HUMAN GENOME AND THE BEGINNING OF HUMAN LIFE

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Abstrak:

Pertanyaan mengenai kapan manusia mulai hidup merupakan pertanyaan yang sudah sangat kuno dan belum bisa dijawab secara memuaskan. Pertanyaan itu baru bisa dijawab secara meyakinkan pada dekade terakhir ini oleh karena perkembangan ilmu biologi, khususnya genetika dan embriologi manusia. Dengan selesainya program Human Genome Project, sekarang kita sudah bisa mengetahui satuan gen manusia beserta fungsinya. Manusia mempunyai sekitar 40.000 gen yang berbeda dengan makhluk hidup lain dan yang bersama-sama membentuk hidup manusia. Kepenuhan kepemilikan gen manusia yang lengkap dalam 46 kromosom itu terjadi dalam pembuahan dan inilah yang menandai permulaan hidup manusia. Oleh karena itu, secara biologis tiada keraguan bahwa hidup manusia itu mulai pada saat selesainya proses pembuahan ovum oleh sperma.

Key Words:

Genetics, Human Genome Project, beginning of life, animation, ensoulment, DNA, chromosome, embryonic development, personality.

1. Beginning of Life in the Ancient Times

The beginning of life is one of the most ancient questions regarding the life of human beings: When does life of a human being actually begin? There is no single answer from the time of the ancient Greeks until now. One of the ancient writings regarding the human embryo was that of Pseudo-Galeno in his work *Ei zoon to kata gastrós*. In it he affirmed that the embryo was a living being and therefore transgressors of the embryo needed to be punished[1]. The ancient Egyptians believed that the soul entered the child at birth through the placenta.[2]

The ancient Greek philosophers did not have the same answer regarding the exact day of the beginning of the human life although they shared almost the same view on the biology of human beings.

In his book *Procreation- Nature of the Children,* Hippocrates (460–377 B.C.) said that the animation of a male occurred on the 30th day of pregnancy and

the female occurred on the 42nd day of pregnancy. The difference of time was caused by the fact that female semen was weaker and more humid than the male semen.[3]

According to Aristotle (348–322 B.C), the animation of a male embryo occurred on the 40th day of pregnancy and the animation of a female embryo occurred on the 90th day of pregnancy. The sign of the animation was the movement of the embryo. "In the case of male children the first movement usually occurs on the right-hand side of the womb and about the fortieth day, but if the child be a female then on the left-hand side and about the ninetieth day."[4]

The female embryo was weaker than the male embryo therefore the development of a female fetus in the womb took more time for animation.

> In man males are more often born defective than females, but in the other animals this is not the case. The reason is that in man the male is much superior to the female in natural heat, and so the male foetus moves about more than the female, and on account of moving is more liable to injury, for what is young is easily injured since it is weak. For this same reason also the female foetus is not perfected equally with the male in women (but they are so in the other animals, for in them the female is not later in developing than the male). For while within the mother the female takes longer in developing.[5]

Aristotle's idea was based on the observation of animal and human reproduction. From his observation, Aristotle got some interesting data. The first data was regarding the sexual intercourse: A woman only became pregnant after she had sexual intercourse with a man during which a man deposited his semen in her. The second data was regarding the menstrual blood of woman: he observed that the monthly menstrual blood of women ceased when a woman became pregnant.

With his philosophical background Aristotle reflected on the above data and he concluded that there must be an active agent to start the process of procreation. He believed that the active agent was the male semen and that women did not contribute semen in the coitus, "Some think that the female contributes semen in coition because the pleasure she experiences is sometimes similar to that of the male, and also is attended by a liquid discharge. But this discharge is not seminal; it is merely proper to the part concerned in each case."[6]

Women, however, provided the material which was the menstrual blood[7] in which the male semen could work on it. He said, "the male contributes to generation is the form and the efficient cause, while the female contributes the material."[8] In the further development, the female's contribution would become the body of the embryo and the male's contribution would be the soul. He

said, "While the body is from the female, it is the soul that is from the male, for the soul is the substance of a particular body".[9]

For Aristotle, therefore, the women's role in reproduction was passive: only providing the material on which the male's semen – the soul – worked. In his eyes the children came from the male because the soul of the children came from the father.[10] Aristotle stressed that by definition "male is that which is able to generate in another" while "female is that which is able to generate in itself and out of which comes into being the offspring previously existing in the generator".[11] Since the main principle of life – soul – came from man that was the reason why only man was counted in the genealogy and the family name came only from man.

