Updated References for Accurate "Language" Re "Human Being"/"Human Person"/"Personhood"

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I. Introduction

Given the continuing epidemic in efforts to scientifically, politically and legally deconstruct the accurate definitions of "human being", "human person", "personhood" and related critical sub-terms, the focus of this article is the accurate definitions of those terms to be used -- especially given the real life and deadly consequences of those linguistic deconstructions to innocent living human beings.

The accurate definitions also refute the current pandemic efforts by transhumanists and related groups to deconstruct those same terms to claim legal "personhood" for non-human animals (e.g., apes, dolphins, etc.), robots, cyborgs, avatars AI's (artificial intelligences), zombies, posthumans, etc. Indeed, for them, many innocent human beings (including human adults) would not be "persons". Consider the real-life implications of that.

Thus paradoxically, either way, such linguistic deconstructions have deadly consequences for living innocent human beings (including adults) and their progeny.

II. Legal Definitions of Human "Person" and Human "Personhood"

Person: applies to all living human beings from the beginning of their biological development as human organisms - regardless of age, race, sex, gender, capacity to function, condition of physical or mental dependency and/or disability, or method of sexual or asexual reproduction used, whether existing in vivo or in vitro. The term "person" does not apply to any non-human animals.

Personhood: is the legal recognition of a human being's full status as a human person, that applies to all human beings, regardless of age, race, sex, gender, capacity to function, condition of physical or mental dependency and/or disability, or method of sexual or asexual reproduction used, whether existing in vivo or in vitro.

III. Definitions of Human Sexual and Asexual Reproduction

[[See lengthy list and direct quotes for critical terms below following this section on "definitions"]]

A. Human Sexual Reproduction:

Based on the long known accurate internationally documented and acknowledged scientific references below, "human sexual reproduction" can be defined briefly as the following:

"In human sexual reproduction (i.e., the immediate use of human sperm and human oocyte) -- both in vivo (inside the body) and in vitro (outside the body) -- the biological beginning of a new human being/organism occurs when a human sperm makes contact with the protective covering of and fuses with a human oocyte (before the "zygote" is developed). Examples include normal
natural sexual intercourse, and artificial sexual reproduction in IVF/ART research laboratories and infertility clinics."

** See, e.g., Carnegie Stage One:

"Embryonic life commences with fertilization, and hence the beginning of that process may be taken as the point de depart of stage 1. Despite the small size and weight of the organism at fertilization, the embryo is "schon ein individual-spezifischer Mensch" [definitely and specifically a human person] (Blechschmidt, 1972). ... Fertilization is the procession of events that begins when a spermatozoon makes contact with an oocyte or its investments and ends with the intermingling of maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote (Brackett et al, 1972). ... Fertilization, which takes place normally in the ampulla of the uterine tube i.e., fallopian tube - not the uterus, includes (a) contact of spermatozoon with the zona pellucida of an oocyte, penetration of one or more spermatozoa through the zona pellucida and the ooplasm, swelling of the spermatozoal head and extrusion of the second polar body, (b) the formation of the male and female pronuclei, and (c) the beginning of the first mitotic division, or cleavage, of the zygote. ... The three phases (a, b, and c) referred to above will be included here under stage 1, the characteristic feature of which is unicellularity. ... The term "ovum", which has been used for such disparate structures as an oocyte and a 3-week embryo, has no scientific usefulness and is not used here. Indeed, strictly speaking, "the existence of the ovum ... is impossible (Franchi, 1970)." [Carnegie Stages of Early Human Embryonic Development, Stage One, at: http://www.medicalmuseum.mil/assets/documents/collections/hdac/stage01.pdf]

B. Human Asexual Reproduction

Based on the long known accurate internationally documented and acknowledged scientific references below, "human asexual reproduction" can be defined briefly as the following:

"In human asexual reproduction (i.e., without the immediate use of human sperm and human oocyte) -- both in vivo (inside the body) and in vitro (outside the body) -- the biological beginning of a new human being/organism occurs when the status of the DNA in a mere human cell or cells is regulated or reversed back to that of a new human being/organism."

