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Human Development

*As Described in
the Qur'an and Sunnah*

Correlation with Modern Embryology



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***Human Development
As Described in
the Qur'an and Sunnah
Correlation with Modern Embryology***

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

«وَيَرَى الَّذِينَ أُتُوا الْعِلْمَ الَّذِي أُنزِلَ إِلَيْكَ مِنْ رَبِّكَ
هُوَ الْحَقُّ وَيَهْدِي إِلَى صِرَاطٍ الْعَزِيزِ الْحَمِيدِ»
(سورة سبأ 34 - آية 6)

*"And those who have been given knowledge
realize that what has been sent down to you
from your Lord is the Truth and that it
guides to the path of the Exalted in Might,
Worthy of all praise." (Surah Saba', 34:6)*

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Introduction

Modern, experimental embryology is a fairly recent development which has its beginnings with the invention of the microscope in the seventeenth century. However, the concept of the human being developing in stages was not recognized until much later, since early investigators initially believed that a fully formed human being was present in the gametes. Later, as a more accurate understanding of the stages emerged, scientists have attempted to devise a system of classification for the stages.

Until recently, it was not known by non-Muslim scientists that the Qur'ān and Sunnah (seventh century A.D.) had provided a detailed description of the significant events in human development, from the stages of the gametes and conception until the full term of pregnancy and delivery. The terminology provided in the Qur'ān and Sunnah is characterized by descriptiveness, accuracy, ease of comprehension, and integration between description of appearance and main internal processes.

The authors of the papers in this book are in agreement concerning the distinctiveness and compatibility of the Islamic terminology with the actual events in human development. This terminology fulfills all the conditions necessary for using scientific terms in this field, and the terminology actually in use today still lacks some of these conditions in some stages of development. Therefore, we hope that these research efforts will result in a valuable contribution in the development of science in general, and in the field of embryology in particular. As awareness increases of these types of studies, it could be expected that scientific institutions, either in the Islamic world, or internationally, might adopt this Islamic terminology due to its ease of use and accuracy.

Some scientists, particularly among non-Muslims, may feel some sensitivity for utilizing this terminology, since its source is a

religious scripture, the Qur'ān. Any merging between science and religion is usually viewed as involving a nonobjective, nonscientific approach, because science and religion are generally considered unrelated areas, especially in the Western world. This conflict has its roots in many social and historical settings, and it is logical that this type of sensitivity or incompatibility would result.

For example, for many centuries the Western world has regarded the relationship between religion and science as antagonistic and inharmonious. The advancement of one has been regarded as indicating the decline of the other. This conflict developed as a result of the authority exerted by the Church during the Middle Ages (fifth to end of fifteenth century A.D.) in Europe, when religious teachings often stifled truly open scientific inquiries into natural phenomena. Scientists often had to defy Church authority in order to express rational interpretations of their observations. As a result, a relationship of conflict arose between religion and science, which has continued until today in the West.

In contrast, during the same period of the European Middle Ages, Islamic civilization was flourishing, and great achievements were attained in the sciences, while the religious teachings of Islam permeated every aspect of life in the Islamic state. Religion and science co-existed in a harmonious relationship.

In fact, Islamic teachings have strongly encouraged and supported scientific achievements and findings. Passages in the Qur'ān and Sunnah encourage the seeking of knowledge as a part of worship of Allah, resulting in many scientific achievements and the adoption of a tolerant, and indeed positive, attitude towards the expression and discussion of scientific opinions. Therefore, Muslim society and the Muslim intellect were spared the type of conflict between religion and science, or the oppression of scientists, that was experienced in the Western world. As a result of this type of atmosphere, we can clearly understand the motivating factors behind the early scientific works of the scholars in the Islamic Empire. For instance, in the ninth and tenth centuries, Muslim scholars measured the height of the atmosphere, described the circulation of the blood, and developed many instruments for astronomical studies.

Many accomplishments were also noted in the fields of algebra,

geometry, chemistry, astronomy and physics. Thābit Ibn Qurrah (d. 288 A.H./901 A.D.) wrote about gravity and its relationship with mass, stating that when there are two bodies, the larger mass exerts a stronger influence on the lesser mass, attracting it towards it. Al-Khāzin (early 4th century A.H./11th century A.D.) identified air pressure, and through recognizing that air pressure is similar to water pressure, which exerts an upward pressure against a body of mass in water, he deduced that the weight of a body in air would be less than its true weight. This information was later utilized by the Europeans to invent the barometer and the vacuum pump. ‘Abdur-Raḥmān Aḥmad Ibn Yūnus (d. 399 A.H./1009 A.D.) derived the mathematical relationship between pendular motion and time, and then utilized this information to invent the pendulum clock. Abū Ar-Rayḥān Muḥammad Ibn Aḥmad Al-Bayrūnī (b. 362 A.H./973 A.D.; d. 440 A.H./1048 A.D.) referred to the rotation of the earth around its axis and wrote a book on astronomy called *At-Taḥḥīm*, which was the most significant book on astronomy in the eleventh century. Al-Bayrūnī also identified 18 elements by their densities. Al-Ḥasan Ibn Al-Haytham, known as ‘Alhazen’ in the West, (b. 354 A.H./965 A.D.; d. 430 A.H./1039 A.D.) was the most renowned scholar in physics during the Middle Ages. He wrote more than 200 books, some of which were translated into Latin, and one of his most famous books, *Al-Manāẓir*, described the nature of light as consisting of particles which carry heat and energy. His writings were the main source for European researchers until the 16th century, such as Roger Bacon (b. c. 617 A.H./1220 A.D.; d. 691 A.H./1292 A.D.), who introduced the experimental method in science to Europe, and Johannes Kepler (b. 979 A.H./1571 A.D.; d. 1039 A.H./1630 A.D.), who discovered the elliptical orbits of the planets and introduced the ray theory of light to explain vision, which directly derives from Ibn Al-Haytham’s writings.¹

¹For more information see King, David A. and Saliba, George, editors, *From Deferent to Equant: A Volume of Studies in the History of Science in the Ancient and Medieval Near East in Honor of E.S. Kennedy*, *Annals of the New York Academy of Sciences*, v. 500, The New York Academy of Sciences, New York, 1987; Burke, James, *The Day the Universe Changed*, Little, Brown and Company, Boston, 1985; Kahhalah, ‘Umar Rida, *Al-‘Ulum al-Baḥṭāh fi al-‘Usur al-Islamiyyah*, Matba‘at at-Taraqi, Damascus, 1974; and Majid, ‘Abdul-Mun‘im, *Tarikh al-Hadarah al-Islamiyyah fi al-‘Usur al-Wista*, Maktabat al-Anglo al-Misriyyah, Cairo, 1963.

The encouragement towards science in Islam, as well as the accurate information in the Qur'an and Sunnah, explain the reason that different images occur to the Muslim mind, versus those occurring to the Western mind, when the topic of science and religion is raised. As recently as the late 19th century, Andrew Dickson White, who with Ezra Cornell, co-founded Cornell University in New York, encountered a high degree of religious opposition when the university was established without the usual requirement that its professors commit themselves to the creed of a particular religious denomination. As a consequence of the extended battle between science and religion that had been ongoing for several centuries in the West, White argued for an open scientific approach that would be free from theological influences.

Experimental science had been condemned as dangerously impious by the Church in the Middle Ages, although Church authorities were aware that Muslim scholars were actively studying and achieving much in the sciences. In fact, in the thirteenth century, the Church sometimes intimidated any would-be researchers in experimental science by hurling the term, "Mohammadan," at them.

As White stated² in a book he wrote as an argument against religious dogma, "Another weapon was also used upon the battle-fields of science in that time with much effect. The Arabs had made many noble discoveries in science, and Averroes had, in the opinion of many, divided the honours with St. Thomas Aquinas; these facts gave the new missile—it was the epithet 'Mohammedan'; this, too was flung with effect at Bacon." Here White was referring to the renowned scientist, Roger Bacon.

He also made further reference to the differences between the Christian and Muslim societies:³ "Men have often asked how it was that the Arabians accomplished so much in scientific discovery as compared with Christian investigators; but the answer is easy; the Arabians were comparatively free from these theologic allurements

²White, Andrew Dickson, *A History of the Warfare of Science and Theology*, D. Appleton and Company, New York, 1899, p. 389. This book is a compilation of White's series of lectures and studies concerning the history of science and Christian theological thought. He wrote them as arguments against the religious opposition he was facing.

³*Ibid.*, p. 397.

which in Christian Europe flickered in the air on all sides, luring men into paths which led no-whither.”

The papers presented in this publication illustrate the type of supportive relationship that exists between religion and science in Islam. Using direct evidence from the Qur’ān and Ḥadīth, and from the latest scientific research, a fully harmonious correlation is found to exist between the findings of modern embryology and the Islamic scriptures (Qur’ān and Ḥadīth). The information presented here clearly indicates the supportive role Islam exerts upon investigations into natural phenomena, since the detailed statements in both the Qur’ān and Ḥadīth serve to stimulate inquiries into their exact meanings. Indeed, the passages occasionally draw attention to new areas of research, since they may refer to concepts not yet investigated in modern science.

Information in the Qur’ān and Ḥadīth also corrected many supersitious ideas about human development that were dominant in previous times. For instance, the prevalent view among Greek, and later European, scientists that the fetus was created from menstrual blood, or the concept that the fetus was fully created and in miniature form in either the sperm or ovum, was refuted by Muslim scholars, who understood from the Qur’anic passages and Ḥadīth that contributions from both the male and female were necessary, and that a series of developments were required, in order to form the fetus.

The majority, if not all, of the information provided in the passages cited in this book was not accessible through experimental means during the time of the Qur’ān, or even ten centuries afterwards. Earlier generations of Muslims accepted the apparent linguistic meanings of these passages, although they were unable to fully comprehend all of their implications. They believed in the truth of this information, through other evidence that the Qur’ān is the Word of God, and they delegated the full explanation and understanding of these passages to the passage of time and the development of human knowledge. The fact that these passages would be understood by future generations, and that their understanding would provide further evidence that the Qur’ān was revealed from God, Who knows the secrets of the earth and heavens, is stated in the Qur’ān as follows:

"سُنُرِيهِمْ آيَاتِنَا فِي الْآفَاقِ وَفِي أَنْفُسِهِمْ حَتَّىٰ يَتَبَيَّنَ لَهُمْ أَنَّهُ الْحَقُّ أَوَلَمْ يَكْفِ بِرَبِّكَ أَنَّهُ عَلَىٰ كُلِّ شَيْءٍ شَهِيدٌ" (سورة فُصِّلَات 41: آية 53)

*"Soon will We show them our Signs in the (farthest) regions (of the heavens and the earth), and within themselves, until it becomes manifest to them that this is the Truth. Is it not enough that your Lord does witness all things?"*⁴ (Surah Fuṣṣilat, 41:53)

"وَقُلِ الْحَمْدُ لِلَّهِ سَيُرِيكُمْ آيَاتِهِ فَتَعْرِفُونَهَا وَمَا رَبُّكَ بِغَافِلٍ عَمَّا تَعْمَلُونَ" (سورة النمل 27: آية 93)

"And say: Praise be to Allah, Who will soon show you His signs, so that you shall know them, and your Lord is not heedless of the things you do." (Surah An-Naml, 27:93)

It is further determined in the Qur'ān that those who have knowledge will be the first to understand the truth of the Qur'ān and to recognize its Source:

"وَيَرَى الَّذِينَ أُوتُوا الْعِلْمَ الَّذِي أُنزِلَ مِنْ رَبِّكَ هُوَ الْحَقُّ وَيَهْدِي إِلَى صِرَاطِ الْعَزِيزِ الْحَمِيدِ" (سورة سبأ 34: آية 6)

"And those who have been given knowledge realize that what has been sent down to you from your Lord is the Truth and that it guides to the path of the Exalted in Might, Worthy of all praise." (Surah Saba', 34:6)

The analyses provided in the following chapters clearly conclude that it is impossible for the information concerning human development, as presented in the Qur'ān and Ḥadīth, to have originated from human sources, since mankind did not possess the technology necessary for gathering such detailed and accurate information during the lifetime of Prophet Muḥammad (peace be upon him) in the seventh century, nor for many centuries afterwards. The existence of this information in the Islamic passages is explained as evidence that the Qur'ān is indeed a Revelation from God and that Muhammad (peace be upon him) is His Messenger.

⁴Translations of the Qur'anic passages, here and in subsequent chapters, are compiled from Arabic and English dictionaries, explanations of Qur'anic passages by Qur'anic scholars (books of *tafsir*), and *The Holy Qur'an, Translation and Commentary* by 'Abdullah Yusuf Ali, *The Koran Interpreted* by A.J. Arberry, and *The Message of the Qur'an, Translated and Explained* by Muhammad Asad.

Various aspects of the topics in the following chapters have been presented in international conferences in Riyadh, Saudi Arabia (September 1983), Cairo, Egypt (October 1985), Islamabad, Pakistan (September 1987), and Dakar, Senegal (July 1991). The presentations have been extended and revised with time, and they were presented recently, as they appear in the chapters in this publication, in Moscow, Russia (September 1993).

The authors are highly regarded and eminently recognized for their qualifications in the subjects of this publication. Sheikh Abdul-Majeed A. Zindani is a very eminent Muslim scholar and has concentrated many of his efforts in these types of correlation studies during the past fourteen years at King Abdul-Aziz University, Jeddah, Saudi Arabia. He is the Secretary General of the Islamic Academy for Scientific Research (Hay'at Abḥāth al-I'jāz al-'Ilmī fi al-Qur'ān was-Sunnah) and the author of *Al-Imān*, *At-Tawḥīd*, and "The Islamic Additions" in Dr. Moore's book, *The Developing Human*, third edition. Sheikh Zindani is also a co-author with Dr. Keith L. Moore and Sheikh Mustafa A. Ahmed of the book, *Qur'an and Modern Science, Correlation Studies*. Through his careful study and analysis of the Qur'an and Sunnah, he has developed much of the main framework in which the information in this book is presented, and he is therefore a co-author of each chapter or presentation.

Dr. E. Marshall Johnson is Professor and Chairman of the Department of Anatomy and Developmental Biology, and Director of the Daniel Baugh Institute, Thomas Jefferson University, Philadelphia, Pennsylvania. He has authored more than 200 publications, almost all of which deal with various aspects of abnormal embryonic development. He is past president of the Teratology Society and has served as a consultant on numerous national, international, and professional organizations, and he serves on the editorial boards of several scientific journals.

Dr. Gerald C. Goeringer is Professor and Coordinator of Medical Embryology in the Department of Cell Biology in the Georgetown University School of Medicine, Washington, D.C. His area of concentration is the study of teratogenesis, and he has published numerous articles in both journals and books, which deal mainly with that particular field.

* The Former Secretary General of The Islamic Academy For Scientific Research.

Dr. Joe Leigh Simpson recently joined Baylor College of Medicine, Houston, Texas, as Professor and Chairman of the Department of Obstetrics and Gynecology after holding the positions of Chairman and Professor in the Department of Obstetrics and Gynecology, University of Tennessee. He is the current President of the American Fertility Society, and he has served in many active capacities in many other professional, national, and international organizations. He has received numerous awards, including the Association of Professors of Obstetrics and Gynecology Public Recognition Award in 1992. He is fully credentialed in both obstetrics and gynecology and in medical genetics, and as a research scientist, he has published more than 400 chapters and articles in journals and books.

Dr. Keith L. Moore is Professor of Anatomy and Cell Biology, University of Toronto, Toronto, Canada. He is a renowned scientist and distinguished researcher in the fields of anatomy and embryology, and he has published more than 150 research articles, chapters, and books in his field. He is the author of several medical textbooks, such as the widely used and acclaimed *The Developing Human: Clinically Oriented Embryology* (now in its fifth edition), *Before We Are Born*, and *Clinically Oriented Anatomy*. He is also a co-author of *Qur'an and Modern Science, Correlation Studies*. Dr. Moore is the recipient of numerous awards and honors, including, in 1984, the J.C.B. Grant Award, which is the highest honor granted by the Canadian Association of Anatomists and the most distinguished award presented in the field of anatomy in Canada. He has held many academic and administrative appointments, and he has served as President of the Canadian Association of Anatomists, 1968-1970, as well as holding many other positions in professional associations and on editorial boards.

Doctor Mustafa A. Ahmed spent five years as a lecturer on Islamic studies at the Islamic Bureau and Military Colleges in Sanaa, Yemen Arab Republic. For the past eleven years he has been associated with King Abdul-Aziz University as a researcher in the area of correlation studies in the Qur'ān, Sunnah, and modern science, and is a representative for the Islamic Academy for Scientific Research in the United States. He is the author of *Narrative in the Qur'ān and its Relationship to Medieval Arabic Narrative Literature* and

Shaykh al-Islam Taqiuddīn Ibn Taymiyah wa Maqifuhu min at-Taṣawwuf ("Shaykh al-Islam Taqiuddin Ibn Taymiyah and his Position on Sufism"). He is also a co-author of *Qur'an and Modern Science, Correlation Studies*, an editor of this book, and through contributing much of the Islamic information to the writings herein, a co-author of each chapter as well.

Dr. T.V.N. Persaud is Professor and Head of the Department of Anatomy, Professor of Pediatrics and Child Health, and Associate Professor of Obstetrics, Gynecology and Reproductive Sciences, University of Manitoba, Winnipeg, Manitoba, Canada. He is the author or editor of 25 books, has contributed 31 chapters to publications, and has published over 181 scientific papers. In 1991, he received the very prestigious J.C.B. Grant Award from the Canadian Association of Anatomists. In addition to editing this book, he is the author of two of the chapters.

Our associate editor, Dr. Margaret B. Tobin, conducted her graduate research in the field of pharmaceutical chemistry before joining the research projects of the Islamic Academy. She is the author of a drug stability monograph, "Chlorambucil," in *Chemical Stability of Pharmaceuticals, A Handbook for Pharmacists*, second edition, compiled by Connors, Amidon, and Stella, and she has presented research papers at various professional meetings in pharmaceutical chemistry before joining our research program. Her careful attention to the editing and organization of the information in this book, as well as participation in all aspects of its preparation, have greatly facilitated our publication efforts.

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==== *Transliteration System*

Most letters in the Arabic alphabet correspond to letters in the English alphabet, but there are a few Arabic letters which have no corresponding equivalent in English. In order to facilitate the pronunciation of Arabic words, we have adopted the Anglo-American system of transliteration as follows:

ā (ا), to correspond to the long sound of “a” as in the word “hat”

ū (و), to correspond to the double “o” sound in the word “moon”

ī (ي), to correspond to the double “e” sound in the word “need”

ḥ (ح), has no corresponding sound in English, but it is a pharyngeal “h”, or “h” pronounced with a guttural sound

kh (خ), to correspond to the sound of “ch” in German or Scottish, as in the word “loch”

dh (ذ), to correspond to the sound of “th” in the word “this”

ṣ (ص), to correspond to the velar “s” as in the word “salt”

ḍ (ض), has no corresponding sound in English but the sound of “d” in “dawn” is similar to this velar “d”

ṭ (ط), has no corresponding sound in English but is a velar “t”

ẓ (ظ), has no corresponding sound in English but is a velar “th”

gh (غ), to correspond to the sound of “r” in French in the Parisian accent

q (ق), has no corresponding sound in English, but is an uvular or guttural “k”

’ (ء), is a glottal stop that does not exist in English, but is similar to the unpronounced “t” in the word “mountain” or “cotton”

' (ع), has no corresponding sound in English, but originates from deep in the pharynx, as a glottal scrape

a (-) *fathah*, corresponds to short "a" as in "map"

i (-) *kasrah*, corresponds to short "i" as in "bit"

u (- ') *dammah*, corresponds to short "u" as in "full"

aw (و) preceded by *fathah*, corresponds to "ow" as in "how"

ay (ي) preceded by *fathah*, corresponds to "ai" as in "aisle"

Essential Definitions

The following definitions are provided to highlight the framework and contextual background associated with the sources of the Islamic Information which would facilitate understanding the topics presented in the following chapters:

Islam: The linguistic meaning of the word Islam is surrender and submission. As a term referring to the religion of Islam, it means the complete submission and obedience of man before Allah (God, Glorified and exalted is He), and it is the religion of all Prophets and Messengers as well as a universal Message for all humanity.

Allah (God): He is the Creator and Sustainer of the universe and all things. He is One, with no partners, Perfect in all characteristics, Unique and Absolute in attributes, and none is comparable to Him. He is the First without Beginning and the Last without End, the Eternal. He is Glorified beyond any similarity to any of His creations. He is Self-Subsisting and the Maintainer of all Creation.

Prophet Muḥammad (peace be upon him): He is a Servant and the Last Messenger of Allah. He was born in Makkah in 570 A.D., began to receive the Message of Islam at age 40 until its completion within 23 years, and died in 632 A.D. His life was well recorded in every aspect and detail, exemplary for all mankind, and he was known among his people as the truthful and trusted even before receiving the Message.

The Qur'ān: The Qur'ān is the final, complete Revelation from Allah

(God) out of all the revelations presented to the Prophets throughout human history, and was revealed to His Prophet Muḥammad (peace be upon him), as a Guidance for all mankind. It is literally God's Word, faithfully memorized and recorded as it was revealed to the Prophet (peace be upon him), and it has been kept, absolutely unchanged, through the centuries. It is important to emphasize the fact that the Qur'ān is the only revealed Book which has been kept in its original language. Translations are not considered Qur'ān, since both the words, or the medium, and their meanings, were revealed without any involvement or modification from Prophet Muḥammad (peace be upon him) or from anyone else. It is not possible to fully transmit the meanings of the passages from the Arabic language, and the characteristic style and unique construction of the Arabic text are also lacking in a translation. Renderings in English are, at most, close approximations to the meaning of the original Arabic text.

Ḥadīth (Sunnah): Ḥadīth refers to the words, deeds, and approvals, both explicit and implicit, of Prophet Muḥammad (peace be upon him) which have been collected and narrated through accepted and known channels according to specific rules of criticism, which apply to the conditions, situations and integrities of the narrators. It is important to note that this type of discipline, which was established by the Muslim scholars, is unique for recognizing the credibility and authenticity of reports and narrations from various sources. Some of their methodology is now followed by modern historians in order to verify the authenticity of the information that they are collecting.

SOME ASPECTS OF THE HISTORICAL PROGRESS OF EMBRYOLOGY THROUGH THE AGES

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I. Introduction.

"مِنْ أَيِّ شَيْءٍ خَلَقَهُ؟" (سُورَةُ عَبَسَ 80: آيَةٌ 18)

"From what substance has He created him (man)?" (Surah 'Abasa, 80: Āyah 18).

This phrase from the Holy Qur'ān embodies a fundamental question of biological science. The enigma of how man develops is part of the earliest recorded history of science and the question rings through the centuries. The record of our attempts to answer it comprises much of the history of science.

In this paper, we attempt to briefly outline some of the milestones in the history of embryology by way of "setting the stage" for the analyses of many of the speakers to follow. Regarding many of the points we emphasize, you will recognize pertinent passages in the Qur'ān and the Ḥadīth.

The history of embryology is linked inescapably to the history of science in general. Inasmuch as embryology deals with the genesis of all higher life forms, it is also closely related to the historical development of philosophical thought. Indeed, the scientist of not too many years ago referred to himself (and was referred to by others) as a 'natural philosopher'.

II. Historical phases.

In broad terms, we can divide the history of embryology into three phases.

A. Phase of descriptions.

The first phase, which we can call 'descriptive embryology', traces back more than six centuries before the Christian era and extends forward into the 19th century, A.D. This was the time during which observations of developmental phenomena were recorded (and interpreted in various ways). Some of the earliest records survive from the 4th, 5th, and 6th dynasties in ancient Egypt. The official title "Opener of the King's Placenta" is on record as being held by at least ten successive individuals. Later, a standard representing the 'royal placenta' (Figure 1-1) was carried ahead of the pharaohs. The properties attributed to the placenta were of magical to mystical significance. In fact, until the time of the ancient Greeks, and after, 'science' and magic were closely joined. You might be interested in one of the earliest recorded recipes for a contraceptive agent. It was recorded on papyri in hieratic script (dating from between 2000 and



Figure 1-1. Standard representing the "royal placenta" of the pharaoh. (Reprinted by permission from Kleiss, 1964)

1800 years B.C.). A key ingredient was crocodile dung, along with other, less esoteric, ingredients.

It was the Greeks who elevated science into the realm of reason. This is by virtue of the fact that observations were less often interpreted in terms of the mystical but rather in the light of reason. Of course reason did not always prove to be in consonance with the facts— but then, even in today's 'enlightened' age our closely reasoned interpretations of scientific observations or experiments may prove to be incorrect. A key concept arising during this period in the history of embryology was that of 'sequential change' during development. Though theirs are far from being the only surviving works, the writings of Aristotle and Galen dominate the early part of the historical record (especially in terms of influence). From the time of Galen (circa 200 A.D.) until the 16th century, no major advances in our knowledge of embryology were recorded in the literature of Western science. In point of fact, were it not for a number of Muslim writers, many of the earlier Greek works would have been lost to us.

During the 16th but especially in the 17th and 18th centuries, scientific enquiry flourished and the works of Vesalius, Fabricius, and Harvey set the stage for the era of microscopy. This was a period of lively debate. The spermatozoon had been discovered and the questions of preformation, spontaneous generation, the "egg", ovism and animalculism were endlessly discussed. Let us briefly consider some things as they were seen during this time. First, some illustrations (Figure 1-2) from the literature of midwifery during the 16th century show how, from a coagulum of blood and seed, a fetus develops, which is an Aristotelian misconception carried down through the centuries. Menstrual blood was commonly thought to give rise to the embryo.

Though this concept prevailed among all physicians even after the discovery of the microscope, Muslim scientists rejected the idea of the embryo originating from the menstrual blood. They held their views according to the Holy Qur'ān, such as:

"أَلَمْ يَكُ نُطْفَةً مِنْ مَنِيِّ يَمَنِى" (سُورَةُ الْقِيَامَةِ 75: آيَةٌ 37)
"Was he not a drop of germinal fluid emitted?" (Surah Al-Qiyāmah, 75: Āyah 37)

And, they also referred to the Ḥadīth discussed by Ibn Ḥajar (d.

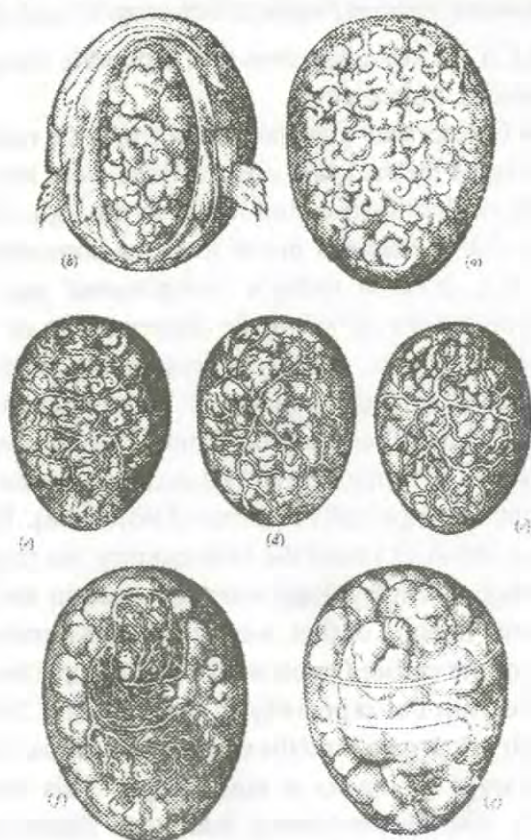


Figure 1-2. Illustrations from Jacob Rueff's "De Conceptus et Generatione Hominis", 1554, showing the Aristotelian coagulum of blood and seed in the uterus. (Reprinted with permission from Needham, 1959)

852 H; 1448 A.D.) in *Faṭḥ al-Bārī* (v. II, pp 477-491):*

"Many anatomists claim that the male fluid has no effect on the creation of the child except for the coagulation [of blood] and that it is formed from the menstrual blood. However, the Prophet's Ḥadīth in this chapter refute this claim." This illustrates a vivid example of how the Qur'an and Sunnah anteceded the scientific beliefs held by non-Muslim scientists over the centuries.

The works of Fabricius (1604) show some excellent drawings of the developing chick embryo (Figure 1-3). (One of Fabricius'

*وَرَدَّعَ كَثِيرٌ مِنْ أَهْلِ التَّشْرِيحِ أَنْ مَنَى الرَّجُلِ لَا أَثَرَهُ فِي الْوَلَدِ إِلَّا فِي عَقْدِهِ، وَأَنَّهُ إِنَّمَا يَتَكَوَّنُ مِنْ دَمِ الْحَيْضِ، وَأَحَادِيثُ الْبَابِ تَبْطُلُ ذَلِكَ. (فتح الباري: ج 2 ص 477 - 491)

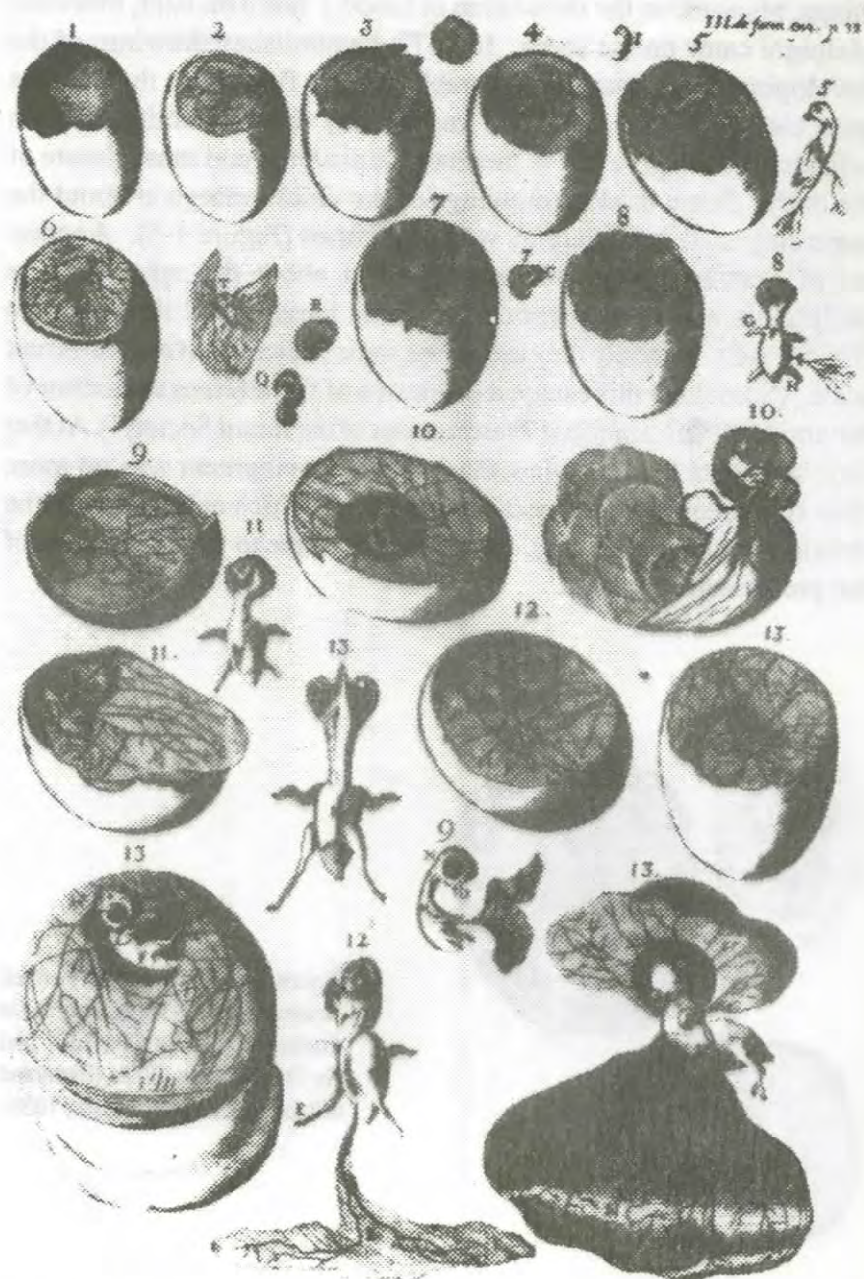


Figure 1-3. From *De Formatione ovi* of Fabricius, *Opera omnia*, 1687, illustrating chick development. (Reprinted with permission from Meyer, 1939)

students at Padua was William Harvey, renowned for, among other things, his work on the circulation of blood.) Just a bit later, Marcello Malpighi came on the scene. In 1672, he published drawings of the developing chick showing (possibly for the first time) the somites quite clearly (Figure 1-4). We know today that the somites contain cells destined to give rise to much of the skeleton and musculature of the body. Some modern drawings of the chick embryo at about the same stages are seen here by way of contrast (Figure 1-5). Another set of drawings were also published at about the same time as Malpighi's and were purported to show human fetal development (Figure 1-6). Actually they are all the same drawing but on a different scale. (Somehow this escaped the notice of the referees and editor of the eminent *Philosophical Transactions of the Royal Society*!) At that time scientists held the view that human development was no more than an increase in the size of a single form which enlarged with the development of pregnancy. This belief was due to the domination of the preformation theory.

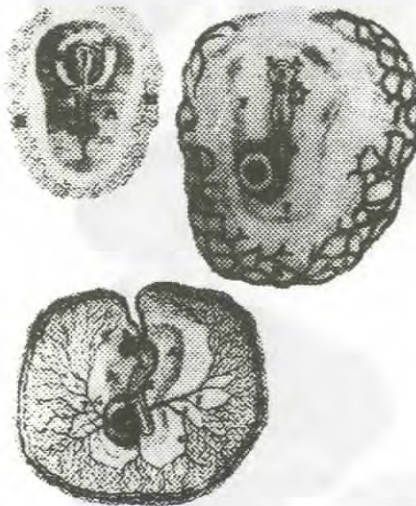


Figure 1-4. Early stages in chick development. After Malpighi, *De Formatione Pulli in Ovo*, 1687 and *De Ovo Incubato*, 1672. (Reprinted with permission from Meyer, 1939)

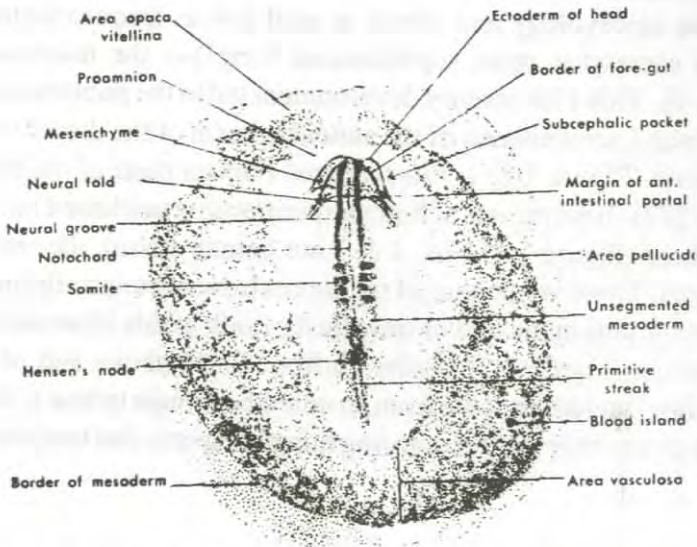


Figure 1-5. Modern drawing of the chick embryo. (Reprinted with permission from Patten's *Early Embryology of the Chick*, Blakiston, Co., New York, 1952)



Figure 1-6. Early drawing purported to show fetal development. (Reprinted with permission from Needham, 1959)

Before discussing the rise of experimental embryology, let us turn for a brief moment to the instrument that capped the progress of descriptive embryology and which is used just as frequently today (albeit in somewhat more sophisticated form!)— the microscope (Figure 1-7). This 17th century development led to the publication by Ham and van Leeuwenhoek of the announcement of the discovery of spermatozoa (Figure 1-8) (*Philosophical Transactions of the Royal Society*, 1677). Illustrations of human spermatozoa published in 1701 are seen here (Figure 1-9; Nos. 1 & 7 are human sperm, the rest are from sheep). These were times of raging controversies and arguments over observations made and/or imagined! Look at this illustration of human semen (Figure 1-10) (after Buffon, 1749) above and of dog sperm below (including some from an unmated female in heat). It was not long before observers were seeing things in sperm that bespeak the

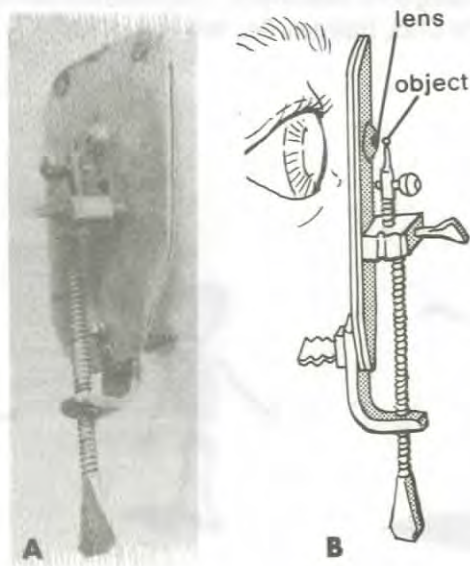


Figure 1-7. A, photograph of a Leeuwen-hoek microscope (1673). B, lateral view of illustration of its use. The object under examination was held in front of the lens on the point of the short rod, while the screw arrangement was used to adjust the object under the lens.

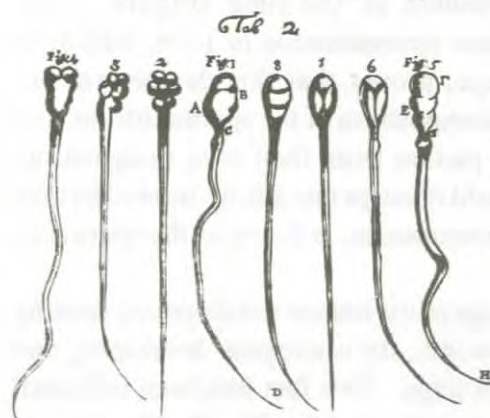


Figure 1-8. Leeuwenhoek's illustration of rabbit and dog spermatozoa (1678). (Reprinted with permission from Meyer, 1939)

Figure 1-9. Spermatozoa after Leeuwenhoek, 1701. (Reprinted with permission from Meyer, 1939)

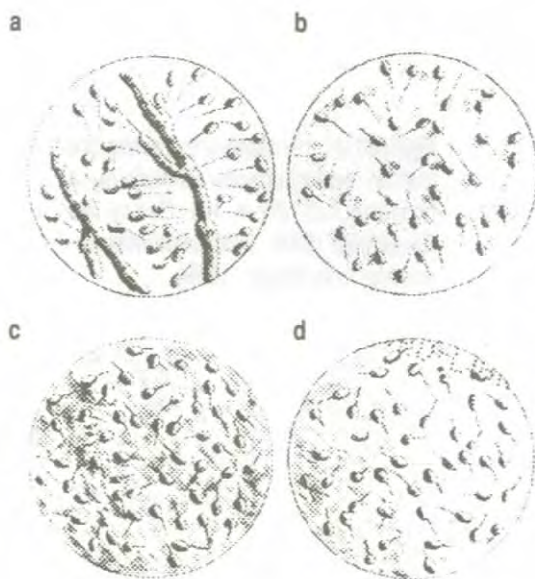
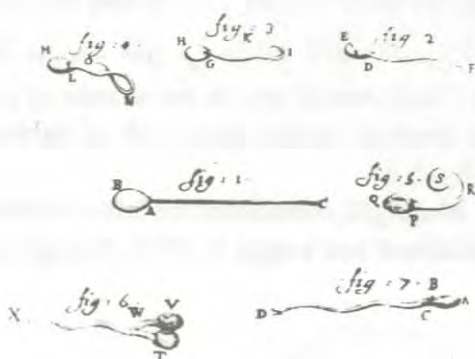


Figure 1-10. Reproduction after Buffon, 1749. *a* is said to represent human semen diluted with rain water in order to separate the contained filaments and permit the "little bodies" to detach themselves; *b*, the same semen allowed to stand some time to become more fluid. *c* is said to be from a male dog and *d* from an unmated female dog in heat!

creativity and imaginative powers of the time (Figure 1-11). Hartsoeker's drawing of a human spermatozoon in 1694, well after the invention of the microscope, proves that this device was not sufficient to show the detailed composition of the spermatozoon, and scientists had to complete the picture from their own imagination. They expressed the generally held concept that a fully formed human being in miniature form, or a homunculus, is found in the spermatozoon (See again Figure 1-11).

Thus, they had no knowledge of the human development passing through various stages in the womb, the conceptus developing and changing appearance with each stage. This fact had been indicated centuries earlier in the Qur'an and the Ḥadīth. The Qur'an states:

"يَخْلُقُكُمْ فِي بُطُونِ أُمَّهَاتِكُمْ خَلْقًا مِّنْ بَعْدِ خَلْقٍ فِي ظُلُمَاتٍ ثَلَاثٍ" (الرُّمُرُ: آيَةٌ 6)
 "He (God) makes you in the wombs of your mothers, in stages one after another, within three veils of darkness..." (Surah Az-Zumar, 39: Āyah 6)

Malpighi, considered the father of modern embryology, studying unfertilized hen's eggs in 1675, thought the eggs contained a minia-



Figure 1-11. Hartsoeker's drawing of a human spermatozoon containing a homunculus (from his *Essay de Dioptrique*, 1694). (Reprinted with permission from Meyer, 1939)

ture chick. While some scientists believed that the human being was fully formed in the sperm, others believed that this preformation occurs in the ovum. The controversy ended around 1775, when Spallanzani showed the necessity of both the ovum and the sperm for the development of a new individual. Twelve centuries earlier, the Qur'ān and Sunnah had established this fact, for the Qur'ān states:

«يَأْيُهَا النَّاسُ إِنَّا خَلَقْنَاكُمْ مِنْ ذَكَرٍ وَأُنْثَى» (سُورَةُ الْحُجُرَاتِ 49: آيَةٌ 13)
"O mankind: We created you from a single (pair) of a male and a female..." (Surah Al-Hujurat, 49: Ayah 13)

B. Experimental embryology.

It was not until the 19th century that the developmental cycle of the mammalian ovum was discovered and the writings of von Baer, Darwin, and Haeckel introduced the second historical phase, the era of 'experimental embryology' (from the late 19th century until the 1940's). Von Baer was a giant of his time. His embryology proceeded from embryological facts towards embryological concepts rather than the reverse. This was an intellectual 'tour de force'. His thinking took him well beyond the concepts under which he was trained.

This second historical phase can be characterized by the search for 'mechanisms.' The name of Wilhelm Roux is preeminent in this regard. Embryological investigations shifted from the description of observations to the intervention in and manipulation of the developing organism. The question of what was the 'mechanism' by which differentiation occurred occupied investigators such as E.B. Wilson and Theodor Boveri. Ross Harrison introduced the technique of in vitro cell culture and Otto Warburg initiated studies on the chemical mechanisms of development. Frank Rattray Lillie investigated the mechanism by which the egg was fertilized by the spermatozoon; Hans Spemann studied the mechanisms of tissue interaction such as occur during embryonic induction; and Johannes Holtfreter investigated the mechanisms by which tissue cells displayed certain affinities for themselves or for cells of other tissues.

