

Alessandra Piontelli

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To Filippo and Roberto, my sons.

To Nicolò, my grandson.

And

To all those who will come.

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Ultimately the responsibility for what I say in this book remains mine only.

Contents

1 Introduction	1
1.1 Brief Historical Survey on the Late Stages of Pregnancy	2
1.2 The Research Environment and Its Difficulties	5
1.3 Investigating Fetal Motions with New Technologies.	6
1.4 Reconstructing Fetuses from Premature Infants and Babies Born at Term	9
1.5 Animal Preparations.	11
1.6 Other Fields	11
1.7 Outline of the Book	11
References.	12
2 General Movements	15
References.	23
3 Localized or Isolated Movements	25
3.1 Head Movements	27
3.2 Hand Movements	28
3.3 Leg and Feet Movements.	31
References.	32
4 Fetal Breathing Movements and Shallow Fetal Breathing Movements.	33
4.1 Lung Development and Possible Functions of Fetal Breathing Movements.	33
4.2 Fetal Breathing Movements: Trends, Apneic Intervals and Tuning or Less with Other Motions	37
4.3 Shallow Fetal Breathing.	39
References.	40
5 Swallowing, Sucking, and Mouthing	41
5.1 Swallowing.	41
5.2 Sucking	43
5.3 Lip Puckering, Regular (or Rhythmical) Mouthing, and Other Mouth Movements	45
5.4 Clustering and Coordination with Other Behavioral Displays.	48
5.5 Why Do Fetuses Suck and Swallow?	49
References.	50

6	Startles, Twitches, and Clonuses	53
6.1	Startles	53
6.2	Twitches	58
6.3	Clonuses	59
	References	60
7	Seemingly Trivial Fetal Motions: Yawning and Hiccups	63
7.1	Yawning: A Brief Survey of the Main Possible Explanations	63
7.2	Why Do Fetuses Yawn?	64
7.3	Hiccups	70
7.3.1	General Facts	70
7.3.2	Hiccups: A Brief Survey of the Main Possible Explanations	71
7.3.3	Hiccups in the Fetus	72
	References	73
8	Fetuses: Facial Motions or Facial Expressions?	75
8.1	Brief Historical Survey	75
8.2	Fetuses: Facial Motions or Facial Expressions?	76
8.3	Face Attraction and Face Imitation at Birth	83
	References	85
9	Fetal Behavioral States	87
9.1	Brief Historical Survey	87
9.2	Sleep in Young Children and Premature Infants	88
9.3	Are Fetuses Ever Awake?	89
9.4	Do Fetuses Sleep REM Sleep?	94
9.5	Fetal Behavioral States Development	95
	References	97
10	Twin Fetuses: Facts and Late-Pregnancy Twin Myths	99
10.1	Twin Pregnancies and the Twin Fetus	99
10.2	Facts	100
10.2.1	Twins in Utero as Experiments in Nature	100
10.2.2	Beginnings and Evolution of Tactile and Proprioceptive Sensitivity	101
10.2.3	Never Behaviorally Identical and Increasingly Dissimilar	102
10.3	Behavioral Individuality	103
10.3.1	Coincidence/Noncoincidence of Rest–Activity Cycles	103
10.3.2	Sensorimotor Inhibition and Refractory Periods	104
10.4	Comparing Two Different Worlds	104
10.5	Late-Pregnancy Myths and Fiction	104
10.5.1	Social Life in Utero	104
10.5.2	Unrestrained Meaning	106
10.6	Longing and Loss in the Twin Fetus	108
	References	110

11 Fetal Sensory Abilities	111
11.1 General Considerations	111
11.2 The Somatosensory System.....	113
11.2.1 Touch or Tactile Perception	113
11.2.2 Proprioception	115
11.2.3 Pain or Nociception	116
11.3 Vestibular and Auditory Functions	119
11.3.1 Vestibular Function	119
11.3.2 Auditory Function or Hearing	121
11.4 The Chemical Senses.....	122
11.4.1 Olfaction or Smell	122
11.4.2 Taste or Gustation.....	124
References.....	125
12 Conclusions	127
12.1 Fetal Motions: Bottom-Up Building Blocks of the Organism	127
12.2 Seemingly Trivial and Unexplained Phenomena.....	130
12.3 Fetuses as Unborn Newborns.....	132
References.....	140
Index	143

This work taking into account the last 15 weeks of pregnancy is intended to be the continuation and completion of another work based on the development of human fetal motions during the first 25 weeks of gestation [1].

