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ABOUT THE AUTHOR: ALAN F. GUTTMACHER, M.D., Professor Emeritus of the Department of Obstetrics and Gynecology at New York's Mount Sinai Medical School, is one of the most distinguished figures in the world of medicine today. The author of four previous notable books, and current President of Planned Parenthood-World Population, Dr. Guttmacher continues to pursue an active professional life, writing, lecturing, and traveling.

To the memories of my mother,
Laura, 1873–1955,
and my twin brother, Manfred,
1898–1966.

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Foreword

Birth is the most dramatic event in human experience. If a Broadway play could pack into two hours half the drama of this crucial moment, it would be a "sell-out" for years on end. Despite more than forty-five years in obstetrics and participation in thousands of deliveries, each birth excites me today as it first did more than four decades ago. As the baby issues forth, questions crowd the mind, some immediate—the sex, condition, and appearance; others remote—longevity, career, progeny, the ultimate proportion of happiness to tragedy.

The sense of responsibility, the emotional involvement doctors feel in the conduct and outcome of each delivery is greater than the uninitiated suspects. A facet which makes the obstetrician's burden unique in the whole field of medicine is his double obligation: he simultaneously cares for two patients, mother and infant. Each has an individual right to life. Fiction suggests that a doctor is frequently faced at the time of birth with the dilemma, which life to save. The fact is that, through the developments of modern medicine, in almost every instance both lives can be and are saved. If the situation were ever to develop that at delivery only one of the two lives could be saved, a situation I have never encountered, I am almost certain the life of a mother would be given primacy.

The author does not intend to deprecate the even greater importance of birth to parents, for he has been a participating father on three happy occasions and a grandfather twice. It is the rare couple which does not face "B" day with a mixture of hope and fear. There is the hope of an easy, safe deliverance of a healthy, normal baby, and the hope of their own superior performance as parents. There is the fear of some obstetric mishap to mother or child, or of an abnormality in the infant. Fortunately, today, with the vast improvements in obstetric care, birth misadventures are uncommon. If congenital abnormalities occur—and they do once or twice

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Duration of Pregnancy

Calculating the Date of Birth

Dr. Brown bent back in his swivel chair, tapped together the ends of his fingers, and asked gravely, "When did your last menstrual period begin?"

Rustling unsuccessfully in her handbag for the forgotten memorandum, young Mrs. Smith replied, "Let's see. It was the day of the last concert, you know. Let me think, wasn't it Wednesday, March eighteenth?"

With telegraphic speed, and without the aid of either fingers or calendar—the use of these marks the neophyte—the wise man announced, "Your baby is due on Christmas Day." Mrs. Smith was impressed! It was barely the first of May, and yet this seer foresaw the birth of her child, seven and a half months distant. How did he do it?

The calculation of the expected date of confinement is very simple, absurdly simple. I hesitate to divulge the formula for fear of revealing a guild secret. The rule is: Add seven days to the first day of the last normal menstrual period. Count back three months. In the case of Mrs. Smith, Dr. Brown added seven to March 18, and then counted back—February, January, December. That made the expected date of confinement December 25. The mystic formula is now exposed. In reality, this formula affords a short cut for counting 280 days from any fixed date. In other words, a woman ordinarily delivers nine months and seven days from the beginning date of her last menstrual period.

It must be stressed that the 280 days is an average figure, which means that a vast number of pregnancies terminate before the 280th day, a vast number after it, and only relatively few on the exact day. At best the calculated or expected date of confinement is an approximate date. This is an important fact for the pregnant couple as well as relatives and other interested persons to remember. It is all too common for panic to become general when "B" day ar-

rives, then passes, and yet there is no sign of labor. Telephones soon begin ringing, and on each occasion the patient is unhappily greeted by the salutation, "Haven't you gone to the hospital yet?"

What Are the Chances of Delivering on Time?

In over 17,000 cases of pregnancy carried beyond the twenty-seventh week, 54 per cent delivered before 280 days, 4 per cent on the 280th day, and 42 per cent later. Forty-six per cent had their babies either the week before or the week after the calculated date, and 74 per cent within a two-week period before or after the anticipated day of birth.