C. Technology and instrumentation.

The third or 'modern' historical phase extends from the 1940's to the present day. This is the age during which instrumentation has greatly influenced the course of investigations. For example, we can

list the electron microscope and other sophisticated imaging tools, the ultracentrifuge and spectrophotometer, the computer, and a host of sensitive methods for the detection, isolation, and analysis of proteins, nucleic acids and complex carbohydrates as factors that have put the developmental biologist of today in a position to perform experiments of which the investigator of only a decade or so ago could only dream. Thus, we can carry out detailed analyses of the cell surface during differentiation; we can study the roles of the nucleus, cytoplasm and extracellular matrix using cell hybridization, nuclear transplantation, gene cloning and other techniques. We can look at embryos with a clarity unimaginable during Malpighi's time (Figure 1-12) and we can look inside these parts (Figures 1-13, 1-14) to better understand the mechanisms of both normal and abnormal differentiation.

III. Embryological information in the Qur'ān and Ḥadīth.

With all of this remarkable progress, much of what we have discussed has already been described, and with infinitely more elegance, in the Qur'ān and Ḥadīth in the 7th century. Magnificent as progress in our understanding of human development has been during this history, we find that discoveries made as recently as the 19th and

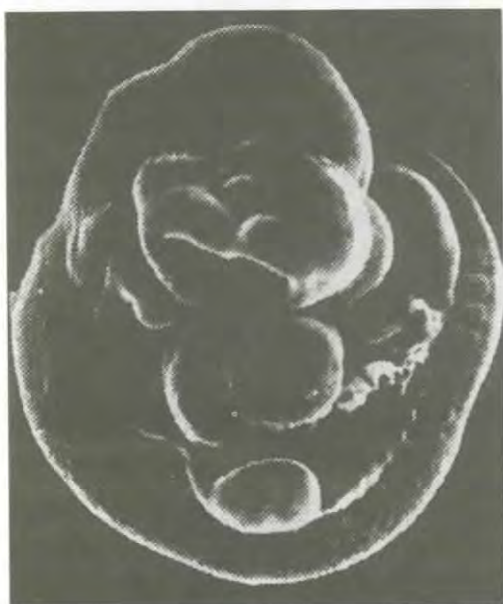


Figure 1-12. Scanning electron micrograph of mouse embryo. (From the laboratory of GCG (courtesy of Dr. A. Fazel))



Figure 1-13. Scanning electron micrograph of embryonic mouse heart. (From the laboratory of GCG (courtesy of Dr. A. Fazel))



Figure 1-14. Scanning electron micrograph of embryonic mouse heart showing a stage in the formation of endocardial jelly. (From the laboratory of GCG (courtesy of Dr. A. Fazel))

even into the 20th centuries, A.D., have antecedent descriptions in the Qur'ān and Ḥadīth from 14 centuries ago. For one of many examples, see Surah An-Najm (53): Āyāt 45-46:

"وَأَنَّهُ خَلَقَ الزَّوْجَيْنِ الذَّكَرَ وَالْأُنثَىٰ مِن نُّطْفَةٍ إِذَا تُمْنَىٰ" (سُورَةُ النَّجْمِ 53:
آيَاتُ 45-46)

"And that He did create the two sexes, the male and female from nutfah (minuscule drop of male and female secretions) as it is emitted or planned."

The Qur'ān mentions that human beings are created from a mixture of the male and female secretions and that after fertilization, the resulting organism settles in the mother's uterus like a seed. The implantation of the blastocyst does indeed resemble the planting of a seed (see relevant details in Chapter 2 on the nutfah). Reference is also made to many other stages in development, some of which are the 'alqah which means that the embryo appears leech-like, the mudghah which indicates a chewed-like substance, i.e. somites, and the development of the skeletal and muscular systems. The Qur'ān and Ḥadīth also refer to the timing of sexual development, fetal development and the acquisition of a human appearance. All of these writings are remarkable in that they refer to the developmental events in their correct sequential order with clear and accurate descriptions.

IV. Ethical considerations.

With the benefit of historical perspective and the accumulated wisdom of those who have gone before, we are in a position today not only to appreciate the remarkable contributions to science of these giants of the past but, just as importantly, we can better appreciate how much we still do not know about development. The advances of modern developmental biology, however, raise as many questions as they solve. How is society going to deal with the many moral, legal, and ethical problems that can arise with embryos that have been produced by in vitro fertilization and then stored away in a freezer? What is to be done if the biological parents then die (as has already happened)? We have the prospect of as many as five parents for such embryos (the donors of egg and sperm, the woman who receives the embryo and provides the uterine environment for embryonic and fetal development, and finally the man and woman who actually raise the child after birth).

The prospect of human cloning looms increasingly large. We can see the specter of a woman giving birth to, in essence, herself, or her sister, or even her mother.

Spermatozoa from one species can be fused with cells from another species to produce hybrids of unknown prospective fates. Perhaps even more alarming is the potential to manipulate embryos before transplanting back into the womb. Because of the pluripotent nature of the cells of the embryonic blastocyst, it is possible to add, subtract, or mix cells (from other blastocysts). This mixing of cells has been accomplished not only with mice but recently with cells of larger mammals as well. The chimeras developing from such mixtures of cells have been born and survive quite well. There is no theoretical reason why this cannot also be done with human embryonic cells.

These are just a few areas of burgeoning concern. The physicians and scientists of today are perhaps more than ever before in need of the wisdom and counsel of scholars and religious leaders. It is not surprising then that we relook at our holy scriptures for help and enlightenment. The scriptures which have been kept most carefully, without any deviations, will fulfill this need.*

*These matters and related subjects have been discussed in a separate conference, "Islam and Contemporary Medical Affairs", held in Cairo, 1986. With regard to the topics in the text above, the Islamic view can be concluded as follows:

If in vitro fertilization between a married couple occurs during their lifetimes, it is permissible as long as implantation is in the wife; otherwise it is not permissible. (See the Islamic ruling (fatwa) of the Islamic Jurisprudence Academy of the Muslim World League issued in Jumādā Al-Ulā, 1405 A.H. corresponding to January 1985.) As for the frozen embryos, the relation between the married couple comes to an end in the case of death or divorce. Moreover, both the Qur' ān and Sunnah state that marriage is the only admissible way to have children, for it preserves and safeguards family ties, protects health and results in human values. God Almighty says in the Qur' ān:

وَمِنْ آيَاتِهِ أَنْ خَلَقَ لَكُمْ مِنْ أَنْفُسِكُمْ أَزْوَاجًا لِتَسْكُنُوا إِلَيْهَا وَجَعَلَ بَيْنَكُمْ مَوَدَّةً وَرَحْمَةً. (الرُّومُ: 30: آيَةٌ 21)
 "And among His signs, is this, that He created for you mates from among yourselves, that you may dwell in tranquility with them, and He has put love and mercy between your (hearts)"
 (Sūrah Ar-Rūm, 30: Āyah 21)

الْيَوْمَ أَحْلَىٰ لَكُمْ الطَّيِّبَاتِ، وَطَعَامَ الَّذِينَ أُوتُوا الْكِتَابَ حَلَّ لَكُمْ وَطَعَامِكُمْ حَلَّ لَهُمْ، وَالْمُحْصَنَاتُ مِنَ الْمُؤْمِنَاتِ وَالْمُحْصَنَاتُ مِنَ الَّذِينَ أُوتُوا الْكِتَابَ مِنْ قَبْلِكُمْ إِذَا آتَيْتُوهُنَّ أُجُورَهُنَّ مُحْصِنِينَ غَيْرَ مُسَافِحِينَ وَلَا مُتَّخِذِي أَخْدَانٍ، وَمَنْ يَكْفُرْ بِالْإِيمَانِ فَقَدْ حَبِطَ عَمَلُهُ وَهُوَ فِي الْآخِرَةِ مِنَ الْخَاسِرِينَ. (سُورَةُ الْمَائِدَةِ: 5: آيَةٌ 5)

"This day are (all) good things made lawful for you. The food of those who have received the Scripture is lawful for you, and your food is lawful for them. And so are the virtuous women of the Believers and the virtuous women of those who received the Scripture before

V. Conclusion.

In summary, the early history of embryology indicates that human development has always generated a great deal of interest. Early studies were restricted to the use of imaginative descriptions, since observers at that time were limited in their technological advancement. Later, after the invention of the microscope, studies were much more accurate and continued to use descriptions as well as experimental techniques. However, many of these descriptions used in the past were highly fanciful and inaccurate. It was not until this century that a more accurate understanding and description of embryological development could be obtained and then only with the use of modern instrumentation.

you (lawful for you) when you give them their marriage portions and live with them in honor, not in fornication, nor taking them as secret concubines. Whoso denies the faith, his work is vain and he will be among the losers in the Hereafter." (Sūrah Al-Mā'idah, 5: Āyah 5)

وَلَا تَقْرُبُوا الرِّثَا إِنَّهُ كَانَ فَاحِشَةً وَسَاءَ سَبِيلًا (سُورَةُ الْاِسْرَاءِ: 17، آيَةُ 32)

"And come not near unto adultery and fornication. Lo! It is an abomination and an evil way."

(Sūrah Al-Isrā', 17: Āyah 32)

With regard to adoption, Islam has prohibited the establishment of a false lineage or false family ties. As stated in the Qur' ān:

وَمَا جَعَلَ اٰدْعِيَاءَكُمْ اَبْنَاءَكُمْ، ذٰلِكُمْ قَوْلُكُمْ بِاَفْوَاهِكُمْ، وَاللّٰهُ يَقُولُ الْحَقَّ وَهُوَ يَهْدِي السَّبِيْلَ، اِدْعُوهُمْ لِاَبَائِهِمْ هُوَ اَقْسَطُ عِنْدَ اللّٰهِ، فَاِنْ لَمْ تَعْلَمُوْا اَبَاءَهُمْ فَاِخْوَانُكُمْ فِى الدِّيْنِ وَمَوَالِيكُمْ، وَلَيْسَ عَلَيْكُمْ جُنَاحٌ فِيمَا اَخْطَاْتُمْ بِهٖ وَلٰكِنْ مَّا تَعَمَّدَتْ قُلُوْبُكُمْ، وَكَانَ اللّٰهُ غَفُوْرًا رَّحِيْمًا (سُورَةُ الْاَحْزَابِ: 33، آيَاتُ 4، 5)

"Nor has He made your adopted sons your sons. Such is (only) your manner of speech by your mouths. But God tells you the Truth and He shows the right Way. Call them by the names of their father: that is juster in the sight of God. But if you know not their fathers' names, call them your Brothers in faith, or your clients. But there is no blame on you if you make a mistake therein: What counts is the intention of your hearts: and God is Most Forgiving, Most Merciful." (Sūrah Al-Aḥzāb, 33: Āyāt 4,5) Islam recommends a high degree of kindness and care towards orphans, or children in similar situations, and those who undertake this care will be rewarded with a high level in Paradise.

The Holy Qur' ān and Sunnah clearly answer the dilemma of manipulating embryonic cells. If the treatment is to heal a diseased embryo it is admissible, as it is considered medical treatment enjoined by the Prophet (peace be upon him):

تَدَاوَرُوا عِبَادَ اللّٰهِ، فَاِنْ اللّٰهُ عَزَّ وَجَلَّ لَمْ يُسْزَلْ دَاءٌ اِلَّا اَنْزَلَ مَعَهُ شِفَاءً، اِلَّا الْمَوْتَ وَالْهَرَمَ. (رَوَاهُ اَحْمَدُ)
"Seek medical treatment for Allah has created no disease except that He created its treatment, except death and old age." (Musnad Aḥmad, Vol. 4, p 278)

However, if this treatment leads to a change in human creation it is not admissible. God Almighty says in the Qur' ān, with regard to the influence of Satan:

وَلَا مَرْتَبَهُمْ فَلَئِنْ خَلَقْنَا خَلْقًا اٰلِهَةً. (سُورَةُ النَّسَاءِ: 4، آيَةُ 119)

"I will order them to deface the fair nature created by God." (Sūrah an-Nisā', 4: Āyah 119)

Therefore, the above statements emphasize the Islamic position regarding human reproduction. Children are to be born only of a husband and wife, and of their family lineage.

In contrast, an analysis of passages from the Qur'ān and Ḥadīth indicate that they contain a rather comprehensive description of human development from the time of co-mingling of the gametes through and beyond organogenesis. With regard to this, the Qur'ān states:

"وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ" (سُورَةُ الْمُؤْمِنُونَ:

آيات 12-14)

"We (God) created man from a quintessence of clay. We then placed him as a nutfah (drop) in a place of settlement, firmly fixed, then We made the drop into an 'alaqah (leech-like structure), and then We changed the alaqah into a mudghah (chewed-like substance, somite stage), then We made out of that mudghah, 'izām (skeleton, bones), then We clothed the bones with laḥm (muscles, flesh) then We caused him to grow and come into being and attain the definitive (human) form. So, blessed be God, the best to create" (Surah Al-Mu'minūn, 23: Āyāt 12-14).

The Prophet (peace and blessings be upon him) also said:

"إِذَا مَرَّ بِالنُّطْفَةِ ثِنْتَانِ وَأَرْبَعُونَ لَيْلَةً بَعَثَ اللَّهُ إِلَيْهَا مَلَكًا فَصَوَّرَهَا، وَخَلَقَ سَمْعَهَا، وَبَصَرَهَا، وَجِلْدَهَا، وَلَحْمَهَا، وَعِظَامَهَا..." (رواه مسلم في صحيحه وغيره)
"When 42 nights have passed over the conceptus, God sends an Angel to it, who shapes it (into human form), makes its hearing, sight, skin, muscles and bones..." (related by Muslim, Abū Dāwūd, Aṭ-Ṭabarānī, Ja'far Al-Faryābī and Ibn Ḥajar).

No such distinctive and complete record of human development, such as classification, terminology, and description, existed before the Qur'ān. In most, if not all instances, the description antedates by many centuries the recording of various stages of human embryonic and fetal development in the traditional scientific literature. Prior to the advent of the compound microscope there existed no means of which we are aware to observe the early stages of human development (e.g. nutfah). To provide a scientific description of the stages of

human development requires obtaining and studying a large number of human embryos and fetuses of known age. Even today it is extremely difficult to assemble such a series!

The existence of various statements regarding details of human development in the Qur'ān and Ḥadīth is explained by the Qur'ān in the following passage:

”وَمَا كُنَّا عَنْ الْخَلْقِ غَافِلِينَ“ (سُورَةُ الْمُؤْمِنُونَ 23: آيَةٌ 17)
 “...And We are never unmindful of (Our) creation.” (Surah Al-Mu'minūn, 23: Āyah 17)



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DESCRIPTION OF HUMAN DEVELOPMENT: THE NUTFAH STAGE

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I. Introduction.

The discovery of the various and successive stages of human development has been complex and difficult throughout the history of embryology. This is due to the extremely small size of the embryo, especially in early weeks of pregnancy. Moreover, the necessary technology to see and study the embryo in the uterus was not available. Not to mention that there was a lack of understanding in the Middle Ages, before the invention of the microscope in the 17th century, of the real role of both the male and female in human development.

However, the Qur'ān, which was revealed in the 7th century, represents the first available reference that mentions distinct stages of the embryo and provides nomenclature and terminology descriptive of its outward appearance and the main processes and events of each stage. These Qur'anic terms remarkably fulfil the prerequisites of scientific terminology.

The Qur'ān has given a special name to each stage:

"وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ" (سُورَةُ الْمُؤْمِنُونَ:

آيات 12-14)

"We (God) created man from a quintessence of clay. We then placed him as a *nutfah* (drop) in a place of settlement, firmly fixed, then We made the drop into an '*alaqah* (leech-like structure), and then We changed the '*alaqah* into a *mudghah* (chewed-like substance), then We made out of that *mudghah*, '*iẓām* (skeleton, bones), then We clothed the bones with *lahm* (muscles, flesh), then We caused him to grow and come into being and attain the definitive (*human*) form. So, blessed be God, the best to create." (Surah Al-Mu'minūn, 23: Āyāt 12-14).

This paper addresses the first of these stages, i.e., the *nutfah* stage.

II. Definition of the term.

Nutfah in Arabic has various meanings; the first meaning is "a drop" or "a small amount of water." Ibn Manẓūr says that *nutfah* is likened to a drop of water (1) and Az-Zabīdī mentions the same meaning (2).

It is reported in a Ḥadīth that the Prophet's companions were waiting for him to come out until he came out with his head '*yanṭuf mā'an*' (dripping with water) (3).

'Abdullāh Ibn Mas'ūd reported that:

«ثُمَّ قَالَ: يَا مُحَمَّدُ مِمَّ يُخْلَقُ الْإِنْسَانُ؟ فَقَالَ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ: يَا يَهُودِيَّ مِنْ كُلِّ يُخْلَقُ، مِنْ نُطْفَةِ الرَّجُلِ وَمِنْ نُطْفَةِ الْمَرْأَةِ» (رواه أحمد في مسنده)
 "When the Prophet (peace be upon him) was asked by a Jewish person, 'O, Muḥammad, what is man created from?' The Prophet answered, 'O, Jew, he is created from both: from the fluid (*nutfah*) of the man and the fluid (*nutfah*) of the woman'" (Musnad Aḥmad, vol. 1, p 465).

III. Phases of the *nutfah*.

Nutfah begins with the sperm and the ovum and ends with the phase of implantation (*al-ḥarth*). The *nutfah* passes through different phases:-

A. Al-mā' ad-dāfiq (the gushing fluid; a drop emitted).

The male discharge gushes forth, as the following Qur'anic passage indicates:

«فَلْيَنْظُرِ الْإِنْسَانُ مِمَّ خُلِقَ، خُلِقَ مِنْ مَّاءٍ دَافِقٍ» (سُورَةُ الطَّارِقِ 86: آيَاتُ 5-6)

"Let man but think from what he is created! He is created from a drop emitted." (Surah Aṭ-Ṭāriq, 86: Āyāt 5-6)

The grammatical form of the Qur'anic statement means that the discharge is self-emitting, indicating thus that it is motile (4).

Modern science has proven that the spermatozoa must be motile and active in order that fertilization can take place (Figure 2-1). It has been proven as well that the female discharge, which contains the ovum, is expelled to the fallopian tube and that the ovum must be moving in the tube for fertilization to occur (Figure 2-2).

The semen contains prostaglandins which induce uterine contractions and may aid in the transport of sperm to the fertilization site (5).

Important components of the female fluid also contribute to the process. During the fertile phase of the woman's menstrual cycle, the cervical mucus, which is otherwise fairly impervious to sperm, becomes clear and gel-like through a realignment of its molecules and allows the sperm to pass (6). Enzymes secreted by the linings of the uterus (endometrium) and the oviducts capacitate the sperm by removing glycoproteins from the head of the sperm (7). Sperm are unable to fertilize ova unless they have been capacitated. Additionally, enzymes secreted by the oviducts loosen the follicular cells surrounding the ovum and expose the protective membrane to the sperm (8).

Since the word *nutfah* means a small amount of fluid, it is comprehensive and covers the male and female discharges (Figures 2-1, 2-2).

B. Sulālah.

The Qur'ān states, regarding fertilization:

«ثُمَّ جَعَلَ نَسْلَهُ مِنْ سَلَالَةٍ مِنْ مَاءٍ مَهِينٍ» (سُورَةُ السَّجْدَةِ 32- آيَةٌ 8)
"Then He (God) made his (man's) progeny from a quintessence (sulālah) of a lowly fluid" (Surah As-Sajdah, 32: Āyah 8).

The word *sulālah* means "gentle extraction from fluid" (9). It means also "a long fish" (10). As for "lowly fluid," it refers to the male discharge in the *sulālah* phase (11).

The sperm itself is a gentle extraction (*sulālah*) from the male fluid and has the form of a long fish (Figures 2-3, 2-4).

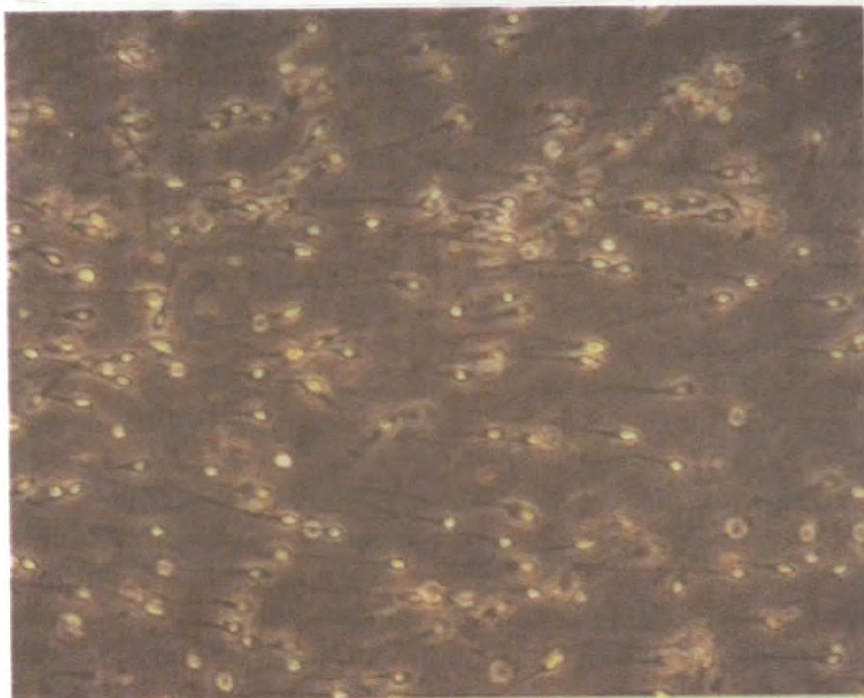


Figure 2-1. Sperm magnified about 450 times. Each has an oval, slightly pointed head, short body and whip-lash tail, which provides the motility that assists in the transport of the sperm to the fertilization site. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976)



Figure 2-2. An ovum with its layer of follicular cells magnified 100 times. The ovum is being drawn into the funnel flaps of the oviduct by millions of small cilia which are flapping toward the interior of the oviduct. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976)



Figure 2-3. An ovum surrounded by sperm which are eagerly striving toward it. When one sperm succeeds in fertilization, it will have been selected and the sulalah phase of nutfah begun. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976)

During the fertilization process, the male fluid migrates from the vagina and meets the ovum in the fallopian tube. Only a tiny volume of the male fluid reaches the fallopian tube. According to the Islamic statements, fertilization does not occur from all of the fluids from the male and female, but from a minute portion of them. The first sperm which touches the cell membrane of the ovum enters easily, but immediately afterwards a rapid change occurs in the cell membrane and all other sperm are locked out (Figure 2-4).

As the Prophet (peace and blessings be upon him) said:

«مَا مِنْ كُلِّ الْمَاءِ يَكُونُ الْوَلَدُ...» (صَحِيحُ مُسْلِمٍ: كِتَابُ النِّكَاحِ - بَابُ الْعِزْلِ)
 “Not from all the fluid is the offspring created” (*Ṣaḥīḥ Muslim: Kitāb An-Nikāḥ, Bāb Al-‘Azl*).

Thus the creation from both fluids is accomplished through special selection. The Prophet’s Ḥadīth accurately determines these meanings confirmed by modern science.

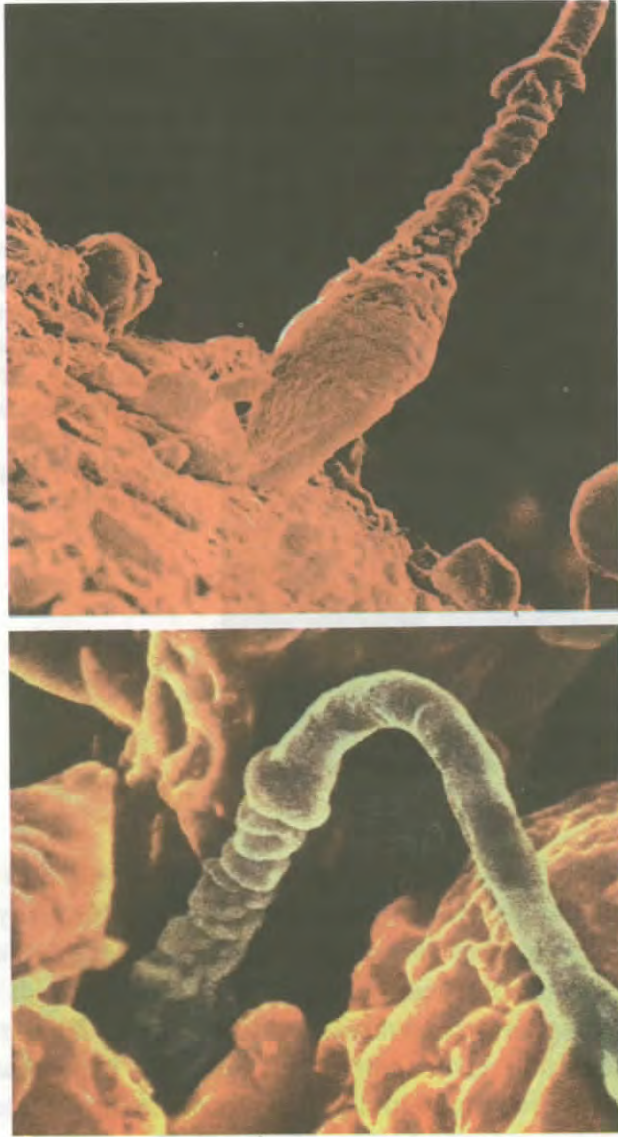


Figure 2-4. Two electron microscope images. *Upper*, the sperm has just touched the surface of the ovum. *Lower*, the head of the sperm has entered the ovum. At this time the cell membrane of the ovum locks out all the other sperm. This process in the nutfah stages is known as *sulalah*, since one sperm and one ovum have now been selected to combine and initiate human development. After entering the cell, the tail and outer coat of the sperm dissolves and the genetic material will combine. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976 (upper), and from Nilsson, *The Incredible Machine*, Washington, National Geographic Society (lower))

C. Nutfah amshāj.

The ovum fertilized with the sperm takes the form of a drop or *nutfah amshāj* (drop of mingled fluid) (Figure 2-5). This mixture of germinal drop, meaning the mixing of male and female gametes, is also known as the zygote in the initial part of the amshāj phase.

As God says in the Qur'ān:

«إِنَّا خَلَقْنَا الْإِنْسَانَ مِنْ نُطْفَةٍ أَمْشَاجٍ» (سُورَةُ الدَّهْرِ 76- آيَةٌ 2)

“We created man from a drop of mingled fluid (*nutfah amshāj*)”
(Surah Ad-Dahr, 76: Āyah 2).



Figure 2-5. Unfertilized ovum in the folds of the oviduct and surrounded by follicular cells. The folded mucus membrane of the oviduct secretes enzymes which gradually loosen the outer envelope of cells and allow the sperm to reach the protective membrane of the ovum. (Reproduced with permission from Nilsson, *The Incredible Machine*, Washington, National Geographic Society)

An important point with regard to this phrase is the fact that “*nuṭfah*” is a singular noun while “*amshāj*” is a plural modifying adjective. Conventional rules of grammar normally permit singular nouns to be modified by singular adjectives. Earlier Qur’anic scholars said that the word “*nuṭfah*” is singular but its meaning is plural (12), although they were unable to completely understand the details of the term “*nuṭfah amshāj*.”

However, science today is able to clarify the meaning interpreted by the early scholars from the Qur’anic text. From a scientific point of view, “*amshāj*” is entirely accurate as a plural adjective modifying the singular “*nuṭfah*”, since it is a single entity consisting of multiple genetic mixtures that carry the characteristics of the ancestors and of the future offspring of each fetus, as well as of the fetus itself.

This stage continues its development, maintaining the shape of the *nuṭfah*, but dividing into smaller and smaller cells called blastomeres, until four days later it forms a spherical mass of cells known as a morula. Four days after fertilization the *nuṭfah* then forms a blastocyst as the morula’s cells separate into two parts (See Figure 2-6). Although the *nuṭfah* divides internally into cells, it does not change

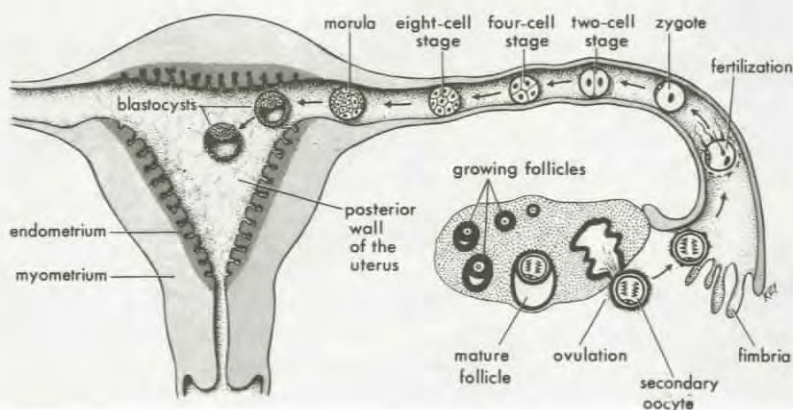


Figure 2-6. Diagrammatic summary of the *nutfah* stage during the first week of human development. The description *sulalah* applies to the selection at fertilization. The term *nutfah amshaj* applies to the time from the formation of the zygote (day 1) through the formation of the morula and early blastocyst (days 4 to 5). Harth refers to the implantation which begins at day 6. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

in terms of its nature and appearance since it has a protective thick membrane. During this time the term *amshāj* very appropriately applies to the *nutfah* in all of its developments, since it continues to be a multifaceted entity.

Up until this stage, the conceptus is formed from a part of the male and female fluids. Since it has the form of a drop, it is a *nutfah*. Furthermore, since it contains many mixtures, it is *amshāj*. The term *nutfah amshāj* truly describes the external appearance and the internal structure of the embryo during this stage. Neither the term *morula*, nor the numerical system currently used to refer to the stages of human development, express these meanings.

The formation of the *nutfah amshāj* results in the following:

1. Al-khalq (creation).

Al-khalq is the real beginning of the human being. The sperm carries 23 chromosomes, and the ovum also carries 23 chromosomes. This number represents half of the chromosomes of any human cell.

The sperm fuses with the ovum to form a new cell which carries a number of chromosomes that equals that carried by a human cell which is 46. This cell marks the beginning of a new human being, for the subsequent stages are determined by and based upon this step (Figure 2-4).

2. Taqdīr (genetic programming).

Immediately after the initiation of a new individual in a complete human cell (zygote), another process begins wherein the future (dominant) characteristics of the fetus are determined. Likewise, the recessive characteristics that might appear in the offspring are determined. Therefore, the fetal characteristics are programmed and determined (13) (Figure 2-7).

The Qur'ān refers to these two successive events, i.e., al-khalq (creation) and at-taqdīr (genetic programming), that occur at the early stages of the *nutfah amshāj*:

«قَتَلَ الْإِنْسَانَ مَا أَكْفَرَهُ ! مِنْ أَيِّ شَيْءٍ خَلَقَهُ ؟! مِنْ نُطْفَةٍ خَلَقَهُ فَقَدَرَهُ»

(سورة عبس 80: آيات 17 - 19)

“Woe to man! What has made him reject God? From what substance has He created him? From a nutfah He has created him, and

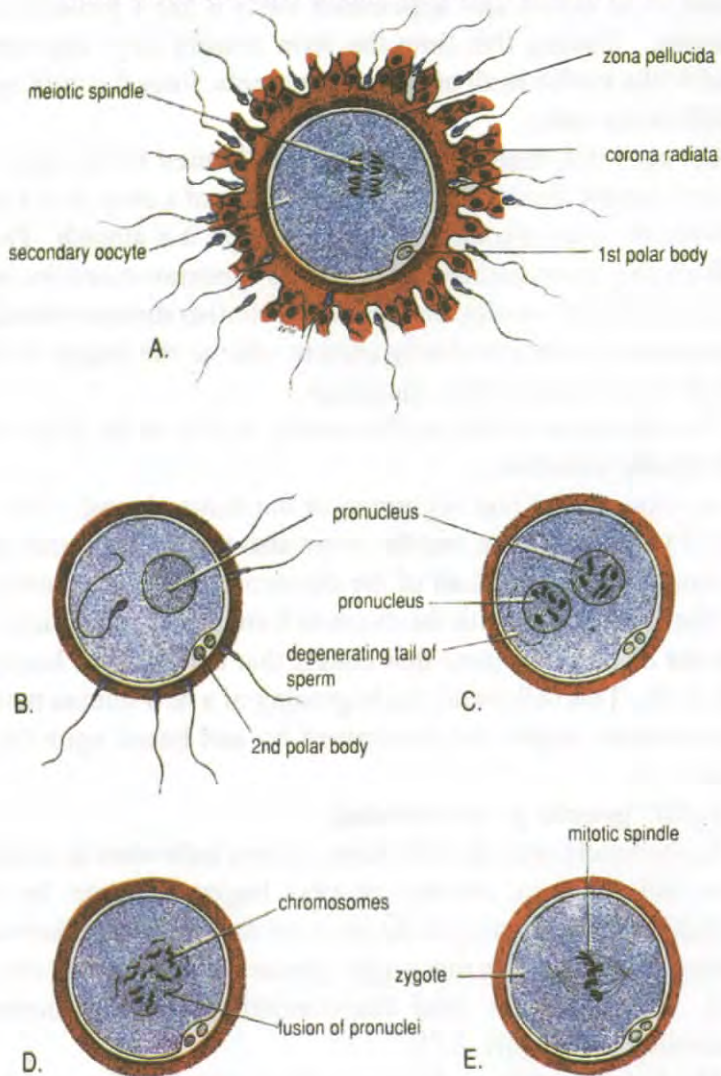


Figure 2-7. Diagrams illustrating fertilization or nutfah, the procession of events beginning when the sperm contacts the secondary oocyte's plasma membrane and ending with the intermingling of maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote. *A*, Secondary oocyte surrounded by several sperms. *B*, The corona radiata has disappeared; a sperm has entered the oocyte, and the second meiotic division has occurred, forming a mature ovum. *C*, The sperm head has enlarged to form the male pronucleus. *D*, The pronuclei are fusing. *E*, The chromosomes of the zygote are arranged on a mitotic spindle in preparation for the first cleavage (mitotic) division. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, 1988)

immediately afterwards planned or programmed him." (Surah 'Abasa, 80: Ayat 17-19)

3. Sex determination.

The process of taqdir that takes place in the nutfah amshāj involves the sex determination. In reference to this fact, the Qur'an states:

"وَأَنَّهُ خَلَقَ الذَّكَرَ وَالْأُنثَىٰ، مِن نُّطْفَةٍ إِذَا تُمْنَىٰ" (سُورَةُ النَّجْمِ 53 :
آيَاتًا 45-46)

"And that He did create the two sexes, the male and female from nutfah when emitted or planned." (Surah An-Najm, 53: Āyāt 45-46)

If the sperm that fertilizes the ovum bears a 'y' chromosome, the child is male. If it bears an 'x' chromosome, the child is female (Figure 2-8).

D. Harth (implantation).

The nutfah migrates before implantation; it continues to do so when it becomes amshāj and afterwards. Once it implants into the endometrium, the stage of settlement begins as referred to in the Prophet's Ḥadīth:

"يَدْخُلُ الْمَلِكُ عَلَى النُّطْفَةِ بَعْدَ مَا تَسْتَقِرُّ فِي الرَّحِمِ بِأَرْبَعِينَ أَوْ خَمْسَةَ وَأَرْبَعِينَ
يَوْمًا.." (رواه مسلم في صحيحه)

"The angel enters upon the conceptus (nutfah) after it rests in the uterus for forty or forty-five nights..." (narrated by Muslim).

In the last phase of nutfah amshāj, the blastocyst implants into the endometrium or uterine lining (Figure 2-6). The Qur'an considers this process analogous to the cultivation of the soil and the implantation of the seed therein, as in the following passage:

"نَسَاؤُكُمْ حَرْثٌ لَّكُمْ فَاتُوا حَرْثَكُمْ أَنَّىٰ شِئْتُمْ" (سُورَةُ الْبَقَرَةِ 2: آيَةٌ 222)
"Your wives are a tilth unto you, so approach your tilth when or how you will" (Surah Al-Baqarah, 2: Āyah 222).

With this implantation, the harth phase begins, and the nutfah by then is six days old. Indeed, the blastocyst embeds and "roots" itself into the endometrium with cells which will eventually form the placenta, just as a seed embeds itself into the soil (Figures 2-9, 2-10). Embryologists now use the term implantation in describing this event, and in Arabic "implantation" is translated as "al-ghars" which is very

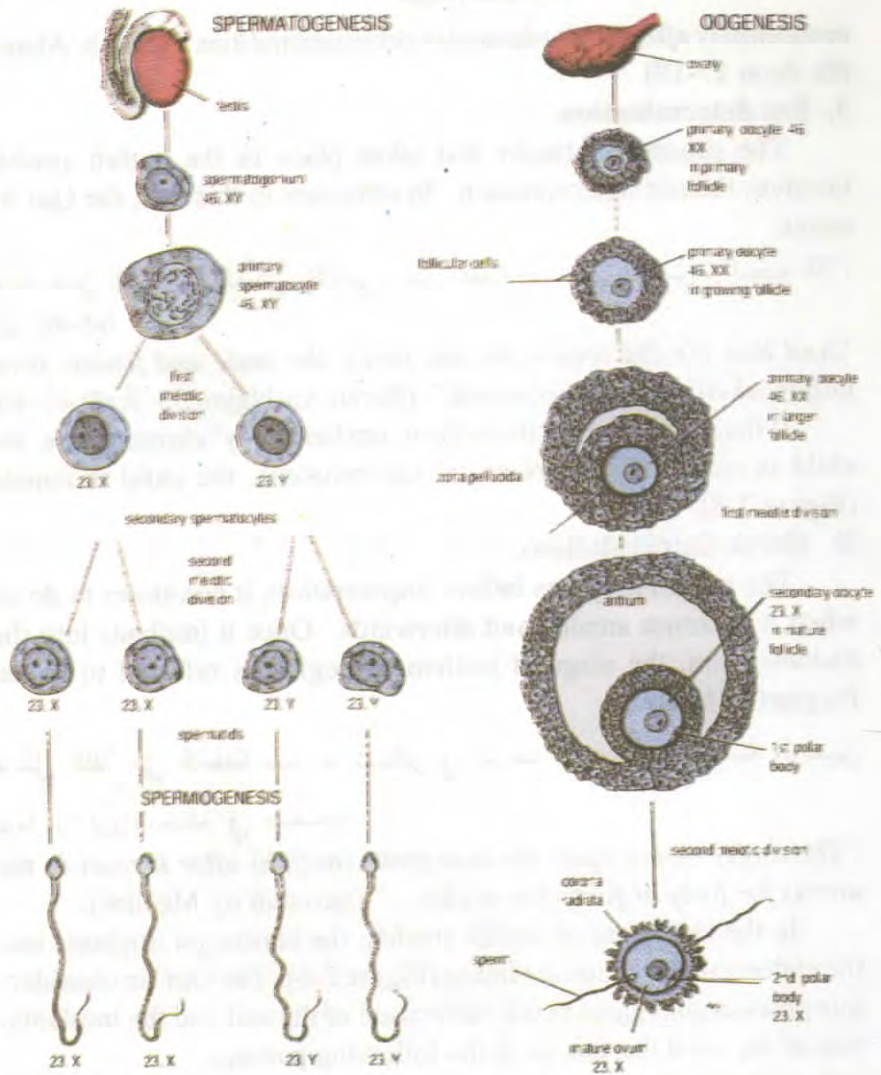


Figure 2-8. Drawings comparing spermatogenesis and oogenesis. Oogonia are not shown since they differentiate into primary oocytes before birth. The chromosome complement is shown at each stage. The number designates the total number of chromosomes, including the sex chromosome(s) shown after the comma. Note that (1) following the two meiotic divisions, the diploid number of chromosomes, 46, is reduced to the haploid number, 23; (2) four sperms form from one primary spermatocyte, whereas only one mature ovum results from maturation of a primary oocyte; and (3) the cytoplasm is conserved during oogenesis to form one large cell, the mature oocyte or ovum. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, Saunders, 1988)

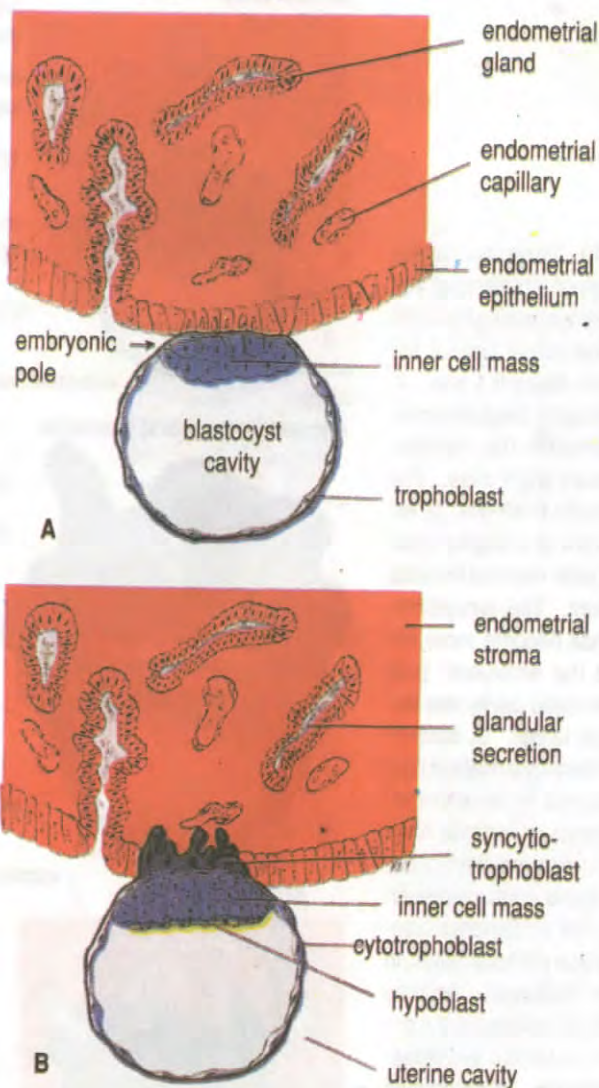
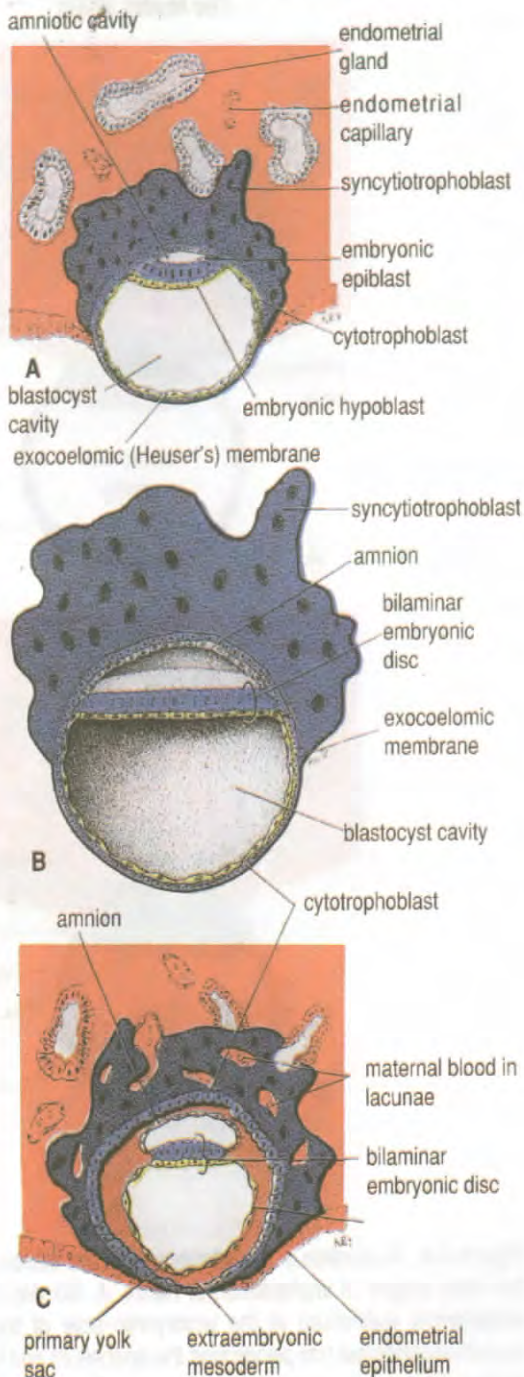


Figure 2-9. Illustration of the attachment of the blastocyst to the endometrial epithelium in the early stages of implantation or hatching. *A*, Six days; the trophoblast is attached to the endometrial epithelium at the embryonic pole of the blastocyst. *B*, Seven days; the syncytiotrophoblast has penetrated the epithelium and has started to invade the endometrial stroma (framework of connective tissue). (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

Figure 2-10. Illustration of the implantation of a blastocyst into the endometrium during the hatching phase. The actual size of the conceptus is about 0.1 mm. **A**, Section through a blastocyst partially implanted in the endometrium at about eight days. The amniotic cavity is slit-like. **B**, An enlarged view of a slightly older blastocyst after removal from the endometrium. The syncytiotrophoblast has become more extensive at the embryonic pole and the amniotic cavity has become much larger. **C**, Section through a blastocyst of about nine days implanted in the endometrium. Spaces or lacunae have appeared in the syncytiotrophoblast, and these soon communicate with the endometrial vessels. This type of implantation, in which the blastocyst becomes completely embedded in the endometrium, is known as interstitial implantation. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)



similar in meaning to “al-ḥarth”. When the harth phase, which is the last phase of the nutfah stage, is accomplished, the embryo transforms from the nutfah form and begins a new stage on day 15.