Examples include naturally occurring human identical (monozygotic) "twinning" within the woman's fallopian tube and/or uterus, and artificial "twinning", pronuclei transfer, somatic cell nuclear transfer, germ line cell nuclear transfer, and other genetic engineering and regenerative medicine research techniques in IVF/ART and other research laboratories and infertility clinics."

** See, e.g., Carnegie Stages 2, 3, 4, and 5 where asexual reproduction by "twinning" is addressed. Also, the human molecular genetics textbook by Strachan and Read:

The term 'clones' indicates genetic identity and so can describe genetically identical molecules (DNA clones), genetically identical cells or genetically identical organisms. Animal clones occur naturally as a result of sexual reproduction. For example, genetically identical twins are clones who happened to have received exactly the same set of genetic instructions from two donor individuals, a mother and a father. A form of animal cloning can also occur as a result of artificial manipulation to bring about a type of asexual reproduction. The genetic manipulation in this case uses nuclear transfer technology: a nucleus is removed from a donor cell then transplanted into an oocyte whose own nucleus has previously been removed. ... The individual providing the donor nucleus and the individual that develops from the 'renucleated' oocyte are usually described as "clones", but it should be noted that they share only the same nuclear DNA; they do not share the same mitochondrial DNA, unlike genetically identical
twins. ... Wilmut et al (1997) reported successful cloning of an adult sheep. For the first time, an adult nucleus had been reprogrammed to become totipotent once more, just like the genetic material in the fertilized oocyte from which the donor cell had ultimately developed. ... Successful cloning of adult animals has forced us to accept that genome modifications once considered irreversible can be reversed and that the genomes of adult cells can be reprogrammed by factors in the oocyte to make them totipotent once again. [Tom Strachan and Andrew P. Read, Human Molecular Genetics 2 (New York: John Wiley & Sons, Inc, 1999), pp. 508-509]. (emphases added)

IV. Definitions of Other Terms Used Within the Major Definition:

**In vivo**: within the body (including the fallopian tube and the uterus).

**In vitro**: outside the body, e.g., in IVF/ART, genetic engineering, regenerative medicine and other research laboratories and infertility clinics.

**Human Being**: any human organism, including the single-cell human embryo, who possesses a genome specific for and consistent with an individual member of the human species, regardless of age, race, sex, gender, capacity to function, condition of physical or mental dependency and/or disability, or method of sexual or asexual reproduction used, whether existing in vivo or in vitro.

**Human Genome**: the total amount of nuclear and extra-nuclear DNA genetic material in a cell that constitutes an organism as an individual member of the human species - including the single-cell human embryo.

**Human embryo**: all human beings during the first 8 weeks of their biological development, including single-cell human embryos from the beginning of their biological development.

**Human fetus**: all human beings from the beginning of the fetal period of their biological development (the beginning of 9 weeks) through birth.

V. Documentation of the Accurate Human Embryology in the Carnegie Stages of Early Human Embryonic Development

Note that the standard URLs for the Carnegie Stages used for decades have now been changed. The URLs used below are the updated ones. Note also that there are some texts and websites that use the phrase "Carnegie Stages", but the scientific definitions portrayed are different from those in the genuine Carnegie Stages. Here are some examples of reliable websites:

(that also includes explanation of natural asexual reproduction), at: http://www.medicalmuseum.mil/assets/documents/collections/hdac/stage05.pdf. See all 23 stages of the early developing human embryo, short descriptions are found at: http://www.medicalmuseum.mil/index.cfm?p=collections.hdac.anatomy.s01. To find more extensive scientific details and scientific references for each of these "stages", click into the desired Stage, then click into the "textbook" at the bottom left side of the screen.

(2) The new website, "The Virtual Human Embryo", housed at the Louisiana State University's Health Sciences Center (probably the easiest to follow). For Stage 1, see: http://www.ehd.org/virtual-human-embryostage.php?stage=1.

(3) There is now even a new iPhone "app" for the Carnegie Stages, entitled "Embryo", available from the National Library of Medicine, at: http://apps.usa.gov/embryo/.