On the basis of these data one can calculate the likelihood which the average woman faces when carrying a single infant, not twins, of having her baby, during each week after the twenty-seventh week from the first day of her last menstrual period.

Weeks	*Days*	*Approximate Chance*
28	189-196	1:625
29	196-203	1:625
30	203-210	1:525
31	210-217	1:240
32	217-224	1:240
33	224-231	1:135
34	231-238	1:115
35	238-245	1:58
36	245-252	1:39
37	252-259	1:22
38	259-266	1:11
39	266-273	1:5
40	273-280	1:3½
41	280-287	1:5⅔
42	287-294	1:12
43	294-301	1:34
44	301-308	1:74
45	308-315	1:140
46+	315+	1:140

Another reliable study has shown that 40 per cent of women go into labor within a ten-day period—five days before and five days after the calculated date, and nearly two-thirds within plus or minus ten days of the expected time.

Factors Affecting the Delivery Date

Ordinarily the woman with a consistent, regular menstrual cycle is more likely to have a baby at the 280th day than the

woman who menstruates irregularly. Furthermore, a short menstrual interval, such as twenty-five days, is frequently associated with delivery a few days early, and a lengthy menstrual cycle with birth beyond the due date. The calculated date increases or decreases by about one day for each day the patient's average menstrual cycle exceeds or falls short of twenty-eight days. Neither age, race, size, nor the previous number of children seems to influence the length of pregnancy.

In a study of almost 15,000 first births of a single infant in Aberdeen, Scotland, 24 per cent of patients with a male infant delivered during the thirty-ninth week and 28 per cent in the fortieth week (total 52 per cent). Twenty-three per cent of mothers in a first labor who gave birth to daughters bore them during the thirty-ninth week and 30 percent in the fortieth week (total 53 per cent). This slight difference in delivery dates between boys and girls is not statistically significant.

A study of over 20,000 total births at the University of Chicago showed that babies weighing over ten pounds averaged pregnancies of 288 days instead of 280 days.

A twin conception shortens pregnancy by about three weeks; actually, the average woman who carries twins delivers them on the 258th day instead of the 280th day. Triplet and quadruplet pregnancies are usually briefer than this, triplets commonly arriving five weeks early and quadruplets six weeks before time. Mrs. Dionne delivered her famous quintuplets on the 219th day (thirty-one weeks).

A Prolonged Pregnancy

A pregnancy carried more than two weeks beyond the calculated date is considered prolonged, and the resulting infant designated as postmature. Such a delivery occurred in 8 to 12 per cent of the pregnancies in the two studies previously cited.

There are apparently medically authentic cases in which pregnancy extended to 336 and 337 days, and one in which the duration was 343 days (forty-nine weeks). When pregnancy is excessively protracted there are three possibilities: an error in menstrual dates; ovulation several weeks later than the usual fourteenth day of the cycle, impregnation therefore not taking place until forty or fifty days after the onset of the last menses; or actually several extra weeks of pregnancy beyond the usual forty weeks before labor commences. In most cases the true answer is never known, but it

is generally believed that in most instances error is at fault. It is believed that at the most 4 per cent of pregnancies are truly carried two weeks or more beyond the average time.

Evidence is accumulating that a baby in the uterus gains little weight after the term date of 280 days is reached, so that the birth of a baby of excessive size adds little proof of true postmaturity. As a matter of fact, babies may actually lose weight in the uterus after the due date is reached, and it is thought by some authorities that the typical postmature baby is thin, scrawny, and old-looking, with loose, baggy skin, long nails, abundance of scalp hair, and a singularly alert look. They may also show desquamation, or peeling, of the superficial skin of the palms and soles. After birth such infants gain back the weight they lost and soon appear normally chubby and well padded. In addition, in such cases the surface of the placenta often displays thick deposits of calcium, perhaps evidence of its relative senility.

Legal Problems Associated with Duration of Pregnancy

The legal problem of legitimacy frequently revolves about duration of pregnancy, its prolongation on one hand or its brevity on the other. In the first type of case, a husband is absent from his wife's bed for more than nine months before the birth and fears that the vacancy was fruitfully filled in the interval. In the second case, a living child arrives with inconsiderate haste after the marriage, leading the husband to suspect the conception was not initiated by him. The laws of different countries differ greatly regarding these issues. In Austria the law recognizes the uncontested legitimacy of a living child born after 240 days of marriage or 307 days after the death of the husband. On the other hand the Scottish law fixes the minimum figure at 168 days (twenty-four weeks).