Thus the Qur’ān has described all aspects of the nutfah stage from beginning to end, using scientifically accurate and descriptive terms for each phase (Figure 2-6). The development and structural changes which occur during the nutfah stage are virtually impossible to detect without a microscope due to the minute size of the nutfah (Figure 2-11). The first phase of the nutfah is the drop emitted, and the last stage is the implantation of the nutfah in a place of settlement, firmly fixed.

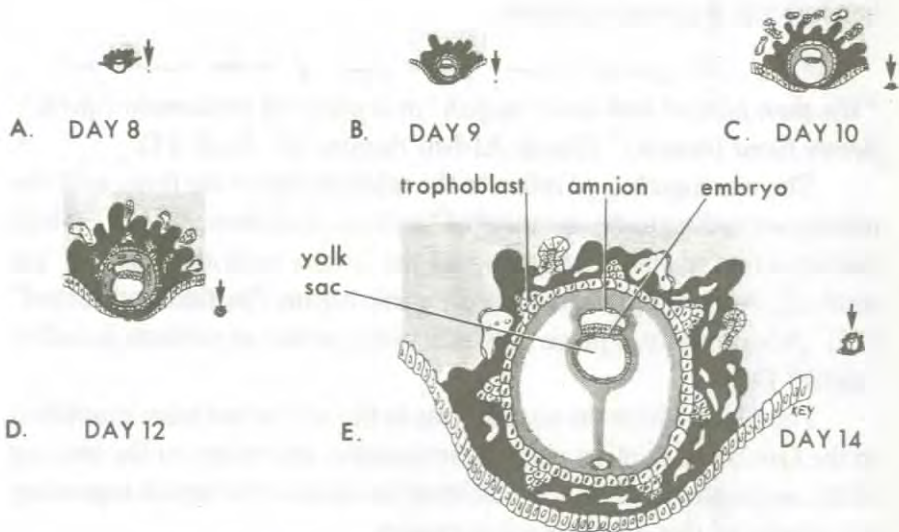


Figure 2-11. Drawings of human blastocysts during the harth phase of the nutfah stage. The trophoblast expands rapidly during this period while the embryo has a relatively minute size (x 25). The arrows indicate sketches which show the actual size of the blastocysts at the gestational ages indicated. The detailed description given for the nutfah in the Qur’an and Hadith is amazing considering the actual size involved as well as the gestational age, since the end of the nutfah stage (day 14) coincides with the time usually expected for menstruation, and it is not likely that a woman would know she is pregnant before this time. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

At the time that the Qur'ān mentioned these aspects of the first stage of human development, anatomists, especially among the non-Muslims, believed that the human individual was created from the menstrual blood. This belief remained popular until the invention of the microscope in the 17th century and the subsequent discoveries of the sperm and ovum. Other misconceptions prevailed until the 18th century when both the sperm and ovum were found to be necessary for conception (14) (See Chapter 1 on the history of embryology).

Thus, several centuries later, science came to understand the facts of embryology in a manner consistent with the statements in the Qur'ān and Ḥadīth.

IV. The descriptions of the uterus: al-qarār al-makīn.

In addition to describing the nuṭfah accurately, the Qur'ān describes as well the place where this nuṭfah settles with two comprehensive and expressive terms:

«ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ» (سُورَةُ الْمُؤْمِنُونَ 23: آيَةٌ 13)
 "We then placed him as a 'nuṭfah' in a place of settlement (qarār), firmly fixed (makīn)" (Surah Al-Mu'minūn, 23: Āyah 13).

The word qarār (قَرَارٌ) refers to the relationship of the fetus with the uterus, according to the meaning of "a place of settlement" (15), while makīn refers to the relationship of the uterus with the body of the mother. According to Az-Zabīdī, qarār means "settled and rested" (16). Additionally, a place in which water settles or collects is called "qarār" (17).

The place where the nuṭfah rests in the uterus has been described in the Qur'ān as qarār, a place of settlement, and refers to the settling of the conceptus in the uterus. Science has discovered much regarding the details of this collective description.

The uterus is for the nuṭfah (from which the human being is created) as well as the other embryonic stages, a lodging for the fetus for nine months. Although the body normally rejects any foreign material, the uterus lodges the fetus and nourishes him. The uterus has muscles and ligaments which protect the fetus within it. It also responds to the fetal growth and expands to a great extent to accommodate him. The fetus is surrounded by amniotic fluid, the amniotic membrane, the placenta, the uterus's thick muscular layer and the

abdominal wall. All of these provide the fetus with a suitable place of settlement for its proper growth. Thus the word qarār is used by the Qur'ān for all of these meanings and others that involve the uterine functions for a proper resting place of the fetus, enabling it to continue his growth (See Figure 2-12).

The word "qarār" (قَرَارٌ) used by the Qur'ān to describe the uterus is comprehensive and inclusive of the scientific facts and shows that the uterus is a suitable place for the settlement of the fetus. The word "makīn" (مَكِينٌ) means "firmly fixed" and refers to the relationship of the uterus with the body of the mother and its ideal situation for the formation and growth of a new being.

The uterus is in the middle of the body and in the center of the pelvis, surrounded by bones, muscles and ligaments that position it firmly in the body, as comprehensively expressed by "makīn." Thus

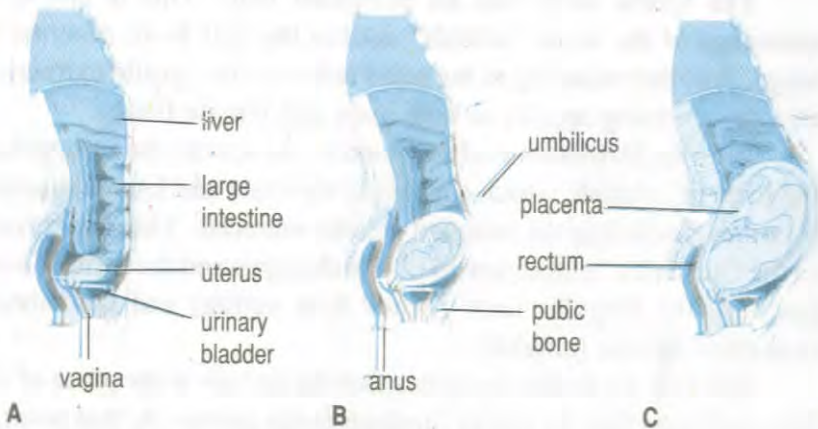


Figure 2-12. These drawings of sagittal sections of a female illustrate the description of the uterus as qarar makin. *A*, Not pregnant. *B*, 20 weeks of pregnancy. *C*, 30 weeks of pregnancy. As the fetus enlarges, the uterus increases in size to accommodate the rapidly growing fetus. By 20 weeks the uterus and fetus reach the level of the umbilicus; by 30 weeks they reach the epigastric region. The mother's abdominal viscera are displaced and the skin and muscle of her anterior abdominal wall are greatly stretched. In each stage of pregnancy, the fetus is in a place of settlement as indicated by 'qarar', and the uterus is firmly fixed in the mother's abdomen as indicated by 'makīn'. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

any descriptions involving the relationship between the fetus and the uterus, and between the uterus and the body of the mother, are encompassed by the meanings of the two words *qarār* and *makīn*, which fully express the exact and delicate functions of the uterus. The importance of these two descriptions can be realized only by the One who has knowledge of the requirements of fetal development and the requirements of the uterus to accompany the fetal growth until the fetus is safely born.

V. Summary.

Both the Qur'ān and the Prophet's Sunnah use the term "nutfah" to describe the first embryonic stage. Nutfah denotes a drop or a small amount of fluid.

Thus, the embryo's creation begins from a tiny amount of the male and female discharge. It takes the form of a drop (zygote) during the fertilization, after the sperm is extracted from the "despised fluid." Therefore, man's progeny is made from a quintessence of the nature of a fluid despised, as the Qur'ān states.

The sperm looks like an elongated fish. This is one of the meanings of the word "*sulālah*" used in the Qur'ān to describe this stage. Another meaning of the word refers to the "gentle extraction," and this meaning applies to both male and female fluids.

With the fertilization of the ovum by the sperm, the embryo takes the form of a *nutfah*, which consists of the male and female discharge mixtures, including the mingled genetic material. This is referred to in the Qur'ān by "*nutfah amshāj*," which expressed the form of a drop (*qaṭrah*), the singular form (hence it is *nutfah*) and the mixtures contained therein (*amshāj*).

The Qur'ān further indicates that the female is the place of tilth. This indicates that the *nutfah* implants in the uterus. At that point, the *nutfah* begins to transform into an '*alaqah* (leech or blood clot).

Then the Qur'ān states that the *nutfah* settles in the uterus, which is given the two most important descriptions, "*qarār*" and "*makīn*" which fully describe the main uterine characteristics.

Thus the Qur'ān and Sunnah used, well over a thousand years ago, a terminology that describes the fetal stages. These terms are consistent with present-day rules of terminology. Each stage is described in a manner according to its appearance and developmental

events at that particular stage.

With the continuation of modern research in this area, the Qur'anic terms can replace, and are perhaps more appropriate than, those presently in use. Clearly they have the additional advantage of being unambiguous and indicating recognizable beginning and ending points.

Comments:

O man, how could you disbelieve?

Allah's signs in the nutfah:

O man, have you asked yourself where you were before your birth? How and from what are you formed; as well as many other similar questions?

Do you know how your creation was initiated? The human body discharges various secretions; sweat, tears, saliva, urine, milk, mucus and semen (despised fluid). From this despised fluid the various nations, tribes, and generations originate.

You were two separate halves, one secreted by your father, the other secreted by your mother. How could the two parts meet? That is the measuring of the Mighty, the Wise.

Who is He Who has put mercy and affection between the two sexes to encourage marriage?

Who is He Who created your half in your father and provided it with accommodation, motility and nourishment?

Who is He Who made it migrate from one place to another and rendered it possible for this half to meet the second half originating from your mother?

Who is He Who made your mother's womb contract to enable your half that has come from your father to migrate to the destined meeting place with the other half?

Who is He Who made your second half that came from your mother migrate and provided it with nourishment and accommodation?

Who is He Who made the two halves meet at a determined moment, in a determined place in a determined environment prepared in a determined period of your mother's life, which rendered it possible for her to conceive you, declaring thus the existence of a new creation?

Who is He Who measured all this to form the unique individual that you are? A creation that is perfectly planned:

A planning in timing, place, appearance, circumstances, glands, hormones, characteristics, behavior, capabilities and future offspring. The planning and unveiling of the future development of the embryo, as well as the transfer of the characteristics from the parents and ancestors to the children and the offspring.

Whether old or young, great or simple, king or celebrity, learned or ignorant, man was no more than a fluid despised, and then he developed into a full grown human being. Who has been behind all this? Has it been mere coincidence, or is it the sperm (nutfah); the glands; or the hormones?

Could any one of these factors have been behind this meticulous arrangement, the perfect planning of appearance, size, functions, characteristics, timing and place? Through men who are themselves powerless and have limited knowledge; or is it rather the Power of the Creator, the Wise, the All-Knowing, whose knowledge encompasses everything and plans the functions and assignment of each and every organ in perfect harmony?

«قَتَلَ الْإِنْسَانَ مَا أَكْفَرَهُ! مِنْ أَيِّ شَيْءٍ خَلَقَهُ؟! مِنْ نُطْفَةٍ خَلَقَهُ فَقَدَرَهُ، ثُمَّ السَّبِيلَ يَسِّرُهُ، ثُمَّ أَمَاتَهُ فَأَقْبَرَهُ، ثُمَّ إِذَا شَاءَ أَنْشَرَهُ، كَلَّا لَمَّا يَقْضِ مَا أَمَرَهُ»
(سورة عبس 80: آيات 17-23)

“Woe to man! What has made him reject God? From what substance has He created him? From a nutfah He has created him, and immediately afterwards planned or programmed him. Then does He make his path smooth for him. Then He causes him to die and puts him in his grave. Then when it is His will, He will raise him up (again). By no means has he fulfilled what God has commanded him.” (Surah ‘Abasa, 80: Āyāt 17-23)

Such was the beginning of man, from a drop which contains the chromosomes and genes that cannot be seen by the naked eye. This drop has produced the human existence which has filled the earth with civilizations and hectic efforts. Likewise, such will be the later creation.

He Who initiated the first creation certainly is able to repeat it.

The Qur'ān refers to this in the following passage:

«أَوَلَمْ يَرَ الْإِنْسَانُ أَنَا خَلَقْنَاهُ مِنْ نُطْفَةٍ فَإِذَا هُوَ خَصِيمٌ مُبِينٌ، وَضَرَبَ لَنَا مَثَلًا وَنَسِيَ خَلْقَهُ قَالَ مَنْ يُحْيِي الْعِظَامَ وَهِيَ رَمِيمٌ؟! قُلْ يُحْيِيهَا الَّذِي أَنْشَأَهَا أَوَّلَ مَرَّةٍ وَهُوَ بِكُلِّ عَلِيمٍ» (سورة يَس 36: آيات 77 - 79)

“Does not man see that it is We Who created him from sperm? Yet behold, he (stands forth) as an open adversary! And he makes comparisons for Us, and forgets his own (origin and) creation. He says, ‘Who can give life to (dry) bones and decomposed ones (at that)?’ Say, ‘He will give them life Who created them for the first time. For He is well-versed in every kind of creation.’” (Surah Yā-Sīn, 36: Āyāt 77-79)

Is this not a foolish dispute, from a sperm emitted, against the Lord of the heavens and the earth, the Initiator of life and the living creatures?

There was an epoch when there was no human existence on the earth. Then man was created and has become the master of this earth. Generations after generations of human beings come forth from mixtures of germinal drop, equipped with the tools of knowledge, namely hearing, vision, etc., so that man is qualified to receive the Guidance and carry the trust.

The Qur'ān states:

«هَلْ أَتَى عَلَى الْإِنْسَانِ حِينٌ مِنَ الدَّهْرِ لَمْ يَكُنْ شَيْئًا مَذْكُورًا، إِنَّا خَلَقْنَا الْإِنْسَانَ مِنْ نُطْفَةٍ أَمْشَاجٍ نَبْتَلِيهِ فَجَعَلْنَاهُ سَمِيعًا بَصِيرًا» (سورة الإنسان 76: آيتا 1-2)

“Has there not been over man a long period of time when he was nothing (not even) mentioned? Verily We created man from a drop of mingled fluid in order to try him. So We gave him (the gifts) of hearing and sight.” (Surah Al-Insān, 76: Āyāt 1-2)

Thus man goes through the test and commits as many deeds as he wishes. Everything in this world passes away except the good deeds and bad deeds for which man is held accountable.



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13. "Taqdīr" means: a) To ponder and reflect upon the preparation of

- something; b) To plan something and mark it with signs; c) To determine something and design it. (Ibn Manzūr, *Lisān al-‘Arab*, vol. 5, p 76).
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GENETIC PROGRAMMING IN THE NUTFAH STAGE: COMPLEXITY DUE TO MULTIPLE MECHANISMS

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I. Introduction.

Several different genetic mechanisms are now known to be responsible for normal and abnormal human development. These mechanisms include: 1) abnormalities of chromosome number or structure; 2) mutations at a single genetic locus (Mendelian); 3) cumulative effects of several genes (polygenic), all acting to produce a single phenotype. There exist in Islamic writings several citations that are consistent with the existence of these different genetic mechanisms. In this communication, we shall consider several relevant citations. Genetic interpretation is primarily the contribution of the senior author, whereas the other authors identified, translated, and analyzed the Islamic writings.

II. Earlier scientific beliefs.

Although science now recognizes the concept that both male and female gametes contribute to the zygote, this idea has not always been accepted.

During the Middle Ages, it was believed that the male sperm contributed a miniature fetus (homunculus) contained within the sperm (See Figure 1-11). The female was believed to contribute nothing of a heritable nature. We now know, of course, that both male as well as female contribute chromosomal complements to make the diploid number of 46.

III. Genetic control beginning at conception.

The multifaceted genetic contribution is specifically acknowledged in the Qur'ān by the phrase "nutfah amshāj" ("mixtures of germinal drop") (Surah Ad-Dahr, 76: Āyah 2).

Of significance is that *amshāj* is a plural adjective, agreeing with the concept that nutfah is a multifaceted single entity. This multifaceted role for genetic programming begins early in development, but not prior to that time. Only when the zygote fuses can the genetic contributions of both parents actually be determined.

As the Qur'ān states:

«مِنْ نُطْفَةٍ خَلَقَهُ فَقَدَرَهُ» (سُورَةُ عَبَسَ 80 - آيَةٌ 19)

"He created him from nutfah and immediately planned or programmed him [his future development] (*faqaddarah*)" (Surah 'Abasa, 80: Ayah 19). *Taqdir* is the noun form of *qaddara* and means programming or planning (1, 2). *fa* is a conjunction which indicates that programming occurs immediately after the fertilization.

Ibn 'Abbās, one of the Prophet's companions, said that "faqaddarah" means planned his hands, legs, eyes, all different organs, countenance, height and disposition (3).

The concept is, then, that programming can be completed only after fertilization. As an example of programming beginning only after conception, recall that only if both parents are heterozygous (carriers of a recessive trait) will their offspring be affected. We also know that the expressivity of dominant genes is not determined until the time of conception, for not until then is presence or absence of modifying genes determined.

A specific example is derived from sex differentiation which becomes programmed during nutfah, but manifested only later in gestation. Both male and female gametes contribute to the sex chromosomes, consistent with the Qur'anic passage:

«وَأَنَّهُ خَلَقَ الذُّكْرَ وَالْأُنثَىٰ مِنْ نُطْفَةٍ إِذَا تُمْنَىٰ» (سُورَةُ النَّجْمِ 53:

آيَتَا 45-46)

"...and He created both male and female from the nutfah (male and female fluids) which is ejaculated and planned" (Surah An-Najm, 53: Ayat 45,46).

Sex determination primarily occurs at fertilization and depends upon the type of sex chromosome in the sperm which fertilizes the ovum (Figure 3-1). An X-bearing sperm results in the formation of a female individual, whereas, a Y-bearing sperm results in the formation of a male individual (Figure 3-2). However, the sex of the new individual cannot be correctly programmed without the contribution of the X-chromosome of the ovum, even though participation of X and Y bearing sperm are necessary for sex determination.

IV. Different Mendelian mechanisms.

The plural nature of amshāj is consistent with existence of different genetic mechanisms, even within the single category of single gene (Mendelian) mutations. There are references in the



Figure 3-1. A dividing human cell has been gently flattened in order to view the chromosomes. After treatment to produce fluorescence under ultraviolet light, each chromosome displays a distinct pattern. In this particular case, the chromosomes are from a male individual and the small, short-armed y chromosome (center) emits a particularly strong light. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976)

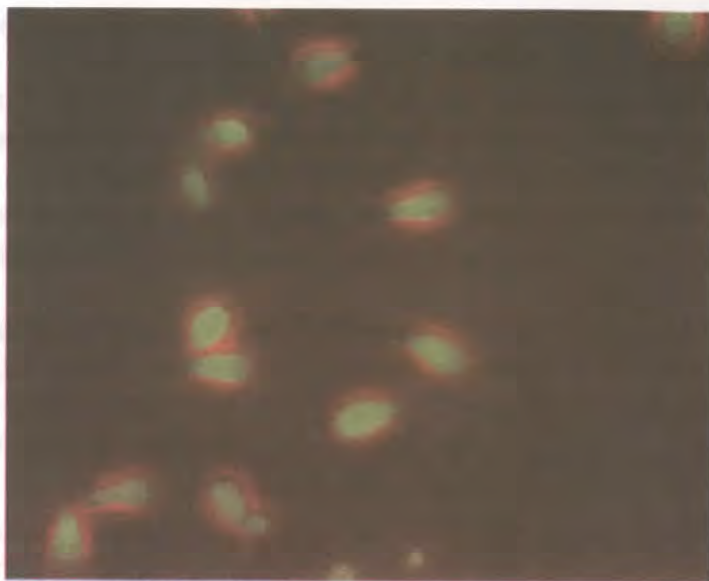


Figure 3-2. Sperm which have been treated to fluoresce under ultraviolet light. X and Y bearing sperm are easily distinguishable, since those carrying the Y chromosome emit a small spot of gleaming light. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Dell Publishing Company, 1976)

Hadīth to several different specific single gene mechanisms, namely both recessive and dominant inheritance.

A potential allusion to recessive inheritance would appear to exist in the following ḥadīth:

«عَنْ أَبِي هُرَيْرَةَ: أَنَّ رجلاً أتى النَّبِيَّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ فَقَالَ: يَا رَسُولَ اللَّهِ وَكَيْدٌ لِي غَلامٌ أَسودٌ؟ فَقَالَ: هَلْ لَكَ مِنْ إِبِلٍ؟ قَالَ: نَعَمْ. قَالَ مَا أَلوانُها؟ قَالَ: حُمْرٌ. قَالَ: هَلْ فِيها مِنْ أورقٍ؟ قَالَ: نَعَمْ. قَالَ: فَأَنَّى ذاك؟ قَالَ: لَعَلَّ نَزَعَهُ عِرْقٌ. قَالَ: لَعَلَّ ابْنَكَ هَذَا نَزَعَهُ عِرْقٌ» (رواه البخاري كتاب الطلاق: باب إذا عرَضَ بَنفَى الولد)

“A man came to the Prophet (peace be upon him) and said, ‘O Allah’s Prophet, a black child has been born for me.’ The Prophet asked, ‘Do you have any camels?’ The man said, ‘Yes.’ The Prophet asked, ‘What color are they?’ The man replied, ‘Red.’ ‘Is there a grey one among them?’ The man replied, ‘Yes.’ ‘Whence come that?’ He said, ‘Maybe it (color) was pulled out by a hidden trait of heredity.’ The

Prophet said, 'Maybe your son's (color) was also pulled out by a trait of heredity.'" (Al-Bukhārī; narrated by Abū Hurayrah)

Two conclusions can be drawn from this ḥadīth. First, the Prophet indicated that the laws of heredity are similar between man and animals. Second, a characteristic which becomes hidden (recessive) for several generations may appear again in the future. This would be in complete agreement with the present knowledge of the laws of heredity.

Therefore the appropriate mechanism for the genetic explanation of this ḥadīth is autosomal recessive inheritance (Table 3-1). Two normal parents, actually heterozygotes, can have a child with a recessive condition (25% likelihood). Allusions exist as well to dominant factors. In a ḥadīth it is stated:

«اللَّهُمَّ مَتِّعْنَا بِأَسْمَاعِنَا وَأَبْصَارِنَا وَقَوَاتِنَا مَا أَحْيَيْتَنَا وَاجْعَلْهُ الْوَارِثَ مِنَّا»
(رواه الترمذی والحاکم فی المستدرک)

"Oh, Allah, make us enjoy our hearing, our vision, our strengths, as long as we live, and make it our inheritor." (At-Tirmidhī and Al-Ḥākim). Heredity, by definition, occurs between parents and offspring. The word "inheritor" is never used to describe what is inherited by children from parents, in which case the word "inherited" is used. The recent discoveries concerning the role of dominant genes which exert a controlling influence in heredity, and therefore cause the recessive genetic characteristics to not appear in the offspring, explain the choice of the word "inheritor". Since the word indicates

Table 3-1

AUTOSOMAL RECESSIVE INHERITANCE*		
Parental gametes	D	d
D	DD	Dd
d	dD	dd

*Progeny expected of a mating between two individuals heterozygous for the same mutant allele (D). d represents the normal allele. The probability is 0.25 that a given offspring will inherit both mutant alleles (dd) and be affected. The probability is 0.50 that a given offspring will be heterozygous (Dd).

that which carries the inheritance, "inheritor" means to make the characteristics mentioned in the ḥadīth to be dominant in genetic inheritance.

V. Polygenic inheritance.

Most normal variation is due to polygenic inheritance, by definition multifaceted and plural in nature. Neither chromosomal nor Mendelian mechanism can readily explain the genetics of normal anatomic and physiologic variations (e.g. stature). On the other hand, the tendency of relatives to resemble one another in physical appearance is obvious. Moreover, most congenital anomalies show some heritable tendencies.

That genetic tendencies, rather than merely shared environmental factors, are responsible for familial aggregates can also be deduced from twin studies. Monozygotic twins are much more likely to be concordant for any given anomaly than are dizygotic twins. Since either monozygotic or dizygotic twins are exposed to the same intrauterine environment, genetic factors must be invoked to explain the differences. On the other hand, monozygotic twins show less than 100% concordance for common traits, indicating existence of environmental as well as genetic factors.

The logical explanation for familial resemblance is that a single trait is influenced by several genes. To illustrate the basis of polygenic inheritance, let us consider the progressively increasing number of genotypes whenever more than one gene influences a single characteristic. Suppose only one gene controls a trait and that this gene has two alleles. If the frequency of allele *S* equals the frequency of allele *s*, 25% of the population is *SS* ($p = q = 0.5$; $p^2 = q^2 = 0.25$), 25% is *ss*, and 50% is *Ss* ($2pq = 0.50$). Now, suppose that not one but two genes influence the trait not only *S*, but a second locus, where alleles *T* and *t* exist. Nine genotypes are now possible: *SSTT*, *SSTt*, *SStt*, *SsTT*, *SsTt*, *Sstt*, *ssTT*, *ssTt*, *sstt*. The population will contain nine distinct classes of individuals if *S*, *T*, *s* and *t* all exert dissimilar influences (Table 3-2).

If one represents histographically the proportion of individuals in each genotypic class, a normal distribution will be approximated as more and more genotypes become possible. Continuous variation will soon be approximated. As the number of genes controlling a trait

Table 3-2.

RELATIONSHIP BETWEEN NUMBER OF GENES AND NUMBER OF GENOTYPIC CLASSES		
No. of Genes	Classes of Individuals	No. of Classes
1 (S,s)	SS, Ss, ss	3
2 (S, s; T, t)	SSTT, SSTt, SStt SsTT, SsTt, Sstt ssTT, ssTt, sstt	9
n		3^n

*S and s represent alleles at one locus, T and t at another. If one gene controls the presence or absence of a given trait, the population consists of three genotypes; if two genes control a trait, the population consists of nine genotypes. If there are more than two alleles at a given locus, the number of genotypes would increase.

increases, the number of genotypic classes increases even more. Figure 3-3 shows the histographic representation for one gene having two alleles. If two genes exist, each with two alleles, there will be nine classes (Figure 3-4) and thus nine histographic bars.

A trait controlled by more than one gene is said to be inherited in polygenic fashion. Although the term polygenic inheritance is often used synonymously with continuous variation, the latter may also result from other mechanisms, namely, a single locus influenced by environmental factors. If environmental as well as genetic factors influence a trait, the term multifactorial is used. Polygenic and multifactorial inheritance usually cannot be distinguished from one another in humans, although comparisons between monozygotic and dizygotic twins theoretically permit such a distinction. Polygenic/multifactorial inheritance is invoked to explain the inheritance of normal anatomic and physiologic variables that display continuous variation - height, skin, color, hair color, blood pressure, age of menarche, ability to metabolize a given drug or toxin.

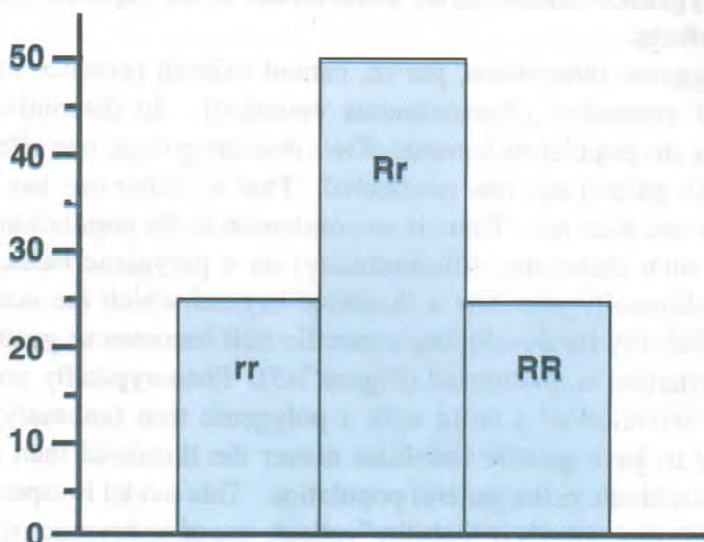


Figure 3-3. Histogram showing the relative proportions of individuals with various genotypes (**RR**, **Rr**, **rr**) if a trait is influenced by a single gene that can exist in two allelic forms (**R** or **r**). Assume the gene frequency of **R** and **r** are equal. If $R = r = 0.5$, $R^2 = r^2 = 0.25$ and $Rr = 0.50$ (Hardy-Weinberg equation; $p = R$ and $q = r$). Thus, 25% of the population is **RR**, 25% is **rr**, and 50% is **Rr**. If $R = 0.9$ and $r = 0.1$, then 81% of the population is **RR**, 19% are **Rr** and 1% are **rr**.

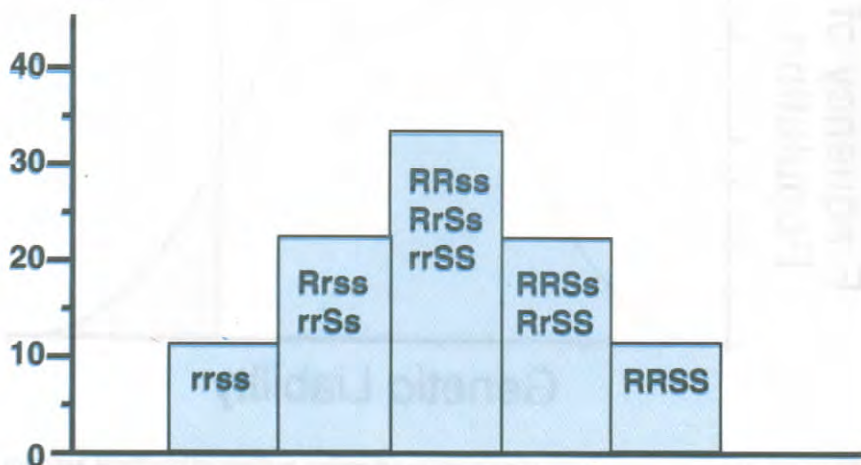


Figure 3-4. Histogram showing the relative proportion of individuals with various genotypes if a trait is influenced by two genes, each with two alleles (**R** or **r**, and **S** or **s**).

VI. Polygenic/Multifactorial inheritance as an explanation for birth defects.

Polygenic inheritance, per se, cannot explain presence or absence of anomalies (discontinuous variation). In discontinuous variation, the population consists of two discrete groups, one affected (e.g., cleft palate) and one unaffected. That is, either one has cleft palate or one does not. There is no continuum in the population. To explain such dichotomy (discontinuity) on a polygenic basis, one must additionally postulate a threshold beyond which the accrued genetic liability for developing a specific trait becomes so great that a malformation is manifested (Figure 3-5). Phenotypically normal parents delivered of a child with a polygenic trait (anomaly) are assumed to have genetic liabilities nearer the threshold than most other individuals in the general population. This model is especially reasonable biologically if "liability" reflects rate of embryonic growth. Growth occurring too slowly could preclude a key embryonic step being accomplished by a certain crucial time, thus leading to anoma-

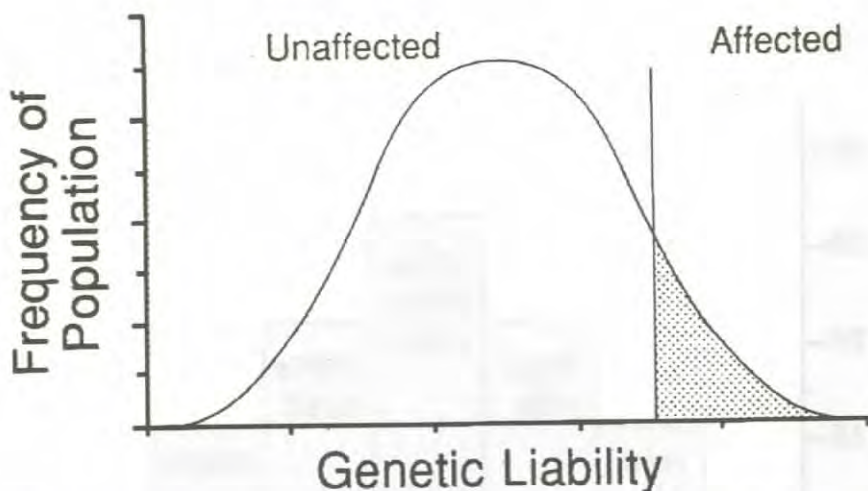


Figure 3-5. Schematic representation of one model for polygenic or multifactorial inheritance, assuming an underlying continuous distribution with a threshold beyond which liability is so great that an abnormality is manifested. Parents of affected individuals presumably have a greater liability (i.e., they are closer to the threshold) than most other individuals in the population.

lous development. For example, if the paired palatine shelves reach the midline before a certain day of development, they fuse to form the secondary palate. After that day the shelves are too widely separated ever to fuse, thus cleft palate. Inherited factors might include velocity of growth, size of mandible and tongue, and rapidity of palatine migration. All would be expected to influence fusion or lack thereof.

VII. Implications concerning inheritance in the two ḥadīths.

In the first ḥadīth, the unusual case of the dark-skinned child born to light-skinned parents, could be explained as an anomaly which occurred due to some aspects of polygenic inheritance discussed here. The two parents may have carried a type of genetic liability such that the combination of their genes went beyond the threshold of liability for the expression of this particular characteristic and therefore produced a dark-skinned child.

The second ḥadīth above is asking that normal functioning of our senses and abilities be inherited, or transferred, to our future generations as expressive traits or phenotypes. These functions and abilities, as well as the aging process as indicated when the ḥadīth asks that these characteristics continue "as long as we live," are traits which would likely involve polygenic/multifactorial inheritance. Therefore, the ḥadīth is a request that within the combination of genetic material transferred to the offspring, the per cent of genes related to some sort of deficiency in functioning or abilities would be low, and that any environmental factors influencing an anomalous, detrimental expression of the genes would also be limited, in order that the desirable characteristics would be expressed.

VIII. Conclusion.

The writings of the Qur'ān and the ḥadīths cited above indicate that genetic programming, including sex determination, occurs in the nutfah stage. Furthermore, it is indicated that some inherited characteristics are dominant and others are recessive. These writings, recorded centuries before modern science, are consistent with the principles of human genetics, specifically the multifaceted nature of its control in development. Certainly, specific scientific knowledge regarding these topics was not available when the Qur'ān and Ḥadīth were written 14 centuries earlier.



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DESCRIPTION OF HUMAN DEVELOPMENT: 'ALAQAH AND MUDGHAH STAGES

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I. Introduction.

The Qur'ān mentioned the stages of human development in the following passages:

«وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ» (سُورَةُ الْمُؤْمِنُونَ:

آيات 12-14)

“We (God) created man from a quintessence of clay. We then placed him as a nutfah (drop) in a place of settlement, firmly fixed, then We made the drop into an ‘alaqah (leech-like structure), and then We changed the ‘alaqah into a mudghah (chewed-like substance), then We made out of that mudghah, ‘izām (skeleton, bones), then We clothed the bones with lahm (muscles, flesh), then We caused him to grow and come into being and attain the definitive (human) form. So, blessed be God, the best to create.” (Surah Al-Mu’minūn, 23: Āyāt 12-14).

The preceding passage divides human development into three main stages separated by the conjunction “*thumma*,” which indicates sequence with a time lag:

The nutfah stage, the takhlīq (creating, formation) stage, and the nash’ah stage. The second stage consists of 4 phases, i.e., ‘alaqah, mudghah, ‘izām, and lahm.

The takhlīq period begins from the 3rd week until the end of the 8th week. It is mainly characterized by rapid cell growth and intense activity with regard to organogenesis (Table 4-1) (for further information, see *The Developing Human*, Keith L. Moore, p 78, Table 5-1).

Thus, the description of the takhlīq stage is very accurate and expressive of the nature of the internal processes that take place, as well as of the external appearance of the embryo. This undifferentiated appearance transforms into a distinct human appearance during the 7th week as a consequence of the formation of the skeleton, then the formation of muscles during the 8th week.

Since the processes of embryonic development are rapid and sequential, the Qur'ān uses the conjunction "fa," which indicates a sequence of events but with no delay, to link the various phases of this stage.

This paper addresses the phases of 'alaqah and muḍghah.

II. The 'alaqah stage.

The word "'alaqah," according to many linguistic Arabic dictionaries, has several meanings. It is a derivative of "alaqa" which means attached and hanging to something. "'Alaqah" is a leech that lives in ponds and thrives on the blood of animals to which it attaches itself. Additionally, "'alaq" is "the red blood in general" or "the thick clotted blood" (1). "'Alaqah" also denotes "the wet blood" (2).

The Qur'ān mentioned the term, 'alaqah, with all of its meanings given above, as applying to the second stage of human development. The findings of modern science regarding this stage should be considered in regard to these meanings.

The nuṭfah, which has now developed into a blastocyst, attaches to the lining of the uterus on the 6th day at the beginning of the ḥarth (implantation) phase. It continues to implant itself in the wall until it is implanted completely (See Figures 2-9, 2-10, Chapter 2). This process takes more than a week until cell differentiation occurs, developing the embryo and placenta from the nuṭfah, and the embryo is attached to the primitive placenta by a connecting stalk that will become the umbilical cord. During the ḥarth period, the nuṭfah loses its distinctive drop-like form in preparation for the cell differentiation, and the embryo acquires the shape of the 'alaqah beginning with its attachment to the placenta. The Qur'ān described this attachment as

Age (Days)	No. of Somites	Length (mm)	Main Characteristics
20-21	1-3	1.5-3.0	Deep neural groove and first somites present. Head fold evident.
22-23	4-12	2.0-3.5	Embryo straight or slightly curved. Neural tube forming or formed opposite somites, but widely open at rostral and caudal neuropores. First and second pairs of branchial arches visible.
24-25	13-20	2.5-4.5	Embryo curved owing to head and tail folds. Rostral neuropore closing. Otic placodes present. Optic vesicles formed.
26-27	21-29	3.0-5.0	Upper limb buds appear. Caudal neuropore closing or closed. Three pairs of branchial arches visible. Heart prominence distinct. Otic pits present.
28-30	30-35	4.0-6.0	Embryo has C-shaped curve. Upper limb buds are flipperlike. Four pairs of branchial arches visible. Lower limb buds appear. Otic vesicles present. Lens placodes distinct. Attenuated tail present.
31-32	*	5.0-7.0	Upper limbs are paddle-shaped. Lens pits and nasal pits visible. Optic cups present.
33-36		7.0-9.0	Hand plates formed. Lens vesicles present. Nasal pits prominent. Lower limbs are paddle-shaped. Cervical sinus visible.
37-40		8.0-11.0	Foot plates formed. Pigment visible in retina. Auricular hillocks developing.
41-43		11.0-14.0	Digital, or finger rays appear. Auricular hillocks outline future auricle of external ear. Trunk beginning to straighten. Cerebral vesicles prominent.

* At this and subsequent stages, the number of somites is difficult to determine and so is not a useful criterion.

Table 4-1. The main characteristics of the embryo as it progresses from the alaqah stage into the mudghah stage. Somites are formed rapidly in the last days of the 'alaqah stage and the transformation into the mudghah stage is quick. (Adapted from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

'alaqah (Figure 4-1). This is in agreement with the first meaning of the word 'alaqah, "attached and hanging to something" (Figure 4-2).

If we consider the literal meaning of "leech" for 'alaqah, we find that the embryo loses its rounded shape and elongates until it takes the shape of a leech (Figure 4-3). It now obtains nourishment from the blood of the mother, similar to the leech which feeds on the blood of others. The embryo is also surrounded by amniotic fluid just as the leech is surrounded by water. The Qur'anic term 'alaqah clearly indicates this meaning of leech according to the appearance and features of the embryo at this stage of development.

