulation and fertilization

Obstetrics is that segment of gynecology devoted to human reproduction. In its original usage the Latin term *obstetrix* meant “one who stands before” and referred to the individual who assisted the pregnant woman at delivery. Since that time the term has come to embrace the entire science of reproduction, as well as the art of its individualized clinical application. The primary goal of those engaged in this field is to sustain the life and to preserve or improve the physical and emotional health of every pregnant woman. The secondary goal is to help each pregnant woman fulfill her desire or her decision regarding the pregnancy. If the pregnancy is to be continued, this goal also incorporates achievement of optimal fetal growth, development, and birth. The immensity of the task worldwide and our current distance from these goals may be appreciated by reviewing the figures in Table 1-1.

In the United States there are approximately 3 million live births a year, a *birth rate* of 14.8 per 1000 population. The annual *fertility rate* is 66.7 live births per 1000 women of reproductive age. The fertility rate is 63.0 for white women and 89.2 for black women. Over 98% of births occur in hospitals. All these figures have been declining slowly in the past several years, including that referable to hospital births.

Maternal mortality in the United States is approximately 15 per 100,000 live births. The *stillbirth* and *neonatal mortality rates* are about 12 and 13 per 1000 live births, respectively. More than 250,000 low birth weight infants are born in the United States each year. This represents approximately 7% of white newborns and 13% of black newborns. The neonatal mortality rate for low birth weight infants is twenty times higher than that for newborns of normal weight.

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Table 1-1. Results of human reproductive activity worldwide, 1975*

	Millions
Number of conceptions	335
Live births	125
Premature	20
Normal delivery	105
Mentally retarded infants	4
Chromosomal abnormalities, hereditary biochemical disorders, and major congenital defects	6
Infant deaths	14
Induced abortions	50
Spontaneous abortions and stillbirths	160
Recognized	50
Unrecognized	110
Maternal deaths	0.2
Maternal morbidity and serious maternal complications	25

*Modified from Greep, R. O., et al.: *Reproduction and human welfare: a challenge to research*, New York, 1976, Ford Foundation.

Two actions have recently been initiated in the United States as a response to the continuing urge to reduce our perinatal mortality figures, as well as to improve maternal health. One of these is "regionalization of obstetric care." The goal of regionalization is to optimize obstetric service by providing each pregnant woman with the intensity of care individually required. The plan embodies referral and transportation of patients with obstetric problems to increasingly sophisticated centers of care, depending on the degree of the complexity of the situation and the type of care required. This should result in the availability of high-cost, intensive care for those requiring such. Simultaneously, it should permit the establishment of less expensive, and possibly less stylized, care in the home area for the majority of women whose pregnancies are uncomplicated.

The other action is the recognition and development of a new echelon of additionally specialized personnel. Since 1974 diplomates of the American Board of Obstetrics and Gynecology have

been awarded certification in the subspecialty of Maternal and Fetal Medicine on fulfillment of certain requirements. These include 2 years of prearranged, postresidency experience in maternal and fetal medicine and the successful completion of written and oral examinations. Practitioners of this subspecialty have assumed the title of perinatologists. This title and that of the subspecialty acknowledge the hugely effective efforts at reduction of maternal mortality and morbidity in the United States in the last 50 years and the current commitment of obstetricians to similar success in reference to the fetus.

GAMETOGENESIS

It seems logical to begin a text on reproduction with a description of the germ cells and the events immediately preceding their union. It is assumed that the reader has previously acquired a reasonable knowledge of the anatomy and embryology of the female reproductive organs and that these topics need not be detailed here.

The ova of the female and the spermatozoa of the male are collectively known as *gametes*. During fertilization a male and a female gamete unite to form a single cell or *zygote*, from which a new individual develops. During embryonic development *primordial germ cells* migrate from the yolk sac entoderm to the embryonic genital ridge and enter the mesenchyme of the future gonad. By the seventh fetal month primordial germ cells in the female (*oogonia*) have been transformed into *primary oocytes* through maturation and repetitive mitotic division (Fig. 1-1). By the time of birth the primary oocytes have entered the prophase of their first meiotic (chromosomal reduction) division and remain in this resting state until individual maturation occurs preparatory to ovulation 15 to 45 years later. The first meiotic division is not completed until shortly following actual release of the egg at ovulation. At birth 1 or 2 million oocytes are present. By the age of 7, through normal atresia, this number has fallen to 500,000. Only about 0.1% of these are destined to mature and be released for fertilization. In the resting state the primary oocyte is about 40 μm in diameter. At the time of release from the ovary, it has gained substance and is about 100 to 150 μm in diameter.