These stages of pregnancy are clearly linked by continuity. However schematically speaking, the first half of pregnancy is a period of turbulent changes and formation. The last 15 weeks of pregnancy is a period of intensifying growth and increasing preparation for living ex utero after birth. Albeit with some even grave consequences which diminish rapidly with advancing gestational age, the majority of fetuses born during the last 15 weeks survive and even thrive. Most fetuses born before 25 weeks do not make it, and even when they do, they do so with often fairly devastating and long-term sequelae [2–4].

Due principally to these reasons, it seemed reasonable to split this work on the development of human fetal motions into two volumes that though linked by essential continuities could also be read separately.

The foundations laid in the first work could, nevertheless, shed light on later behavioral phenomena.

Between the writing of the first volume and the present work, time has elapsed, several views have been updated or modified, and new data have been added.

Some repetition, however, is to be expected and inevitable.

The present work is not intended as the last word on the subject. In fact, our knowledge and comprehension of fetal motions during any stage of pregnancy is still incomplete and lacking. This book only aims at presenting a fresh look on human fetal motions during the last 15 weeks of pregnancy in the light of new technological refinements and consequent attainments in this and other related fields as well as in the light of previous work on the foundations of fetal behavior during the first 25 weeks gestation.

Only once normal functioning is described and understood in detail can we hope to notice deviations from the norm that could be useful in clinical practice. So far despite some claims to the contrary, we are far from having reached this goal.

Besides an as accurate as possible description of when and why fetuses perform given motions, this work also aims to raise questions of a hypothetical and even controversial nature on the last stages of pregnancy which one hopes will be verified and refined by other researchers in this or different but related fields.

Throughout this book, I have tried to make myself comprehensible by using as simple a language as possible. It was also an editorial decision to keep linear trends and correlated statistics to a bare minimum, as these have been extensively investigated. It was also decided to use as far as possible a plain, descriptive style of prose, as an accurate description of what and how fetuses move still needs perfecting. Only once

this basis will be formed will it be possible to proceed to other deeper and wider steps.

Additionally when writing a book, one often has the vain hope of reaching a larger public, not just a specialist one.

1.1 Brief Historical Survey on the Late Stages of Pregnancy

Since ancient times, the late stages of pregnancy and the delivery have attracted an overwhelming attention compared to the early stages of gestation. Through the centuries, conception and the beginning of gestation were predominantly the object of religious, philosophical, and even astrological speculation.

The initial phases of pregnancy were generally a private, uncertain matter. The cessation of menses and feeling faint or nauseous could all be signs of gestation, yet each could also be due to various other ailments.

Miscarriages were also certainly not unheard of and possibly exceedingly frequent given the load of work women had to carry as well as the young age at which they started reproducing and the number of children they bore.

Even increasing abdominal dimensions, albeit clearly suspicious and public, were also not an indisputable indication of gestation. Other ailments such as ascites (from a Greek word meaning sack like), an impressive accumulation of fluid in the peritoneal cavity mainly due to severe liver problems but also to parasites such as various types of schistosomes, or big tumors and cysts could all cause striking and pregnancy-like abdominal distension. Women bearing illegitimate or unwanted children were sometimes able to disguise their condition by wearing torturously tight garments or by lying about their bulging belly claiming that it was caused by immoderate weight gain. Pregnancy was detected only at parturition, and numerous of its unfortunate fruits never came to the public attention by being quickly disposed of [5].

In addition to increasing dimensions, quickening, generally beginning to be felt around mid-pregnancy by the mother, was *the* only sure sign that gestation had started and that various “strange” phenomena such as a molar pregnancy or simulation due to whatever reasons could be ruled out.

Quickening also meant that by then fetuses were no longer inchoate, undeveloped matter, as many scholars believed.

Only in 1816 did the stethoscope invented by the French physician René Laennec add the recognition of fetal heartbeat as a precious, revolutionary tool to confirm pregnancy, detecting twin pregnancies and assessing fetal lie and even some fetal problems [6].

Apart from the uncovering of pregnancy, manifest fetal motions were important for religious and philosophical matters.