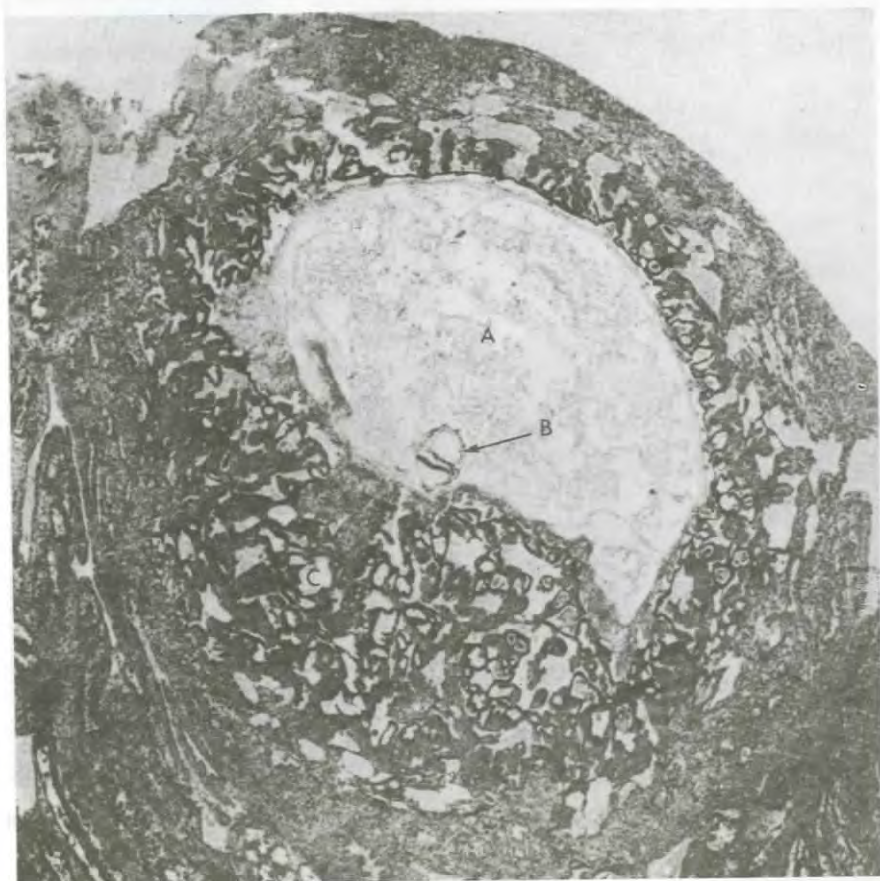


Figure 4-1. Photomicrograph (x 15) of a section through the endometrium showing an implanted embryo (B), in the 'alaqah stage (about 15 days). (Reproduced with permission from Leeson, C.R., and Leeson, T.S., *Histology*, 4th edition, Philadelphia, W.B. Saunders, 1981)

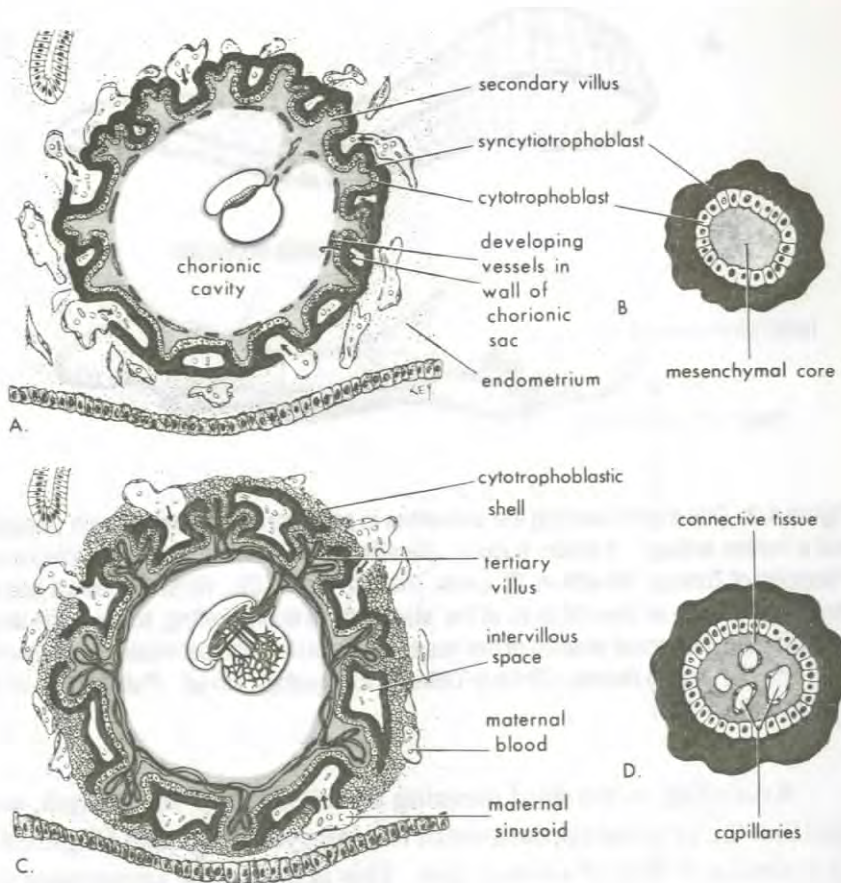


Figure 4-2. The embryo in the 'alaqah stage, suspended in the chorionic cavity by the body stalk and surrounded by fluids of the amnion and the yolk sac. Here the embryo is "attached and hanging" and is surrounded by fluid, in accordance to the meanings given for 'alaqah in the text. *A*, Sagittal section of an embryo at about day 16. *B*, Section of a secondary chorionic villus. *C*, Section of an implanted embryo at about 21 days. *D*, Section of a tertiary chorionic villus. The fetal blood in the capillaries is separated from the maternal blood surrounding the villus by the placental membrane, composed of the endothelium of the capillary, mesenchyme, cytotrophoblast, and syncytiotrophoblast. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

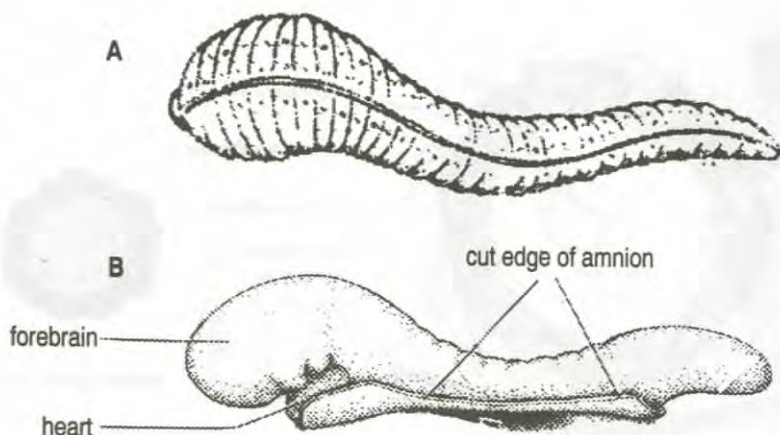


Figure 4-3. Drawings illustrating the similarities in appearance between a leech ('alaqah) and a human embryo. A shows a leech. (Modified from Hickman, C.P. *et al*, *Integrated Principles of Zoology*, 6th edition, St. Louis, The C.V. Mosby Co., 1979) B shows a lateral view of an embryo at days 24 to 25 of the 'alaqah stage during folding, showing the large forebrain and the ventral position of the heart. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

According to the third meaning of "blood clot" for 'alaqah, we find that the external appearance of the embryo and its sacs (Figure 4-2) is similar to that of a blood clot. This is due to the appearance of the chorionic sac, primitive heart, and the cardiovascular system. The blood, though fluid, does not circulate until the end of the third week (Figure 4-4). On the 21st day, the heart of the embryo connects with the blood vessels in the embryo, the connecting stalk, the chorion and the yolk sac, and the blood starts to circulate.

Thus the embryo takes the appearance of a blood clot even though its blood is fluid. These features incorporate the third and fourth meanings of "a blood clot" and "wet blood" for 'alaqah given above.

During the implantation or ḥarth phase of the nuṭfah stage, there is a slow rate of development until the 'alaqah stage. It takes about a week from the beginning of ḥarth (day 6) for the connecting stalk to

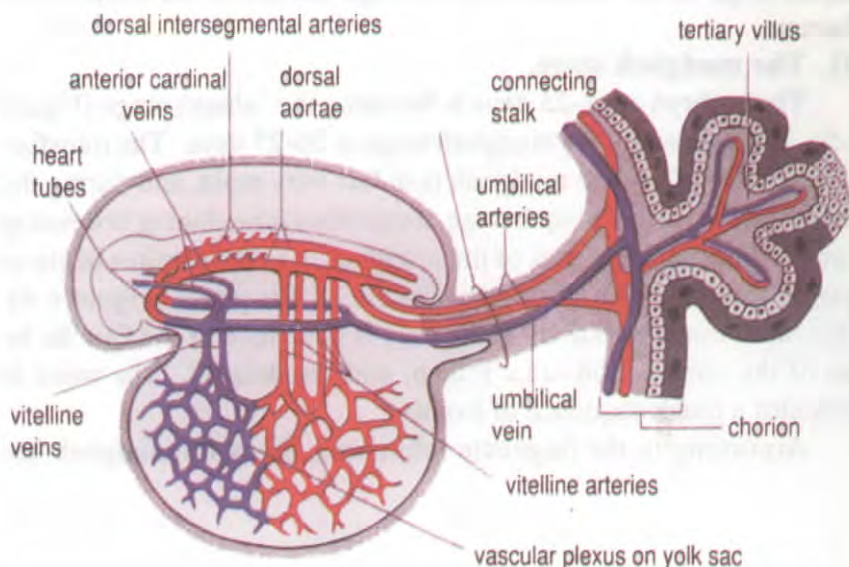


Figure 4-4. Diagram of the primitive cardiovascular system in an embryo during the 'alaqah stage (about 20 days). At this stage, the embryo is now dependent on the maternal blood for its nutrition. Due to the presence of large amounts of blood present in the embryo and the chorion, the description of 'alaqah as a blood clot is clear. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

form (day 14 or 15), such that the embryo becomes "attached and hanging". It takes about 10 days for the notochord to begin development (day 16) in order for the embryo to take on the appearance of a leech. The indications in the Qur'anic passage for the period of time required for the transformation into 'alaqah come from the word *thumma* (ثُمَّ) ("then"), which is a conjunction indicating a time delay.

Therefore the Qur'anic term 'alaqah is a comprehensive expression for the first phase of the second stage of embryonic development, including the primary external and internal features. The general shape of the embryo as a leech is described, the internal events such as the formation of blood and closed vessels are described, and the attachment of the embryo to the placenta is also brought to mind. Additionally, the Qur'ān indicates the slow transformation from the

nutfah stage to the 'alaqah stage through the use of the conjunction *thumma*.

III. The muḍghah stage.

The embryo at 24-25 days is finishing the 'alaqah stage (Figure 4-5). It changes into the muḍghah stage at 26-27 days. The transformation from 'alaqah to muḍghah is in fact very rapid, and during the last day or two of the 'alaqah stage, the embryo is beginning to develop some of the characteristics of the muḍghah, e.g. the somites begin to appear and become a distinctive feature of this phase (Figure 4-6). This rapid transformation (Table 4-1) is described in the Qur'ān by use of the conjunction *fa* فَا ("then, with no delay"). The word *fa* indicates a quick sequence of events.

According to the linguistic references, the word muḍghah has



Figure 4-5. Photograph of embryo at the end of the 'alaqah stage (age 24 to 25 days). Ten of the 13 pairs of somites are easily recognized, but the embryo is still relatively straight and has a leech-like appearance. (From Professor Hideo Nishimura, Kyoto University, Kyoto, Japan)

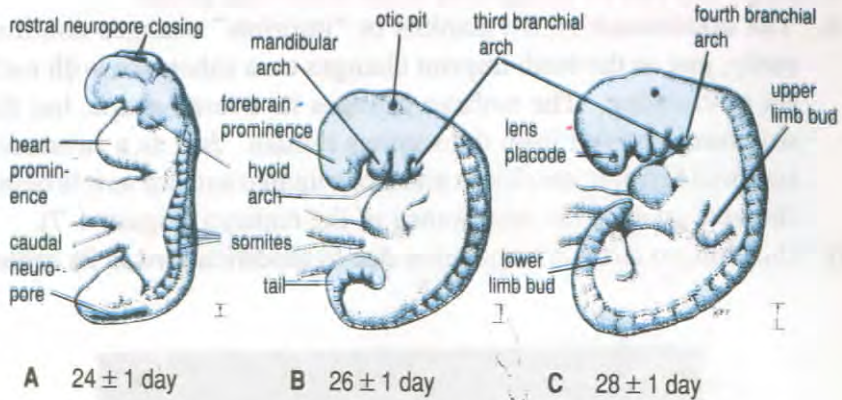


Figure 4-6. Drawings of embryos during the fourth week. A, B, and C, Lateral views of the embryos, showing 16, 27, and 33 somites respectively. A, The embryo in the last day of the 'alaqah stage. B and C, Embryos in the beginning of the mudghah stage. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

several meanings. The first meaning is “something that has been chewed by the teeth” (3). A second meaning is incorporated in the derived term *مصغ الأُمُور* *mudagh al-umūr* which means “the small substances” (4). A third meaning of *mudghah*, mentioned by some Qur’anic commentators, is “a piece of meat of a size that can be chewed” (5).

When choosing terms for the stages in embryonic development, the term should be related to the appearance and the main internal features of the embryo. Therefore, the term *mudghah* should apply with the shape of a substance that the teeth have chewed, according to the first meaning we have given. The appropriateness of the use of *mudghah* has been indicated in modern embryology. It has been determined that after the formation of the embryo and the placenta at this stage, the embryo receives its nutrients and energy. Thus the growth process increases rapidly. The bodily masses, called somites, from which the bones and muscle of the back will be formed, start to appear. Due to the multitude of bead-like structures or somites present, the embryo has the appearance of a substance that has been imprinted by teeth.

The application of the term *mudghah* in describing the processes of this period can be recognized in the following points:

- A. The appearance of the somites or "imprints" changes continuously, just as the teeth imprint changes on a substance with each act of chewing. The embryo changes its overall shape, but the structures derived from the somites remain. Just as a substance acquires furrows, swellings and a corrugated surface as it is being chewed, so does the appearance of the embryo (Figure 4-7).
- B. The embryo turns in its position due to modifications in its center

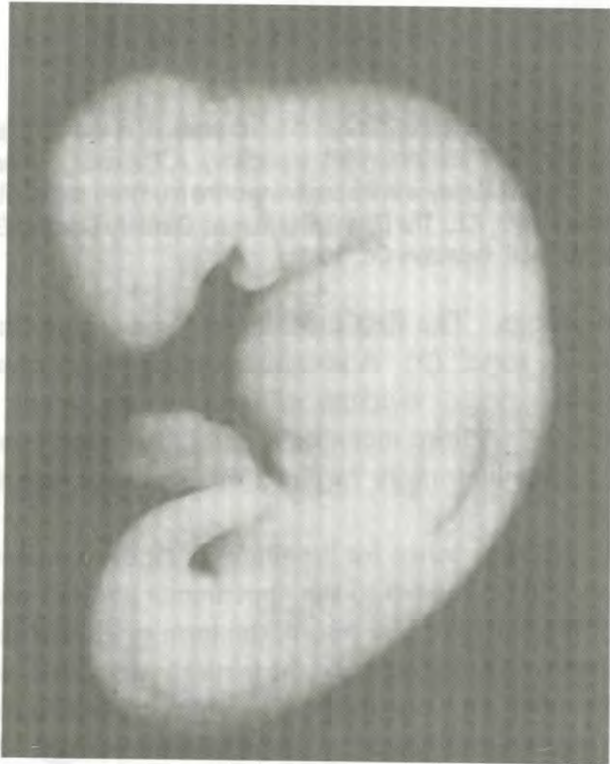


Figure 4-7. Photograph of an embryo, age 28 days, during the *mudghah* stage of development. The embryo has a characteristic C-shaped curvature similar to the curved appearance of a substance which has been chewed extensively. The heart prominence is easily recognized. The ventrally-curved tail, with its somites, is a characteristic feature of this stage. (From Professor Hideo Nishimura, Kyoto University, Kyoto, Japan.)

of gravity with new tissue formation, similar to the turning of a substance with chewing.

- C. Just as a chewed substance becomes curled before being swallowed, so does the back of the embryo become curved.
- D. As for the second meaning of "small substances" for mudghah, the embryo is approximately 1.0 cm in length at this stage, and therefore it is very small. Thus this second meaning applies in the sense of the embryo's size. This is so because all human organs form during the mudghah stage as small buds.
- E. The third meaning of mudghah as "a piece of meat of a size to be chewed", given by some of the Qur'anic commentators, applies again in regard to the size of the embryo. At this stage, the embryo is approximately 1.0 cm in length, and this is approximately the size of a substance that would be chewed. The preceding stage of 'alaqah, for example, is not of a size to be chewed, since it is not more than 3.5 mm in length.

As the somites form, they are undifferentiated, but they quickly differentiate into cells which will develop into various organs. Some of these organs will form in the mudghah stage, and some will form in later stages. The mudghah phase ends by the end of the 6th week. The following Qur'anic statement mentions these facts:

«ثُمَّ مِنْ مَضْغَةٍ مُخَلَّقَةٍ وَغَيْرِ مُخَلَّقَةٍ» (سُورَةُ الْحَجِّ: 22: آيَةٌ 5)

"Then out of a chewed-like substance partly differentiated and partly undifferentiated" (Surah Al-Hajj, 22: Ayah 5).

The Qur'an specifies that the bones form after the mudghah phase and then the muscles cover the bones. This description is consistent with modern embryology.

IV. Summary.

The 'alaqah phase begins with the embryo's attachment to the placenta. In doing so, the embryo acquires the shape of an attached and long leech.

This phase ends with the rapid growth of the embryo's cells in different directions. Then the 'alaqah transforms into the mudghah. Then the mudghah phase comes to an end with the formation of the skeleton at the beginning of the 7th week.

Therefore, we have stages defined with distinct beginnings and

endings, terms that correctly describe the shape and main events, and appropriate conjunctions that indicate time intervals for the development processes. Knowledge of these features was impossible 1400 years ago and even in the last two centuries.

The above-mentioned developmental phases are very short-lived. When the Qur'ān was revealed, it was impossible to observe the embryo without special instruments which were not available at that time. Moreover, aborted embryos are extremely hard to study, for they are in tiny pieces in the blood that is expelled with them. Furthermore, it was not known in the past that such blood contained an abortus, due to the fact that it was not possible, until quite recently, to detect a pregnancy within the first weeks during the embryonic stages.

The Qur'anic descriptions are clear indications that this knowledge came to Muḥammad (peace and blessings be upon him) from God.



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DESCRIPTION OF HUMAN DEVELOPMENT: 'IZAM AND LAHM STAGES

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I. Introduction.

Human development from the gamete stage (nutfah) through-out pregnancy has been mentioned in the Holy Qur'an with elegant simplicity and clarity:

"وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ" (سُورَةُ الْمُؤْمِنُونَ: آيَات 12-14)

"We (God) created man from a quintessence of clay. We then placed him as a nutfah (drop) in a place of settlement, firmly fixed, then We made the drop into an 'alaqah (leech-like structure), and then We changed the 'alaqah into a mudghah (chewed-like substance), then We made out of that mudghah, 'izām (skeleton, bones), then We clothed the bones with lahm (muscles, flesh), then We caused him to grow and come into being and attain the definitive (human) form. So, blessed be God, the best to create." (Surah Al-Mu'minūn, 23: Āyāt 12-14).

In this paper, the processes of embryonic osteogenesis and myogenesis are described in current biological terminology; then the

'izām and lahm developmental stages, which describe the occurrence of these processes, are discussed.

II. Osteogenesis.

Development of both human bone and muscle has been well described and reported in contemporary scientific literature. Bone, of course, does not develop simultaneously throughout the body. Rather, there is a program or timetable of osteogenesis. For example, the ossicles of the inner ear are the first bones to fully ossify (during fetal life) whereas the growth centers in long bones of the leg do not close until 20 or more years after birth.

However, a distinct stage for bone formation is discernible in which cartilaginous skeleton begins to form with the spread of the cartilage in the 7th week.

Bone develops in one of two ways (depending upon its locale), viz., as endochondral bone or as intramembranous bone. Both types of bone formation involve a precursor population of mesenchyme (embryonic connective tissue) cells.

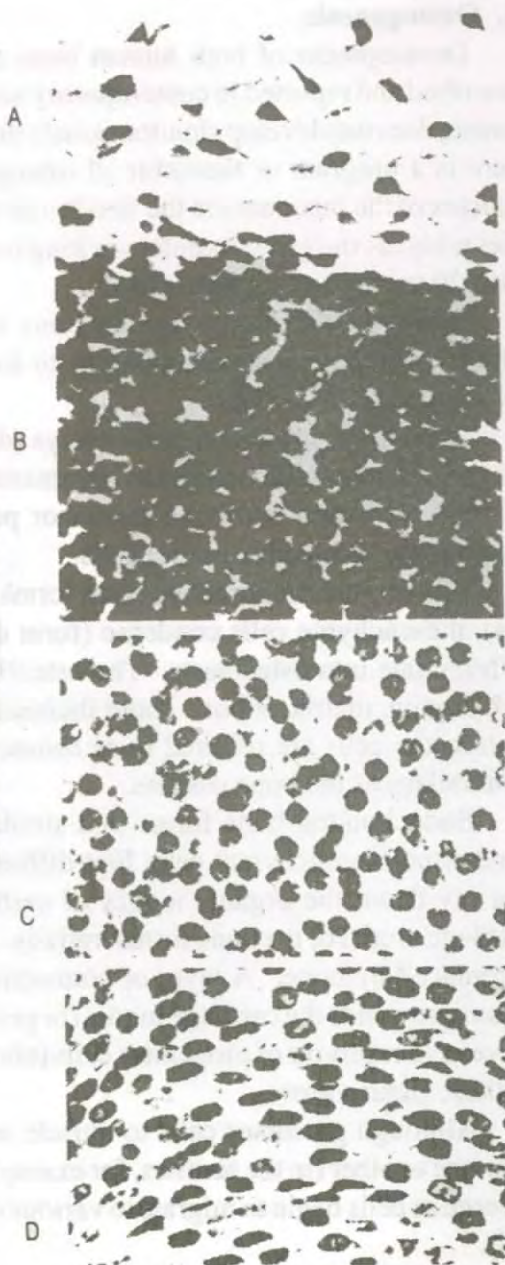
Where intramembranous bone forms (e.g., mandible and maxilla), mesenchyme cells condense (form dense cell aggregates) and differentiate into osteoblasts. The osteoblasts secrete the collagen-rich organic matrix of bone about themselves. Once surrounded by matrix, the cells are referred to as osteocytes. The organic matrix mineralizes as the bone ossifies.

Endochondral bone forms in a similar fashion except that the condensed mesenchymal cells first differentiate into chondroblasts that lay down the organic matrix of cartilage (Figure 5-1). So, a cartilage model of the bone forms initially. Secondly, the cartilage is replaced by bone. A layer of connective tissue called perichondrium surrounds the cartilage model (or periosteum around bone) and serves as a reservoir of progenitor cells (chondroblasts or osteoblasts) as these tissues grow.

Although precursor cells to muscle and bone may reside quite near one another (in the somites, for example), their histories begin to diverge as cells begin to migrate to various sites in the embryo (Figure 5-2).

The long bones of the body are derived from embryonic mesenchyme. Mesenchymal cells in the limbs condense, i.e., aggregate in

Figure 5-1. In the histogenesis of cartilage, mesenchymal cells (A) withdraw their processes and become crowded together to form an area of precartilage (B). In newly formed embryonic cartilage (C) in the 'izam stage, the densely aggregated cells of the precartilaginous stage have been moved apart by deposition of clear hyaline matrix between them. The cells then become angular (D) and isolated in clearly demarcated lacunae. (Reprinted with permission from Fawcett, 1986)



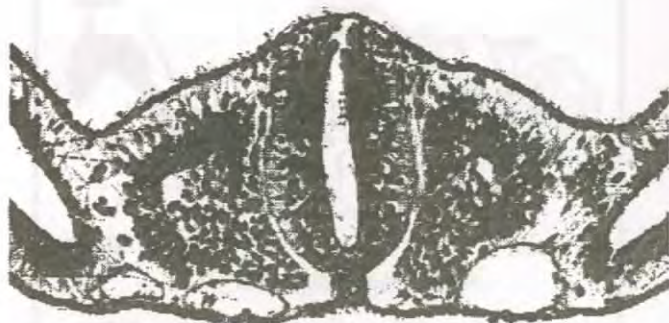


Figure 5-2. Section through 2.9 mm human embryo (in early mudghah stage) showing somite cells prior to migration. (Reprinted with permission from Blechschmidt, 1961)

the region where osteogenesis is going to occur later. From this densely packed mass of cells begins the histogenetic process by which mesenchyme cells differentiate into chondroblasts. The chondroblasts, in turn, secrete around themselves the organic matrix of cartilage. The chondrification process results in the appearance of a cartilage model of the bone that is to form, resulting in a skeleton and human shape for the embryo. From the connective tissue of the perichondrium, cells differentiate and form a bony collar around the shaft of the cartilage model. As a consequence of this, the avascular cartilage is cut off from diffusing nutrients, becomes necrotic, and the chondrocytes die. This is followed by an invasion of connective tissue cells and vascular elements from the adjacent connective tissue. Certain of these invading cells differentiate into osteoblasts, surround themselves with newly secreted bony organic matrix and thereby the osteocytes of newly developing bone (where previously there was a cartilage model).

Formation of bone does not begin uniformly throughout the body. Rather, there is a sequential appearance of bony tissue. However, in the 7th week the spreading development of the skeleton occurs. Bone development in the limbs commences in the limb buds from mesenchymal cells. Primary ossification centers appear in the femur during week 7 (Figure 5-3) and in the sternum and the maxilla in weeks 8-9 (Figures 5-4, 5-5).

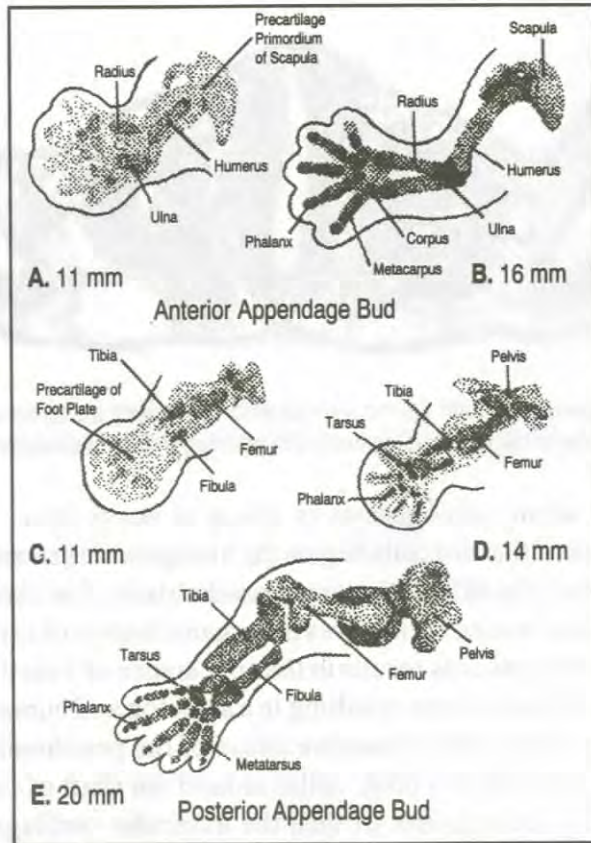


Figure 5-3. Primary ossification centers in the human embryo during the seventh week. (Reprinted with permission from Patten, 1968)

In recent decades, the process of osteogenesis in the human embryo has been reasonably well documented. At the histological level, the role of the mesenchyme, osteoblasts, osteoclasts, and osteocytes has been studied. Staging of cartilage deposition and mineralization in the embryo has been facilitated by the application of staining procedures specific for cartilage and bone.

Although precursor cells (myoblasts) are present adjacent to developing bone, differentiation into skeletal muscle attachments occur after the ossification process in the shaft and ends of the bones has begun (Figure 5-6).

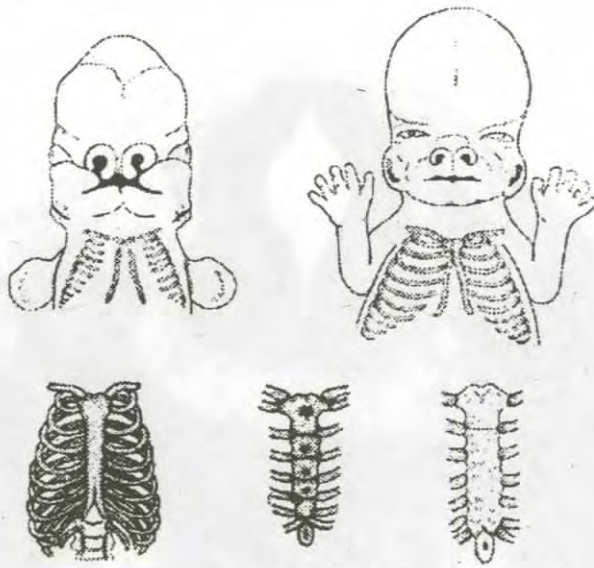


Figure 5-4. Primary ossification centers in the sternum during weeks eight through nine. (Reprinted with permission from Patten, 1968)

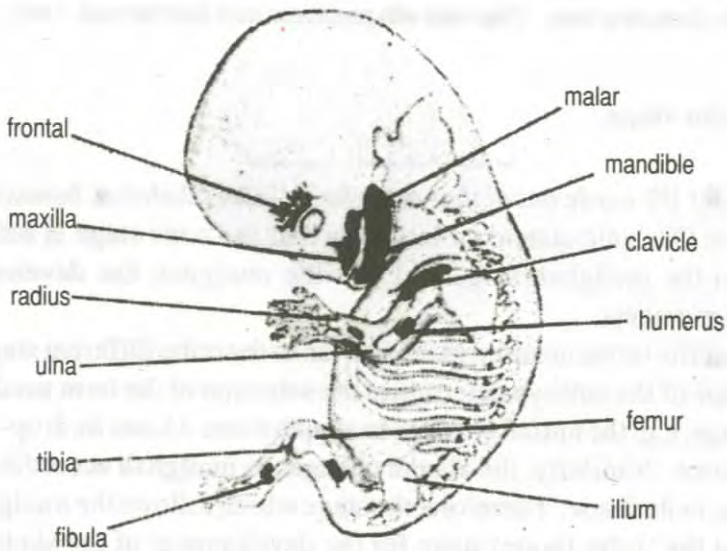


Figure 5-5. Primary ossification centers in the maxilla during weeks eight through nine. (Reprinted with permission from Patten, 1968)

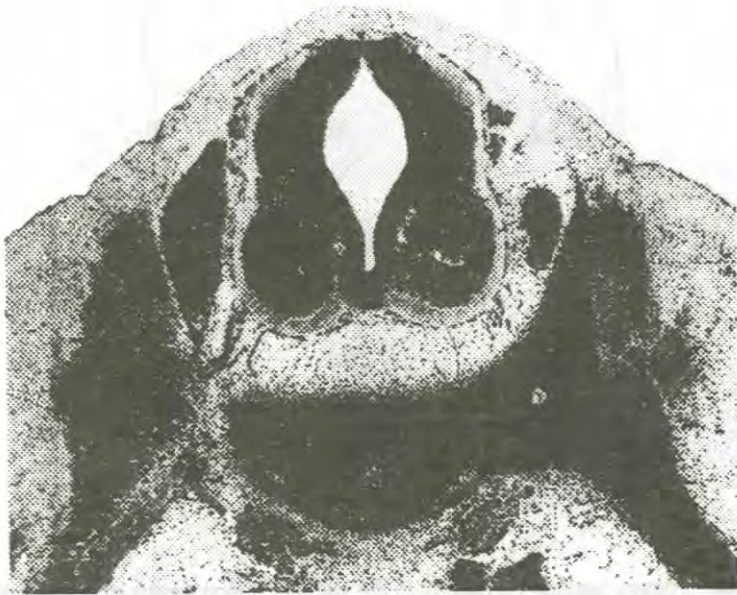


Figure 5-6. Section through 11 mm human embryo. Note precursor musculature forming adjacent to developing bone. (Reprinted with permission from Blechschmidt, 1961)

III. 'Izām stage.

فَخَلَقْنَا الْمُضْغَةَ عِظَامًا

“Then (fa) We made out of that mudghah, ‘izām (skeleton, bones)...”

This Qur’anic statement indicates that the bone stage is subsequent to the mudghah stage and that the mudghah has developed skeletal elements.

Specific terms are used in the Qur’ān to describe different stages. The shape of the embryo determines the selection of the term used for each stage, e.g. the *nutfah* changes to *alaqah* when it loses its drop-like appearance. Similarly, the *alaqah* changes to *mudghah* according to a change in its shape. Therefore, the stage which follows the *mudghah* is called the ‘*izām* (bone) stage for the development of the skeleton spreads during this stage.

The conjunction *fa* (then) of the Qur’anic āyah indicates that the ‘*izām* stage develops after the *mudghah* stage without a long delay.

The mudghah stage lasts approximately until the 6th week, and the bones make their appearance by the beginning of the 7th week with the development of the cartilaginous skeleton in accordance with the ḥadīth:

«عَنْ حُذَيْفَةَ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ: "إِذَا مَرَّ
بِالنُّطْفَةِ ثِنْتَانِ وَأَرْبَعُونَ لَيْلَةً بَعَثَ اللَّهُ إِلَيْهَا مَلَكًا فَصَوَّرَهَا، وَخَلَقَ سَمْعَهَا
وَبَصَرَهَا، وَجِلْدَهَا، وَلَحْمَهَا، وَعِظَامَهَا" (صَحِيحُ مُسْلِمٍ: كِتَابُ الْقَدَرِ)

"When 42 nights have passed from the time of the nutfah (time of conception), Allah sends an angel to it, who shapes it and makes its hearing, sight, skin, muscles and bones...." (Saḥīḥ Muslim, Kitāb Al-Qadar).

In the early part of the 'izām stage, the embryo takes on a human appearance (*taṣwīr ādamī*), and the ḥadīth describes this with the word of "shapes." Before the 42nd day, it is difficult to distinguish the human embryo from the embryos of many animals, but at this time it becomes clearly distinguishable in its appearance (Figure 5-7).



yolk sac yolk stalk

Figure 5-7. A, Photograph of an embryo during the 'izam stage (44 to 46 days in age) in its amniotic sac, exposed by opening the chorionic sac (x 2.7). B, Higher magnification of the 14 mm (crown-rump length) embryo (x 4.8). Note the human appearance (*taswir adamī*) at this age. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, Saunders, 1988)

Also, some of the generalized cells of the embryo begin to differentiate into various lines and modify into different functional moieties. This process results in straightening and the formation of organs necessary for viability. The body surface is becoming more even and attaining a straighter configuration at this stage, as described in the Qur'ān:

«الَّذِي خَلَقَكَ فَسَوَّاكَ فَعَدَلَكَ» (سورة الإنفطار 82: آية 7)

“Who (God) created you, then (fa) made you even and straight (sawwak) and then (fa) modified you ('addalak)” (Surah Al-Infīṭār, 82: Āyah 7).¹

IV. Myogenesis.

Most skeletal muscle cells take origin in the somites. Hence, the musculature arises in a metameric (segmented) fashion. This segmentation is indicated in the adult body by distribution of the cutaneous nerves (Figure 5-8) and can be related back to the embryonic segments (myotomes, Figure 5-9). The sclerotomal (presumptive skeletal elements) and dermatomal (presumptive dermis of the skin) cells migrate away from the original somite region by the end of the 5th and beginning of the 6th weeks of development, leaving the myotome as the dominant structure. The myotomes expand, make contact with their neighbors, and grow ventrally to form the myomeres. The myomeres, in their turn, are destined to segment into epimeric and hypomeric components, each of which is supplied by a ramus (branch) of a spinal nerve. Generally speaking, the epimeres give origin to the musculature of the back; the hypomeres to the muscles of the ventral body wall and ribs.

The process of myogenesis has been well worked out at the cellular level over the last few decades. Myoblasts, the precursors of the muscle cells, have been shown to fuse with one another to form multinucleated complexes which assume the shape of myotubes (Figure 5-10). Growth continues by fusion of myoblasts and myotubes. During or shortly after fusion, progressive synthesis and organization of the myofilaments (actin, myosin, etc.) occur in the muscle cells (fibers). At first, the arrangement of myofilaments appears random. Gradually, the myofilaments become aligned into the bundles of

¹See Chapter 10, “The Scientific Significance of the Qur'anic Terms”

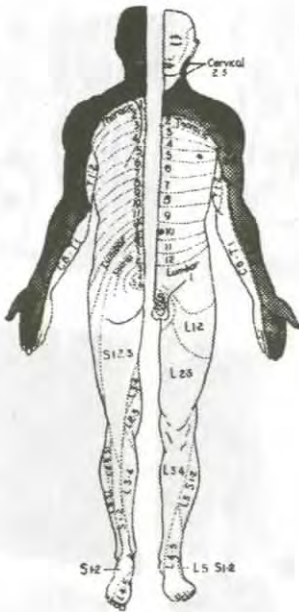


Figure 5-8. Distribution of the cutaneous nerves in the adult body indicating the metameric (segmented) fashion in which musculature formed. (Reprinted with permission from Patten, 1968)

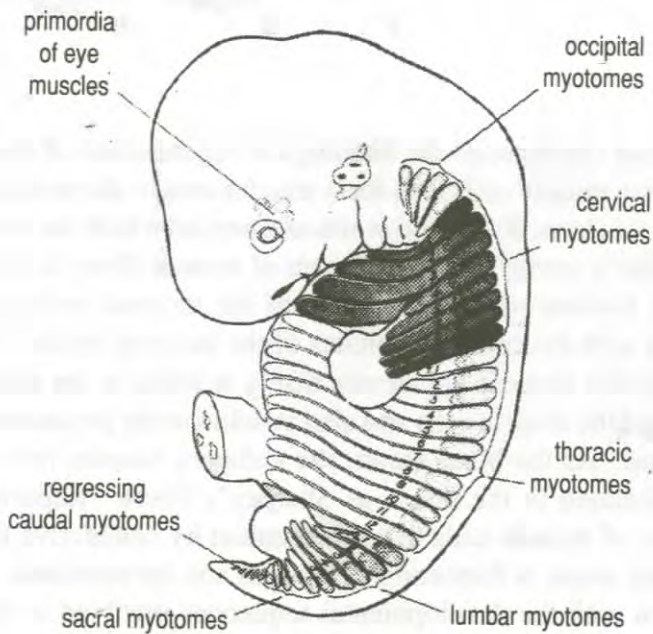
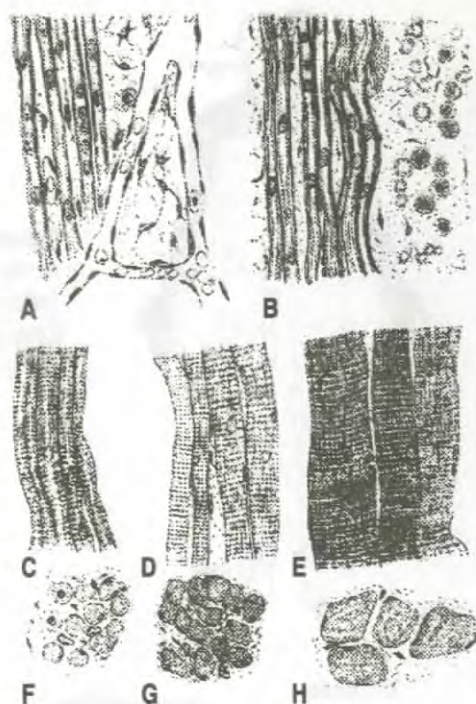


Figure 5-9. Embryonic myotomes, or segments, from which musculature arises, during the lahm stage (51 days). (Reprinted with permission from Patten, 1968)

Figure 5-10. Histogenesis of muscle. Samples taken from (A) a 32 mm embryo; (B) a 45 mm embryo; (C) a 200 mm embryo; (D) a term fetus; and (E) an adult diaphragm. F, G, and H, Transverse sections through specimens C, D, and E. (Reprinted with permission from Patten, 1968)



myofibrils that characterize the histological organization of skeletal muscle. These muscle cells then form attachments to the periosteum of the bones that have developed *in situ* and around which the process of myogenesis is occurring. Attachment of muscle fibers to bone is mediated in tendons by interdigitation of the terminal ends of the muscle cells with the collagen bundles of the forming tendon. This dense connective tissue is apparently firmly attached to the external lamina around the muscle cells and also attaches to the periosteum of forming bone. As the bone grows, the collagen bundles may also become embedded in the bones as Sharpey's fibers. Reportedly, degeneration of muscle cells and replacement by connective tissue elements may occur in formation of tendons and aponeuroses.

Concern with the developmental sequences involved in osteogenesis and myogenesis is an occurrence in the science of developmental biology. The general sequential pattern has been summarized as follows:

“As the bones of the appendicular skeleton become differentiated, the mesoderm from which the muscles will take shape tends to aggregate in masses grouped dorsal to, or ventral to, the developing skeletal parts” (Patten, *Human Embryology*, 3rd ed., p 248, 1968).

The Qur’ān stated the fact that the embryonic bones form first, then they are clothed with flesh (muscles):

فَكَسَوْنَا الْعِظَامَ لَحْمًا

“Then (fa) We clothed the bones with laḥm muscle, flesh)...”

V. The laḥm stage - Al-kisa’ bil-laḥm (clothing the bones with flesh).

During the first forty days, the bones and flesh (muscles) do not differentiate (see Chapter 7). As the embryo forms, a new distinct stage begins which is different in appearance and structure from the preceding mudḡḡah stage. The primordia from which the bones and muscles develop are formed before the 7th week, differentiation of the skeleton occurs first in the 7th week and differentiation of the muscles occurs next in the 8th week.

A major developmental landmark during the 8th week is the laḥm stage, which describes the myogenesis period described above, and which marks the development of definitive muscles in the trunk and limbs. Movement also begins. The muscles take their position around the bones (“clothing the bones”) and continue the process of straightening and smoothing (*taswiyah*) which began in the ‘izām stage (Figure 5-11).

During the laḥm stage, the embryo develops human features, and the various organs assume their proper positions and are better proportioned. This stage differs from the ‘izām stage in structure, congruity, image and the embryo’s ability to move. This stage begins from the end of the 7th week to the end of the 8th week and comes immediately after the ‘izām stage.

The correct timing and sequencing of the embryonic and fetal developments are indicated not only in the order in which they are mentioned in the Qur’ān but also in the uses of the conjunctions *fa* and *thumma*. The Qur’anic text (see Introduction) uses *fa* (then) between the ‘izām and laḥm stages to indicate a rapid sequence of events with little delay between them. The passage also indicates that the laḥm stage represents the end of the embryonic (*takhliq*) stage, which is



Figure 5-11. Photograph of a 29 mm (crown-rump length) embryo during the lahm stage (56 days) (x2). The intestine is still in the umbilical cord (arrow). The digits are clearly defined. The regions of the limbs are apparent, and the tail has disappeared. The smoothing and straightening (*taswiyah*) which has occurred is a result of the formation of musculature. (From Professor Jean Hay, Department of Anatomy, University of Manitoba, Winnipeg, Canada)

followed by the nash'ah (fetal) stage. The conjunction *thumma* (then) indicates a slow sequence with a time lag between these two major stages.

VI. Summary.

The use of the terms 'izām (skeleton) and lahm (muscles) clearly indicates major features of the 7th and 8th weeks respectively, which are marked by the periods of osteogenesis and myogenesis, and describe these stages in clear, unambiguous terms.

Although reference to the concept of sequential development was made by Aristotle and some others of the ancients who made many advances in this field, many of their observations were based on the development of chick embryos and did not apply to the very early development of humans. Scientists did not recognize that human development passes through various stages until the second half of the 19th century (see Chapter 1 on the historical progress of embryology).

It is to the Holy Qur'ān that one must turn for the earliest "stage-by-stage" descriptive statements on this topic. Here one can find a description of developmental events antedating by many centuries information only acquired during the lifetime of many of today's developmental biologists, and only after sophisticated instrumentation had been developed.



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DESCRIPTION OF HUMAN DEVELOPMENT: NASH'AH STAGE - THE FETAL PERIOD

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I. Introduction.

At the end of the 8th week of gestation, the developing fetus shows human characteristics. The bones are clothed by muscles, covered by skin. By this time all definitive organs have been established and some of them have begun to function.