(5) The most recent updating of the Carnegie Stages online (Jan. 2011) by the international nomenclature committee on human embryology, i.e., the Terminologia Embryologica Committee (TE) which has operated internationally and updated the Carnegie Stages continuously since 1942 to the present. Go to: http://www.unifr.ch/iafa/Public/EntryPage/ViewTE/TEe02.html. You are viewing "Page 8"; now use buttons at top to move to Page 10 to arrive at description of Carnegie Stages 1-5 in Chart; The right side of chart provides the following documentation of the first 5 Stages; see especially "Single cell EMBRYO [St. 1]."

(6) Although the Carnegie Stages focus mainly on human sexual reproduction, it has always also addressed human asexual reproduction as well, especially human monozygotic (identical) "twinning". For example, see Carnegie Stages 2, 3, 4, and 5 (identical twins/triplets). See also explanations of "twinning" and many other human asexual reproductive techniques -- in vivo and in vitro -- in human embryology textbooks and in human molecular genetics textbooks (e.g., as provided above).

VI. Other Resources:


-- The usual site of fertilization [i.e., sexual reproduction] is the ampulla of the uterine tube [fallopian tube, not the uterus itself], its longest and widest part. If the oocyte is not fertilized here, it slowly passes along the tube to the uterus, where it degenerates and is reabsorbed. Although fertilization may occur in other parts of the tube, it does not occur in the uterus. ... Human development begins when an oocyte is fertilized (p. 34).

-- The embryo's chromosomes sex is determined at fertilization by the kind of sperm (X or Y) that fertilizes the ovum; hence it is the father rather than the mother whose gamete determines the sex of the embryo (p. 37).


The embryonic period proper occupies the first 8 postovulatory weeks (i.e., timed from the last ovulation). The fetal period extends from 8 weeks to birth (p. 55).

Muller, Fabiola, and Ronan O'Rahilly. ibid. (New York: Wiley-Liss, 2001)

Recapitulation, the So-Called Biogenetic Law. The theory that successive stages of individual development (ontogeny) correspond with ("recapitulate") successive adult ancestors in the line of evolutionary descent (phylogeny) became popular in the nineteenth century as the so-called biogenetic law. This theory of recapitulation, however, has had a "regrettable influence on the progress of embryology" (G. de Beer). ... According to the "laws" of von Baer, general characters (e.g., brain, notochord) appear in development earlier than special characters (e.g., limbs, hair). Furthermore, during its development an animal departs more and more from the form of other animals. Indeed, the early stages in the development of an animal are not like the adult stages of other forms but resemble only the early stages of those animals. The pharyngeal clefts of vertebrate embryos, for example, are neither gills nor slits. Although a fish elaborates this region into gill slits, in reptiles, birds, and mammals it is converted into such structures as the tonsils and the thymus (p. 16).

(Fertilization is) the procession of events that begins when a spermatozoon makes contact with a secondary oocyte or its investments, and ends with the intermingling of maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote. The zygote is characteristic of the last phase of fertilization and is identified by the first cleavage spindle. It is a unicellular embryo (p. 19).

Although life is a continuous process, fertilization ... is a critical landmark because, under ordinary circumstances, a new, genetically distinct human organism is formed... (p. 31).

Fertilization takes place normally in the ampulla (lateral end) of the uterine tube (p. 31).

"The term 'pre-embryo' is not used here for the following reasons: (1) it is ill-defined because it is said to end with the appearance of the primitive streak or to include neurulation; (2) it is inaccurate because purely embryonic cells can already be distinguished after a few days, as can also the embryonic (not pre-embryonic!) disc; (3) it is unjustified because the accepted meaning of the word embryo includes all of the first 8 weeks; (4) it is equivocal because it may convey the erroneous idea that a new human organism is formed at only some considerable time after fertilization; and (5) it was introduced in 1986 'largely for public policy reasons' (Biggers)." ... Just as postnatal age begins at birth, prenatal age begins at fertilization," (p. 88).

"Undesirable terms in Human Embryology": "Pre-embryo"; ill defined and inaccurate; Use "embryo" (p. 12).