Because the male semen had to work on the female matter to initiate a new human being, that was the reason why there was body first and then came the human soul which was the principle of movement/active power of movement. "We find that, whenever one thing is made from two of which one is active and the other passive, the active agent does not exist in that which is made; and, still more generally, the same applies when one thing moves and another is moved. But the female, as female, is passive, and the male, as male, is active, and the principle of the movement comes from him".[12]

Therefore, we can summarize Aristotle's thinking as follow: In the generation of children, a woman contributed the material (the body) and a man infused his creative power (the soul) inside his semen so that the new life of a human being emerged. The process of entering the soul into the body took time so that it did not take place at the time of coitus or conception but it took place many days after. One can recognize the existence of the soul in the embryo through the movement of the embryo for the first time, since the human soul was the principle of the movement. The conception only made an embryo which was the first mixture between semen and menstrual blood.[13]

So, according to the ancient Greek philosophers, the life of a human being started with the ingression of soul into the body of an embryo. Before the ingression of the soul, there was no human life although there may exist another form of life. The ingression of the soul (Latin: *anima*) in the fetus is technically called animation or ensoulment. The presence of the soul in the body was detected by the movement of the fetus in the uterus as felt by the mother. The first movement of the fetus was called quickening. In other words, the beginning of human life is the animation of the fetus (=the ingression of the soul) which can be detected by the quickening (movement) of the embryo. In the further discussion, since the animation of embryos occurred many days after fertilization, this animation was called "late animation" in contrast to the

"immediate animation" which is when the soul entered in the body at the time of fertilization.

The late animation was a logical conclusion to the biological data which was available in that time as well as the philosophical reflection on this biological data. Accordingly, the development of human life followed the cycle of life on the earth which starts from the lowest form of life to the highest form of life (soul). It started with vegetative life and then sensitive life and finally intellective life.[14] Vegetative life was assigned to the plants; sensitive life was assigned to the animals and the highest level of life – intellective life – was assigned exclusively to the human beings. The higher level of life was achieved through the lower level of life.

So in the first step of human embryo's development, the embryo had vegetative life, and then sensitive life and finally intellective live. "For at first all such embryos seem to live the life of a plant. And it is clear that we must be guided by this in speaking of the sensitive and the rational soul. For all three kinds of soul, not only the nutritive, must be possessed potentially before they are possessed in actuality".[15]

There were special prerequisites for the intellective life (soul), such as a brain and nerves which had to be prepared (developed) before being capable of receiving the intellective soul. These prerequisites were formed only after many days of development so that the ensoulment took place many days after fertilization.

Most of the ancient Greek philosophers shared the same view on the above nature of the development of human life. This view lasted for more than two thousand years until the era of St. Thomas Aquinas (1226–1274) and the Christian tradition which then followed for many centuries.

2. Thomas Aquinas and the Beginning of Human Life

In the discussion about the beginning of life, especially in relation to early abortion, many people[16] cited St. Thomas Aquinas. According to them, St. Thomas also agreed that the animation occurred at the 40th day of gestation for male and at the 90th day for the female embryo. We will look at a glance at this problem.

St. Thomas Aquinas was heavily influenced by Aristotle and in many ways he developed Aristotle's view of human animation. Aquinas' view of embryological development was based on the Aristotelian biology with a slight difference. According to Aquinas, during intercourse men deposited semen as the active power while the woman provided the matter, "In perfect animals,

generated by coition, the active force is in the semen of the male, as the Philosopher says (De Generatione Animalium ii,3); but the foetal matter is provided by the female."[17] This semen contained the active power of motion while the female's matter – menstrual secretion – contained a vegetative soul which existed since the beginning, "the active force is in the semen of the male .... In this matter, the vegetative soul exists from the very beginning".[18] Although the female matter was composed of living cells, it could not become a fetus by itself because there was no internal development guide or power. The male semen provided this internal power. After the fertilization, Aquinas followed Aristotle's human development who said that a human being developed from vegetative (nutritive) soul into a sensitive soul and finally into an intellective soul, "Therefore the vegetative soul, which comes first, when the embryo lives of the life of a plant, is corrupted, and is succeeded by a more perfect soul, which is both nutritive and sensitive, and then the embryo lives an animal life; and when this is corrupted it is succeeded by the rational soul introduced from without".[19]

This development did not follow a linear development, however, but a discontinuous development because upon the arrival of the higher soul, the lower soul was destroyed, although the higher level had the characteristic of the lower level.