The nash'ah stage begins in the 9th week. The growth of the fetus progresses until the 12th week after which it enters a new phase of rapid growth and remarkable changes (Figure 6-1). This phase has been mentioned in the Qur'ān in the following statement:

«ثُمَّ أَنشَأْنَاهُ خَلْقًا آخَرَ...» (سورة المؤمنون 23: آية 14)

"Then We (*ansha'nāhu*) cause him to grow and come into being and attain the definitive (human) form." (Surah Al-Mu'minūn, 23: Āyah 14)

II. Definition of nash'ah.

The word *nash'ah*, a derivative of the verb *nasha'a* means:

1. "To initiate" (1)
2. "Grow and develop" (2)
3. "To rise and increase" (3)

The interpreters of the Qur'ān understood the following meaning for the Qur'anic passage:

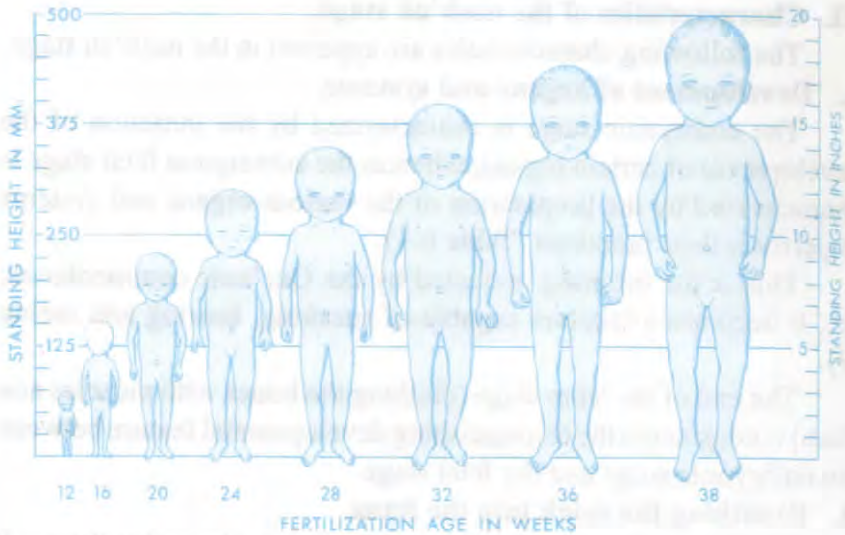


Figure 6-1. Illustration, drawn to scale, of the changes in size of the human fetus during the nash'ah stage. Note the extremely rapid growth from 12 weeks until full term at 38 weeks. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, Saunders, 1988)

- a. Development of the fetus into a creature capable of speaking, hearing and seeing (4).
- b. Breathing the spirit into the fetus (5).

The conjunction *thumma*, or “then,” is used with *ansha'nāhu* in the āyah to denote that the nash'ah stage comes gradually after the lahm stage. The nash'ah or fetal stage can be considered as beginning in the 9th week, but is delayed in the expression of all of its above meanings until later. For example, the period between the beginning of the 9th week and the end of the 11th week is a period of relatively slow growth, and it is not until the 12th week that the rapid growth indicated by “ansha'nāhu” begins. Additionally, the initiation of the development of certain organ systems occurs after the 8th week, or after the lahm stage, but the changes in these organs become more apparent after the 11th week. Thus, there is a delay until the 12th week for the full expression of the nash'ah stage which continues until the end of the pregnancy, i.e., the 38th week. The Qur'ān indicates this delay by the word “thumma.”

III. Characteristics of the nash'ah stage.

The following characteristics are apparent in the nash'ah stage:

A. Development of organs and systems.

The embryonic stage is characterized by the initiation of the development of certain organs, whereas the subsequent fetal stage is characterized by the preparation of the various organs and systems to perform their functions (Table 6-1).

This is the meaning indicated by the Qur'anic commentators, i.e., it becomes a creature capable of speaking, hearing and seeing (7).

The end of the lahm stage (clothing the bones with muscles and flesh) is considered the distinguishing developmental feature between the embryonic stage and the fetal stage.

B. Breathing the spirit into the fetus.

Statements from the Qur'an and Sunnah indicate that the spirit is acquired during the fetal period, according to the passage quoted above regarding the attainment of the "definitive human form" (see the Introduction), and according to a ḥadīth narrated by 'Abdullah Ibn Mas'ūd (see Chapter 7).

This indication signifies that the embryonic life prior to the fetal stage is of a different nature. Muslim scholars have distinguished between the nature of the life of the embryonic period and the fetal period, comparing the former to the life of plants, since they are alive but have no soul.

The Islamic statements, in the Qur'an and Ḥadīth, express a relationship between the phenomenon of sleep and the existence of a soul. The Qur'an states:

«اللَّهُ يَتَوَفَّى الْأَنْفُسَ حِينَ مَوْتِهَا وَالَّتِي لَمْ تَمُتْ فِي مَنَامِهَا فَيُمْسِكُ الَّتِي قَضَىٰ عَلَيْهَا الْمَوْتَ وَيُرْسِلُ الْأُخْرَىٰ إِلَىٰ أَجَلٍ مُّسَمًّى ۚ إِنَّ فِي ذَٰلِكَ لَآيَاتٍ لِّقَوْمٍ يَتَفَكَّرُونَ» (سُورَةُ الزُّمَرِ 39: آيَةٌ 42)

"It is God Who holds the souls (of men) at death; and those that die not (He holds) during their sleep: those on whom He has passed the decree of death, He keeps back (from returning to life), but the rest He sends (to their bodies) for a term appointed. Verily in this are Signs for those who reflect." (Surah Az-Zumar, 39: Āyah 42)

Table 6-1. Developmental Progression During the Nash'ah Stage

Age (weeks)	CR Length (mm) ^a	Foot Length (mm) ^a	Fetal Weight (gm) ^b	Main External Characteristics
Previable Fetuses				
9	50	7	8	Eyes closing or closed. Head more rounded. External genitalia still not distinguishable as male or female. Intestines in the umbilical cord.
10	61	9	14	Intestines in the abdomen. Early fingernail development.
12	87	14	45	Sex distinguishable externally. Well-defined neck.
14	120	20	110	Head erect. Lower limbs well-developed.
16	140	27	200	External ears stand out from head.
18	160	33	320	Vernix caseosa present. Early toenail development.
20	190	39	460	Head and body hair (lanugo) visible.
Viable Fetuses^c				
22	210	45	630	Skin wrinkled and red.
24	230	50	820	Fingernails present. Lean body.
26	250	55	1000	Eyes partially open. Eyelashes present.
28	270	59	1300	Eyes open. Good head of hair often present. Skin slightly wrinkled.
30	280	63	1700	Toenails present. Body filling out. Testes descending.
32	300	68	2100	Fingernails reach finger tips. Skin pink and smooth.
36	340	79	2900	Body usually plump. Lanugo hairs almost absent. Toenails reach toe tips. Flexed limbs; firm grasp.
38	360	83	3400	Prominent chest; breasts protrude. Testes in scrotum or palpable in inguinal canals. Fingernails extend beyond finger tips.

^a These are average measurements and may not apply to specific cases; the dimensional variations increase with age. CR stands for crown-rump.

^b Weights refer to fetuses that have been fixed for about two weeks in ten per cent formalin. Fresh specimens usually weigh about five per cent less (6).

^c There is no sharp limit of development, age, or weight at which a fetus automatically becomes viable or beyond which survival is assured, but experience has shown that it is rare for a baby to survive whose weight is less than 500 gm or whose fertilization age is less than 22 weeks. Fetuses born between 26 and 28 weeks have difficulty surviving, mainly because the respiratory system and the central nervous system are not completely differentiated. The term abortion refers to all pregnancies that terminate before the period of viability. (From Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, Saunders, 1988)

"وَهُوَ الَّذِي يَتَوَفَّاكُم بِاللَّيْلِ وَيَعْلَمُ مَا جَرَحْتُم بِالنَّهَارِ ثُمَّ يَبْعَثْكُمْ فِيهِ لِقَاضِي أَجَلٍ مُّسَمًّى ثُمَّ إِلَىٰ رَبِّكُمْ ثُمَّ إِنَّكُمْ لَعِندَهُ بِمَا كُنتُمْ تَعْمَلُونَ ، وَهُوَ الْقَاهِرُ فَوْقَ عِبَادِهِ وَيُرْسِلُ عَلَيْكُمْ حَفَظَةً حَتَّىٰ إِذَا جَاءَ أَحَدَكُمُ الْمَوْتُ تَوَفَّتْهُ رُسُلُنَا وَهُمْ لَا يُفِرُّونَ" (سُورَةُ الْأَنْعَامِ 6: آيَاتَا 60,61)

"It is He Who holds your souls by night, and has knowledge of all that you have done by day: then by day He raises you up again; that a term appointed be fulfilled; in the end unto Him will be your return; then will He show you the truth of all that you did. He is the Omnipotent over His servants. He sends recorders over you till, when any one of you is visited by death, Our messengers take him and they neglect not." (Surah Al-An'ām, 6: Āyāt 60-61)

According to a hadith, the Prophet (peace and blessings be upon him) used to say upon awakening:

"الْحَمْدُ لِلَّهِ الَّذِي أَحْيَانَا بَعْدَمَا أَمَاتَنَا وَإِلَيْهِ النُّشُورُ" (رَوَاهُ الْبُخَارِيُّ)
"Praise be to God Who has raised us up after He held our souls, but unto Him is the Resurrection." (related by Al-Bukhārī)

The time for the acquisition of a soul has not been determined in embryological studies. Understanding the nature of the soul is generally beyond the realm of experimental science and is not known at this time to mankind. As God says in the Qur'an:

"وَيَسْأَلُونَكَ عَنِ الرُّوحِ ، قُلِ الرُّوحُ مِنْ أَمْرِ رَبِّي ، وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا" (سُورَةُ الْإِسْرَاءِ 17: آيَةٌ 85)

"They ask you concerning the Spirit. Say: 'The Spirit (comes) by command of my Lord; of knowledge it is only a little that is communicated to you (O men)!'" (Surah Al-Isrā', 17: Āyah 85)

However, it is known that there is a difference between life and the soul, although specific knowledge of either is a mystery. The existence of a soul indicates self-awareness. On the other hand, the sperm and ovum are alive, similar to the vegetative life referred to by the Qur'anic commentators, and without this life they would be unable to participate in fertilization.

The phenomenon of a sleep cycle in the fetus could be considered an indication that the soul has been acquired. More studies are

needed regarding the neurological development of the fetus in order to determine the time of the development of fetal sleep patterns. This might determine when the soul is acquired.

Additionally, when the fetus is capable of moving voluntarily from its own desire, as opposed to moving reflexively, this voluntary movement could be taken as evidence that it has acquired a soul. For example, the fetus exhibits spontaneous movements and moves in response to stimuli during the 10th week of development. These movements may reflect primitive neurological reflexes and do not present conclusive evidence of the presence of a soul, but they may also be taken as indicators that the soul may be acquired near this time, and this timing would be within the time frame presented in the Islamic statements.

C. Modifications of body proportions and acquisition of personal image.

These processes occur as mentioned in the following Qur'anic statement:

«الَّذِي خَلَقَكَ فَسَوَّاكَ فَعَدَلَكَ، فِي أَيِّ صُورَةٍ مَّا شَاءَ رَكَّبَكَ» (سورة الإنفطار 82: آيَاتُ 7,8)

“...Who (God) created you, made you even and straight (*sawwāk*) and then modified you (*'addalak*). In whatever form (facial features) (*šūrah*) He wanted, He put you together.” (Surah Al-Infīṭār, 82: Āyāt 7,8)

The word *sawwāk* above means to make even and straight, and prepared to perform the functions. This phase is referred to as *taswīyah* (تَسْوِيَة) (the gerund form of *sawwa*, meaning “straightening”) which begins during the *‘izām* stage (See Table 10-1, Chapter 10).

The word *'addalak* in the statement has the contextual meaning of modifying in form and shape to create a definitive thing (8). The word *fa*, which precedes *'addalak*, indicates immediate succession, and therefore the meaning is “then immediately modified your form,” since *'addalak* qualifies the meaning of the second ayah (9).

During this time, the body proportions change such that by the end of the gestational period (week 38) as compared to the 9th week, the head size has become relatively small compared to the body, the

facial features have acquired humanlike proportions, i.e. the ears move from the neck to the head and the eyes move toward the front of the face, and the lower limbs have become relatively long compared to the body (Figures 6-2, 6-3).

This phase is referred to as *ta'dīl* (تَعْدِيلٌ) (the gerund form of '*addala*, meaning "modifying"). The word *ṣūrah* (صُورَةٌ) in the second ayah means "appearance or image," and this phase in which the fetus acquires its individual appearance is called *taṣwīr fardī* (تَصْوِيرٌ فَرْدِي) (the gerund form of *ṣawara*, meaning "giving the appearance or image"). Therefore, the statement means that immediately after the initiation of the process of straightening (*taswīyah*), the modifying into humanlike proportion (*ta'dīl*) occurs, and then the acquisi-

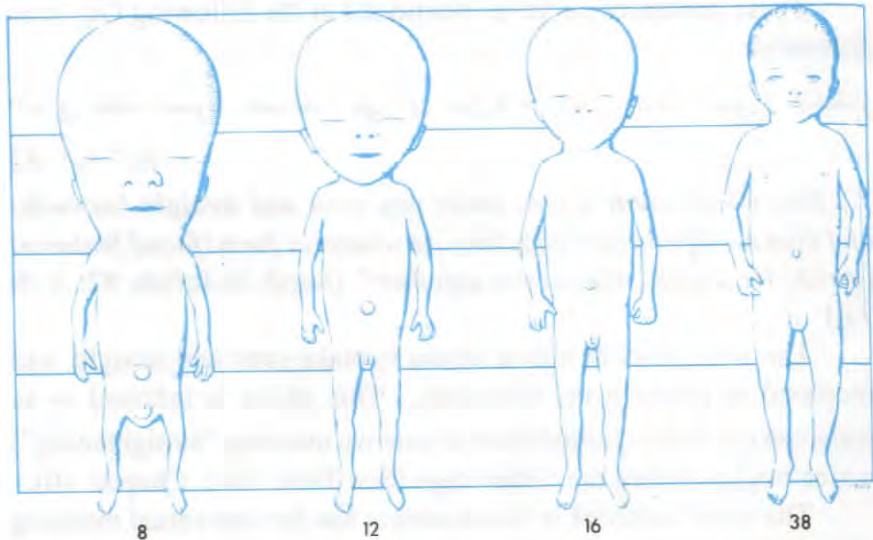


Figure 6-2. Diagram illustrating the changing proportions of the body during the nash'ah stage. By 36 weeks, the circumference of the head approximately equals that of the abdomen. Afterwards, the circumference of the abdomen may be greater. The Qur'anic term for the process of modifying bodily proportions is *ta'dil*. All stages are drawn to the same total height. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th edition, Philadelphia, Saunders, 1988)



Figure 6-3. Fetus, 12 weeks old, in the nash'ah stage. 1, ear. 2, eye. 3, placenta. 4, umbilical cord. The ta'dil phase has begun, and the ear has moved onto the head from the neck and the eyes have moved toward the front of the face. The length of the fetus is 85 mm from crown to rump. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers, Inc., 1983)

tion of the personal image (taṣwir) occurs (Figure 6-4). The latter two phases of ta'dīl and taṣwīr continue in their processes until birth and even afterwards.

D. Sexual characteristics.

The Qur'ān and Ḥadīth mention three steps involved in the development of sexual characteristics (*tadhkīr* and *ta'nīth*). The first



Figure 6-4. This fetus, which is $4\frac{1}{2}$ months old and about 7 inches long, is in the nash'ah stage. The taswir fardi developmental process is apparent by this time, since the fetus has begun to acquire an individual image. The fetus has also developed the sucking reflex during this time. (Reproduced with permission from Nilsson, *A Child is Born*, New York, Delacorte Press, 1982)

step of genetic determination occurs during the nuṭfah stage (See Chapter 2), and the second step of the differentiation of the gonads into testes and ovaries occurs during the laḥm stage (See Chapter 10). The third step of the differentiation of the external genitalia occurs during the nash'ah stage and is indicated in the following ḥadīth:

”عَنْ حُدَيْفَةَ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ: إِذَا مَرَّ
بِالنُّطْفَةِ ثِنْتَانِ وَأَرْبَعُونَ لَيْلَةً، بَعَثَ اللَّهُ إِلَيْهَا مَلَكًا فَبَصَّرَهَا، وَخَلَقَ سَمْعَهَا،
وَبَصَّرَهَا، وَجَلَدَهَا، وَلَحَمَهَا، وَعَظَمَهَا، ثُمَّ قَالَ يَا رَبِّ أَذَكَرٌ أَمْ أُنْثَى؟ فَيَقْبِضِي
رَبُّكَ مَا شَاءَ وَيَكْتُبُ الْمَلَكُ“ (صحيح مسلم: كتاب القدر)

“When 42 nights have passed over the conceptus, God sends an angel to it, who shapes it (into human form) and makes its hearing, sight, skin, muscles and bones. Then he says, ‘O Lord, is it male or female?’ and your Lord decides what He wishes and the angel records it.” (Ṣaḥīḥ Muslim: Kitāb Al-Qadar)

This ḥadīth states that the angel asks for Allah’s permission to shape the conceptus into a male or a female once ears, eyes, flesh, bones and skin develop. Then Allah grants him the permission to do so.

Until the 9th week, the genitalia are similar in both sexes (Figures 6-5, 6-6). However, the external genitalia are not clearly distinguishable as male or female until the 12th week (Figures 6-5, 6-7). This differentiation occurs as the external genitalia develop and definitively distinguish the sex of the fetus. This process is accomplished during the 12th week. Before the 12th week, it is not easy to distinguish the sex of the fetus.

The conjunction *thumma* (then) in the above ḥadīth, indicates a delay in the occurrence of this sexual development after the development of “ears, eyes, skin, flesh and bones,” and embryological studies are in agreement with this delay in the sequence.

Even though the further development of the gonads and sexual organs is generally determined by the sex chromosomes, occasionally, the external genitalia develop contrary to the genetic sex. This abnormal development usually occurs because of an imbalance of androgens in XX individuals (Figure 6-8), and because of a defect in

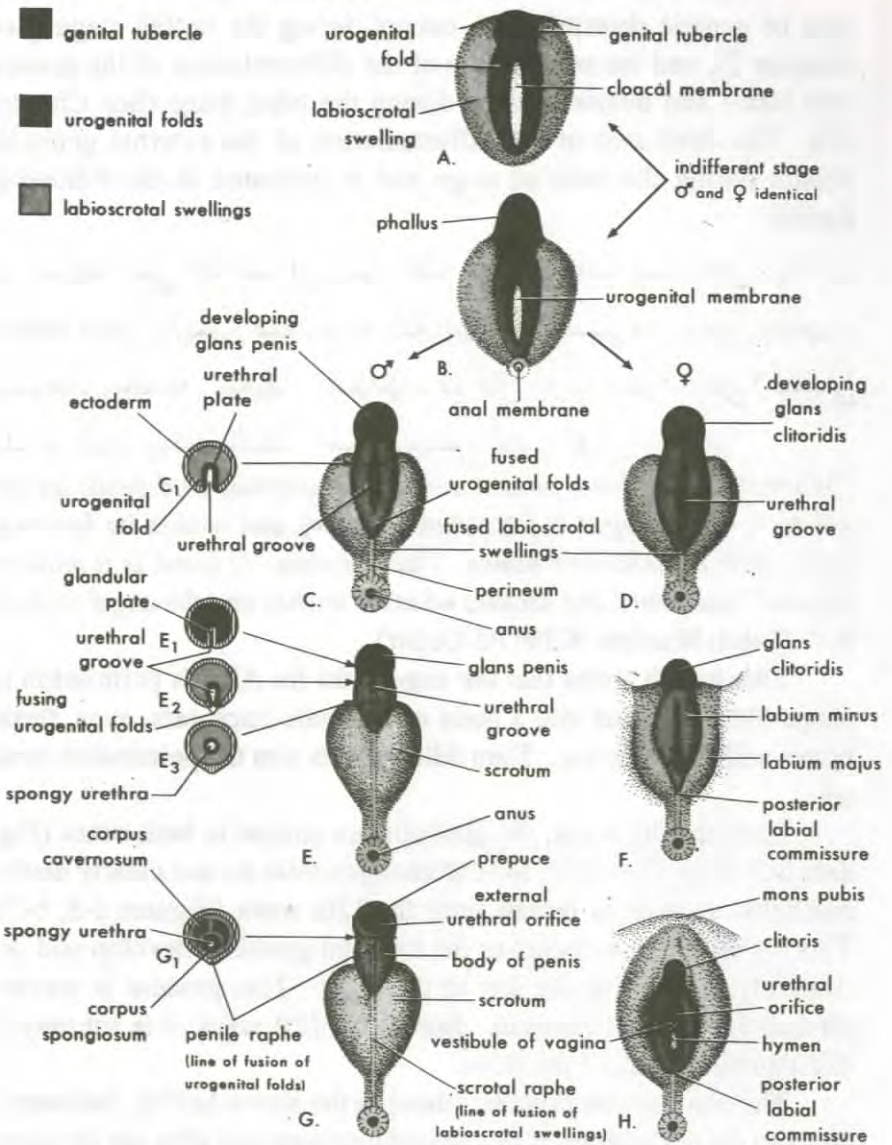


Figure 6-5. A and B, Illustrations of the development of the external genitalia during the indifferent stage (fourth to seventh weeks). C, E, and G, The development of the male external genitalia at 9, 11 and 12 weeks, respectively. On the left are schematic transverse sections (C₁, E₁ to E₃, and G₁) through the developing penis, illustrating formation of the spongy urethra. D, F, and H, Development of the female external genitalia at 9, 11, and 12 weeks, respectively. (Reproduced with permission from Moore, K.L, *The Developing Human, Clinically Oriented Embryology*, 4th edition, Philadelphia, Saunders, 1988)

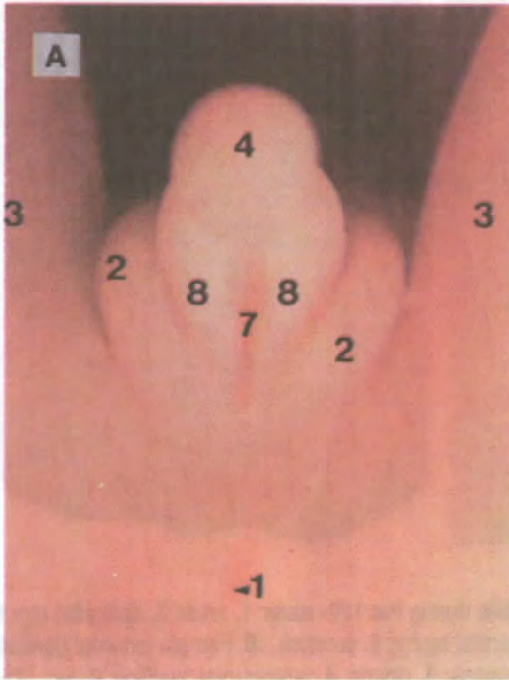


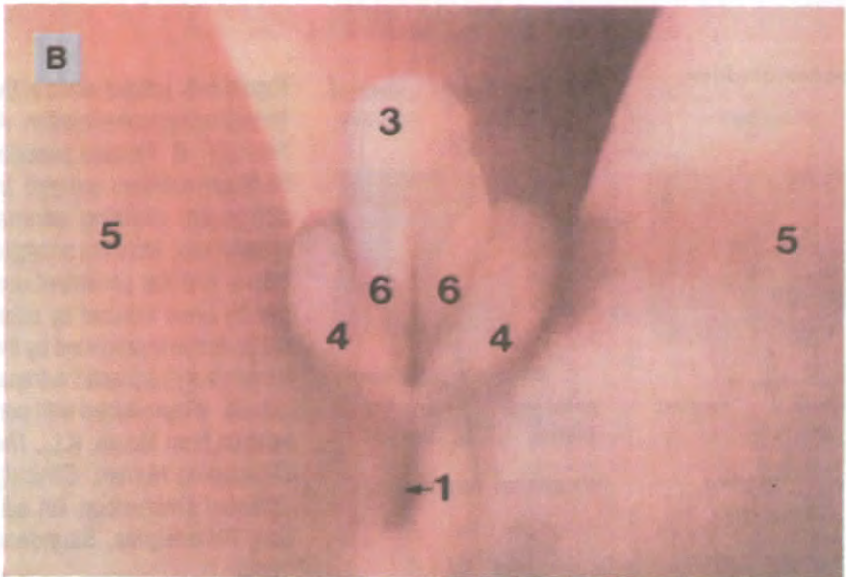
Figure 6-6. A, Male external genitalia during the 9th week. View from below.

1. anus
2. labioscrotal swelling
3. leg
4. penis
5. scrotal raphe
6. scrotum
7. urethral groove
8. urogenital folds

B, Female external genitalia during the 9th week. View from below.

1. anus
3. clitoris
4. labioscrotal swelling (labia majora)
5. leg
6. urogenital fold

Note the great similarity between the male and female. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers, Inc., 1983)



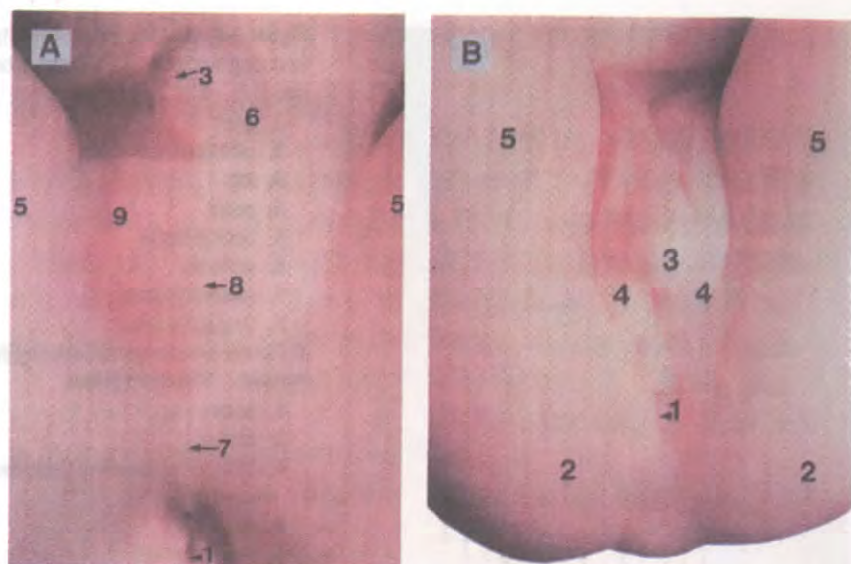


Figure 6-7. **A**, Male external genitalia during the 12th week: 1. anus; 3. epithelial tag; 6. penis (body); 7. perineal raphe; 8. scrotal raphe; 9. scrotum. **B**, Female external genitalia during the 12th week: 1. anus; 2. buttock; 3. clitoris; 4. labioscrotal swelling; 5. leg. The genitalia are clearly distinguishable as male and female at this time. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers Inc., 1983)

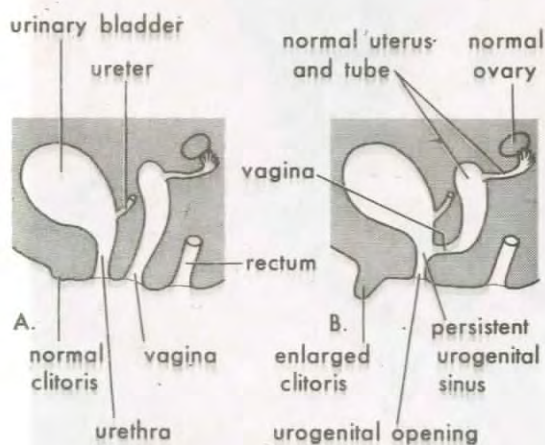


Figure 6-8. Lateral views of the female reproductive system. **A**, Normal. **B**, Female pseudohermaphroditism caused by congenital virilizing adrenal hyperplasia. Note the enlarged clitoris and the persistent urogenital sinus induced by adrenal androgens produced by the female's hyperplastic adrenal glands. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th edition, Philadelphia, Saunders, 1988)

the androgen receptors in XY individuals. For this reason, it is likely that the ḥadīth mentions that the angel asks with regard to the sex of the fetus, since this step in *tadhkīr* and *ta'nīh* may be inconsistent with the previous steps which were determined by the sex chromosomes.

IV. Phases of the nash'ah period.

A. An-nash'ah khalqan ākhar (attaining the definitive human form).

This phase begins at the 9th week and lasts until the 26th week. The following characteristics are apparent in the fetus:

1. Rapid growth and development. This feature directly applies to the meaning of *nasha'a* as explained above. Directly after the *lahm* stage (9th week) until the 12th week, the fetus grows slowly, and then the growth becomes very rapid (Figure 6-9; Table 6-1).

2. Change in the nature of the fetus and development of its organs. The skeleton develops from soft cartilaginous bones to more solid, calcified bones, and by the time of 12 weeks gestation, centers of ossification are present in most bones. The limbs become differentiated and nails can be detected on the fingers and toes (See Figure 5-3). The proportional sizes of the head, body and limbs change and their relative proportions become more balanced, particularly between the 9th and 12th weeks (See Figure 6-2). Lanugo hair appears on the skin, which is fully differentiated into epidermis and hypodermis by 12 weeks. As mentioned before, these changes are initiated in the period between the 8th and 12th weeks and are then fully apparent during the 12th week. The overall size of the fetus increases rapidly.

The external genitalia begin to differentiate in the 9th week. Also, the testes begin their descent and the internal genitalia (uterus, oviducts, vagina) develop. At this stage in the 12th week, a male fetus can be distinguished from a female on the basis of the external genital organs (10).

Voluntary and smooth musculature are established. Fetuses at this stage of development reveal mimic or spontaneous movements, and reflex muscular contractions can be elicited by an external stimulus. In general, the overall physiological development of the nervous system parallels the maturation of the brain and spinal cord.

Primitive and instinctive responses, such as sucking and grasp-

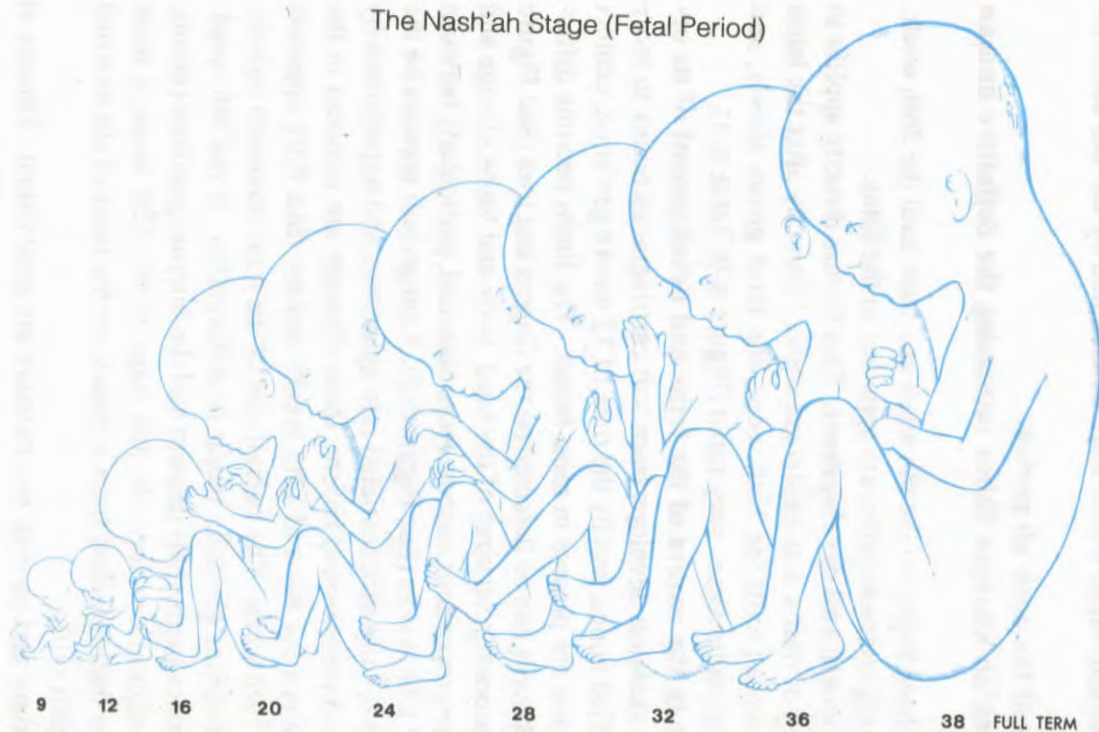


Figure 6-9. The embryonic period ends at the end of the 8th week; by this time, the beginnings of all essential structures are present. The nash'ah stage is characterized by rapid growth and elaboration of structure. From the 9th to the 12th weeks, development and growth proceed slowly until the nash'ah stage is fully expressed in the 12th week, after which the growth and development proceed rapidly. Sex is clearly distinguishable by 12 weeks. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th edition, Philadelphia, Saunders, 1988)

ing, are subcortical functions and appear much later. Nevertheless, this stage of development represents an important transitional landmark for the fetus because of its reasonably well coordinated reflexes and movements which become progressively vigorous with time. Other delicate and subtle developments occur in the fetus, which has changed from its first creation (embryo) to another one (fetus), attaining the definitive human form, as the Qur'an described (Table 6-1). By the end of the phase, the various fetal organs are fully developed and prepared to function.

3. Period of viability. After the an-nash'ah khalqan ākhar period, the fetus becomes viable, or capable of sustaining life outside the womb, at around six months of development. This is in agreement with the meanings of the following statements from the Qur'an:

"...وَحَمْلُهُ وَفِصَالُهُ ثَلَاثُونَ شَهْرًا..." (سُورَةُ الْأَحْقَافِ 46: آيَةُ 15)

"The duration of pregnancy and separation is thirty months" (Surah Al-Aḥqāf, 46: Āyah 15).

"...وَفِصَالُهُ فِي عَامَيْنِ فِي سُوْرَةِ لُقْمَانَ 31: آيَةُ 14"

"His separation is at the end of two years" (Surah Luqmān, 31: Āyah 14).

"وَالْوَالِدَاتُ يُرْضِعْنَ أَوْلَادَهُنَّ حَوْلَيْنِ حَوْلَيْنِ كَامِلَيْنِ لِمَنْ أَرَادَ أَنْ يُتِمَّ الرَّضَاعَةَ" (سُورَةُ الْبَقَرَةِ 2: آيَةُ 233)

"Mothers shall breastfeed their offspring for two whole years, for those who want to complete the breastfeeding" (Surah Al-Baqarah, 2: Āyah 233).

Together these statements indicate the period of pregnancy is about 6 months. Such was the opinion of the 4th caliph, 'Alī Ibn Abī Ṭālib, and this view was endorsed by the companions of the Prophet (peace and blessings be upon him) (11) as well as the Qur'anic commentators.

B. Uterine incubation (al-ḥaḍānah ar-raḥimiyyah).

Since the total period of breastfeeding and pregnancy is stated to be 30 months, and the period of breastfeeding is considered to be 2 years, the minimum period necessary for the fetus to become viable is 6 months. However, it is common knowledge that the duration of pregnancy is usually 9 months. The remaining 3 month pe-

riod can be considered a time for the uterus to provide additional support and a place for normal growth. However, if born immature after a minimum of 6 months of pregnancy, it is possible for the infant to survive with outside support. The Qur'anic commentators (12) understood from the above-mentioned verses that the 6 month period is the minimum duration of pregnancy. In fact, it is now believed that the minimum age for infant survival is 24 weeks of gestational age (Table 6-1), since the lungs are too undeveloped to accept artificial ventilation before this age. This information highlights the following:

1. The preceding Qur'anic passages accurately determine the minimum duration of pregnancy.
2. It is possible to consider the last 3 month period of pregnancy a time for the uterus to provide support for the fetus.

V. Parturition, or labor.

The nash'ah stage ends with the birth of the fetus, and this time is mentioned in the Qur'ān as follows:

«ثُمَّ السَّبِيلَ يَسَّرَهُ» (سُورَةُ عَبَسَ 80: آيَةٌ 20)

“Then He made the passage (through the birth canal) easy” (Surah ‘Abaṣa, 80: Āyah 20).

Normally the birth canal appears to be a difficult passage for the baby. However, at the time of birth various factors facilitate this passage (Figure 6-10), and we now know on a scientific basis of the following (13):

1. **Relaxin:** A hormone which is secreted by the ovaries and placenta, and which loosens the ligaments of the pelvic joints and softens the cervix.
2. **Uterine contractions:** These begin in the upper uterine segment which is composed of the active contracting muscle tissue which supplies the force necessary to push the baby through the thin passive lower uterine segment.
3. **Amniotic sac:** With each uterine contraction, the membranes which are filled with amniotic fluid bulge as a bag of water through the cervix and facilitate its dilatation. After the membranes rupture, the membranes provide a smooth slippery surface on which the fetus can glide down.

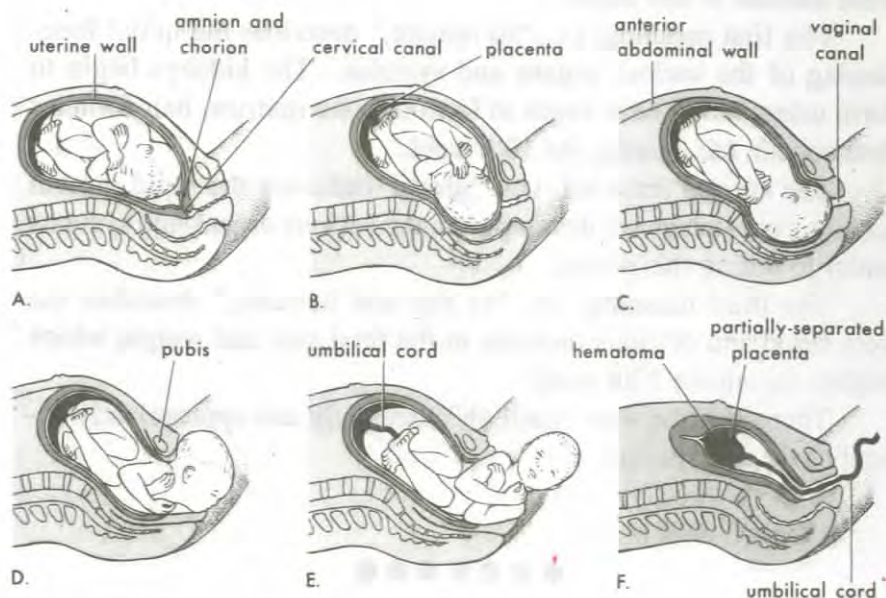


Figure 6-10. Drawings illustrating the process of birth. The Islamic term for this process is *taysir as-sabil* (making the passage easy). A and B, The cervix is dilating during the first stage of labor. Note that the fused amnion and chorion (bag of waters) is being forced into the cervical canal, facilitating the dilatation. C to E, The fetus passes through the cervix and the vagina during the second stage of labor. F, As the uterus contracts during the third stage of labor, the placenta folds up and pulls away from the uterine wall. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th edition, Philadelphia, Saunders, 1988)

- 4. Mechanism of labor:** The fetus changes its position as it passes through the irregularly shaped pelvic cavity. As an example, these changes for the occiput position are descent, flexion, internal rotation, extension, restitution and external rotation.

The above mentioned factors contribute in various ways to make the passage of the fetus through the birth canal easy.

VI. Conclusion.

It is evident from the preceding information that the word *asha'nāhu*, as used in the Qur'ān, covers the most obvious external and internal developments and transformations as far as the fetal features are concerned during the sixth stage of human development.

The three meanings of nash'ah apply in a clear and comprehensible manner to this stage.

The first meaning, i.e., "to initiate," describes the initial functioning of the various organs and systems. The kidneys begin to form urine, blood cells begin to form in bone marrow, hair follicles first appear, etc., during the 10th week.

The second meaning, i.e., "grow," indicates the rapid growth and the comprehensive development the various organs and systems undergo during this period.

The third meaning, i.e., "to rise and increase," describes the very rapid and obvious increase in the fetal size and weight which begins during the 12th week.

Therefore, the term "nash'ah" accurately and appropriately describes the fetal period.



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EMBRYOGENESIS AND HUMAN DEVELOPMENT IN THE FIRST FORTY DAYS

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I. Introduction.

The Qur'anic passages indicate that human development goes through various successive stages:

«وَقَدْ خَلَقَكُمْ أَطْوَارًا» (سورة نوح 71: آية 14)

"It is He Who has created you in diverse stages." (Surah Nūḥ, 71: Āyah 14)

«يَخْلُقُكُمْ فِي بُطُونِ أُمَّهَاتِكُمْ خَلْقًا مِّن بَعْدِ خَلْقٍ فِي ظُلُمَاتٍ ثَلَاثٍ» (الرؤم: آية 6)

"He makes you in the wombs of your mothers in stages, one after another, in three veils of darkness..." (Surah Az-Zumar, 39: Āyah 6)

The aḥādīth (plural form of "ḥadīth") of the Prophet determine that the 7th week of development represents a distinct point in the embryo's life and describe its form in the first 40 days and the shape it acquires later.

The Prophet had indicated the details of each stage. This paper reviews the aḥādīth which describe the embryo in the first 40 days. The paper also reviews the views of Muslim scholars in the light of philology, semantics, and the principles of religious text exegesis. Then, the relevant established scientific facts are underlined and the miraculous aspect of the aḥādīth highlighted.

II. The first 40 days.

The Prophet describes the first 40 days in the following ḥadīth, narrated by ‘Abdullah Ibn Mas‘ūd:

«عَنْ عَبْدِ اللَّهِ بْنِ مَسْعُودٍ - رَضِيَ اللَّهُ عَنْهُ - قَالَ حَدَّثَنَا رَسُولُ اللَّهِ - صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ - وَهُوَ الصَّادِقُ الْمَصْدُوقُ، قَالَ: إِنَّ أَحَدَكُمْ يُجْمَعُ خَلْقُهُ فِي بَطْنِ أُمِّهِ أَرْبَعِينَ يَوْمًا، ثُمَّ يَكُونُ فِي ذَلِكَ عِلْقَةً مِثْلَ ذَلِكَ، ثُمَّ يَكُونُ مُضْغَةً فِي ذَلِكَ مِثْلَ ذَلِكَ، ثُمَّ يَبْعَثُ اللَّهُ مَلَكًا يُؤَمِّرُ بَارِعَ كَلِمَاتٍ، وَيُقَالُ لَهُ: اكْتُبْ عَمَلَهُ وَرِزْقَهُ وَشَقِيًّا أَوْ سَعِيدًا، ثُمَّ يَنْفَخُ فِيهِ الرُّوحَ» (أخرجه البخاريُّ ومسلمٌ واللفظ له، وأبو داود والترمذيُّ وابن ماجه وعبد الرزاق في مصنفه وأحمد في المسند من طريق أخرى وأبو نعيم في الحلية)

“The Prophet (peace be upon him), the truthful and trusted, told us, ‘In every one of you, all components of your creation are collected together in your mother’s womb by 40 days, and in that it is an ‘alaqah like that, then in that it is a muḍghah like that. Then God sends an angel ordered with four instructions. He is told to record his (the human being now developing) deeds, his provision (future benefits), whether he will be miserable or happy, and then the spirit is breathed into him (the soul is acquired).” (narrated by Muslim, Al-Bukhārī, Abū Dawūd, At-Tirmidhī, Ibn Mājah, Aḥmad, ‘Abdur-Razzāq, and Abū Na‘īm)¹

The preceding ḥadīth indicates two facts:

1. The components of human creation are collected together in the first 40 days.
2. The first stages of development, i.e., nuṭfah, ‘alaqah, and muḍghah are formed and completed during this period (the first 40 days).

¹ روى أبو عوانة الحديث بإدراج لفظ “نطفة” بعد قوله “أربعين يوماً” أي أن روايته هي: “إن أحدكم يُجمَعُ خلقه في بطن أمه أربعين يوماً نطفة”، إلا أن هذه الرواية ضعيفة السند، كما أن هذا اللفظ المدرج لا أصل له في جميع روايات البخاري ومسلم ولا حتى في غيرها من الروايات في كتب الأصول. (فتح الباري: 479/11-481)

This ḥadīth had been narrated also by Abū ‘Awānah, but with the insertion of “nu ṭfah” after “40 days,” and it reads: “In every one of you, all components of your creation are collected together in your mother’s womb by 40 days as a nu ṭfah...” However, this version has a nonauthentic chain of narrators, and all authentic versions do not have this addition. (See *Faṭḥ Al-Bārī*, vol. 11, pp 479-481)

A. The collection of components (jam' al-khalq).

The Prophet described the embryo in the first 40 days in the ḥadīth narrated by Ibn Mas'ūd:

"In every one of you all components of your creation are collected together in your mother's womb by 40 days..."

The version of this ḥadīth related in Ṣaḥīḥ Al-Bukhārī is the same except it is without the phrase "in that."