Both England and the United States have no such laws and each case is decided by court trial. In recent years pregnancies of 331 and 346 days were declared legitimate by English courts; and in the United States a New York Supreme Court found a 355-day (eleven months, twenty days) pregnancy legitimate (*Lockwood* vs. *Lockwood*). In the now famous 1949 *Preston-Jones* vs. *Preston-Jones* peerage case, conducted by the English House of Lords, the husband sought divorce on the grounds of adultery, since the date of last coitus preceded birth by 360 days. The divorce commissioner decided in favor of the wife, but the Court of Appeals overthrew the verdict in favor of the husband, granting him a divorce.

Extremely brief pregnancies sometimes involve not only the reputation of the mother, but the father as well. In Scotland in 1835 the Reverend and Mrs. Jardine had a living baby born five months and three weeks after marriage (twenty-four and a half weeks). Charges of immorality against the reverend couple were brought by the Presbytery of Kirkcaldy, and after four years of investigation a doubtful verdict was rendered. Both sides appealed to the General Assembly of the Church of Scotland, which found the charge of immorality unproved, absolving the couple.

Calculating the Delivery Date from the Day of Insemination

In calculating the expected date of confinement from 425 cases in which a purported single, fruitful coitus led to impregnation, it was found that the average patient delivered 269.9 days after insemination. However, there was wide variation, extending from 231 to 329 days. A second study, involving fifteen cases of artificial insemination, yielded an average duration of pregnancy of 272 days from the day of treatment, with a span of 261 to 288 days. It is obvious that calculating the anticipated delivery date from coital data has little or no advantage over the more standard technique of utilizing the first day of the last menstruation.

Calculating the Delivery Date from Onset of Fetal Movements

Another method of computing the "due date" is to count eighteen or twenty weeks from the time the patient first feels fetal movements; however, this is even less exact than the calculations from menstrual and coital data.

After sifting all available modern scientific data, we come to the conclusion that the generalization first made decades ago about the duration of pregnancy is relatively correct. If the date is calculated from the onset of the last menses, almost 50 per cent will deliver within the week before or after the 280th day, and 75 per cent within two weeks of it.

The Effect of Prolonged Pregnancy on the Fetus

There is no clear-cut evidence one way or the other whether carrying the baby three or four extra weeks jeopardizes its safety. There are a number of studies which demonstrate an increased risk for the fetus, and an equal number which refute such hazard.

In the meantime, the important thing to do is not to panic

and force your doctor into taking unjustified steps when he may rightly feel that the situation calls for no other treatment than the time-tested method of "letting nature take its course." On the other hand, if the cervix is "ripe" and ready for induction of labor, he may think it wise to take you into the hospital and simply rupture your membranes—the bag of waters—or initiate contractions through the administration of Oxytocin or sparteine (see page 254). It is difficult to justify Cesarean section for postmaturity unless there are complicating factors such as the rare occurrence of a baby of extraordinary size which appears too big for safe vaginal delivery, or the fetus has been observed to be growing very slowly near or after term is reached.

Determining the Duration of Pregnancy

The physician determines the duration of pregnancy in a given case from the patient's history and from his findings on physical examination. Usually they agree. From thousands of observations we know that a pregnant uterus of a certain size represents a conception of a certain number of weeks. For measurement, three abdominal points have been selected: the front of the pelvic bone (symphysis), the navel (umbilicus), and the tip of the breastbone (xiphoid). Sometime during the third month the uterus can be felt above the pelvic bone; it is felt midway between the pelvic bone and the navel at the end of the fourth month, at the navel in the fifth, and midway between the navel and the breastbone at the end of the seventh. At the beginning of the ninth month the top of the uterus is two and a half inches below the end of the breastbone. In most women pregnant for the first time, the top of the uterus is now lower in the abdomen because the child starts to descend into the pelvis. The layman calls this "lightening" or "dropping"; medically it is termed "engagement of the fetus." Frequently in those who have had previous pregnancies the uterus continues to grow upward until labor starts, virtually reaching the xiphoid, since the engagement of the fetus may not take place in them until labor has begun. The earlier engagement of the fetus in a first pregnancy is due to the greater pressure which surrounds it, since the uterus and the abdominal wall have not been stretched by previous childbirth.