> We must therefore say that since the generation of one thing is the corruption of another, it follows of necessity that both in men and in other animals, when a more perfect form supervenes the previous form is corrupted: yet so that the supervening form contains the perfection of the previous form, and something in addition. It is in this way that through many generations and corruptions we arrive at the ultimate substantial form, both in man and other animals. This indeed is apparent to the senses in animals generated from putrefaction. We conclude therefore that the intellectual soul is created by God at the end of human generation, and this soul is at the same time sensitive and nutritive, the pre-existing forms being corrupted.[20]

The passage from sensitive to intellective soul was different between Aristotle and Aquinas. Aristotle maintained that the intellective soul came from without[21] whereas Aquinas affirmed that the intellective soul (human soul) came from the power of God. "Therefore others say that the same soul which was at first merely vegetative, afterwards through the action of the seminal power, becomes a sensitive soul; and finally this same soul becomes intellectual, not indeed through the active seminal power, but by the power of a higher agent, namely God enlightening (the soul) from without".[22]

The active power of the male worked at a distance or immediately through the power in the semen to form the female matter into the body of a human fetus.[23] It continued to work until the first principal part – the heart - was

present within the embryo and it organized the body parts so that the human body was ready to receive the human soul (intellective soul). The organization of the body took time and occurred after fertilization but before birth. Aquinas discussed this case when he said about the sanctification of Blessed Virgin Mary. He said, "The Lord says that He 'knew' Jeremiah before he was formed in the womb, by knowledge, that is to say, of predestination: but He says that He 'sanctified' him, not before formation, but before he 'came forth out of the womb', etc."[24] Because the preparation of the body to receive the human soul took time, Aquinas believed that God imposed the human soul when the fetus was ready to receive it. Furthermore, according to Thomas, the nature of human beings as the image of God was in his intellectual nature and that was the reason it was only after the presence of *ratio* that human being could receive soul (intellective soul). "Since man is said to be the image of God by reason of his intellectual nature, he is the most perfectly like God according to that in which he can best imitate God in his intellectual nature.... The image of God, in its principal signification, namely the intellectual nature, is found both in man and in woman".[25]

It is interesting to note that St. Thomas Aquinas never mentioned the exact time of animation. When he spoke about the sanctification of Mary, he stated that Mary was sanctified after animation because sanctification was the cleansing from original sin and only an animated human being had original sin. Before animation, the fetus did not have sin,

> I answer that, the sanctification of the Blessed Virgin cannot be understood as having taken place before animation, for two reasons. First, because the sanctification of which we are speaking, is nothing but the cleansing from original sin: for sanctification is a "perfect cleansing," as Dionysius says (De Divinis Nominibus xii). Now sin cannot be taken away except by grace, the subject of which is the rational creature alone. Therefore before the infusion of the rational soul, the Blessed Virgin was not sanctified. Secondly, because, since the rational creature alone can be the subject of sin; before the infusion of the rational soul, the offspring conceived is not liable to sin.[26]

So the cleansing of sin happened after animation and before birth, "But the Blessed Virgin did indeed contract original sin, but was cleansed therefrom before her birth from the womb."[27] Unfortunately, Aquinas did not know exactly when the sanctification took place. That was the reason, the Church tolerated the celebration of sanctification of Mary in her conception although he affirmed that the sanctification did not take place in her conception. "But since it is not known when she was sanctified, the feast of her Sanctification, rather than the feast of her Conception, is kept on the day of her conception".[28]

Certainly when Aquinas formulated his opinion, he did not know about the modern human embryology and human genetics. He had no knowledge

about the sperm and ovum which contain 23 chromosomes and how they function. He did not know about the chromosomes, the DNA, and the genes which play an important role in the fertilization process. Neither did he know about what happens in the fertilization. These are his serious drawbacks in his reflection on the human embryo.