Embryology has established that in the 5th week, the embryo acquires a characteristic "C"-shaped curvature, its size does not exceed 0.5 inch, its upper part is two-thirds of its total size, it acquires limb buds, and it has a tail and a primitive heart which beats regularly. The upper limbs appear during the 4th week. In the beginning of the 5th week, they look like a paddle. However, the upper limbs begin, by the end of the 5th week, to show some regional differentiation as the hand plates develop and show finger rays (Figure 7-1).

By the end of the 6th week, before the 42nd day, the face is neither distinct nor looks human (Figure 7-2).



Figure 7-1. Embryo at 6 weeks (Day 34-36) attached by the umbilical cord to the early membranes. The size is 12 mm from crown to rump. 1, arm bud. 2, branchial arches. 3, early membranes. 4, eye. 5, genital tubercle. 6, heart bulge. 7, leg bud. 8, tail. 9, umbilical cord. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers Inc., 1983)

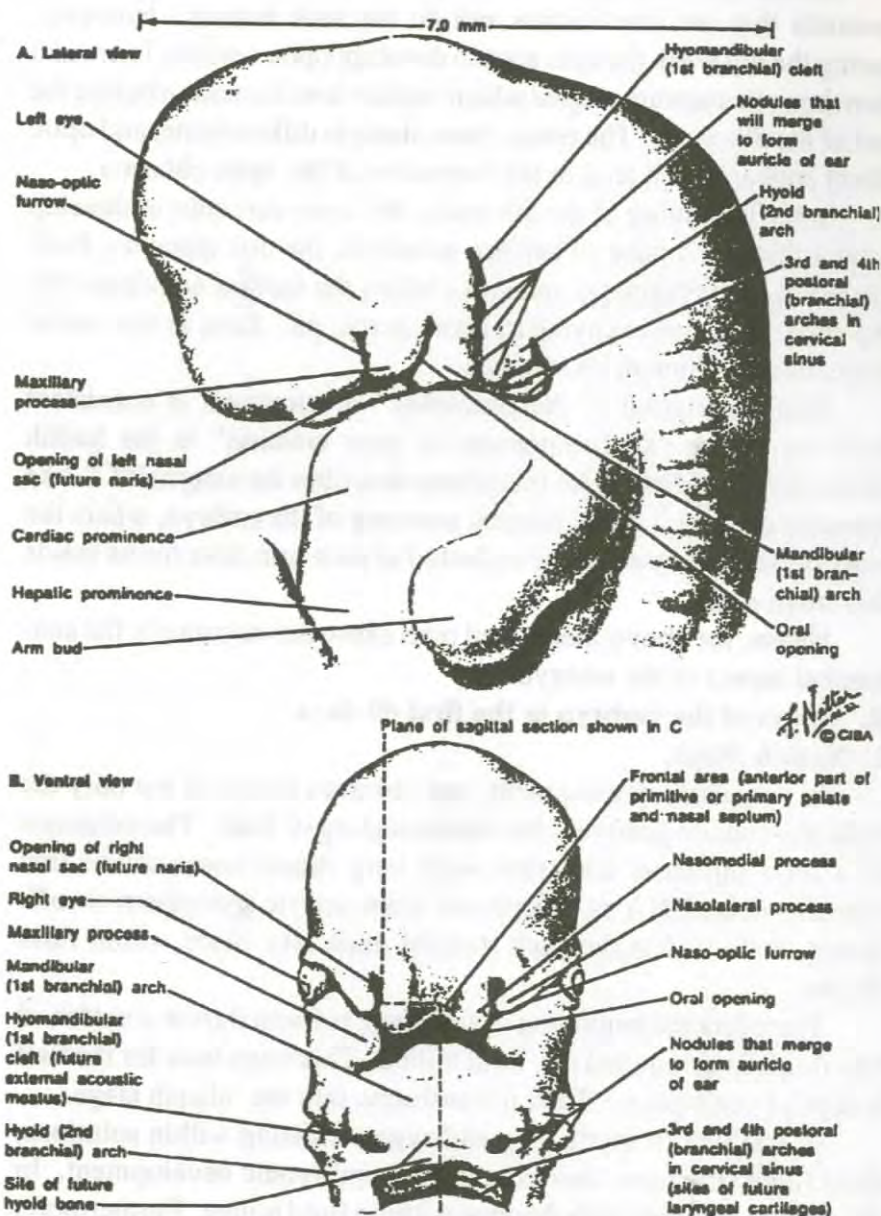


Figure 7-2. Drawing of embryo at 6 to 7 weeks. The appearance at this time cannot be clearly distinguished as that of a human embryo. (Reproduced with permission from CIBA, *Clinical Symposia*, vol. 28, No. 3)

Before the 40th day, the embryo has primitive eyes, ears, and genitalia that are functionless and do not look human. However, during the 4th week the eyes start to develop; optic vesicles form, and then the optic cups are shaped which leads to lens formation before the end of the 5th week. The retina, then, starts to differentiate, and optic fibers appear which lead to the formation of the optic chiasma.

In the beginning of the 5th week, the inner ears start to develop from a thickened plate of surface ectoderm, the otic placode. Each placode soon invaginates and sinks below the surface ectoderm into the underlying mesenchyme to form an otic pit. Ears, at this initial stage, have no human appearance.

This description of the conceptus' development is consistent with the phrase "all components of your creation" in the ḥadīth narrated by Ibn Mas'ūd, for this phrase describes the external "C"-like appearance as well as the internal anatomy of the embryo, where the body organs and systems are collected in their primitive forms inside this small mass.

Hence, the above-mentioned term expresses accurately the anatomical aspect of the embryo.

B. Stages of the embryo in the first 40 days.

1. Nuṭfah Stage.

In very early development, one observes fusion of not only the male and female genomes, but intermingling of fluid. The existence of a fluid milieu is consistent with very recent observations that mitochondrial DNA is transferred from oocyte cytoplasm to offspring, male or female; such transfer must take place within fluid media.

Therefore the beginning of this stage is formed from a nuṭfah of two fluids intermingled in a fluid milieu. This stage lasts for the first 6 days of conception. Then it transforms into the 'alaqah stage.

In addition to sperm, egg and zygote existing within solutions, fluid filled structures also exist in later embryonic development. In the morula, multiple cells develop within a fluid milieu. Furthermore, all this is occurring within the fluid-filled Fallopian tubes. The nuṭfah also continues its development in the uterus in a fluid milieu.

Following implantation on day 6 or so, the embryo burrows under the surface of the endometrium. Thus the nuṭfah stage is

completed in around day 14 of fertilization, taking its share of the first 40 days (See Chapter 2, "The Nuṭfah Stage").

2. 'Alaqah Stage.

After the nuṭfah stage, cells continue to accumulate. The embryo becomes more solid as more and more cells begin to accumulate, later indenting as the neural fold develops. At this stage, about 21 days of age, the embryo bears the analogy to a leech-like structure (See Chapter 4, "Alaqah and Muḍghah Stages"). It is attached to the placenta and has the shape of a leech. Blood islands in the embryo's blood vessels give it the color of a piece of congealed blood. In this manner, the 'alaqah stage takes its share of the first 40 days.

The following phrase from the Qur'ān refers to this process:

«ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً» (سورة المؤمنون 23: آية 14)

"Then we made the nuṭfah into a leech-like structure ('alaqah)" (Surah Al-Mu'minūn, 23: Āyah 14).

3. Muḍghah Stage.

This stage begins with the formation of body masses, or somites, on day 24 or 25, at the upper part of the embryo, and continue to form gradually to its tail.

Later somites will form the backbone of the embryo. By 28 days after conception, the embryo consists of various somites. Indentations are identified between somites, and with these indentations, the embryo resembles a chewed substance like gum in external appearance (Figure 7-3). Gradually, the muḍghah attains a size of about 1 cm, the smallest chewable size. With this development, the muḍghah stage completes the rest of the first 40 days.

Gradually the embryo acquires the muḍghah shape which applies with the Qur'anic description:

«فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً» (سورة المؤمنون 23: آية 14)

"Then of that leech-like structure ('alaqah) is made a chewed substance (muḍghah)" (Surah Al-Mu'minūn, 23: Āyah 14).

This stage is completed by the end of the 6th week. During the 7th week, the embryo gradually acquires a human appearance as the skeleton develops.

C. Timetable.

In review, then, each of the three stages - nuṭfah, 'alaqah,

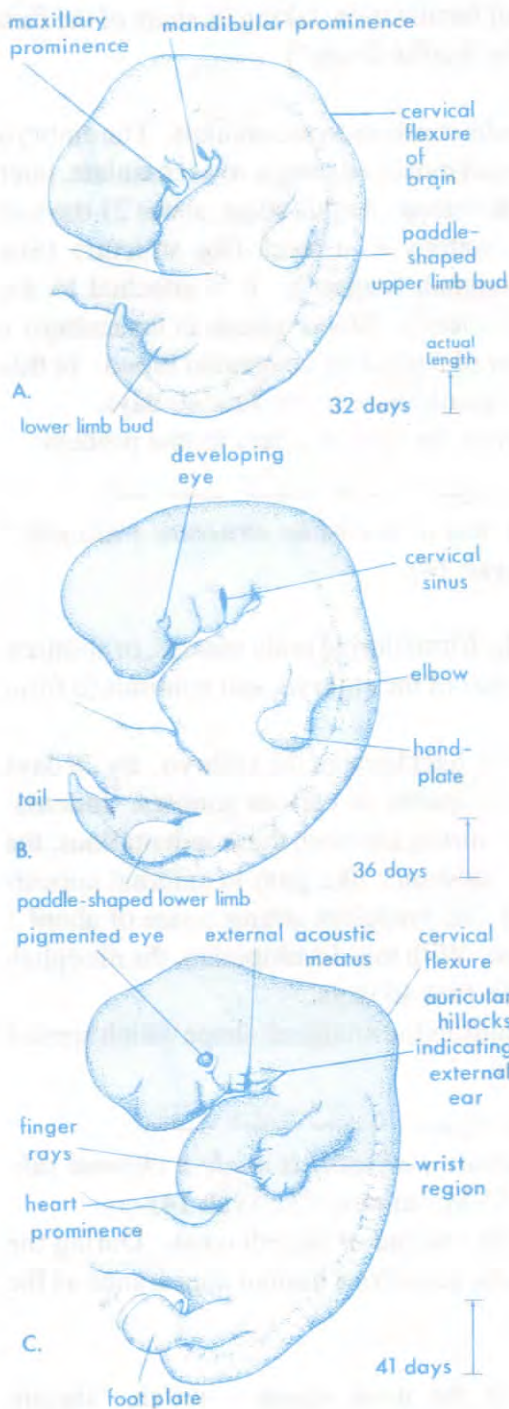


Figure 7-3. Drawings of lateral views of embryos in the mudghah stage during the 5th and 6th weeks of development. All the early components have been collected together and are in bud form by 40 days. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

muḍghah - is accomplished within the first 40 days. By the end of this period, the embryo resembles a chewed-like structure which does not resemble a human being. Thereafter bones are laid down. By day 45, organogenesis is essentially completed. Cell division obviously still proceeds, with fine tuning of differentiation. However, major steps in differentiation have been completed by 40-45 days.

III. Controversial understanding of the preceding ḥadīth.

Controversy had arisen among ancient Muslim scholars concerning the understanding of the above-mentioned ḥadīth narrated by Ibn Mas'ūd. They differed on defining the timetable of the nuṭfah, 'alaqah and muḍghah stages. Was it 40 days for each stage, or for the three stages in total?

Some interpreted this ḥadīth as meaning that the nuṭfah, 'alaqah and muḍghah stages occur in sequential 40 day intervals. They understood that "like that" referred to the period of 40 days, thus concluding that the completion of the muḍghah stage occurs only after 120 days.

A. Linguistic resolution of conflict.

Once the various relevant texts are compiled, compared, scrutinized and studied, several reasons can be identified that make the 120 day interpretation incorrect:

1. The ḥadīth narrated by Ibn Mas'ūd has been reported by Muslim and Al-Bukhārī, but Muslim's version inserts "in that" in two places; between "and" and "it is an 'alaqah" and between "then" and "it is a muḍghah". This addition is acceptable and considered as part of the preceding ḥadīth. On this basis, the complete version of the ḥadīth will be as that reported by Muslim:

"In every one of you all components of your creation are collected together in your mother's womb by 40 days and in that it is an 'alaqah like that..."

2. The Qur'ān indicates that the bones begin to form after the muḍghah stage:

"We changed the muḍghah into izam (bones)" (Surah Al-Mu'minūn, 23: Āyah 14)

The Prophet states in the ḥadīth narrated by Hudhayfah that the bones begin their formation immediately after 42 days from the beginning of the nuṭfah formation. This ḥadīth states:

«إِذَا مَرَّ بِالنُّطْفَةِ ثِنْتَانِ وَأَرْبَعُونَ لَيْلَةً بَعَثَ اللَّهُ إِلَيْهَا مَلَكًا فَصَوَّرَهَا، وَخَلَقَ سَمْعَهَا وَبَصَرَهَا، وَجَلَدَهَا، وَلَحَمَهَا وَعِظَامَهَا...» (أَخْرَجَهُ مُسْلِمٌ وَأَبُو دَاوُدَ وَالطَّبْرَانِيُّ وَالسَّيُوطِيُّ وَجَعْفَرُ الْفَرِيَّابِيُّ وَذَكَرَهُ ابْنُ حَجْرٍ فِي الْفَتْحِ)
 “If forty-two nights have passed over the conceptus, God sends an angel to shape it and create its hearing, sight, skin, muscles and bones...” (narrated by Muslim, Aṭ-Ṭabarānī, Abū Dawūd, and Ja‘far Al-Firyābī in *Faḥ al-Bārī*, vol. 11, p 484) (1).

To say that the bones are formed after 120 days would be in contradiction with the apparent meaning of the ḥadīth narrated by Ḥudhayfah.

3. Modern, well-established and conclusive embryological studies have proven that osteogenesis begins immediately after the 6th week, and not after the 17th week, as was previously believed. This substantiates the evident and explicit meaning of this ḥadīth. Hence, “like that” in the ḥadīth narrated by Ibn Mas‘ūd cannot refer to similarity with regard to the period of 40 days (2).

To reconcile the various relevant aḥādīth, we can say that since the demonstrative article “like that” can refer to one of three events already mentioned in the ḥadīth; namely i) the collection of the components of creation; ii) the mother’s womb; and iii) 40 days. Therefore “that” is collective and should be understood according to its indications and the manifest meanings of the other passages.

The ḥadīth of Ḥudhayfah, mentioned above, prevents us from interpreting “like that” as referring to “40 days,” since the rule of shariah principles is that the collective meaning should be understood according to a detailed, manifest meaning in another version.

The demonstrative article cannot refer to “the mother’s womb,” since its repetition is meaningless. Otherwise, the text would read as follows:

“In every one of you, all components of your creation are collected together in your mother’s womb by 40 days, then in that womb it is an ‘alaqah like that, then in that womb it is a mudghah like that.” The repetition of the word “womb” is inconsistent with the Prophet’s eloquence.

Since the demonstrative “that” refers neither to “40 days” nor to “mother’s womb,” it refers then to the collecting together of the

components of creation. This conclusion had been determined by the 7th century AH Muslim scholar, Ibn Az-Zamlakānī,² who reached the conclusion that the stages of *nuṭfah*, *'alaqah*, and *muḍghah* were completed during the first 40 days. He said:

قال ابن الزملاكاني: «وأما حديث البخاري فمُنزَلٌ على ذلك، إذ معنى "يُجْمَعُ في بطن أمه" أي يُحْكَمُ وَيُتَقَنُّ، ومنه رَجُلٌ جَمِيعٌ أَي مُجْتَمِعُ الخَلْقِ».

"The ḥadīth of Al-Bukhārī (mentioned through 'Abdullah Ibn Mās'ūd) should be understood according to the rule above. Thus, the meaning of being collected in the mother's womb means being perfected and established. As an example we say that a 'collected man' has his personality gathered to a high standard" (4).

Ibn Az-Zamlakānī also stated:

وقوله: «ثُمَّ يَكُونُ عُلْقَةً مِثْلَ ذَلِكَ» أَي ثَمَّ إِنَّهُ فِي الْأَرْبَعِينَ الْمَذْكُورَةَ يَكُونُ عُلْقَةً تَامَةً الخَلْقِ، مِتَقَنَةً مُحْكَمَةً الْإِحْكَامِ الْمُمْكِنَ لَهَا، الَّذِي يَلِيقُ بِنِعْمِهِ، فَهِيَ مِتْسَاوِيَانِ فِي مُسَمَى الْإِتْقَانِ وَالْإِحْكَامِ لَا فِي خِصُوصِهِ، ثَمَّ إِنَّهُ يَكُونُ مُضْغَةً فِي حِصَّتِهَا أَيْضًا مِنَ الْأَرْبَعِينَ، مُحْكَمَةً الخَلْقِ مِثْلَمَا أَنَّ صُورَةَ الْإِنْسَانِ مُحْكَمَةٌ بَعْدَ الْأَرْبَعِينَ يَوْمًا، فَنَصَبَ "مِثْلَ ذَلِكَ" عَلَى الْمَصْدَرِ لَا عَلَى الظَّرْفِ، وَنَظِيرُهُ فِي الْكَلَامِ قَوْلُكَ: إِنَّ الْإِنْسَانَ يَتَغَيَّرُ فِي الدُّنْيَا مُدَّةَ عُمُرِهِ، ثَمَّ تَشْرَحُ تَغْيِيرَهُ فَتَقُولُ: ثَمَّ إِنَّهُ يَكُونُ رَضِيعًا، ثَمَّ فَطِيمًا، ثَمَّ يَافِعًا، ثَمَّ شَابًا، ثَمَّ كَهْلًا، ثَمَّ شَيْخًا، ثَمَّ هَرَمًا يَتَوَفَّاهُ اللَّهُ بَعْدَ ذَلِكَ، وَذَلِكَ مِنْ بَابِ تَرْتِيبِ الْإِخْبَارِ عَنْ أَطْوَارِهِ الَّتِي يَنْتَقِلُ فِيهَا مُدَّةَ بَقَائِهِ فِي الدُّنْيَا. (البرهان: 275)

"In that it is an 'alaqah like that' means that in the aforementioned 40 days, the conceptus will be an 'alaqah which is completely and perfectly formed within the perfection which is possible for it. Thus [the descriptions of collecting the components together and of the 'alaqah and muḍghah] are equal in [referring to] their completion in general and not in particularities. 'In that it is a muḍghah like that' means that in its own share of the 40 days the muḍghah is also completely formed as the complete human being is formed. Here we define the name rather than its temporal meaning, just as it can be said that a man changes during his life as in, 'then he becomes an infant,

² His full name is Kam' al-'Abdul-Wah'id Ibn 'Abdul-Kar'im Az-Zamlakānī (d. 651 AH; 1253 AD), and he wrote *Al-Burhān al-Kāshif 'An I'jāz al-Qur'ān* (3).

then he is weaned, then he is a child, then he is a youth, then he becomes middle-aged, then he becomes an old man, and then he dies by God's will.' This is an arrangement of events according to the stages which a man passes through during his life." (5)

It is known that in the Arabic language, the word *thumma* (then) indicates the sequence and the delay of events before and afterwards, unless there is an indication to the contrary, as the Qur'ān indicated in Surah Al-An'ām, 6: Āyāt 153, 154:

"ذَلِكُمْ وَصَّاكُم بِهِ لَعَلَّكُمْ تَتَّقُونَ ، ثُمَّ آتَيْنَا مُوسَى الْكِتَابَ . . . (الأنعام : آيتا 153, 154)
 "...Thus doth He command you, that ye may be righteous. Moreover, We gave Moses The Book...". Here *thumma* has been translated as "moreover".

Therefore, the meaning of the ḥadīth must be, "In every one of you, all components of your creation are collected together in your mother's womb by 40 days and in that (in this period of time) it is an 'alaqah (a collected and completed creation as determined for it) like that (just like the collection of your components in 40 days), then in that (in the same 40 days) it is a muḍghah (a collected and completed creation as determined for it) like that (just like the collection of your components in 40 days)."

With this reconciliation of the texts the controversy is resolved. The meaning of "and in that it is an 'alaqah like that" is that it is a fully developed and perfected 'alaqah, and similarly, the muḍghah is fully developed and perfected, in a manner for both that befits His favors.

IV. Scientific aspects of the first forty days.

A. The collection of the components.

It is related in the ḥadīth, "...all components of your creation are collected together in your mother's womb by 40 days." It is evident from this that the components of the human creation are collected in 40 days. It is now known in the field of embryology that all the organs are created during the first 40 days and are all collected together in the embryo with the end of the 40 days. All the organs and the systems are collected in the form of buds in a space of not more than 1.0 cm. The fetus is collected around itself in the form of an arc (Figure 7-4).

B. "...And in that it is an 'alaqah like that":

The embryo becomes a completed 'alaqah in the 40 days as determined for it, just like the collection of the components during this

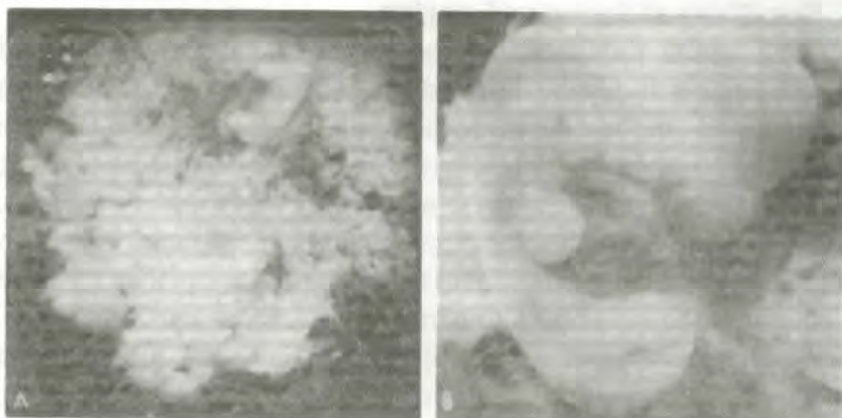


Figure 7-4. A, Photograph of an embryo in its amniotic sac, exposed by opening the chorionic sac (x 2). B, Higher magnification of the 12 mm (crown-rump length) embryo during the mudghah stage (41 to 42 days) (x 6). The embryo has an arc shape and the organ components are collected together during this stage. The cerebral vesicles, or primordia of the cerebral hemispheres, are especially prominent. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

period as explained earlier. Modern science accepts that between days 15-24 the conceptus is in the shape of an ‘alaqah (leech) which lives in the water and attaches to animals (See Figures 4-2, 4-3 and 4-4, Chapter 4, “‘Alaqah and Muḍghah”).

C. “...Then in that it is a muḍghah like that”:

This statement in the ḥadīth accurately defines the stage following that of the ‘alaqah. Specifically, the muḍghah stage develops gradually until it takes a curved shape and is characterized by indentations (somites) similar to those resulting from teeth imprints and by an irregular surface (See Figures 7-3, 7-4, and 4-6, Chapter 4). The appropriateness and accurateness of applying the term muḍghah, which is given in the Qur’ān and Sunnah, to the embryo is clearly indicated, although its size is not more than 1.0 cm. As mentioned in a previous presentation (6), in describing this stage, “The main organs start to differentiate inside. The cavities between the body masses produce a shape similar to a chewed mass (muḍghah) and gradually the embryo takes the shape of muḍghah.”

D. Sensitivity of timing and staging.

The ḥadīth indicates that the stages of nuṭfah, 'alaqah and muḍghah occur during the first 40 days. During this time, the embryo is very small, and the durations between the successive stages are short. The estimation of the embryo's age before the discovery of the ovum and its association with the menstrual cycle was very difficult, and error could result in an underestimation of gestational age by up to 21 days, since conception could have occurred at any time from the beginning to the end of the *tuhr* period (interval between the menses). Moreover, the stages of nuṭfah, 'alaqah and muḍghah, mentioned in the Qur'ān and Sunnah, were not even recognized by scientific knowledge at that time.



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2. Al-Jamal, *Ḥāshiyat al-Jamal 'Ala Tafsi'r al-Jalālayn*, vol. 3, p 185.
3. Az-Zamlakānī, Kamal 'Abdul-Waḥid Ibn 'Abdul-Karīm, *Al-Burhān al-Kāshif 'An I'jāz al-Qur'ān*.
4. Shaykh 'Abdul-'Azīz Bin Bāz said, "It is mentioned in Ash-Shafā'ah ḥadīth in the talking of Ḥasan Al-Baṣrī, 'He told us that twenty years ago, at that time he was a collected person.'" See *Fath al-Bārī*, vol. 13, p 474.
5. Az-Zamlakānī, Kamal 'Abdul-Waḥid Ibn 'Abdul-Karīm, *Al-Burhān al-Kāshif 'An I'jāz al-Qur'ān*, p 275.
6. "The first forty days of embryogenesis", presented by Joe Leigh Simpson in the *8th Saudi Medical Conference*, Oct. 30 - Nov. 3, 1983.

HUMAN DEVELOPMENT AFTER THE FORTY-SECOND DAY

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I. Introduction.

This paper is concerned with the period of prenatal development after the 42nd day. The 7th week of development marks a time of several eventful changes in the external and internal features of the fetus.

II. Developments during and after the 7th week.

With the beginning of the 7th week of growth, or approximately at the time of the 42nd day, an osteocartilaginous skeleton is formed in the embryo. This gives it a characteristic human form. The trunk of the embryo becomes straight and the embryo now has a relatively large and rounded head (Figure 8-1). The eyes move to the front of the face in their specific position and the face acquires a human shape, i.e. it has been formed (Figure 8-2). The internal and external parts of the ear are formed after the 42nd day in a shape similar to that of the human, and the nose is also recognizably human. Limb buds which made their appearance towards the end of the 4th week are now (after the 42nd day) longer and show clearly defined fingers and toes which were not present before. The prominent tail bud has regressed, leaving a rudiment that is barely conspicuous. For comparison between the human embryo before and after the 42nd day, see Figures 7-2 and 8-2.



Figure 8-1. Embryo at the beginning of the 7th week (Day 40-42). The arms curve over the heart bulge and the toe rays are present on the foot. The size is 20 mm from crown to rump. 1, arm. 2, ear. 3, elbow. 4, eye. 5, forebrain. 6, heart bulge. 7, hindbrain. 8, liver bulge. 9, midbrain. 10, midgut herniation. 11, mouth. 12, notched hand plate. 13, umbilical cord. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers Inc., 1983)

In the case of the external genital organs, the anlage, or primordium, are the same in both male and female, and they begin their development before the 42nd day, during the 4th week. The genital tubercle, labioscrotal swellings and urogenital folds do not evolve into distinguishing sexual characteristics until the 9th week. The differentiation between the male and the female fetuses can be made after the 12th week only (See Chapter 6, "Nash'ah Stage").

The eyes and ears continue to develop advanced features after the 42nd day. At 11 weeks of development, even though the size of the eye is the size of a small bean, it shows more advanced features such as the cornea. By the 7th month, the retina is light sensitive, but perception of form and color develops only shortly after birth.

By the end of the 7th week, or 49th day, the cochlea coils of the ear are already established and to a large extent resemble the adult form. Chondrification of the precartilaginous ear ossicles begins about

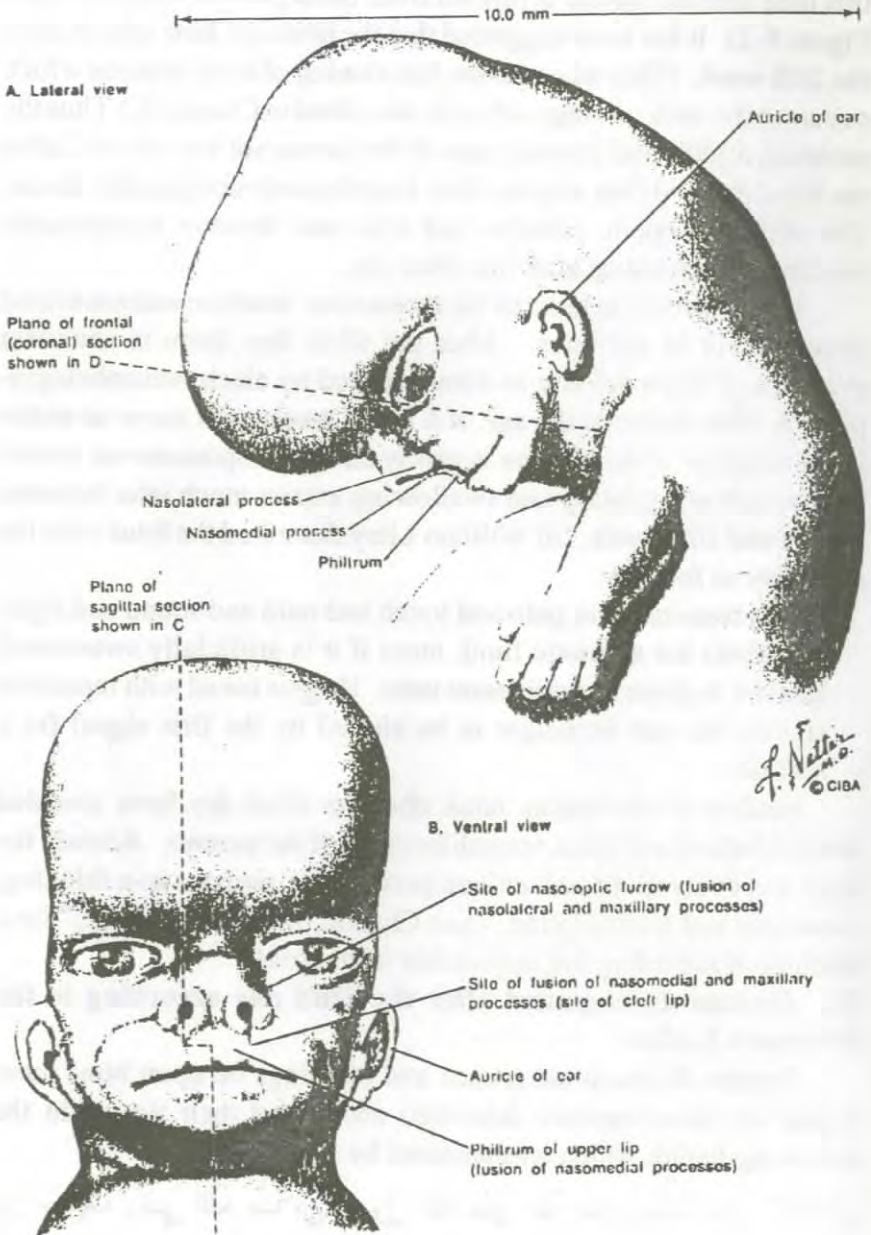


Figure 8-2. Drawing of embryo at 7 to 8 weeks. The appearance is now clearly that of a human embryo. (Reproduced from CIBA, *Clinical Symposia*, Vol. 28, No. 3)

this time and the auricle is formed from three pairs of tubercles (See Figure 8-2). It has been suggested that the fetus can hear sounds after the 24th week. (This relates to the functioning of body systems which occurs in the nash'ah stage, which is described in Chapter 6.) Thus the external, middle and internal parts of the ear are not formed until after the 42nd day and then acquire their function and recognizable shape. The skeletal system, muscles and skin also develop recognizable human characteristics after the 42nd day.

There is much to learn of the instinctive, intuitive and emotional development of the fetus. After the 42nd day, there is abundant evidence of brain activity as demonstrated by electroencephalography. A fetus between the age of 6 and 7 weeks will show an entire body response if the lip area is gently stroked. Spontaneous movements such as squinting and swallowing appear much later between the 9th and 10th week. Sir William Liley described the fetus after the 42nd day as follows:

"He is responsive to pain and touch and cold and sound and light. He drinks his amniotic fluid, more if it is artificially sweetened, less if it is given an unpleasant taste. He gets bored with repetitive signals but can be taught to be alerted by the first signal for a second."

Studies of the human fetus after the 42nd day have revealed distinct behavioral traits not unlike those of the parents. Already the fetus has evolved its own unique personality, perhaps as a thinking, conscious and feeling being. (See Chapter 6, "Nash'ah Stage," for a discussion regarding the acquisition of the soul.)

III. Human development after the 42nd day according to the Prophet's ḥadīth.

Prophet Muhammad (peace and blessings be upon him) mentioned the developments described above and their timing in the following ḥadīth which was narrated by Ḥudhayfah:

عَنْ حُذَيْفَةَ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ: "إِذَا مَرَّ
بِالنَّفْطَةِ ثِنْتَانِ وَأَرْبَعُونَ لَيْلَةً بَعَثَ اللَّهُ إِلَيْهَا مَلَكًا فَصَوَّرَهَا، وَخَلَقَ سَمْعَهَا
وَبَصَرَهَا، وَجِلْدَهَا، وَلَحْمَهَا، وَعِظَامَهَا، ثُمَّ قَالَ يَا رَبِّ أَذْكَرُ أَمْ أَتَنَسِي؟ فَيَقْضِي
رَبُّكَ مَا شَاءَ، وَيَكْتُبُ الْمَلَكُ" (صَحِيحُ مُسْلِمٍ: كِتَابُ الْقَدْرِ)

"When 42 nights have passed over the conceptus, God sends an angel to it, who shapes it (into human form) and makes its hearing, sight, skin, muscles and bones. Then he says, 'O Lord, is it male or female?' and your Lord decides what He wishes and the angel records it" (Ṣaḥīḥ Muslim: Kitāb Al-Qadar).

This ḥadīth describes the importance of the 42nd day in the intrauterine prenatal development. Embryological studies have shown that the human appearance is acquired during this time, just as mentioned in the ḥadīth. Prior to the 42nd day, it is difficult to distinguish the human embryo's appearance from the appearance of embryos of many other species such as the chicken, fish, or rabbit (Figure 8-3). After the 42nd day, the human shape begins to be recognizable (Figure 8-4). The ḥadīth refers to these processes as *taṣwīr ādamī* or shaping into human form.

The reference to hearing and sight in the ḥadīth indicates the development of the organs of the eyes and ears, and the initial changes necessary for their functioning. It is understood that the 7th and 8th weeks are critical periods for the embryonic development of the ear, since it has been observed that rubella infection at this time can cause maldevelopment of the organ of Corti and a resulting defect in hearing (Figure 8-5, 8-6). The optic stalk between the eye and brain undergoes changes which result in the formation of the optic nerve between the 6th and 8th weeks (Figures 8-7, 8-8). The formation of skin involves its differentiation into its layers, sebaceous and sweat glands, and hair, which are recognized in complete skin, and the development of its functions through innervation. The process of differentiating into layers begins in the 7th week (Figure 8-9) and formation of the glands and hair occur a few weeks later. Sensitivity to touch, pain, and temperature, which would indicate that innervation has occurred, is present after the 42nd day, as stated by Liley above.

As discussed in Chapter 5, the cartilaginous skeleton is formed, and ossification begins, in the 7th week, and myogenesis, which results in muscle formation around the bones, begins in the 8th week. These processes serve to straighten and smooth the embryo's body and contribute to the development of the human shape.

With regard to the sex of the embryo, the ḥadīth refers to the

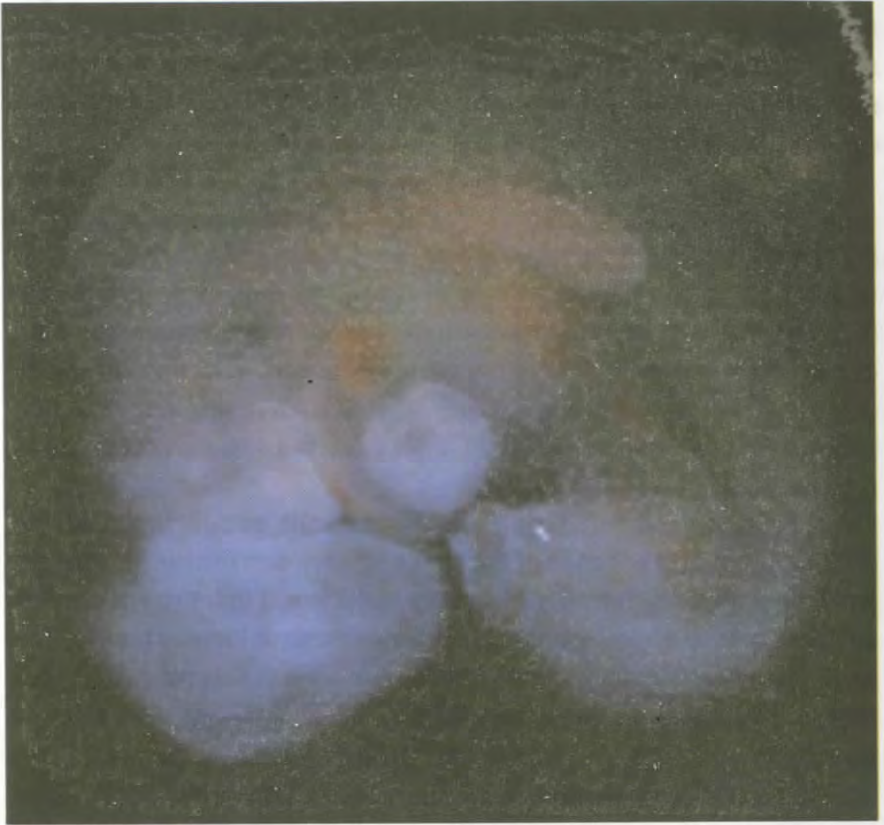


Figure 8-3. Embryo at 30 days, about 6-7 mm (0.24-0.28 inch). The organs are partly differentiated and partly undifferentiated during the mudghah stage. The embryo now has a body with a head, a trunk, and a tail. The heart is positioned, almost literally, in the embryo's mouth. On the side of the trunk, an arm bud and a leg bud bulge out. The apparent shape of the embryo can not be distinguished as that of a human at this time. Early stages of embryos of some other species such as chicken, fish, or rabbit appear similarly to this stage in the human. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, New York, Delacorte Press, 1982)

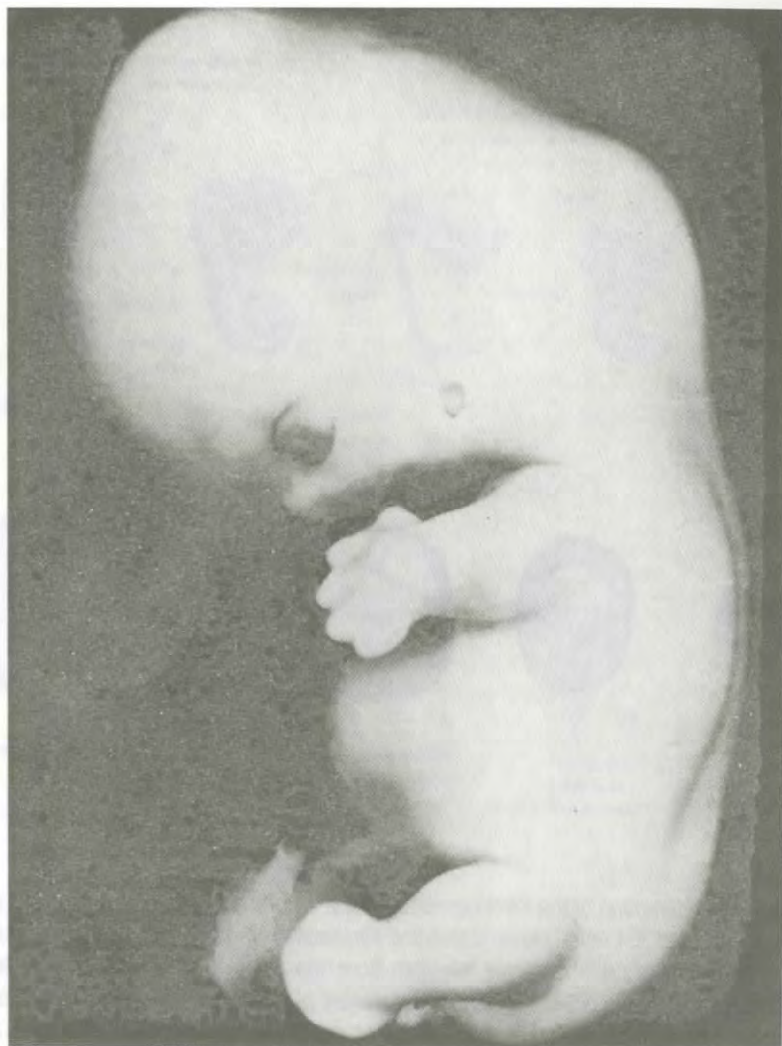


Figure 8-4. Embryo at about 48 days, during the 'izam stage. Actual size: 18.0 mm. The eye is noticeably well-developed, there are notches between the digital rays of the hand, and the developing external ear is set low upon the head. Taswir adami (forming the human shape) is clearly recognizable at this time, due to the formation of the cartilaginous skeleton and the beginnings of ossification. (From Dr. Kazumasa Hoshino, former Professor of Anatomy and Director of the Congenital Anomaly Center, Faculty of Medicine, Kyoto University, Kyoto, Japan, and reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

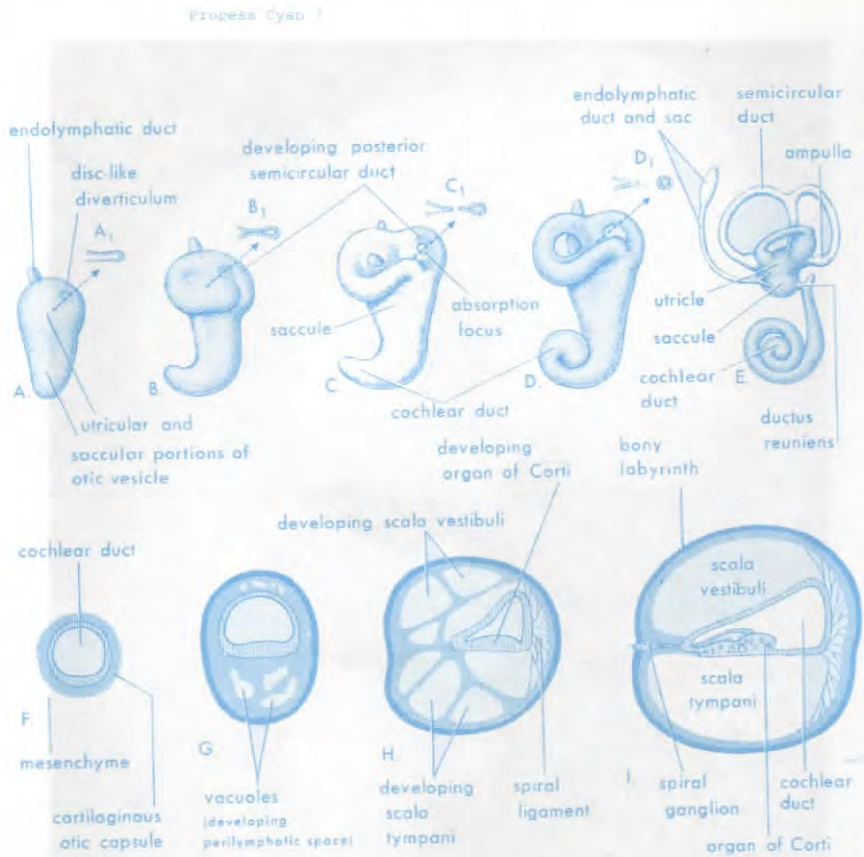


Figure 8-5. Illustration of the development of the membranous and bony labyrinths of the internal ear. *A to E*, Lateral views illustrating successive stages in the development of the otic vesicle into the membranous labyrinth from the 5th to the 8th weeks. *A₁ to D₁*, Diagrammatic sketches illustrating the development of a semicircular duct. *F to I*, Sections through the cochlear duct showing successive stages in the development of the spiral organ (of Corti) and the perilymphatic space from the 8th to the 20th week. The organ of Corti transfers the vibrations of sound to the nerve (See *I*) and defects in its development directly impact the ability to hear. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