Since antiquity, the question of when and whether the embryo becomes human has been hotly debated.

Different religious faiths took up the question with differing attitudes. Some claimed that ensoulment took place at conception, others viewed it as a gradual process, and still others considered the infant as human only once its head emerged from the birth channel. Through the centuries, doctrines concerning ensoulment have changed even within the same religious faith [7].

Though updated by current scientific knowledge, the question still lies at the foundation of the abortion debate.

This work does not intend to enter in any way into this thorny issue nor into the far from clarified questions about the commencement of consciousness and awareness, which are modern derivations of the ensoulment debate and pertaining to specialist branches ranging from philosophy to neurosciences.

Religious matters began to diverge from scientific interest and inquiry once the prohibition of dissecting the human body was lifted. The Catholic Church is regarded by most as responsible for this ban but in fact the veto came largely from the Greek and the Romans [8]. Both cultures feared dissecting cadavers, which were con-

sidered to be polluted and polluting and thus limited the knowledge of the inside of the human body. Except for a generation of Greek medical scholars who lived in Alexandria in the early third century BC and who were exposed to the Egyptian tradition of embalming, human dissections, following Greek and Roman traditions, were restrained till the Middle Ages.

Starting from the fourteenth century, dissections were actually encouraged by the church. From the beginning, these focused predominantly on women's bodies. These initial dismemberments were linked with religion as they had the principal scope of extracting from dead pregnant women their fetuses in order to baptize them [9]. Women were dying by numbers during gestation and labor, and "emergency cesareans" were frequent and performed mainly in their homes by a host of people ranging from midwives to barbers, husband, and surgeons.

These postmortems, though intended for other purposes, had the end result of exposing some of the mysteries of women's bodies, as well as handing over to mainly male hands the so-called secrets of women.

Only in the Faculty of Medicine in Bologna (the oldest university in the world) were some dissections for reasons of inquiry initiated more or less at the same time.

Physicians, surgeons, and clerics began inspecting what was considered the most mysterious of all organs, the uterus. Men had been reflecting since the dawn of times on women's bodies by which they were repelled, alarmed, inspired, attracted, and fascinated, but from then on, they began to have a good look at its enigmatic contents. Knowledge of anatomy was the main overt interest of all concerned. Fetuses, however, being dead and often the cause of death itself were of scarce relevance.

It was only with the renewal of anatomical enquiries in the sixteenth to eighteenth centuries that fetuses witnessed a rekindled and distinct interest.

Leonardo's beautiful drawings and the extraordinary anatomical wax figures in the Museum of La Specola in Florence (started in 1771) all testify to such a renaissance.

Nevertheless fetal development and even more so fetal behavior were of limited interest. Fetuses were almost invariably represented as fully formed neonates customarily crouched in the "fetal position." Comprehensibly all concentrated their efforts on pregnancy and particularly on parturition, as both actors in the event often risked their lives. A fear of the delivery permeated all cultures, not only western ones.

Additionally the pangs of delivery could be unbearable, lasting for hours and days, and only at parturition the woman could be sure to have carried to term a live, healthy infant without deformations or defects.

In the developed world, the delivery is now a largely safe event, and analgesia, especially the epidural, has decreased the pain. Furthermore ultrasound, nuchal translucency test, chorionic villous sampling, amniocentesis, and other instruments and tests have enormously reduced painful surprises at birth. Last but not least, perinatal and neonatal mortalities have hugely decreased.

Only once the safety of the mother and of the newborn was largely assured did clinicians, aided by increasingly sophisticated technological advancements, turn to the "fetus as a patient" and the branches of Maternal-Fetal Medicine and Perinatology begin to develop and flourish.

Despite all these advancements, to these days the so-called trauma of birth is still very real in many other areas of the world [10]. Parturition and pregnancy continue to be life-threatening events (Fig. 1.1).

According to the World Health Organization, in the world a woman dies of delivery and of pregnancy-linked complications every minute. Children do not fare better. It is calculated that every year four million babies die in the first 4 weeks of life; three million of these deaths occur in the neonatal period. Moreover more than 3.3 million babies are appraised to be stillborn every year; one in three of these deaths occurs during delivery and could largely be prevented. Ninety percent of these deaths take place in developing countries (Fig. 1.2) [10].

Clearly, fetal behavior is of no or scarce interest when such vital issues are at stake.