3. Modern Human Embryology and Genetics

Let us see what modern human embryology and genetics say about the beginning of human life. All living organisms are composed or made of cells. Simple organisms such as bacteria have only one cell, while complex organisms such as animals and human beings are multi cellular. There are about 3×10^{12} cells in an adult human being.[29]

If we incise a cell, we will find many compartments which are separated by membranes. For our purposes, we will focus on the two of them: mitochondrion and nucleus. Mitochondrion (plural: mitochondria) is a structure outside the nucleus that is the site of the cell's energy production and contains a small number of genes. There are from hundreds to several thousands mitochondria within each cell and they have their own DNA, called mtDNA (mitochondrial DNA). Unfortunately the mechanism and the content of the mitochondria are poorly understood today.[30] One thing that is clear is that only maternal mitochondria with their genes are transmitted to the children because at the time of natural fertilization, the sperm left its mitochondria outside the ovum. The unification between sperm and ovum occurs between the nucleus of the sperm and the nucleus of the ovum.

The nucleus is the center of a cell and acts as the information center of a cell. Inside the nucleus there are chromosomes. The word chromosome is derived from Greek words *cromo* (color) and *soma* (body), because we can easily recognize it in the microscope by its colorful body. The chromosomes are identified by their length and the position of the centromeres. In 1959 the system of chromosome classification was established in Denver and as such was called the Denver System of Chromosome Classification.[31] In a human cell, there are 46 chromosomes which are inherited from the parents: 23 from the mother and 23 from the father.

Based on the number of chromosomes, all human cells are divided into two kinds of cells: somatic cells (*soma* = body; somatic cell = cell of the body) that contain 46 chromosomes (diploid) and germ cells or gametes that contain 23 chromosomes (haploid or monoploid). Germ cells are called haploid (from Greek word *aplous* = single) because it has a single set of unpaired chromosomes in a single cell. So the ovum has 22 autosome chromosomes plus

X chromosome while the sperm has 22 autosome chromosome plus either Y chromosome or X chromosome. Human chromosomes are divided into two types: sex chromosomes (X or Y chromosome) and autosome which are all human chromosomes except sex chromosomes. So a man has 22 pairs of autosome chromosomes and XY chromosome while a woman has 22 pairs of autosome chromosomes and XX chromosomes.

If we unwind chromosomes, we find the chain of DNA (deoxyribonucleic acid) whose shape is like a double helix ladder. There are about two meters long of DNA chain that are tightly packaged and coiled in each cell of the human body. Since the human body is composed of about 3×10^{12} cells, if we join together the entire DNA strands in a human being, it would connect the earth and the moon 8,000 times round trip[32]. It was James Watson and Francis Crick who discovered the double-helix structures of DNA in 1953.

The structure of DNA is a molecule that consists of two intertwined strands, wrapped around each other in helical fashion. It is composed of two important parts. The first is the double helix with its backbone which is composed of repeating compounds of phosphate and deoxyribose (a kind of sugar). The second is nucleotide which is located between the two helices and are linked one to another along the backbone of each strand by regularly repeating chemical bonds. Nucleotide is always composed of paired bases. The first is the paired base between Adenine (A) and Thymine (T) and the second is the paired between Guanine (G) and Cytosine (C). There are about 3.1 billion base pairs in the entire human DNA contained in our chromosomes.[33]

The composition of a certain sequence of DNA makes up a gene. So the gene is not a point in a certain place of DNA but a certain sequence of DNA. The term gene comes from a German word *Gen* and was used for the first time in 1909 by Danish geneticist Wilhelm L. Johannsen (1857-1927). It is the gene that acts as the unit controlling the formation of a single polypeptide chain and contains genetic information. Although all genes are made of DNA, not all DNA make up genes because there are some places in the DNA strand that contain no genetic information. A single long strand of DNA contains several genes, many structural sequences, and plenty of sequences. Previously it was thought that there were about 50,000 – 100,000 human genes[34] but after finishing the Human Genome Project it was then estimated that there are 25.000 – 40.000 human genes.[35] Genome is the entire set of genetic instruction in the nucleus of every cell.[36] The Human Genome Project aims to sequence and to map the entire human genes. The completion of the rough draft sequence of the human genome was announced by Bill Clinton and Tony Blair on June 26, 2000.