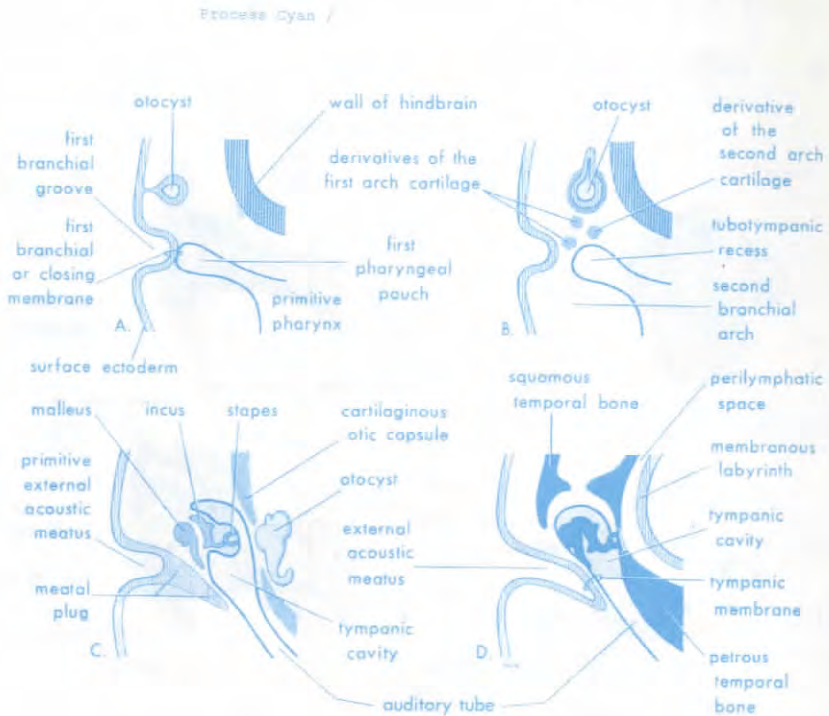


Figure 8-6. Drawings showing the development of the external and middle ear. *A*, Four weeks, illustrating the relation of the otic vesicle of the branchial apparatus. *B*, Five weeks, showing the tubotympanic recess and branchial (pharyngeal) arch cartilages. *C*, Later stage, showing the tubotympanic recess (future tympanic cavity and mastoid antrum) beginning to envelop the ossicles. *D*, Final stage of ear development, showing the relationship of the middle ear to the perilymphatic space and the external acoustic meatus. Note that the tympanic membrane develops from three germ layers: surface ectoderm, mesoderm, and endoderm of the tubotympanic recess. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

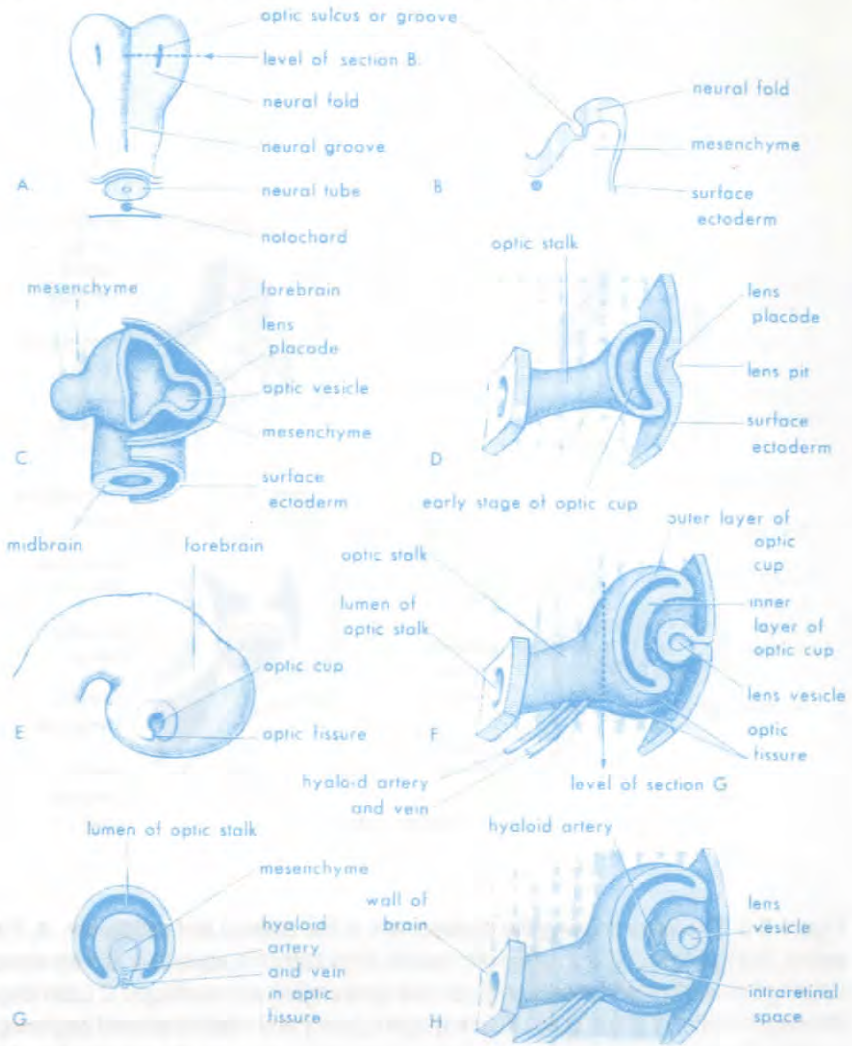


Figure 8-7. Illustrations of early eye development. *A*, Dorsal view of the cranial end of an embryo of about 22 days, showing the first indication of eye development. Note that the neural folds have not fused to form the primary brain vesicles at this stage. *B*, Transverse section of an optic sulcus. *C*, Schematic drawing of the forebrain, its covering layers of mesoderm and surface ectoderm, at about 28 days. *D*, *F*, and *H*, Schematic sections of the developing eye, showing successive stages in the development of the optic cup and lens vesicle. *E*, Lateral view of the brain of an embryo of about 32 days, showing the external appearance of the optic cup. *G*, Transverse section of the optic stalk, showing the optic fissure and its contents. Note that the edges of the optic fissure grow together and fuse, thereby completing the optic cup and enclosing the central artery and vein of the retina in the cup and the optic nerve. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

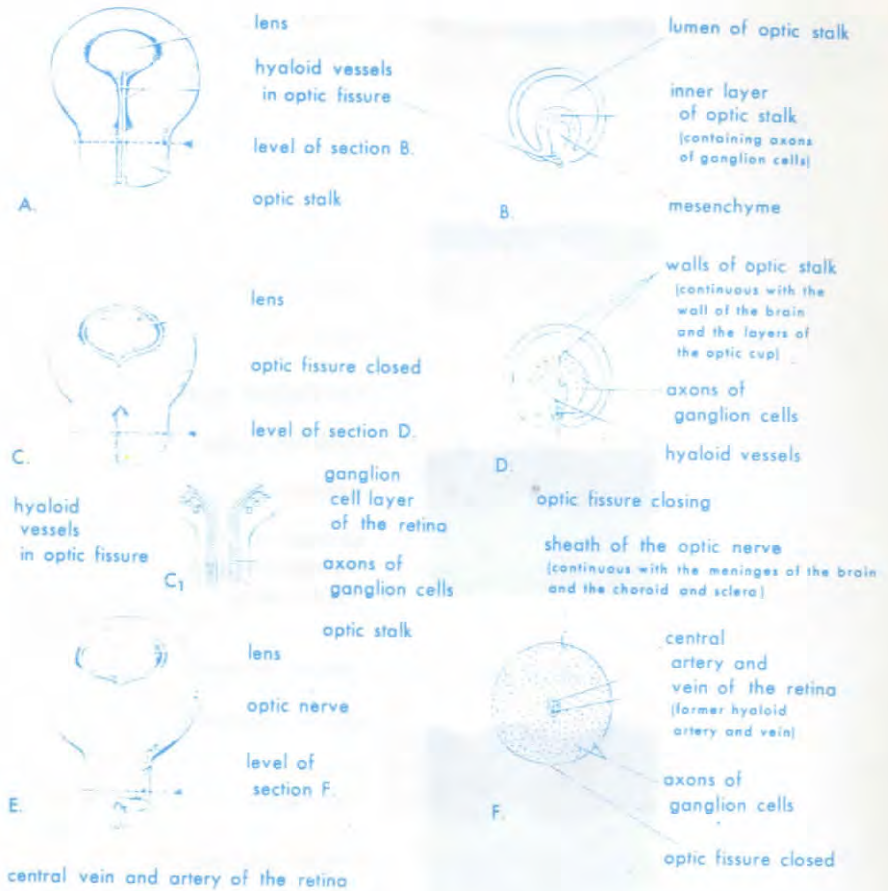


Figure 8-8. Drawing showing the closure of the optic fissure and formation of the optic nerve. A, C, and E, Views of the inferior surface of the optic cup and stalk, showing progressive stages in the closure of the optic fissure. C₁, Schematic drawing of a longitudinal section of a portion of the optic cup and optic stalk, showing axons of ganglion cells of the retina growing through the optic stalk to the brain. B, D, and F, Transverse sections of the optic stalk, showing successive stages in the closure of the optic fissure and in formation of the optic nerve. The optic fissure normally closes during the 6th week, just prior to the 7th week, and formation of the optic nerve is necessary for the function of sight. Note that the lumen of the optic stalk is gradually obliterated as axons of ganglion cells accumulate in the inner layer of the optic stalk as the optic nerve forms. (Reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

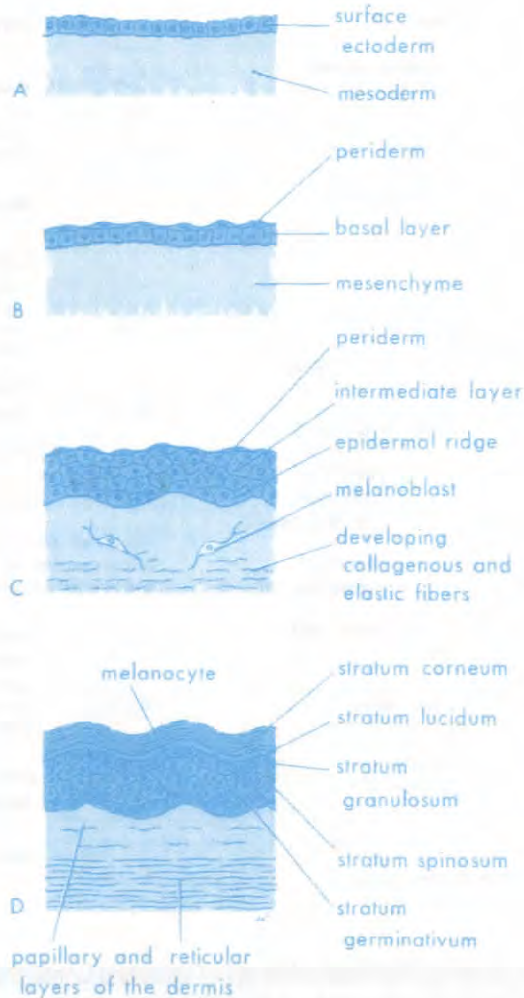


Figure 8-9. Illustrations of successive developments in the formation of thick skin. *A*, Four weeks. *B*, Seven weeks. The periderm is just beginning to form at this time. *C*, Eleven weeks. The cells of the periderm are continually undergoing keratinization and desquamation, and the exfoliated peridermal cells comprise part of the vernix caseosa which coats the fetal skin. *D*, Newborn. The dendritic branches of the melanocytes in the basal layer of the epidermis supply the epidermal cells with melanin. (Reproduced with permission from Moore, K.L. and Persaud, T.V.N., *The Developing Human*, 5th ed., Philadelphia, Saunders, 1993)

development of the external genitalia and not to the primary genetic sexual determination which is established with fertilization in the nuṭfah stage (See Chapter 2, "The Nuṭfah Stage"). The Qur'ān mentions this fact as follows:

"وَأَنَّهُ خَلَقَ الذَّكَرَ وَالْأُنثَىٰ مِن نُّطْفَةٍ إِذَا تُمْنَىٰ" (النَّجْم: آيَات ٤٥ ، ٤٦)
 "...And that He did create the two sexes, the male and female from nuṭfah, as it is emitted or planned" (Surah An-Najm, 53: Āyāt 45,46).

In the preceding ḥadīth, the question by the angel relates to the determination of the distinctive external genitalia which develop during the 12th week after the embryo has acquired its human form. The conjunction "thumma" is used in the ḥadīth to refer to the time of formation of the external genitalia and therefore means that this formation occurs after the development of the other processes mentioned in the ḥadīth.

The functioning of the organ systems mentioned in the ḥadīth begins in a later stage, for the creation of these systems precede their further development which is necessary for functioning.

The above-mentioned ḥadīth indicates the development and function of these organs, their timing, and the day after which these systems are created. Modern scientific information and embryological studies are in full agreement with the statements recorded in the Qur'ān and the Sunnah 14 centuries ago.



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NEW TERMS FOR CLASSIFYING HUMAN DEVELOPMENT

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I. Introduction.

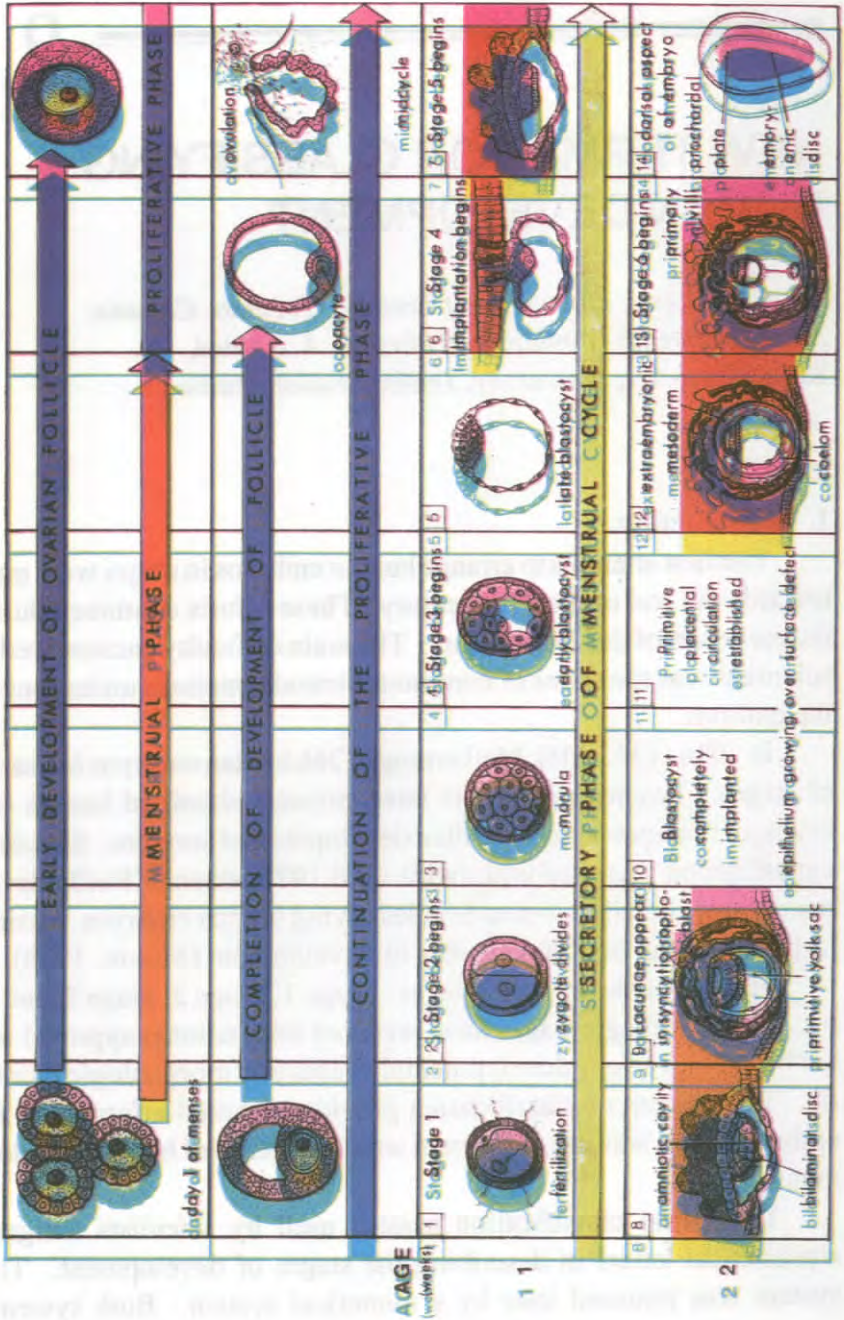
The first attempts to arrange human embryos in stages were made towards the end of the 19th century. These efforts continued during the early part of the 20th century. The main difficulty encountered by scientists was the series of continuous transformations undergone by the embryo.










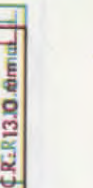
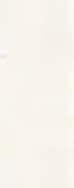




In 1914 (1332 AH), Mall arranged 266 human embryos in a series of stages. Twenty-eight years later, Streeter classified human embryos in 23 stages which he called developmental horizons. Streeter's classification was used worldwide until 1973, when O'Reilly developed a more detailed system for classifying human embryos, particularly during the first three weeks of development (Moore, 1988).

Figure 9-1 shows these stages - Stage 1, Stage 2, Stage 3, and so on. These Carnegie stages have received international approval and are based on various developmental events and morphological criteria. This system of classification provides detailed information for embryologists who are concerned with the details of human development.

The initial classification system used by scientists assigned alphabetical letters in describing the stages of development. This system was replaced later by a numerical system. Both systems,

Figure 9-1. TIMETABLE OF HUMAN PRENATAL DEVELOPMENT
1 to 38 weeks












<p>15 19</p> <p>first missed menstrual period</p> 	<p>16 23</p> <p>Stage 7 begins</p> <p>notochordal process</p> 	<p>17 24</p> <p>Stage 8 begins</p> <p>neural plate</p> <p>primitive streak</p> 	<p>18 25</p> <p>Stage 9 begins</p> <p>brain vesicles</p> <p>somites</p> <p>neural crest</p> <p>grooves</p> <p>somite</p> 	<p>19 26</p> <p>Stage 10 begins</p> <p>neural tube</p> <p>notochord</p> <p>embryonic tail</p> 	<p>20 27</p> <p>Stage 11 begins</p> <p>4 pairs of branchial arches</p> <p>arm and leg buds</p> <p>present</p> <p>C.R.: crown-rump length</p> 	<p>21 28</p> <p>Stage 12 begins</p> <p>arm and leg buds</p> <p>indicated</p> <p>actual size</p> 	<p>22 29</p> <p>Stage 13 begins</p> <p>Head begins to beat</p> <p>to breathe</p> <p>Neural tube fusing</p> 	<p>23 30</p> <p>Stage 14 begins</p> <p>Hand plates (paddle-shaped)</p> <p>Let's pits and notochordal process formed</p> 	<p>24 31</p> <p>Stage 15 begins</p> <p>Head much larger relative to trunk</p> <p>cerebral vesicles distinct</p> <p>leg buds (paddle-shaped)</p> 	<p>25 32</p> <p>Stage 16 begins</p> <p>Arms bent at elbow</p> <p>Finger rays and notochordal processes distinct</p> <p>Palate developing</p> 	<p>26 33</p> <p>Stage 17 begins</p> <p>Finger rays and notochordal processes distinct</p> <p>ventral view</p>
<p>3 3</p> <p>primitive streak</p> 	<p>4 4</p> <p>Head begins to beat to breathe</p> <p>Neural tube fusing</p> 	<p>5 5</p> <p>Let's pits, optic cups, nasal pits forming</p> 	<p>6 6</p> <p>Oral & nasal cavities formed</p> 								

3 3

4 4

5 5

6 6

AGE (weeks)	7	8	9	10
43	 C.R.: 16.0 mm.	50. Upper limbs longer & bent at elbows Fingers distinct	57. beginning of fetal period	64. Face has human profile. Note growth of chin compared to day 44.
44	Stage 18 begins Eyelids beginning	51. Anal membrane perforated Urogenital membrane degenerating. Testes and ovaries distinguishable.	58. 	65. 
45	Tip of nose distinct Toe rays appear Ossification may begin C.R.: 17.0 mm Stage 21 begins	52. Stage 21 begins External genitalia still in sexless state but have begun to differentiate.	59. Genitalia show some ♀ characteristics but still easily confused with ♂.	66. Face has human appearance. 
46	 Loss of villi Smooth chorion forms.	53. Stage 21 External genitalia still in sexless state but have begun to differentiate.	60. phallus urogenital fold labioscrotal fold perineum ♀	67. clitoris labium minus urogenital groove labium majus ♀
47	genital tubercle urogenital membrane anal membrane ♀ or ♂	54. Stage 22 begins genital tubercle urethral groove anus ♀ or ♂	61. Genitalia show fusion of urethral folds. Urethral groove extends into phallus.	68. Genitalia have ♀ or ♂ characteristics but still not fully formed.
48	Stage 19 begins Trunk elongating and straightening	55. Beginnings of all essential external & internal structures are present.	62. phallus urogenital fold labioscrotal fold perineum ♂	69. glans penis urethral groove scrotum ♂
48	 C.R.: 18 mm	56. Stage 23  C.R.: 30 mm	63.  C.R.: 50 mm	70.  C.R.: 61 mm

The Nash'ah Stage (Fetal Period)



Figure 9-1. Development begins at fertilization, about 14 days after the onset of the last menstruation. On a daily basis, the nutfah stage, involving cleavage of the zygote in the uterine tube and implantation of the blastocyst, and the takhliq stage, involving early development of the embryo until the 8th week, are shown. Development in the fetal or nash'ah stage is shown in weeks 9 and 10. Finally, the growth in the nash'ah stage is shown for the remainder of the pregnancy. (Reproduced with permission from Moore, Keith L., *The Developing Human, Clinically Oriented Embryology*, 4th edition, W.B. Saunders Co., Philadelphia, 1988)

however, failed to establish a descriptive concept capable of distinguishing between the various stages.

Until recently it was known mainly to the Muslim scholars that the Qur'ān, the holy book of the Muslims, and the Sunnah, or Ḥadīth, the teachings of Muḥammad (peace be upon him), contain many citations referring to the stages of human development. Until recently these statements were not understood, because they referred to details of development which were scientifically unknown in earlier times.

In fact the Qur'anic system for classifying human development is amazing since it was recorded in the 7th century A.D. Although Aristotle, the founder of the science of embryology, realized that chick embryos developed in stages from his study of hens' eggs in the 4th century B.C., he did not give any details about these stages. As far as is known from the history of embryology, little was known about the staging and classification of human embryos until the last 100 years, as mentioned previously.

II. Rules of scientific terminology.

When describing embryos, scientists strive to choose terms that are truly descriptive of the embryological stages. This terminology should be fully consistent with the nature of the events and developments that occur during these stages. To avoid ambiguity, each term should describe a stage which has a distinct beginning and end. Overlapping of stages should, by all means, be averted (Table 9-1).

Because the staging of human embryos is complex, going through a continuous process of change during development, it is proposed

PRINCIPLES FOR TERMINOLOGY
1. To be Descriptive of Appearance
2. Reflect Processes Occurring
3. Avoid Ambiguous Beginning and End

Table 9-1.

that a new system of classification could be developed, using the terms mentioned in the Qur'ān and Sunnah. The proposed system is clear, comprehensive, based on morphological changes, conforms with present embryological knowledge, and meets the conditions specified in Table 9-1.

The Qur'ān was the first source to mention these distinct stages of human development:

"يَخْلُقْكُمْ فِي بُطُونِ أُمَّهَاتِكُمْ خَلْقًا مِّنْ بَعْدِ خَلْقٍ فِي ظُلُمَاتٍ ثَلَاثَ" (الرُّمَرُ 39: آيَةُ 6)
"He (God) makes you in the wombs of your mothers in stages, one after another, within three veils of darkness" (Surah Az-Zumar, 39: Āyah 6). The concept develops in the uterus protected by three veils or layers (Figure 9-2).

A specific term is given to each stage:

"وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِّنْ طِينٍ ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَّكِينٍ ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ" (سُورَةُ الْمُؤْمِنُونَ: آيَات 12-14)

"We (God) created man from a quintessence of clay. We then (thumma) placed him as a nutfah (drop) in a place of settlement, firmly

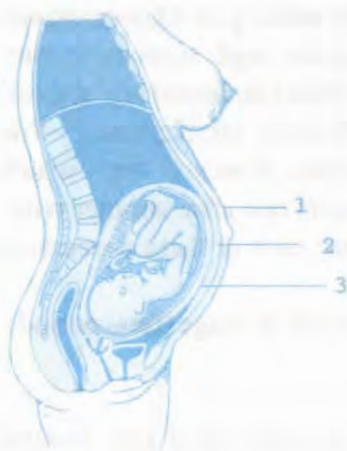


Figure 9-2. 30 weeks of pregnancy. The three veils of darkness are: 1 represents the anterior abdominal wall, 2 the uterine wall, and 3 the amniochorionic membrane. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., W.B. Saunders Co., Philadelphia, 1988)

fixed, then (*thumma*) We made the drop into an 'alaqah (leech-like structure), and then (*fa*) We changed the 'alaqah into a mudghah (chewed-like substance), then (*fa*) We made out of that mudghah, 'izām (skeleton, bones), then (*fa*) We clothed the bones with laḥm (muscles, flesh), then (*thumma*) We caused him to grow and come into being and attain the definitive (human) form. So, blessed be God, the best to create." (Surah Al-Mu'minūn, 23: Āyāt 12-14).

This terminology obviously meets the prerequisites of ideal terms, i.e., they are characterized by clarity and conformity to each stage of human development.

For this reason, the descriptions of human development in the Qur'ān cannot be based on scientific knowledge in the 7th century. The only reasonable conclusion is that these descriptions were revealed to Muḥammad (peace be upon him) by God. He could not have known such details because he was an illiterate man with absolutely no scientific training.

III. The Qur'anic terms.

A. The main stages.

The Qur'ān determines that human development goes through three main distinct stages, with an interval between them indicated by the conjunction *thumma* (indicated in the passage above) which refers to a time lag between stages. These stages are the following:

1. **Nuṭfah stage.** The first stage is the nuṭfah: "nuṭfah" literally means "a drop" or "a small quantity of fluid."
2. **Takhliq stage.** The second stage is the takhlīq, or differentiation, in which human development passes through successive sub-stages or phases: 'alaqah, mudghah, 'izām (skeleton) and al-kisā' bil-laḥm (clothing the bones with muscle; laḥm phase). The conjunction used between each of these phases is "fa," which indicates that each transformation occurs one after another without any interval or delay, and therefore each of these successive phases occur within the takhlīq stage.
3. **Nash'ah stage.** The third stage is the nash'ah stage (fetal period).

B. Events in each stage.

1. The nuṭfah

The first main stage, the nuṭfah, is subdivided into several phases:

a. Al-mā' ad-dāfiq (the gushing fluid; a drop emitted).

This phase describes the gushing fluid that contains either the spermatozoa or the ovum (See Figures 2-1, 2-2, Chapter 2).

b. Sulālah.

"Sulālah" in Arabic means "something that is small in quantity" and "an extract." It is also used to mean "a long fish." The Qur'ān refers to this phase in the context of the male secretion:

"ثُمَّ جَعَلَ نَسْلَهُ مِنْ سُلَالَةٍ مِنْ مَاءٍ مَهِينٍ" (سُورَةُ السَّجْدَةِ 32- آيَةٌ 8)
 "Then He (God) made his (mān's) progeny from a quintessence (sulālah) of a lowly fluid" (Surah As-Sajdah, 32: Āyah 8).

A spermatozoon is one of millions of sperms extracted from the male fluid, and it could resemble the shape of a long fish. This phase follows the emission of the fluid (Figures 9-3, 9-4).

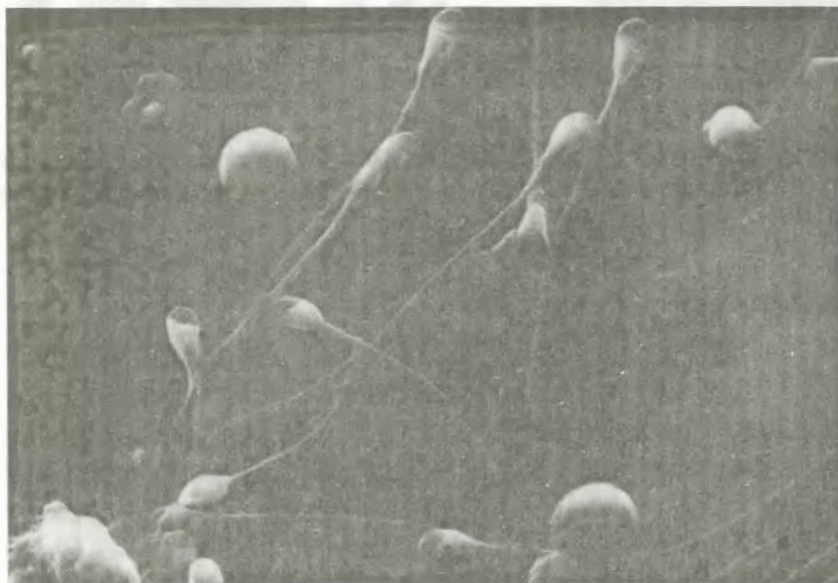


Figure 9-3. Scanning electron micrograph of several human sperms. Each consists of a head and a long tail. The head is formed mainly by the nucleus, which contains the genetic material that is transmitted to the zygote during fertilization. The tail provides motility to aid in the transport of the sperm to the fertilization site. (From Page, E.W., Villet, C.A., and Villet, D.B., *Human Reproduction. Essentials of Reproductive and Perinatal Medicine* 3rd edition, Philadelphia, W.B. Saunders Co., 1981. Courtesy of J.E. Flechon and E.S.E. Hafez.)



Figure 9-4. A sperm cell on its way to the ovum. It will swim, aided by uterine contractions, 15-18 cm and take about six hours to reach the fertilization site. (Reproduced with permission from Nilsson, *Behold Man*, Little, Brown, and Company)

c. Nuṭfah amshāj.

Nuṭfah means, as mentioned previously, “a drop.” “Amshāj” means “mixtures.” The term describes the mixture and convergence of male and female fluids in the uterine or Fallopian tube to form the zygote. It has the form of a drop of fluid and consists of a mixture of male and female secretions. This description expresses both the appearance and structure of this development (See Figure 2-6, Chapter 2).

The nuṭfah amshāj can be subdivided into the following subphases:

i. Khalq.

When the sperm and ovum fuse, a new human being is programmed or planned with the formation of a zygote that carries 46 chromosomes. The zygote multiplies through cell division in the initial steps of the formation of a human individual.

Thus, a human being is created by the fusion of a sperm and ovum. This process in the *nuṭfah amshāj* differs from the processes in the preceding phase, since the conceptus has now formed from two separate components (See Figure 2-7, Chapter 2).

ii. **Taqdīr.**

The human creation begins with the fusion of a sperm with an ovum as has already been specified. But, what are the characteristics of the newly formed embryo? What will it inherit from its parents and ancestors? This process takes place a few hours after the *khalq* phase. The Qur'ān called this development the *taqdīr* phase, and modern embryologists refer to it as the genetic programming. The modern terminology is amazingly similar to the term *taqdīr*, since "taqdīr" means "planning," "determining," and "programming." During this process, both the embryo's dominant traits, and other traits that will affect the offspring are determined (Figure 9-5).

The Qur'ān refers to these successive phases of the *nuṭfah* stage:

"قَتَلَ الْإِنْسَانَ مَا أَكْفَرَهُ! مِنْ أَيِّ شَيْءٍ خَلَقَهُ؟! مِنْ نُطْفَةٍ خَلَقَهُ فَقَدَرَهُ"
(سورة عبس 80: آيات 17 - 19)

"Woe to man! What has made him reject God? From what substance has He created him? From a nutfah He has created him, and immediately afterwards planned or programmed him." (Surah 'Abasa, 80: Āyāt 17-19)

The Qur'ān indicates that the process of *taqdīr* follows the process of *khalq* in immediate succession, and it is now known in modern embryology that both processes are accomplished in less than 30 hours after fertilization.

d. **Ḥarth.**

Once the phases of *khalq* and *taqdīr* are completed, the *nuṭfah* (zygote) migrates from the uterine tube to the uterus where it implants similarly to a seed implanting in the soil (See Figure 2-10, Chapter 2).

The *ḥarth* phase, distinct from the preceding and succeeding phases, is the last phase of the *nuṭfah* stage. At this time, the *nuṭfah* attaches to and then embeds into the endometrium from which it gets nourishment, and then it develops a different shape and structure. The Qur'ān refers to this process in the following passage:



Figure 9-5. The programming of the taqdir phase is accomplished through the mingling of chromosomes from both the sperm and ovum. In this photograph, a dividing human cell has been gently flattened in order to view the chromosomes. After treatment to produce fluorescence under ultraviolet light, each chromosome displays a distinct pattern. In this particular case, the chromosomes are from a male individual and the small, short-armed y chromosome, in the center, emits a particularly strong light. (Reproduced with permission from Nilsson *et al*, *A Child is Born*, Dell Publishing Company, 1976)

«نَسَاؤُكُمْ حَرْثٌ لَكُمْ فَاتُوا حَرْثَكُمْ أَنَّى شِئْتُمْ» (سُورَةُ الْبَقَرَةِ 2: آيَةٌ 222)

“Your wives are a tilth unto you, so approach your tilth when or how you will” (Surah Al-Baqarah, 2: Āyah 222). “Tilth” (ḥarth) refers to the cultivation of the soil. The analogy here is that the endometrium, or lining of the uterus, is similar to the soil in which a seed is planted and then develops into a plant.

2. The takhlīq (differentiation).

During the second main stage, the takhlīq, cell differentiation takes place to form systems and organs. This stage starts at the

beginning of the third week. The embryo goes through the following substages or phases:

a. The 'alaqah.

This period begins on day 15 and is completed on day 23 or 24, when the embryo gradually acquires the shape of a leech (Figure 9-6).

“Alaqah” in Arabic indicates the following meanings:

- i. “A leech that lives in ponds and thrives on blood-sucking.”
- ii. “Something attached or hanging on to something else.”
- iii. “A blood clot.”

The first two meanings apply to the shape of the human embryo which resembles a leech (See Figure 4-3, Chapter 4) and which attaches to the placenta through the umbilical cord (See Figure 4-2, Chapter 4). These two meanings of the word 'alaqah describe and reflect accurately the external appearance of the embryo at this stage.

The meaning of “a blood clot” describes the most prominent internal structure that affects the external appearance, for in the 'alaqah stage, blood forms in the blood vessels in the form of isolated islands. Therefore the vessels resemble coagulated blood since the blood is circulating very slowly (See Figure 4-4, Chapter 4).

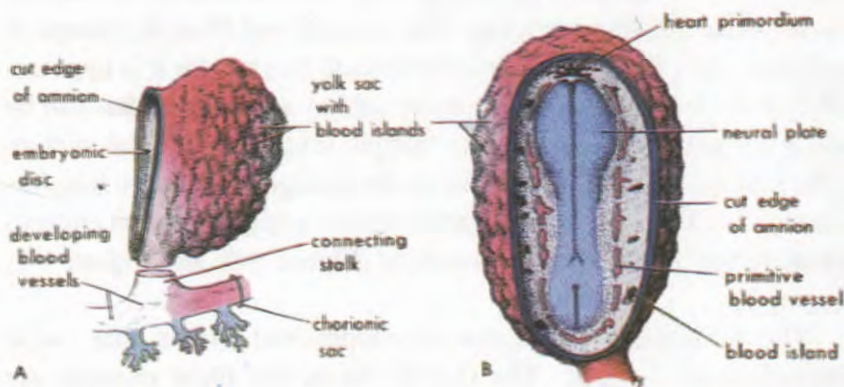


Figure 9-6. Illustration of the embryo at about 18 days in the 'alaqah stage. *A*, The yolk sac, which contains the developing embryo, and a portion of the chorionic sac. *B*, Dorsal view of the embryo as it would appear by removing the amnion. The resemblance to a leech is clear. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

The Qur'ān refers to the 'alaqah stage:

"Then We made the nutfah into a leech-like structure ('alaqah)" (Surah Al-Mu'minun, 23: Āyah 14).

b. The muḍghah.

The embryo begins to transform from the 'alaqah shape to the muḍghah shape at 24-26 days (Figure 9-7). This is a short period compared with the period of nutfah transformation into 'alaqah. The word "muḍghah" means:

- i. "Something that has been chewed by the teeth."
- ii. "A piece of meat of a size that can be chewed."
- iii. "Small substances."

In this phase, the embryo resembles a chewed substance whose shape changes constantly but still bears the teeth imprints; likewise, the embryo's shape undergoes changes during this phase. The embryo shows distinct somites which resemble teeth marks in the embryo's body. The appearance of these somites at the end of the 'alaqah stage emphasizes the rapidity of the transformation into the muḍghah, as indicated in the Qur'ān by the conjunction "fa" (See Figures 9-7, 9-8).

Due to differentiation of tissue, and therefore changes in the center of gravity, the embryo turns in its position similar to the rotation of a substance during chewing. The second and third meanings of muḍghah apply to the embryo in relation to its size, for it is approximately 1.0 cm in length, which is the size of a substance that can be chewed (Figure 9-9). During the 'alaqah stage, the external surface of the embryo looks smooth, but in the muḍghah stage, it acquires furrows, swellings and a corrugated surface which gives the embryo the muḍghah, or chewed, appearance (Figure 9-9; see Figure 4-7, Chapter 4).

The terminology indicates developmental events that cause morphological changes. The Qur'ān states that these changes are caused by differentiation of body organs:

"ثُمَّ مِنْ مَّضْغَةٍ مُخَلَّقَةٍ وَغَيْرِ مُخَلَّقَةٍ" (سُورَةُ الْحَجِّ: 22 آيَةٌ 5)

"Then out of a chewed-like substance partly differentiated and partly undifferentiated" (Surah Al-Ḥajj, 22: Āyah 5).

This development in partial differentiation or undifferentiation is

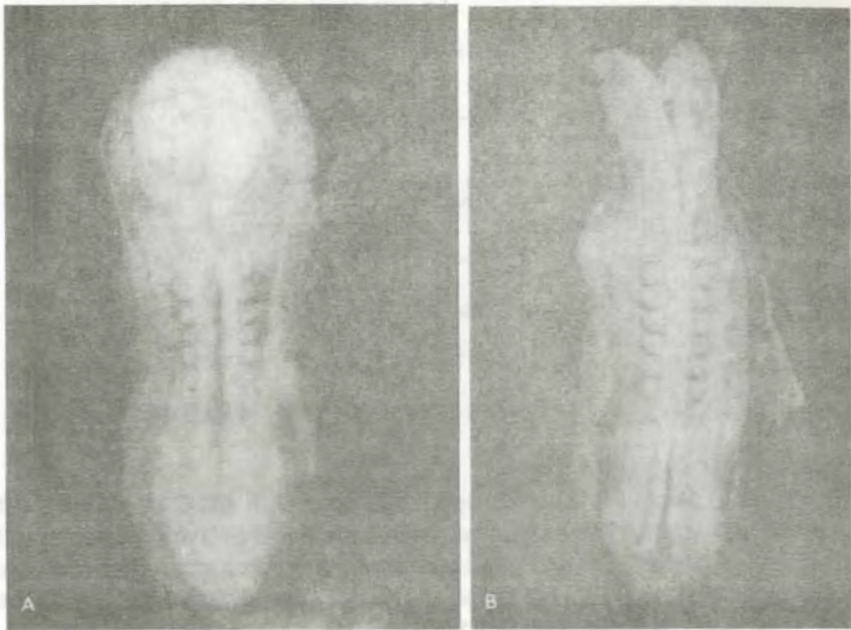


Figure 9-7. Photographs of embryos during the 'alaqah stage (22 to 23 days). The somites, which have the appearance of teeth imprints, are beginning to appear. In *A*, the embryo is essentially straight, whereas the embryo in *B* is slightly curved. There is a rapid transformation from this stage to the mudghah stage. (From Professor Hideo Hishimura, Kyoto University, Kyoto, Japan, and reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)



Figure 9-8. Photograph of an embryo at the end of the 'alaqah stage (age 24 to 25 days). Ten of the 13 pairs of somites are easily recognized, but the embryo is still relatively straight and has a leech-like appearance. The mudghah stage immediately follows this period in the development. (From Professor Hideo Hishimura, Kyoto University, Kyoto, Japan, and reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

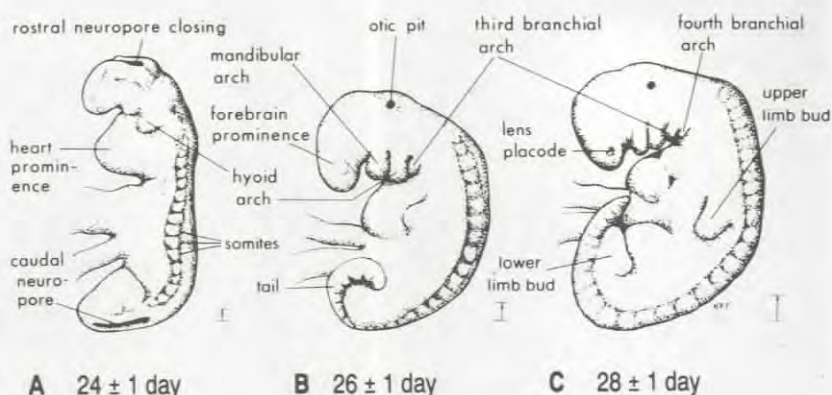


Figure 9-9. Drawings of embryos during the fourth week. A, B, and C, Lateral views of the embryos, showing 16, 27, and 33 somites respectively. A, The embryo in the last day of the 'alaqah stage. B and C, Embryos in the beginning of the mudghah stage. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

a well-known fact in modern embryology (Figure 9-10).

The Qur'anic term *mudghah* defines a distinct new phase that describes the external appearance of the embryo as well as the most important internal events.

c. The 'izām.

The embryo maintains the *mudghah* shape, which shows no human features, until the end of the 6th week. In the beginning of the 7th week, the cartilaginous skeleton begins to form. The embryo acquires a soft skeleton. Cartilaginous bone formation is the most prominent event during this phase (See Figure 5-9, Chapter 5). The transformation from the *mudghah* shape to the beginning of the skeletal shape occurs in a short period. This latter phase is characterized by the skeleton formation which gives the embryo its human shape (Figure 9-11; see Figure 8-1, Chapter 8).

The term "‘izām" used by the Qur'ān for this phase describes accurately the events in this period, including the external features, the most important internal features, as well as the accompanying new



Figure 9-10. Photograph of an embryo at the end of the *mudghah* stage at about 41 days. The wrist region, hand plate with digital rays, pigmented eyes, and external ear can be observed. The size of the head is large in relation to the rest of the body. Actual size: 11 mm. (From Kazumasa Hoshino, former Professor of Anatomy and Director of the Congenital Anomaly Center, Faculty of Medicine, Kyoto University, Kyoto, Japan; reproduced with permission from Moore, *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

interrelations of body parts, and the straightening of the embryo. This phase is distinctly different from the *mudghah* phase. The Qur'ān states to this effect:

«فَخَلَقْنَا الْمُضْغَةَ عِظَامًا» (سورة المؤمنون 23: آية 14)

“Then (*fa*) We made out of that *mudghah* (chewed-like substance), ‘*izām* (skeleton, bones)...” (Surah Al-Mu'minun, 23: Āyah 14).

d. Al-kisā' bil-laḥm (clothing the bones with muscles).