[Note: O'Rahilly is one of the originators of The Carnegie Stages of Early Human Embryological Development, and has sat on the international Nomina Embryologica Committee for decades]

The following references were taken from web sites, full citation listed along with pertinent material.

-- "Carnegie Stages of Early Human Embryonic Development" (updated): Carnegie Stages of Early Human Embryonic Development, Stage 1: Embryonic life commences with fertilization, and hence the beginning of that process may be taken as the point de depart of stage 1. Despite the small size (ca. 0.1 mm) and weight (ca. 0.004 mg) of the organism at fertilization,
the embryo is "schon ein individual-spezifischer Mensch" (Blechschmidt, 1972).

... Fertilization is the procession of events that begins when a spermatozoon makes contact with an oocyte or its investments and ends with the intermingling of maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote (Brackett et al., 1972).

... Fertilization, which takes place normally in the ampulla of the uterine tube, includes (a) contact of spermatozoa with the zona pellucida of an oocyte, penetration of one or more spermatozoa through the zona pellucida and the ooplasm, swelling of the spermatozoal head and extrusion of the second polar body, (b) the formation of the male and female pronuclei, and (c) the beginning of the first mitotic division, or cleavage, of the zygote.

... The three phases (a, b, and c) referred to above will be included here under stage 1, the characteristic feature of which is unicellularity.


-- Some recent Irving articles (note, older articles still retain the now-unusable URLs for the Carnegie Stages):

"Personhood 'Language' 2008 - 2011" (October 2, 2011), at:
http://www.lifeissues.net/writers/irv/irv_192personhoodlanguage.html

"Why Accurate Human Embryology Is Needed To Evaluate Current Trends In Research Involving Stem Cells, Genetic Engineering, Synthetic Biology and Nanotechnology" (November 20, 2012), at:
http://www.lifeissues.net/writers/irv/irv_206accuratehumanembryology1.html

Notice: Carnegie Stages - Lost, and Found (Aug. 10, 2012), at:
http://www.lifeissues.net/writers/irv/irv_200lostandfound.html

"Any Human Cell - iPS, Direct Programmed, Embryonic, Fetal or Adult - Can Be Genetically Engineered to Asexually Reproduce New Human Embryos for Purposes of Reproduction ('Infertility')" (November 2011), at:
http://www.lifeissues.net/writers/irv/irv_194cellasexuallyreproduce1.html

-- Relevant References from Irving article:


-- Also similar work by R. K. Humphries, A. Schnieke. E.g., as determined in extensive numbers of transgenic mice experiments, "The human beta-gobulin gene contains downstream developmental specific enhancer."

-- Moore, Keith, and T.V.N. Persuad, The Developing Human: Clinically Oriented Embryology, 6th ed. only (Philadelphia: W.B. Saunders Company, 1998): "Sutton and Boveri declared independently in 1902 that the behavior of chromosomes during germ cell formation and fertilization agreed with Mendel's principles of inheritance. In the same year, Garrod reported alcaptonuria as the first example of Mendelian inheritance in human beings. Many consider Garrod to be the Father of Medical
Genetics. It was soon realized that the (single-cell embryo) contains all the genetic information necessary for directing the development of a new human being (p. 12).

-- Holtzer et al., "Induction-dependent and lineage-dependent models for cell-diversification are mutually exclusive," Progress in Clinical Biological Research 175:3-11 (1985). Also similar work by, e.g., F. Mavilio, C. Hart.


Further references for: "The Single-Cell Human Embryo Asexually Reproduced is a Human Being When the Cell's DNA is in the State of Differentiation as that of a Single-Cell Sexually Reproduced Human Embryo":

The following quotations were taken from embryology books, full citation listed:

-- Campbell, Keith, and Ian Wilmut. Cambridge Quarterly of Healthcare Ethics 139 (Spring 1988): "One potential use for this technique would be to take cells - skin cells, for example - from a human patient who had a genetic disease... You take these and get them back to the beginning of their life by nuclear transfer into an oocyte to produce a new embryo. From that new embryo, you would be able to obtain relatively simple, undifferentiated cells, which would retain the ability to colonize the tissues of the patient."