The Human Genome Project succeeded in mapping and sequencing human genome. Now we know the unit of each gene and how it functions of when and where each of our gene functions during normal development from embryonic stage until death. Biologically speaking, it is the genes that make up human life. It is genes which make up DNA that all living beings are said to have in common. Thus DNA is the substance and mechanism of heredity intrinsic to the notion of life itself. Today the most definitive accounts of life rely on evolutionary and genetic models. Franklin cited one of the great twentieth-century biologists, Ernst Mayr, who said, "The possession of a genetic program provides for an absolute difference between organisms and inorganic matter".[37] Further, James Watson, the inventor of double helix structures, said, "It is our DNA that distinguishes us from all other species, and that makes us the creative, conscious, dominant, destructive creatures that we are."[38]

When President Bill Clinton announced the completion of the rough draft sequence of the human genome, he said, "Today, we are learning the language in which God created life."[39] What he means by "the language in which God created life" is the human genes.

The human genome is formed in fertilization. Gametes (ovum and sperm) contain 23 chromosomes which are only half of the normal number of human chromosomes. The union between ovum and sperm which happens in fertilization makes a normal number of human chromosomes (46 chromosomes). With the completion of normal human chromosomes in fertilization it also means the completion of human genome and it also means the beginning of human life.

Now, most of the human embryologists agree that human life starts at the fertilization. Larsen opens his famous book on the human embryology by stating:

> In this text, we begin our description of the developing human with the formation and differentiation of the male and female sex cells or gametes, which will unite at fertilization to initiate the embryonic development of a new individual.... Fertilization takes place in the oviduct. After the oocyte finish the meiosis, the paternal and maternal comes together resulting in the formation of a Zygote containing a single diploid nucleus. Embryonic development is considered to begin at this point.[40]

Regarding Thomas Aquinas, it is clear for us now that he made wrong conclusion regarding the beginning of life based on the wrong premises (biological data). He thought that embryonic development followed the Aristotelian embryology. Now there is no single human embryologist who agrees with Aristotelian embryology.

Aristotelian embryology assumed a discontinued development in each stage of life: vegetative life and then sensitive life and finally intellective life. Modern embryology states clearly that embryonic development is continuous and uninterrupted development. Although embryologists give many names to the embryo during its development (such as zygote, morula, blastocyst etc.), it does not mean that its development is in discontinuity. Embryonic development follows the uninterrupted rigorous cell's development and differentiation (specialization) to come up with a full human being as the finality of its development.

Now, it is clear for us why Thomas Aquinas make a wrong statement on the beginning of human life. As the common rule in logic states: a false premise cannot be followed by a right conclusion. The science of modern embryology proves clearly that Aristotelian and Thomistic view on the development of the human embryo is wrong. Because of his complete lack of factual biological knowledge as the basis of his reflection, Aquinas made an erroneous conclusion regarding the beginning of human life.

If Aquinas had known that:

- the active power which forms a human embryo is both the sperm and the ovum and that there is no "female matter" on which the active power needs to work on it to start a new embryo,
- the formatting elements of an embryo is the fusion of ovum and sperm with their genetic materials and this happens at fertilization,
- that at the end of the fertilization have formed the genome of the child which lead and control further embryonic development until the person dies,
- that the man and the woman contribute equally in the genome of their child,
- that the embryonic development is continuous without any discontinuity,

he would have concluded that the life of a human being has existed since the fertilization.

4. Further Controversies

Although human embryologists state that human life starts at fertilization, unfortunately, the controversy about the beginning of life of a human being remains until the present time. It may be true that a human embryo is a sign of contradiction.[41] Some people have said that there is no set time for the beginning of life of a human being whereas other people have said that the beginning of life occurs many days after fertilization. In his famous book, *Remaking Eden: Cloning and Beyond in a Brave New World*, Lee M. Silver, a professor at Princeton University, in the USA, said: "What science tells us is

that there is no single moment that marks your beginning. No single moment that can be isolated away from so many other important moments and that we can all agree upon. Instead, a scientist will tell you that you emerged slowly over time from the genetic information and molecules that made up your developing body."[42]