The ovum is surrounded by the transparent *zona pellucida*, which, in turn, is surrounded by a layer of radially elongated ovarian

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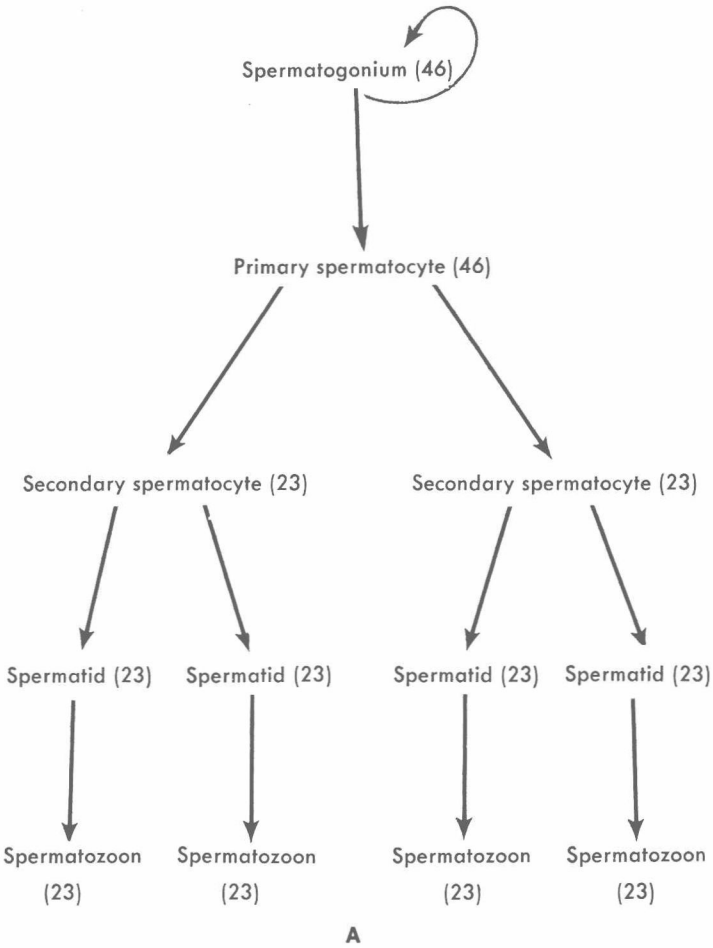


Fig. 1-1. Stages of gametogenesis in the human male **(A)** and female **(B)**. Note that spermatogonia are self-replenishing, whereas oogonia are not. (The numbers in parentheses represent the number of chromosomes at each stage.)

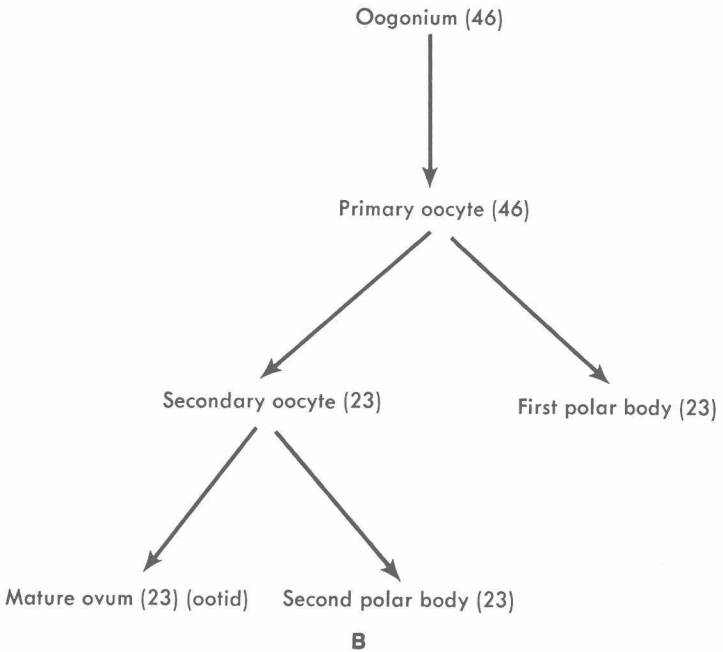


Fig. 1-1, cont'd. For legend see opposite page.

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follicular cells termed the *corona radiata*. This entire structure is a *primary* or *primordial ovarian follicle* (Figs. 1-2 and 1-3).

When maturation begins preparatory to ovulation, cells surrounding the ovum multiply, and a cavity known as the antrum appears in the follicle. The ovum becomes larger than any of the surrounding follicular cells, and its cytoplasm becomes dotted with yolk granules. As fluid accumulates in the antrum, follicular cells increase in number and are pushed peripherally to form the *stratum granulosum*. The follicular cells accumulate most rapidly at the point in the stratum granulosum where the ovum is located. These cells surround the ovum, bulge into the antrum, and are known as the *cumulus oophorus*. Ovarian connective tissue surrounding the maturing follicle is condensed into the *theca folliculi*. This is subdivided into the *theca interna* (relatively loose and highly vascular cellular tissue close to the follicle) and *theca externa* (densely fibrous tissue located at the periphery).