On being asked in an interview: "Do you think that society should allow cloning of human embryos because of the great promise of medical benefit?": "Yes. Cloning at the embryo stage - to achieve cell dedifferentiation - could provide benefits that are wide ranging..." - Keith Campbell, head of embryology at PPL Therapeutics

-- Carlson, Bruce M. Human Embryology and Developmental Biology, 2nd ed. (St. Louis, MO: Mosby, 1999): "Early mammalian embryogenesis is considered to be a highly regulative process. Regulation is the ability of an embryo or an organ primordium to produce a normal structure if parts have been removed or added. At the cellular level, it means that the fates of cells in a regulative system are not irretrievably fixed and that the cells can still respond to environmental cues." (p. 44).

"Of the experimental techniques used to demonstrate regulative properties of early embryos, the simplest is to separate the blastomeres of early cleavage-stage embryos and determine whether each one can give rise to an entire embryo. This method has been used to demonstrate that single blastomeres, from two- and sometimes four-cell embryos can form normal embryos, ..." (p. 44).

"...The relationship between the position of the blastomeres and their ultimate developmental fate was incorporated into the inside-outside hypothesis. The outer blastomeres ultimately differentiate into the trophoblast, whereas the inner blastomeres form the inner cell mass, from which the body of the embryo arises. Although this hypothesis has been supported by a variety of experiments, the mechanisms by which the blastomeres recognize their positions and then differentiate accordingly have remained elusive and are still little understood. If marked blastomeres from disaggregated embryos are placed on the outside of another early embryo, they typically contribute to the formation of the trophoblast. Conversely, if the same marked cells are introduced into the interior of the host embryo, they participate in formation of the inner cell mass. Outer cells in the early mammalian embryo are linked by tight and gap junctions ...
Experiments of this type demonstrate that the developmental potential or potency (the types of cells that a precursor cell can form) of many cells is greater than their normal developmental fate (the types of cells that a precursor cell normally forms)" (p. 45).

"Another means of demonstrating the regulative properties of early mammalian embryos is to dissociate mouse embryos into separate blastomeres and then to combine the blastomeres of two or three embryos. The combined blastomeres soon aggregate and reorganize to become a single large embryo, which then goes on to become a normalappearing tetraparental or hexaparental mouse. By various techniques of making chimeric embryos, it is even possible to combine blastomeres to produce interspecies chimeras (e.g., a sheep-goat)" (p. 45).

"... Blastomere removal and addition experiments have convincingly demonstrated the regulative nature (i.e., the strong tendency for the system to be restored to wholeness) of early mammalian embryos. Such knowledge is important in understanding the reason exposure of early human embryos to unfavorable environmental influences typically results in either death or a normal embryo." (p. 46).

"... Classic strategies for investigating developmental properties of embryos are (1) removing a part and determining the way the remainder of the embryo compensates for the loss (such experiments are called deletion experiments) and (2) adding a part and determining the way the embryo integrates the added material into its overall body plan (such experiments are called addition experiments). Although some deletion experiments have been done, the strategy of addition experiments has proved to be most fruitful in elucidating mechanisms controlling mammalian embryogenesis." (p. 46).

"... Some types of twinning represent a natural experiment that demonstrates the highly regulative nature of early human embryos," (p. 48).

"... Monozygotic twins and some triplets, on the other hand, are the product of one fertilized egg. They arise by the subdivision and splitting of a single embryo. Although monozygotic twins could ... arise by the splitting of a two-cell embryo, it is commonly accepted that most arise by the subdivision of the inner cell mass in a blastocyst. Because the majority of monozygotic twins are perfectly normal, the early human embryo can obviously be subdivided and each component regulated to form a normal embryo." (p. 49)

*** Elder, Kay T. "Laboratory techniques: Oocyte collection and embryo culture," ed. Peter Brinsden, A Textbook of In vitro Fertilization and Assisted Reproduction, 2nd ed. (New York: The Parthenon Publishing Group, 1999): "Surprisingly, fragmented embryos, repaired or not, do implant and often come to term. This demonstrates the highly robust nature of the human embryo, as it can apparently lose over half of its cellular mass and still recover." (p. 197)

Even proponents of human cloning research admit that the immediate product of cloning is a new living human embryo, a human being. See, for example:

*** Ian Wilmut: "The majority of reconstructed embryos were cultured in ligated oviducts of sheep... Most embryos that developed to morula or blastocyst after 6 days of culture were transferred to recipients and allowed to develop to term," etc.