Silver argued that the moment of fertilization is not the beginning of human existence. The genetic materials in our body have already existed long before fertilization in the mother's egg, and the grandmother's egg, and so forth. So if a woman is pregnant, she not only has her child within her womb but also her grand children and great-grand children. If we trace back our beginning, there may be no stopping until we come to the first cell some 3.5 billion years ago.[43]

In responding to this argument let us return to the biological data of the embryo. It is true that the genetic materials of our bodies are not made from nothing (*creatio ex nihilo*) in the time of fertilization. The elements of the genetic materials have existed for millions years and have been transmitted from generation to generation as hereditary. With the help of modern technology, one can trace his ancestors based on their DNA. Some researchers have concluded that the origin of modern people occurred somewhere in Africa approximately 180.000 – 360.000 years ago.[44] So, in this case, Silver's statement is true because some genetic materials are inherited and have existed in the world for many generations.

It is also true that the formation of the ovum (oogenesis) occurs in the embryonic stage so that when a woman is pregnant, inside her womb there is not only her daughter (embryo) but also the primitive gametes which eventually may become her grand-children. The formation of the ovum starts at third month of gestation, and by the fifth month of gestation, the total number of germ cell cells in the ovary reaches its maximum of approximately 7 million cells.[45]

But it has to be noted carefully that these genetic materials are only a part of the genome of a person[46] and the primitive gamete cells with their haploid chromosomes are not a human being. They have only 23 chromosomes. The whole sum of genetic materials (genome) of a person who has 46 chromosomes are created at the time of fertilization. The genome of a child is completely new. It has never existed before an after, although some of the forming elements are not new. Although the genomes of the mother and father are the same, they transmit a different set of genetic material to each of their children so that one child's genome is different from another child's genome. Biologically speaking, the genome of a human being is formed at the time of fertilization and it starts its life cycle from the time of fertilization.

In this case, Silver made wrong generalizations regarding all types of life and he failed to make a distinction between cell, organism, population, and species. Although all of these are the forms of living beings and they may exist in the same subject, but each of them is a different category.

A cell is the basic unit of all living organisms that can reproduce itself. First of all, it has to be noted well that there are differences among a one-cell zygote, one cell of a somatic cell, and one cell of a germ cell. In his above statement, Lee Silver actually spoke about genetic information in the primitive gamete (germ) cells. The gametes cells are haploid cells that have only 23 chromosomes while a cell which is a zygote is diploid which has 46 chromosomes. A haploid cell is not a form of life of a human being because a normal human being has 46 chromosomes (diploid). A gamete cell alone never develops naturally into a human being. Secondly, a cell which is part of a living being (somatic cell) is very different from a cell which comes from the fusion of ovum and sperm (zygote). Although both kinds of cells have the same number of chromosomes (46 chromosomes) and both of them are living, there are big differences. A cell which is a zygote has a completely new genome, has totipotency to develop into all organs which are needed to be a human being, and has the inner program which leads its development into a full human being, whereas a somatic cell as a part of a living being (somatic cell) does not have these characteristics. These facts have immense differences and consequences. In their natural development, a zygote develops into a full human being whereas a somatic cell will never develop into a human being.

Except for a few living beings such as bacteria and algae which have only one cell, most of all the living beings are multi cellular. All of the multi cellular beings are recognized through their individual form of existence. This form of individual existence is characterized and constituted throughout their life and is called an organism. This organism represents the integration, the coordination and the ultimate expression of the structures and functions of a living being, which make it this single living being and not another one of the same species.[47]

A species is a sequence of ancestral and descendant populations closely related to each other and, therefore, more or less similar in essential characteristics. Among the same species, they can actually or potentially interbreed to produce natural populations that are genetically similar and reproductively isolated from other such group.[48]

A population is a group of organisms of the same species which live in the same environment or in the same territorial sphere.[49]

So when we apply the above categorization onto human beings, it means that the human being as an organism is a certain human being, that human

being or this human being (individual). A species of human beings refers to all human beings as a whole regardless of where they live and when they lived. A population of human beings is a group of human beings who live in a certain place, for example a group of human beings who live at the North Pole.