If the menstrual history and the physical examination do not agree as to the duration of pregnancy, the doctor must investigate the cause of the discrepancy. Either there is an error in the menstrual history, or the uterus, because of some

abnormality of pregnancy, does not correctly indicate the duration by its size. The uterus may be abnormally enlarged by tumors, a multiple pregnancy, excess of fluid (hydramnios), etc. It may be small because the fetus has died *in utero*, or the child's development is progressing slowly.

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The Fetus

The origin and growth of the fetus was a simple thing to our medical forefathers. In 1548 all embryology could be put on a single page; today it cannot be crammed into a library of hundreds of volumes. I venture the guess that more pages have been written about the obscure fetus than about the illustrious Shakespeare.

The biological life of a fetus begins with fertilization, as stated in the first chapter. At that moment the precursor of the child is of almost microscopic size, a speck of tissue so very tiny that it is just barely visible to the naked eye of the expert—a mass so light that its weight cannot be expressed in even thousandths of an ounce. Within nine months this minute dot of tissue develops into a twenty-inch, seven-and-a-half-pound screaming infant. The initial ten days in the life of the future citizen are reported in Chapter 2. As described there, the ovum implants itself into the substance of the uterus, excavating the permanent home which it will occupy for more than eight months by digesting its way into the interior lining of the uterus. In the process it taps very, very small maternal blood vessels and soon finds itself surrounded by a veritable lake of its mother's blood, into which it dips vigorous, hungry cells. These cells, which grow like streamers from the surface of what is called the blastocyst at this state of development, absorb minerals, vitamins, carbohydrates, proteins, and fats essential to growth. With absorption of nourishment the fertilized ovum increases rapidly in size. At a certain region on the inside of the covering a thickened mass of cells now appears; this mass is called the inner cell mass or embryonic area, and it is from these cells that the embryo itself develops. The egg continues to grow, and the

covering surface, which is most distant from the cavity of the uterus and deepest in the uterine lining, forms the placenta, or afterbirth.

Summary of Fetal Development for Each Period of Pregnancy

Let me now summarize the development of the fetus, always designating the weeks or months since the onset of the last menses. If one assumes that fertilization takes place on the fourteenth day of the cycle, then there is a constant difference of two weeks between the actual age of the conceptus and the duration of pregnancy, since the latter is calculated from the beginning of the last menses. To prevent confusion I shall discuss embryonic and fetal development in terms of duration of pregnancy, not in actual fetal age, for potential parents think in terms of weeks and months of pregnancy.

End of second week: Fertilization occurs. First day in the life of fertilized ovum.

End of third week of pregnancy; first week after conception: Fertilized ovum traveling down tube; on 17th day enters uterus as a round solid mulberry-like mass of cells; then transforms into blastocyst, an outside cover of hundreds of cells with fluid in the center, like a tiny hollow rubber ball filled with fluid instead of air. Floats in uterus (17th-22nd day). Blastocyst about 1/100 of an inch in diameter.

Beginning of fourth week: Implantation (23rd day), i.e., 9-10 days after fertilization. Egg still barely visible to naked eye. After implantation fertilized ovum begins to grow rapidly, doubling its size every 24 hours. Cells forming embryonic area (from which embryo will grow) appear on inner wall of blastocyst. Placenta begins to form on that part of outer wall of blastocyst deepest within maternal tissues.

Beginning of fifth week: The fertilized ovum is now termed an embryo. The embryo itself is a minute piece of uniform gray-white flesh. The primitive streak which will become the spine is laid down. The embryonic sac containing the embryo is $\frac{2}{5}$ inch in diameter.

End of fifth week: Backbone forming, 5 to 8 vertebrae laid down. Nervous system and spinal canal forming. By end of fifth week the foundation for the child's brain, spinal cord, and entire nervous system will have been established, as well as rudiments of its eyes (20 days after conception). Tubular