This stage is characterized by clothing the bones with muscles. Once this process is accomplished, the human shape is modified gradually, and the various body parts are better proportioned.

Once the muscles form, the fetus is capable of moving. Thus, during this phase, the effect on the embryo of muscles clothing the



Figure 9-11. Photograph of an embryo in the 'izam stage towards the end of the 7th week at about 48 days. The development of a cartilaginous skeleton has straightened the embryo and given it a human shape. Actual size: 18.0 mm. (From Kazumasa Hoshino, former Professor of Anatomy and Director of the Congenital Anomaly Center, Faculty of Medicine, Kyoto University, Kyoto, Japan, and reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

bones is manifested in the external appearance (Figures 9-12, 9-13). The term "al-kisā' bil-laḥm" expresses the main events of this period of embryonic development and indicates a distinct stage that is unlike the preceding phase both in appearance and internal features.

The stage of al-kisā' bil-laḥm begins at the end of the 7th week and continues throughout the 8th week. It takes place after the stage of skeleton formation, as the Qur'ān states:

"فَكَسُونَا الْعِظَامَ لَحْمًا" (سورة المؤمنون 23: آية 14)

“Then (fa) We clothed the bones with *lahm* (muscle, flesh)...” (Surah Al-Mu’minun, 23: Āyah 14).

With completion of this phase at the end of the 8th week, the stage of *takhliq* is accomplished. Embryologists consider the end of the 8th week as the end of the embryonic period of development. The fetal stage, which follows, corresponds to the *nash’ah* period, as the Qur’ān indicates:

«فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ» (سورة المؤمنون 23: آية 14)
 “Then (fa) We clothed the bones with *lahm* (muscles, flesh), then (thumma) We caused him to grow and come into being and attain the



Figure 9-12. Photograph of an embryo in the early *lahm* stage at about 52 days. With the development of muscles, the embryo has a smoother appearance. Actual size: 23.0 mm. (From Kazumasa Hoshino, former Professor of Anatomy and Director of the Congenital Anomaly Center, Faculty of Medicine, Kyoto University, Kyoto, Japan; reproduced with permission from Moore, *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)



Figure 9-13. Photograph of an embryo at the end of the lahm stage at about 56 days. The development of muscles over the skeleton has given the embryo a clearly smooth appearance which is especially noticeable in the upper and lower limbs. (From Kazumasa Hoshino, former Professor of Anatomy and Director of the Congenital Anomaly Center, Faculty of Medicine, Kyoto University, Kyoto, Japan, and reproduced with permission from Moore, K.L., *The Developing Human*, 4th ed., Philadelphia, Saunders, 1988)

definitive (human) form. So, blessed be God, the best to create" (Surah Al-Mu'minun, 23: Āyah 14).

3. Nash'ah.

"Nash'ah" is a derivative of the verb "nasha'a," which has three meanings:

- i. "To initiate."
- ii. "Grow and develop."
- iii. "To rise and increase."

The nash'ah stage begins with the end of the phase of clothing the bones with muscles, i.e., from the 9th week, and lasts until the end of the pregnancy. Its development is indicated by the conjunction *thumma* (see the Qur'anic passage above) which signifies a time delay between the two stages.

During this stage, several important processes take place with regard to the fetal development. In clear reference to these events, the Qur'ān states:

«ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ» (سورة المؤمنون: آية 14)
 "Then (*thumma*) We (*anshá' nahu*) cause him to grow and come into being and attain the definitive human form" (Surah Al-Mu'minun, 23: Ayah 14).

The nash'ah stage is characterized by the following processes:

a. An-nash'ah khalqan ākhar (attaining the definitive human form).

The following developments are apparent in the fetus during this process:

i. Rapid growth and development.

This description is manifested during this stage, for the developmental rate accelerates compared with the preceding stage (Figure 9-14).

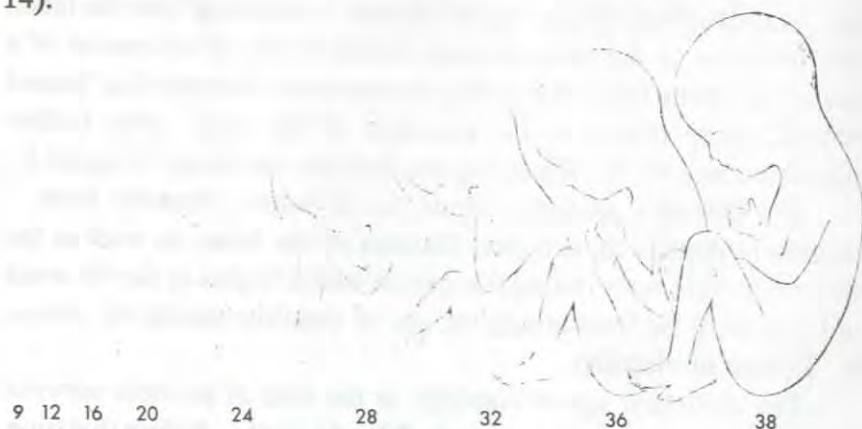


Figure 9-14. Drawings of fetuses, at different weeks of development. At about 20 weeks, head hair begins to appear. By 24 weeks, eyebrows and eyelashes are usually recognizable. The eyes reopen at 26 weeks. Fetuses born prematurely (22 weeks or more) may survive, but intensive care is required. (Reproduced with permission from Moore, K.L., *The Developing Human, Clinically Oriented Embryology*, 4th ed., Philadelphia, W.B. Saunders Co., 1988)

ii. Change in the nature of the fetus and development of his organs.

This description is consistent with the preceding description of rapid growth, indicating that the embryo has transformed in the nash'ah period into another creation, a functioning human being.

In the period from the 9th week until the 12th week, the embryo's head, limbs and body become better proportioned in the ta'dil phase (See Figure 6-2, Chapter 6). During the 12th week, the external sex organs grow and differentiate definitively into male and female genitalia (See Figure 6-7, Chapter 6).

Also in the 12th week, the cartilaginous bones begin to undergo ossification to form the bony skeleton, limbs differentiate, and nails can be detected on the fingers and toes (Figure 9-15). Moreover, the following developments occur:

- lanugo hair is present on the skin
- the fetus gains weight
- voluntary and involuntary musculature further develop
- voluntary movements begin to occur
- various organs and systems become ready to assume their normal functions

During this period, according to the statements of both the Qur'an and the Sunnah, the "spirit" or soul "is breathed" into the fetus. One indicator of this phenomenon would be the development of a sleep cycle in the fetus. According to statements from the Qur'an and Sunnah, sleep relates to the presence of the soul. (For further discussion, see III. B. "Breathing the soul into the fetus," Chapter 6.)

The Qur'anic passage, "attain the definitive (human) form," accurately depicts the external features of the fetus, as well as the major internal events during this period which begins in the 9th week and lasts until the fetus attains the age of viability outside the uterus.

iii. Period of viability.

The minimum age of viability, or the time of possible survival outside the uterus, is approximately 22 to 26 weeks. Before that time, the respiratory system is not sufficiently developed to accept artificial respiration. Furthermore, the nervous system has matured to a stage at which it has some control of body temperature.

The time of 22 to 26 weeks equals approximately 6 lunar months.

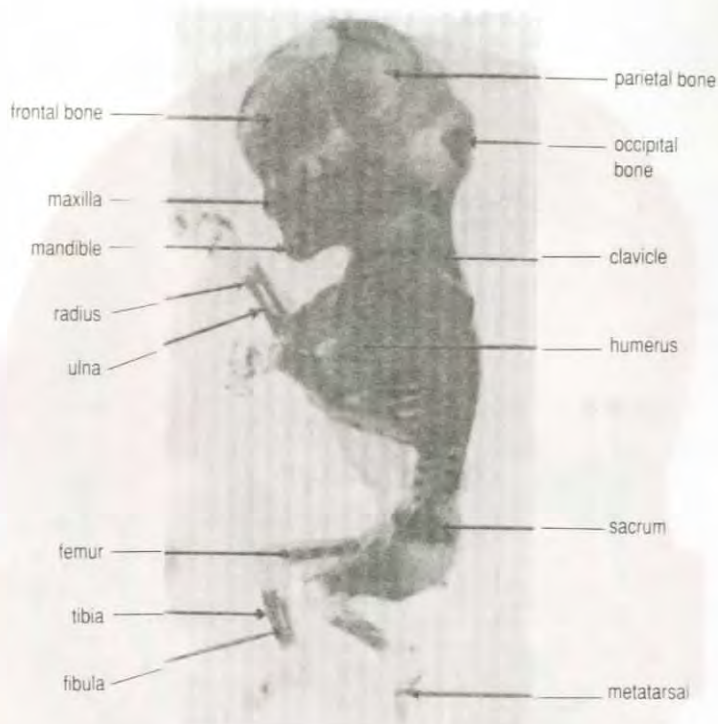


Figure 9-15. Photograph of a 12-week fetus, in the early nash'ah stage, that has been cleared and stained with alizarin to show the developing skeleton. The degree of progression of ossification from the primary centers can be observed. It is endochondral in the appendicular and axial skeletons, except for the clavicles and most of the cranial bones that are recognizable here. The portion of occipital bone visible here is preformed in cartilage and is undergoing endochondral ossification. *Actual size.* (Courtesy of Dr. Gary Geddes.)

Statements from the Qur'ān indicate that the minimum period necessary for the fetus to become viable is 6 lunar months (See IV. A. 3. "Period of viability," Chapter 6), although the duration of a normal pregnancy is 9 months. Prior to the period of viability, loss of the fetus, or termination of pregnancy, is referred to as abortion since the fetus cannot survive.

b. Uterine incubation (al-ḥaḍānah ar-raḥimīyah).

Once the creation of an individual is accomplished and the fetus has become viable after the 6th month, the period of uterine incubation or support begins (Figure 9-16). All body organs and systems

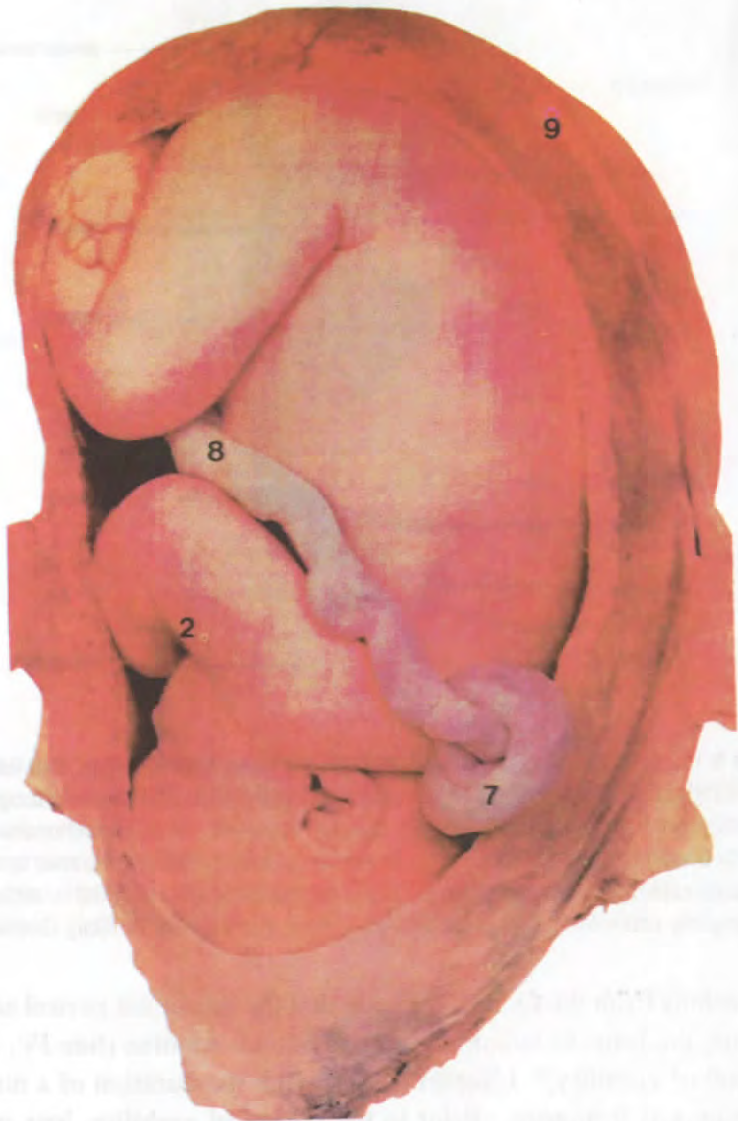


Figure 9-16. The fetus at 28 weeks. Organ systems are now developed, and viability outside the uterus is possible. At this time, the uterus provides a supportive and nourishing environment. Size: x 0.5. 2, arm. 7, true knot. 8, umbilical cord. 9, uterus. (Reproduced with permission from England, *Color Atlas of Life Before Birth*, Chicago, Year Book Medical Publishers, Inc., 1983.)

have been developed and prepared for functioning. The uterus then provides the nourishment and necessary milieu for the fetus to grow, strengthen, and mature (See Figure 2-12, Chapter 2). This phase of uterine incubation lasts until birth.

c. Parturition or labor (taysīr as-sabīl).

This process usually begins after 9 lunar months. The preceding phase was that of uterine incubation, or support and nourishment, and now the fetus is pushed from the uterus during labor (See Figure 6-10, Chapter 6). The Qur'ān states:

"Then He made the passage (through the birth canal) easy" (Surah 'Abasa, 80: Āyah 20).

IV. Conclusion.

The Qur'anic terms describe accurately the events that occur during the various stages of development. They describe the events in their chronological order and depict accurately the changes in the embryo's shape, as well as morphological changes, during each stage.

Prophet Muḥammad (peace be upon him) could not have known these facts in the 7th century, for the majority of them were discovered only in the 20th century. This knowledge could have only been conveyed to the Prophet by God, the Creator, the Omniscient, Who has full knowledge of the stages of human development and of the whole universe.



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THE SCIENTIFIC SIGNIFICANCE OF THE QUR'ANIC TERMS

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I. The correlation between the Qur'anic passages regarding human development.

A. The Qur'anic statements.

The following Qur'anic statements mention the major stages of human development from the time of conception to the time of birth:

«وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ، ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ، ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنشَأْنَاهُ خَلْقًا آخَرَ فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ» (سُورَةُ الْمُؤْمِنُونَ:

آيات 12-14)

“We (God) created man from a quintessence of clay. We then placed him as a nutfah (drop) in a place of settlement, firmly fixed, then We made the drop into an ‘alaqah (leech-like structure), and then We changed the ‘alaqah into a mudghah (chewed-like substance), then We made out of that mudghah, ‘izām (skeleton, bones), then We clothed the bones with laḥm (muscles, flesh), then We caused him to grow and come into being and attain the definitive (human) form. So, blessed be God, the best to create.” (Surah Al-Mu’minūn, 23: Āyāt 12-14).

"الْمَ يَكُ نُطْفَةً مِنْ مَنِيِّ يُمْنَى ، ثُمَّ كَانَ عَلَقَةً فَخَلَقَ فَسَوَّى ، فَجَعَلَ مِنْهُ الزَّوْجَيْنِ الذَّكَرَ وَالْأُنثَى" (سورة القيامة 77: آيات 37-39)

"Was he not a drop of germinal fluid (nutfah) emitted or programmed? Then he became 'alaqah (leechlike), then did God make (him) and then fashioned (straightened and smoothed) him. Then of him He made the two sexes, male and female." (Surah Al-Qiyāmah, 75: Āyat 37-39)

"الَّذِي خَلَقَكَ فَسَوَّاكَ فَعَدَلَكَ ، فِي أَيِّ صُورَةٍ مَا شَاءَ رَكَّبَكَ" (سورة الإنفطار 82: آيتا 7-8)

"...Who (God) created you, made you even and straight, and then modified you. In whatever form (facial features) He wanted, He put you together." (Surah Al-Infīṭār, 82: Āyat 7,8)

B. The three main stages of development.

In light of the preceding Qur'anic statements, the events of human development are divided into three main stages:

1. Nuṭfah. This stage covers the period from fertilization until implantation.
2. Takhlīq (embryonic). This stage extends from the beginning of the 3rd week until the end of the 8th week and covers the developmental events involved with cell differentiation and organ formation.
3. Nash'ah (fetal). This stage is subsequent to the early stages of formation. During this period, the shaping and modeling are active, and the external appearance develops in such a way that the embryo becomes recognizably human. This stage lasts until the completion of the pregnancy.

C. Use of conjunctions.

In the Qur'anic texts, the stages are mentioned as descriptive terms according to the external appearance, and important developmental events are mentioned through descriptive verbs. Table 10-1 shows the correlation between the three texts. It is also noted that different conjunctions are used to indicate the sequence of change in shape or the sequence of events. In the Arabic language, the conjunction *thumma* indicates a time lag between one event and another, while the conjunction *fa* indicates that events follow immediately upon one another.

STAGES	Al-Mu'minun 23: 13,14	Al-Qiyamah 75: 37-39	Al-Infitar 82: 7,8
1. Nutfah (drop)	ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ مَكِينٍ We then placed him as a nutfah (drop) in a place of settlement firmly fixed.	أَلَمْ يَكْ نُطْفَةً مِنْ سَمِيٍّ يَنْسَى Was he not a nutfah (drop) or part of germinal fluid emitted or programmed.	
2. 'Alaqah (leech-like)	ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً Then We made the nutfah into an 'alaqah (leech-like structure).	ثُمَّ كَانَ عَلَقَةً Then he became an 'alaqah (leech-like structure).	
3. Mudghah (somites)	فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً Then We changed (created) the 'alaqah into a mudghah (chewed-like substance)	فَخَلَقَ Then did God make (create) him.	الَّذِي خَلَقَكَ Who (God) created you.
4. 'Izam (skeleton)	فَخَلَقْنَا السُّفْهَةَ عِظَامًا Then We made out of that mudghah 'izam (bones; skeleton).	فَسَوَّى And then fashioned (straightened and smoothed) him.	فَسَوَّاكَ Made you even and straight.
5. Lahm (muscles)	فَكَسَوْنَا الْعِظَامَ لَحْمًا Then We clothed the 'izam with lahm (muscles).	فَجَعَلَ مِنْهُ الذَّكَرَ وَالْأُنثَى Then of him He made the two sexes male and female.	فَعَدَّلَكَ فِي أَيِّ صُورَةٍ مَّا شَاءَ رَكَّبَكَ. And then modified you, in whatever form (facial features) He wanted He put you together.
6. Nash'ah (growth)	ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ Then We caused him to grow and come into being and attain the definitive (human) form.		

Table 10-1. Correlation between Qur'anic statements regarding the major stages in human development.

D. Analysis of Table 10-1.

The information in Table 10-1 indicates the following (1):

1. The congruent use of the two conjunctions, *thumma* and *fa*.

“Thumma,” which indicates a slow sequence, is used in both Surah Al-Mu'minūn and Surah Al-Qiyāmah to indicate the slow transition between one main stage and another. “Fa,” which indicates order and rapid succession, is used to indicate a quick transition between the events within each stage.

Thus, the order and rate of development is similar in the two surahs.

2. *Nuṭfah* and 'alaqah.

The conjunction *thumma* is used between these two developmental events in both Surah Al-Mu'minūn and Surah Al-Qiyāmah, indicating an agreement between the two passages with regard to the timing of these developmental events.

3. *Muḍghah*.

“Muḍghah” is used in Surah Al-Mu'minūn to describe the stage which follows the 'alaqah. This term is indicative of the shape. In the text of Surah Al-Qiyāmah, the verb “khalaqa” is used and corresponds with regard to the use of the term *muḍghah* in Surah Al-Mu'minūn. This verb means “create,” or “originating one thing from another,” and indicates the events of the second main stage which is the *takhlīq* (a term derived from “khalaqa”). The second meaning is emphasized in the passage from Surah Al-Qiyāmah, since it can be inferred from the sequential order of events in Surah Al-Mu'minūn that “khalaqa” indicates the process of transformation from the 'alaqah to the *muḍghah*. As a result, the process of creation is a particular feature of the *muḍghah*.

Furthermore, in Surah Al-Ḥajj, 22: Āyah 5, the *muḍghah* is also described as formed and unformed. Thus, the process of formation and initiation of the various organs is a prominent characteristic of this stage (See Figure 4-6, Chapter 4).

“Khalaqa” is therefore understood as corresponding to distinct developmental processes. Embryology determines that the various organs begin to form during the *muḍghah* phase, and the *takhlīq* process is a characteristic feature of this period (See Figure 7-3, Chapter 7).

As the outer appearance of the embryo alters with the changes taking place inside it, the verb "sawwa" ("straightened and smoothed") in Surah Al-Qiyāmah is understood as indicating that the muḍghah stage is over. The muḍghah has no bones or muscles, and therefore does not have a human shape (See Figure 7-2, Chapter 7).

Thus the phase of straightening, or *taswiyah*, and making the surface of the embryo more even, as mentioned in Surahs Al-Qiyāmah and Al-Infīṭār, must come after the muḍghah stage. The order of events in Surahs Al-Mu'minūn, Al-Qiyāmah, and Al-Infīṭār is the same. Therefore, the "straightening" mentioned in Surahs Al-Qiyāmah and Al-Infīṭār corresponds to the 'izām (skeleton, bones) stage in Surah Al-Mu'minūn.

This correspondence is further indicated by the congruent and sequential reference to "khalaqa," and then to *taswiyah*, in the texts of both Surah Al-Qiyāmah and Surah Al-Infīṭār. Then the modification of facial features is mentioned in Surah Al-Infīṭār, and the development of sexual characteristics is mentioned in Surah Al-Qiyāmah. Both of these events correspond to the events beginning with the laḥm stage and continuing through the nash'ah stage, as referred to in Surah Al-Mu'minūn. A sequential analysis of all three surahs therefore indicates that the straightening phase corresponds to the 'izām stage.

The congruence in sequence also indicates that the passage in Surah Al-Infīṭār begins with referring to the muḍghah stage through the use of the verb "khalaqa," which is an important characteristic of this stage as explained above.

4. 'Izām.

As explained above, the beginning of the 'izām (skeleton, bones) stage corresponds to the phase of straightening. Furthermore, Surah Al-Infīṭār shows that the stage of straightening does not include modification, or *ta'dīl*, since this is stated as separately following straightening. Modification occurs through forming the general human appearance, which cannot occur during the stage of skeletal formation before the presence of the muscles. It can therefore be concluded that the modification phase starts with the beginning of the laḥm (clothing with muscle) stage, i.e., it follows the 'izām stage, which corresponds to the straightening phase (See Figure 5-9, Chapter 5). This conclusion is indicated by the order of events stated in

Surah Al-Mu'minūn on one hand, and in both Surah Al-Qiyāmah and Surah Al-Infīṭār on the other. The Qur'ān has therefore used a noun for the term 'izām to indicate change in the first instance, and a verb "sawwa" in the latter two surahs to describe an event.

Accordingly, the verb "sawwa" has the following three contextual meanings (2):

- a. Making the embryo erect and straight.
- b. Making the organs properly prepared for their functions.
- c. Straightening the surface and making it even.

The embryo at this stage becomes straighter after having been bent ('C'-shaped), its various organs and systems take their proper places, and its surface becomes more smooth after having been uneven during the muḍghah stage.

5. Al-Kisā' bil-laḥm (clothing the bones with muscles; laḥm).

According to the above discourse, the beginning of the laḥm stage corresponds to the beginning of the modification stage in Surah Al-Infīṭār. This process corresponds to the statement "and We made from it the male and female" in Surah Al-Qiyāmah, because this statement and the reference to modification both are preceded by reference to the straightening stage. Therefore, the beginning of male and female differentiation (tadhkīr and ta'nith; see Figure 6-6, Chapter 6) corresponds to the laḥm stage in Surah Al-Mu'minūn. This is, in fact, what actually takes place. There is differentiation of the genital ridge into either an ovary or testis during this stage.

6. Nash'ah.

In Surah Al-Mu'minūn, the conjunction *thumma* was used between the references to laḥm and nash'ah. However, in Surah Al-Qiyāmah and Surah Al-Infīṭār, no sixth stage is mentioned (See Table 10-1). This wording indicates that male and female sex differentiation continues to its completion, and this is what actually happens. The external genitalia differentiate between the 11th and 12th weeks (3) (See Figure 6-7, Chapter 6). Similarly, ta'dil, or modification of the organs and acquisition of human proportions of the body, continues until a late stage of pregnancy (See Figure 6-2, Chapter 6). Since these events require a relatively long period of development to be completed, they are referred to at the end of the passages in Surahs Al-Qiyāmah and Al-Mu'minūn.

However, in Surah Al-Mu'minūn, two distinct phrases are mentioned: *al-kisā' bil-laḥm*, or "clothing the bones with muscles;" and *an-nash'ah khalqan ākhar*, or "attain the definitive (human) form." Both phrases occur in sequence with the last events mentioned in the other two surahs, indicating that these developmental processes occur in concert with those mentioned in Surah Al-Mu'minūn.

7. Summary of table analysis of passages.

We can conclude the following regarding the references made to human development in the three surahs cited in Table 10-1:

- a. A complete description of each developmental process is made with regard to the appearance and events. This result is achieved through the use of nouns as specific terms which indicate external appearance and internal developments, as in the passage from Surah Al-Mu'minūn. In other cases, verbs, from which the terminology are derived, are used to describe ongoing processes, as in Surah Al-Qiyāmah and Surah Al-Infīṭār.
- b. There is full concurrence among the texts of the three surahs with regard to the sequence of the developments.
- c. The conjunctions, *thumma* and *fa*, indicate both the duration of each event, whether long or short, and the rate of transition from one event to another, whether slow or rapid. They also emphasize the congruity and parallel sequencing of events among the passages, and indicate the timing of the developments as mentioned above.

II. The significance of the Qur'anic terms.

Fourteen centuries ago, the Qur'ān and Sunnah mentioned the fact that prenatal human development occurs in stages. This fact was unknown to non-Muslim scientists until the middle of the 19th century. Furthermore, until the invention of the microscope in the 17th century, many scientists held the Greek view that the human embryo developed from the menstrual blood. In the 13th century, an eminent Muslim scholar, Ibn Ḥajar (4), disagreed with this view and cited the Qur'anic statements and Hadith as evidence, although he lacked the scientific instrumentation to provide experimental proof. These statements clearly indicate that the human develops from the products of both the male and female.

After the invention of the microscope and the subsequent discovery of the sperm, scientists believed that each sperm cell of the male

carried a fully created, miniature human being (5). This belief led them to completely ignore the genetic and physical contribution of the female towards the creation of the embryo. Later, the ovum was discovered in the 18th century, and scientists came to believe that a fully created miniature human being existed in it. Thus, misconceptions regarding the role of the male in reproduction prevailed. These theories were the result of the belief that a fully created human being should be present from the beginning of conception.

During the last two centuries, it was discovered that embryonic development occurred in stages. However, scientists continue to have difficulty in choosing terms that adequately describe the major features of the stages. For example, the terms currently in use for these stages do not fully reflect the most identifiable characteristic of the embryo at each stage. Numerals have been used, but they merely sequentially number developmental observations and do not indicate any description. However, the terms used in the Qur'ān are suitable and "outstandingly remarkable" (6), since each major change or stage is given a name that comprehensively describes the main internal and external characteristics of embryonic development (Table 10-2). A further advantage of the Islamic terms is that they are comprehensible to people of many different backgrounds.

Moreover, the uterus is described in the Qur'ān as "a place of settlement, firmly fixed" (Surah Al-Mu'minūn, 23: Āyah 13). According to modern scientific knowledge, this description comprises the major characteristics and functions of the uterus. "As a place of settlement" refers to the uterus in relation to the fetus, and "firmly fixed" refers to the uterus in relation to the body of the mother (See Chapter 2).

The Qur'anic terms of *nuṭfah*, *'alaqah* and *muḍghah* refer to the conceptus when it is exceedingly small. The diameter of the *nuṭfah*, which can be seen only by a microscope, is 0.1 mm (7). The *'alaqah* is 0.7-3.0 mm in length and the *muḍghah* is 3.2-13 mm in length (8). Due to the small sizes involved, scientists could not have recognized the detailed features of these stages until the second half of the 19th century and the beginning of the 20th.

The Qur'anic passages have also determined the sequence of all the stages and the relative time between the occurrence of each stage.

TERMS	AGE (DAYS)	SIZE (mm)
NUTFAH (DROP) STAGE	0-14	0.055-0.68
al-Ma' ad-dafiq (sperm and ovum)	0	0.055 & 0.13
Sulalah (selection for fertilization)	(in) 1	0.055 & 0.13
Nutfah Amshaj (zygote-blastocyst)	1-5	0.13
Khalq (creation)	(in) 1	0.13
Taqdir (programming)	(in) 1	0.13
Harth (implantation)	6-14	0.1-0.68
TAKHLIQ (DIFFERENTIATION) STAGE	15-56	0.7-31.0
'Alaqah (leech-like structure)	15-25	0.7-3.0
Mudghah (chewed-like substance)	26-42	3.2-13.0
'Izam (skeleton)	43-49	14.0-20.0
Lahm (muscles)	50-56	22.0-31.0
ACCOMPANYING PROCESSES IN THE TAKHLIQ STAGE		
Taswir Adami (human appearance)	40-49	12-20
Taswiyah (straightening)	43-56	14.0-32.0
Tadhkir & Ta'nith (sexual glands)	50-56	22.0-32.0
NASH'AH (GROWTH: FETAL) STAGE	57-266	33.0-500
Nash'ah khalqan akhar (organ maturation)	57-175	33.0-262
Hadanah rahimiyyah (uterine incubation)	176-266	262-500
Taysir as-sabil (parturition or labor)	266	500
ACCOMPANYING PROCESSES IN THE NASH'AH STAGE		
Ta'dill (modifications)	57-266	33.0-500
Tadhkir & Ta'nith (external genitalia)	60-77	35.0-78.0
Taswir fardi (individual images)	64-266	58.0-500
STEPS OF SEX DETERMINATION		
In the nutfah stage; taqdir, programming	(in) 1	0.13
In the lahm stage; sexual glands	50-56	22.0-32.0
In the nash'ah stage; external genitalia	60-77	35.0-78.0

Table 10-2. The Qur'anic terms for human development with the age and size for each stage.

Additionally, each stage is further subdivided into a series of developments such that a complete description exists from the initial germinal development to the end of the fetal period (Table 10-2). The three major stages are denoted by the use of the conjunction *thumma*, while the substages or phases, which occur in relatively rapid succession, are denoted by the conjunction *fa*. These statements apply completely with modern scientific observations. The accuracy and descriptiveness of the Qur'anic terms is further evidence of their Divine origin.

It is even more remarkable and astonishing, if we consider the sequence of terms expressing the corresponding stages and events, as they occur in all of the preceding Qur'anic passages examined here. Had such detailed and remarkably coordinated descriptions, complete with specific terminology, been recorded from a human source, surely they would have been found in need of change in more recent times, due to the lack of scientific development and information in that age 1400 years ago.



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Appendix:

- Glossary of Qur'anic Terminology
- Index

Glossary of Qur'anic Terminology

Word	Meaning	References*
'Addala:		
ta'dīl	Straightening and balancing	1D, 4/246-7; 2D, 15/1760-1; 4D, 11/430-6; 5D, 8/209.
'addalak	Made you straight and well proportioned	1A, 30/55; 2A, 4/228; 3A, 9/48; 5A, 6/468; 6A, 20/247; 8A, 8/436; 9A, 4/487; 11A, 787; 13A, 5/395; 14A, 17/81; 15A, 30/64.
	Modified and altered you to any appearance He wished	1A, 30/55; 2A, 4/228; 3A, 9/48; 5A, 6/468; 6A, 20/247; 8A, 8/436-7; 13A, 5/395; 14A, 17/18; 15A, 30/64.
	Altered organs on each other until they become straightened	2A, 8/436; 5A, 6/468-9; 8A, 8/436; 11A, 787; 14A, 17/18; 15A, 30/64.
'Alaqah		
'alaqah	Elongated like the shape of a leech	9A, 3/242; 20A, 2/281; 7B, 5/139; 2D, 4/1529; 3D, 343; 4D, 10/267.

* The capital letters in the references indicate the section of the lists of references following the glossary. The number preceding the letter indicates the position of the reference within each section. Following the comma, is the volume number if applicable, and then the page number

Word	Meaning	References
'Alaqah (cont.):		
'alaqah	Derived from "ta'laq" which means to cling and attach to something	7B, 5/440; 3/287-8; 1D, 4/125; 2D, 4/1529; 3D, 343; 4D, 10/267; 5D, 7/20.
Amshāj		
	Mixtures of the fluid of the male with that of the female.	1A, 29/126-7; 3A, 8/428; 2A, 4/195; 6A, 19/121; 7A, 6/418; 8A, 8/393; 9A, 4/454; 11A, 774; 12A, 6/418; 13A, 5/344-5; 15A, 29/152; 4D, 2/367.
	Mixtures of colors of nutfah.	1A, 29/127; 2A, 4/195; 6A, 19/121; 8A, 8/394; 12A, 6/419; 4D, 2/367.
Ansha'nāhu:		
nasha'a	To grow and develop	2D, 1/77; 4D, 1/170; 5D, 1/126.
	To rise and increase	1D, 5/428; 2D, 1/78; 5D, 1/126.
	Acquisition of the soul	3A, 5/463; 6A, 12/109; 8A, 6/397; 9A, 3/242; 11A, 452; 12A, 4/375; 13A, 3/476.
	Make a creature which can speak, hear, and see.	2A, 3/28; 4A, 12/85; 7A, 4/336; 8A, 6/398;

Word	Meaning	References
Ansha'nāhu (cont.):		
		9A, 3/242; 12A, 4/336; 15A, 18/15.
Fiṣāluhu: in "wa fiṣāluhu fī 'āmayn"		
	Its weaning from the mother's breast, after the passage of two years.	1A, 21/45; 2A, 3/233; 3A, 6/319; 6A, 14/64-5; 8A, 7/187; 9A, 3/446; 11A, 544; 13A, 4/234; 15A, 21/86.
Fiṣāluhu: in "wa ḥamluhu wa fiṣāluhu thālhūn shahrā"		
	The period of pregnancy plus breastfeeding is thirty months.	2A, 30/521; 3A, 7/377; 5A, 5/480; 6A, 16/163; 8A, 8/60; 9A, 4/158; 11A, 667; 13A, 5/18; 14A, 15/15; 15A, 26/17; 19A, 7/386.
Ḥarth		
Ḥarth	Working on the land, ploughing and planting.	4D, 2/134; 5D, 1/614.
	A place of planting.	1A, 2/231; 2A, 1/91; 3A, 1/251; 4A, 6/71; 5A, 1/335; 6A, 3/92; 7A, 1/335; 9A, 1/261; 10A, 13/281; 11A, 1/34; 12A, 1/335; 13A, 1/226; 14A, 3/224; 15A 2/124; 17A, 51; 19A, 1/124; 18A, 2/361.

Word	Meaning	References
Khalaqahu		
Khalaqa	To decide and plan.	1D, 2/214; 2D, 4/1470; 3D, 157; 4D, 10/87; 5D, 6/335.
	To create something without a previous example.	3D, 157; 4D, 10/85; 5D, 157.
	Originating one thing from another.	3D, 157.
Khalqan min ba'd khalq		
	The stages of creation inside the uterus, i.e., nutfah, then 'alaqah, then mudghah.	1A, 23/125; 2A, 3/388; 3A, 7/164; 5A, 5/301; 6A, 15/236; 8A, 7/417; 9A, 4/47; 13A, 4/450; 14A, 14/197; 15A, 23/240-1.
Maniy		
Mana	To decide or plan.	1D, 5/276; 2D, 6/2497; 3D, 475; 4D, 15/ 292; 5D, 10/347.
Maniy	Male fluid.	2D, 6/2497; 4D, 15/293.
	Male and female fluids.	1D, 5/276; 5D, 10/348.

Word	Meaning	References
Mukhallaqah wa ghayr mukhallaqah		
	This is describing two contrasting features of the <i>muḍghah</i> which must be present simultaneously. An analogy is that if a paper is described as both white and black, one feature cannot be considered while ignoring the other. The description applies to all <i>muḍghahs</i> , those which are mature and those which are aborted.	
	With features formed and unformed.	1A, 17/69-70; 3A, 5/407; 4A, 12/8; 5A, 4/288; 6A, 12/9; 11A, 439; 13A, 3/436; 14A, 12/8; 15A, 17/116; 17A, 488.

Muḍghah

Some interpreters explained the *muḍghah* as a piece of meat and others explained that it is similar to a piece of meat. However, according to the passage in Surah Al-Mu'minūn, the *laḥm* (muscles, flesh) stage comes later than the *muḍghah*, and therefore the tissue of the *muḍghah* differs in nature from muscle or flesh.

Muḍghah	A piece of meat, or like a piece of meat, the size of a bite.	1A, 18/8; 2A, 3/5; 3A, 5/407; 4A, 12/8; 5A, 4/288-9; 6A, 12/906; 9A, 3/207; 10A, 13/9; 11A, 439; 13A, 3/436; 14A, 12/8; 15A, 17/116; 1D, 5/330; 2D, 4/1326; 4D, 8/450; 5D, 6/30.
	Chewed with the teeth.	1D, 5/330; 5D, 6/430; 2D, 4/1326.

Word	Meaning	References	
Nuṭfah	A drop.	6A, 12/6; 17/118; 19/120; 13A, 3/436; 5/342; 15A, 17/116; 1C, 2/121; 7B, 3/116; 4D, 9/236; 5D, 6/258.	
	A small amount of water.	4A, 30/234; 6A, 17/118; 7A, 4/336; 10A, 13/9; 12A, 4/288; 13A, 3/436; 4D, 9/235; 5D, 6/258.	
Sawwa	Taswiyah	Erect and straight.	1D, 3/113; 2D, 6/2384-6; 4D, 14/408-17; 5D, 10/189.
		Preparing the organs for their uses.	2A, 4/228; 4A, 31/80; 5A, 6/468; 7A, 6/468; 8A, 8/436; 11A, 787; 14A, 17/81; 15A, 30/64.
		Making the body erect and straight.	9A, 4/283.
		Straightening the surface and making it even.	2B, 2/666; 4/1866; 3B, 1/432; 7B, 5/324; 1C, 3/79.

Word	Meaning	References
Şawwara		
Şūrah	Shape and external appearance.	1D, 3/319-20; 5D, 3/342; 4D, 4/473.
	Special features which differentiate one thing from another.	3D, 289.
	Facial features.	1B, 2B, 3B, 4B, 5B, 7B, 3/116.
	...And then modified you in whatever form (facial features) He wanted to put you together.	
	Resembling relatives; In any remembrance of the father, mother, uncle, etc.	1A, 30/55-6; 2A, 4/228; 3A, 9/47-8; 6A, 20/247; 9A, 4/483; 12A, 6/468.
	Beauty, ugliness, height, and sex.	2A, 4/228; 3A, 9/48; 6A, 20/247; 8A, 8/437; 12A, 6/469; 14A, 17/81; 15A, 30/64.
	There is no conjunction between this sentence and what came before it; which means that it is an explanation of 'addalak.	2A, 4/228; 5A, 6/469; 7A, 6/468; 8A, 8/437; 15A, 30/64.
Sulālah.		
Sulālah	What is extracted from a thing and taken out gently.	1D, 3/56-60; 2D, 5/1730; 4D, 11/338; 5D, 7/377.

Word	Meaning	References
Sulālah (cont.)		
	Extraction; also giving the meaning of decreasing; or what is drawn out of a thing or extracted from it.	1A, 18/6; 2A, 3/27; 3A, 5/462; 4A, 12/85; 5A, 4/355; 6A, 12/109; 10A, 3/113; 11A, 452; 13A, 3/476; 14A, 12/75; 15A, 18/13.
Tamakkun ar-raḥim		
	Stability of the uterus in itself so that is not subject to imbalance.	1A, 19/7; 2A, 3/27; 4A, 12/85; 5A, 4/336; 8A, 6/398; 9A, 3/242; 14A, 12/75; 15A, 18/13; 19A, 5/778-81.
	Firm settlement of what occupies the uterus, i.e., the embryo.	2A, 3/27; 5A, 4/336; 8A, 6/398; 15A, 18/13; 19A, 5/778-81.
Taqdīr:		
qaddara a 'dā'ah	Its head, eyes, hands, and legs prepared for their function.	2A, 4/219; 3A, 9/31; 6A, 19/218; 8/A, 8/448; 13A, 5/384; 14A, 17/58; 15A, 30/44.
qaddara	"Correct origin" indication of the entire extent and nature of a thing and its destiny.	1D, 5/62; 2D, 2/780; 4D, 5/78; 5D, 3/481.
	To plan a thing with marks that outline it.	4D, 5/78; 5D, 3/483.

Word	Meaning	References
Taqdīr (cont.)	Decided its stages, i.e., nuṭfah, then 'alaqah, etc.	1A, 30/35; 3A, 90/32; 6A, 20/218; 9A, 4/384; 11A, 784; 13A, 5/384; 15A, 30/44; 19A, 9/54.
Thumma as-sabīl yassarah	Made easy the exit from the mother's abdomen.	1A, 30/35; 2A, 4/219; 3A, 9/31; 8A, 8/428; 9A, 4/473; 11A, 784; 13A, 5/384; 15A, 30/44.
Tumna	Poured and spilled in the uterus.	1A, 27/44; 2A, 4/34; 3A, 8/83; 4A, 15/20; 5A, 6/117; 6A, 17/118; 8A, 8/168; 13A, 5/116; 14A, 15/255; 15A, 27/69; 19A, 7/711.
	Decided, planned, or programmed.	2A, 4/34; 3A, 8/83; 4A, 15/20; 5A, 6/117; 6A, 17/118; 8A, 8/168; 13A, 5/116; 15A, 27/69; 19A, 7/711.
Ẓulumātun thalāth	The abdomen, uterus, placenta.	1A, 23/125; 2A, 3/388; 3A, 7/164; 5A, 5/301; 6A, 15, 236; 8A, 7/417;

Word	Meaning	References
Zulumātun thalāth (cont.)		
		9A, 4/47; 13A, 4/450; 14A, 14/197; 15A, 23/241.
Zulmah.	Opposite of illumination and light.	1D, 3/468; 2D, 5/1978; 3D, 315; 4D, 12/377-9; 5D, 8/384-5.

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FOCUS OF THIS BOOK

The understanding that the human embryo develops in stages is a fairly recent discovery in modern science. Since the end of the nineteenth century, researchers have attempted to devise reasonably accurate terminology for classifying these stages. Until recently, it was not known to many Western scientists that the Qur'an and Sunnah, which are the sources of Islamic belief, provide detailed descriptions of significant events in human embryological development, and this terminology is characterized by descriptiveness, accuracy, ease of comprehension, and integration between description of appearance and main internal processes.

This publication is a compilation of conference proceedings presented by renowned scientists and scholars in embryology, anatomy and Islamic studies who investigated and compared the direct linguistic meanings of the Islamic terminology with the latest scientific findings. They concluded that the appearance of these terms fourteen hundred years ago is astonishing, since it was impossible for this knowledge to have been attained through any human means, given the limitations of human scientific advancement and technology at the time.

Furthermore, these terms, as explained in this book, can serve as valuable additions to the field of embryology.

The relationship between science and religion in the West has often been characterized by antagonism, opposition, and hostility. In contrast, this relationship in Islamic society has been one of cooperation, harmony, and mutual benefit. The information presented in this book illustrates the clear support and encouragement provided through Islamic teachings for objective scientific research and is a solid evidence for this type of harmonious relationship.

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