So when Lee Silver said, "there is no single moment that marks your beginning",[50] it can be applied to the human being as a species, or as population or as a carrier of certain genetic information. It cannot be applied to a human being as an organism or an individual. It may be true that human beings as species and their genetic information have been in the world for 3.5 billion years ago. It may be true that human beings as a population – like those in the Iraq (formerly Babylon) – may have been there for more than three thousand years ago. Such a category cannot be applied to a human being as an organism or individual.

In the bioethical discussion, the attention is more focused on the beginning of human life as an individual (organism) rather than as a species or population or as certain genetic information because the beginning of life as an organism is closely related to the embryonic treatment: how do we have to treat embryos in their first days of development? Can we kill them? Can we make them tools of research? Can we freeze them?

5. What Happens in Fertilization

Let us make clear on what happens in fertilization. All living beings – including human beings – which reproduce sexually start their life as an organism (an individual life) from one-cell as the fruit of the fusion between sperm and ovum at the end of the fertilization process. There are some reasons to affirm that the beginning of the life cycle of a human being as an organism starts at fertilization. The one-cell zygote – as the fruit of fertilization – has properties that other types of cells do not have:

- The genome of the embryo is determined exactly in the fertilization. The new genome of the baby is formed by the fusion of two hereditary which comes from the father and mother. Both of them contribute equally to form the new genome. The new genome becomes biological identity for the new human being. This new genome will never be changed and will last for life. It means that the first stage of human embryo is not a cell mass without identity or a clump of cells without any direction. It is a new living being with distinctive proper identity.
- The sex of the embryo is determined right in the fertilization. It depends on what kind of sperm who fertilizes the ovum. If a sperm contains X chromosomes it will become female (XX) while if it contains Y chromosome

it will become male (XY). So the determination of the child's sex depends on father rather than mother.

- Once fertilization has occurred, the subsequent developmental processes follow one another in a systematic and structured order[51]. The fertilized egg (zygote) develops continuously without any discontinuity until it reaches its final goal: a human being. Right after the fertilization is completed, the zygote starts the preparation for the first development (mitotic cleavage) and the first development occurs only a couple of hours later. From that time on, the zygote develops uninterruptedly to become a human being and continues until the death of the subject. It means that the life cycle of a human being as an organism starts at the time of fertilization and finishes at the death of the organism (person). Before the fertilization, gametes do not have this capacity of starting the life cycle of a human being. Gametes will always remain gametes, die as gametes, and will never become a human being.
- Right after the fertilization, the new one-cell zygote organizes a completely new genome as the information center for the whole human development and activity[52]. This new complete genome of the human being becomes his biological identity throughout his life. Therefore, the zygote is not a mass of cells without any identity; on the contrary, the zygote has her own proper identity with no one identical to it anywhere or at anytime. This proper and unique identity is formed at the time of the fertilization and such genomic identity has never existed before this fertilization.
- The zygote has an inner program which leads, shapes, directs, and controls the development of the zygote into a specific and predetermined final goal: a human being. So it is an active cell that possesses the inner capacity to develop into its precise final goal. In their natural development (without any external interferences or disruptions), human zygotes will develop into human beings and never become monkeys. This inner genomic program takes control of the development so that the stimulus from the outside will be accepted and responded according to the criteria that are established by this inner program. For example: the alimentation which the embryo receives from the mother through the umbilical cord, is processed and secreted according to the zygote's program. The control of zygote genome over his development is clearer in the case of a surrogate mother. If an ovum of a pure white woman is fertilized by the sperm of a pure white man, although after the fertilization the zygote is transferred into a womb of a black woman, the child will remain a white child. Although the embryonic development was sustained and fed by the black mother and circulated by the black mother's apparatus, but the child remains a white child because the control of the development is done not by the mother's

genome but by the genome of the child which has completed its formation at the fertilization.