Ovulation. The mature follicle measures 5 to 10 mm in diameter and distends the surface of the ovary. A stigma forms, the follicle ruptures, and the ovum is released. The physiochemical events that cause the follicle to grow toward the ovarian surface during matu-

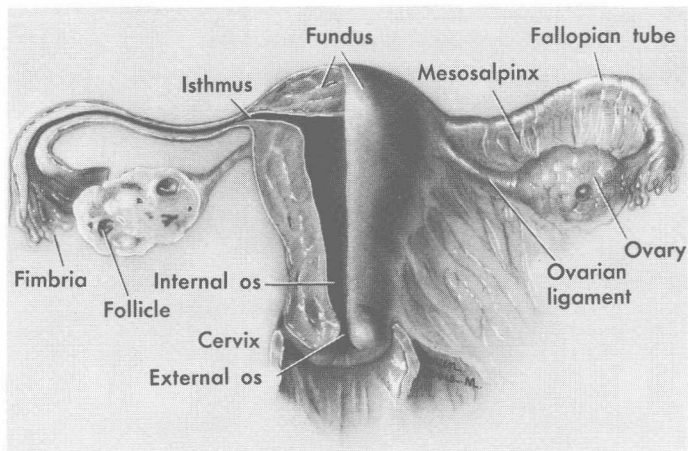


Fig. 1-2. Normal uterus, tubes, and ovaries.

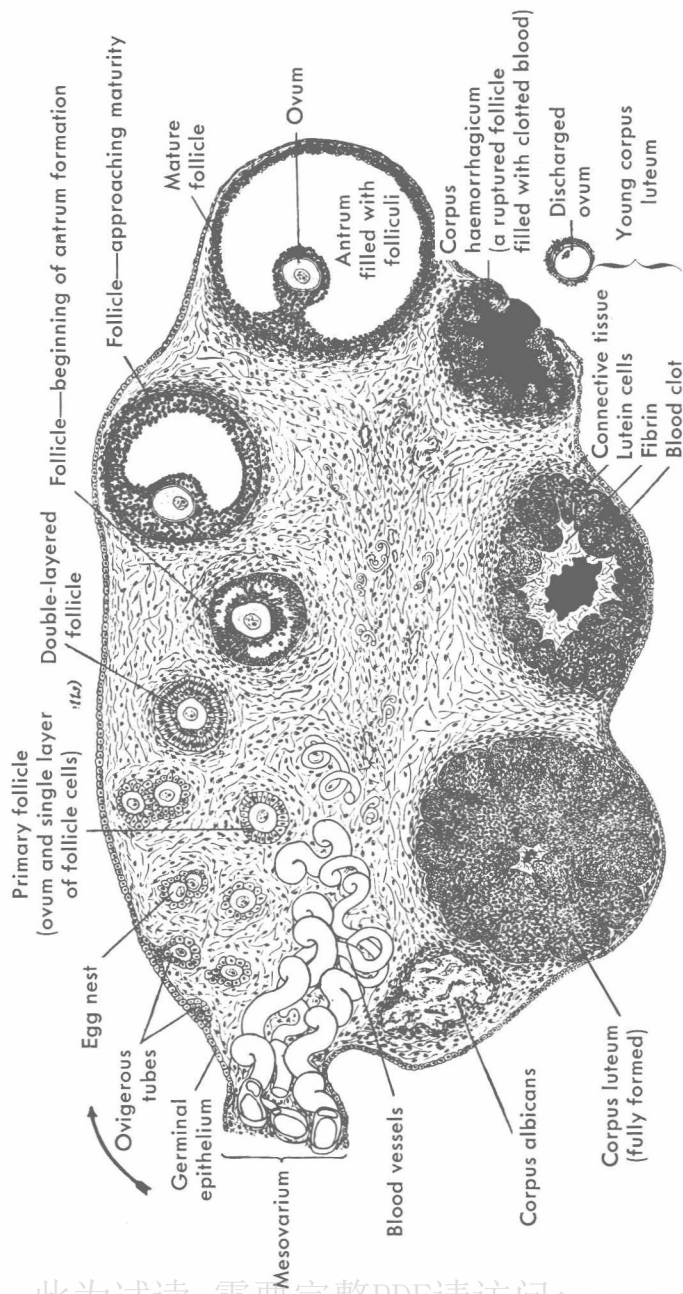


Fig. 1-3. Diagrammatic representation of the maturation and release of the ovum and of the formation and regression of the corpus luteum. (From Patten: Human embryology, ed. 3, New York, Blakiston Division, McGraw-Hill Book Co.)