To make it clearer, let us see what the modern human embryologists exactly say about fertilization and the beginning of human life:

In his famous book *The Developing Human: Clinically Oriented Embryology,* Moore testifies clearly that human being begin at fertilization:

> Human development is a continuous process that begins when an oocyte (ovum) from a female is fertilized by s sperm (spematozoon) from a male.... Study of the timetable reveals that the most visible advances occurs during the third to eighth weeks of embryonic development; however, the embryo begins to develop as soon as the oocyte is fertilized... Zygote: This cell results from the union of an oocyte and a sperm during fertilization. A zygote is the beginning of a new human being (i.e., an embryo)."[53] He said further, "Human development begins when an oocyte is fertilized.[54]

Another famous human embryologist, O'Rahilly states: "Although life is a continuous process, fertilization ... is a critical landmark because, under ordinary circumstances, a new, genetically distinct human organism is formed when the chromosomes of the male and female pronuclei blend in the oocyte".[55]

One of the best developmental biologists, Scott F. Gilbert, in his very famous book, *Developmental Biology,* dedicates one chapter on fertilization which he entitles "Fertilization: Beginning a New Organism". In this chapter, he states: "Fertilization is the process whereby two sex cells (gametes) fuse together to create a new individual with genetic potentials derived from both parents. Fertilization, then, accomplishes two separate activities: sex (the combining of genes derived from two parents) and reproduction (the creation of a new organism)".[56]

Although there are many new developments and discoveries in biology and Gilbert has changed the placement of this chapter in his book, he has never changed his statement about fertilization since the first edition of his book in 1985 until the seventh edition in 2003.

The most extraordinary statement came from a woman researcher, Helen Pearson. She said: "Your world was shaped in the first 24 hours after conception. Where your head and feet would sprout, and which side would form your back and which your belly, were being defined in the minutes and hours after sperm and egg united. Just five years ago, this statement would have been heresy".[57]

Pearson shows the fast rapid development on genetics and human embriology. The new data on human embryology come up on and on rapidly

so that people who do not follow the ultimate research may get lost on the way. Many people may still hold the old data that say human being starts some time after fertilization.

Leon R. Kass who is the Chairman of the President's Councill on Bioethics and the Addie Clark Harding Professor at the University of Chicago says clearly,

> First of all, the zygote and early embryonic stages are clearly alive. They metabolized respire and respond to changes in the environment; they grow and divide. Second, though not yet organized into distinctive parts or organs, the blastocyst is an organic whole, self-developing, genetically unique and distinct from the egg and sperm whose union marked the beginning of its career as a discrete, unfolding being.... For after fertilization is complete, there exists a new individual, with its unique genetic identity, fully potent for the self-initiated development into a mature human being, if circumstances are cooperative... Any honest biologist must be impressed by these facts, and must be inclined, at least on first glance, to the view that a human life begins at fertilization.[58]

Kass pays attention particularly to *"any honest biologist"* because he knows exactly that there are some dishonest even deceptive biologists who made misleading and even wrong statement regarding the beginning of human life. There are many vested interest behind their statements, such as bussiness, personal acchievement and popularity and so on which lead them to make a wrong statement or conclusion.

Finally, Ian Wilmut, the cloner of Dolly, said that fertilization is not only the beginning of human life but also the beginning of new individual life, "In a sexual reproduction, a female gamete (an egg) joins with a male gamete (a sperm) in the act of fertilization to produce a diploid cell. This diploid cell is, in effect, a new individual. It is a one-celled embryo and is known as a zygote."[59]

6. Conclusion

We can conclude that fertilization which is the completion of human genome marks the beginning of human life both as organism and as individual or person.

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Endnotes

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2 Keith L Moore and T.V.N. Persaud, *The Developing Human: Clinically Oriented Embryology* (7th), 9.

3 Jacques Jouanna, *Ippocrate*, 276.

4 Aristotle, *History of Animals* (VII, 583b, 3-5). See Jonathan Barnes (ed.), *The Complete Works of Aristotle: The Revised Oxford Translation*, 914. All references and citations of Aristotle's works come from this book.

5 Aristotle, *Generation of Animals* (IV, 775a.4–11). Jonathan Barnes, 1199.

6 Aristotle, *Generation of Animals* I.727b.35.

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10 Aristotle, *Generation of Animals* I.729b.1.

11 Aristotle, *Generation of Animals* I.716a.20–23.

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13 Aristotle, *Generation of Animals* I.728b.34.

14 Aristotle, *Generation of Animals* I.736a and 736b.

15 Aristotle, *Generation of Animals* I.736b.14–15.

16 Olivier de Dinechin and Yves de Gentil-Baichis, , *L'homme de la bioéthique: Entretiens avec Yves de Gentil-Baichis*, p. 52; Norman M. Ford, *When did I Begin?: Conception of the Human Individual in History, Philosophy and Science*, 41.

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