*** Larsen, William, Essentials of Human Embryology (New York: Churchill Livingstone, 1998): "If the splitting occurred during cleavage - for example, if the
two blastomeres produced by the first cleavage division become separated - the monozygotic twin blastomeres will implant separately, like dizygotic twin blastomeres, and will not share fetal membranes. Alternatively, if the twins are formed by splitting of the inner cell mass within the blastocyst, they will occupy the same chorion but will be enclosed by separate amnions and will use separate placentae, each placenta developing around the connecting stalk of its respective embryo. Finally, if the twins are formed by splitting of a bilaminar germ disc, they will occupy the same amnion." (p. 325)

** Muller, Fabiola, and Ronan O'Rahilly. Human Embryology & Teratology . (New York: Wiley-Liss, 2001):
"Biopsy of an embryo can be performed by removing one cell from a 4-cell, or two cells from an 8-cell, embryo. This does not seem to decrease the developmental capacity of the remaining cells." (p. 37).
"The embryo enters the uterine cavity after about half a week ... Each cell (blastomere) is considered to be still totipotent (capable, on isolation, of forming a complete embryo), and separation of these early cells is believed to account for one-third of cases of monozygotic twinning," (p. 37).

** National Bioethics Advisory Commission. Cloning Human Beings: Report and Recommendations. (Rockville, MD: June 1997): "The Commission began its discussions fully recognizing that any effort in humans to transfer a somatic cell nucleus into an enucleated egg involves the creation of an embryo, with the apparent potential to be implanted in utero and developed to term." (p. 3).

** National Institutes of Health. Background Paper: Cloning: Present uses and Promises, Jan. 29, 1998. "This experiment [producing Dolly] demonstrated that, when appropriately manipulated and placed in the correct environment, the genetic material of somatic cells can regain its full potential to direct embryonic, fetal, and subsequent development." (p. 3).

** Read, Andrew P., and Tom Strachan, Human Molecular Genetics 2, 2nd ed. (New York: John Wiley & Sons, Inc., 1999): "Nuclear transfer technology was first employed in embryo cloning, in which the donor cell is derived from an early embryo, and has been long established in the case of amphibians. ... Wilmut et al (1997) reported successful cloning of an adult sheep ["Dolly"]). For the first time, an adult nucleus had been reprogrammed to become totipotent once more, just like the genetic material in the fertilized oocyte from which the donor cell had ultimately developed. ... Successful cloning of adult animals has forced us to accept that genome modifications once considered irreversible can be reversed and that the genomes of adult cells can be reprogrammed by factors in the oocyte to make them totipotent once again. ... Animal clones occur naturally.... For example, genetically identical twins are clones who happened to have received exactly the same set of genetic instructions from two donor individuals, a mother and a father. A form of animal cloning can also occur as a result of artificial manipulation to bring about a type of asexual reproduction. The genetic manipulation in this case uses nuclear transfer technology: a nucleus is removed from a donor cell then transplanted into an oocyte whose own nucleus has previously been removed. The resulting 'renucleated' oocyte can give rise to an individual who will carry the nuclear genome of only one donor individual, unlike genetically identical twins. The individual providing the donor nucleus and the individual that develops from the 'renucleated' oocyte are
usually described as "clones", but it should be noted that they share only the same nuclear DNA; they do not share the same mitochondrial DNA, unlike genetically identical twins."

Silver, Lee M., Remaking Eden: Cloning and Beyond in a Brave New World (Avon Books 1997): "Yet there is nothing synthetic about the cells used in cloning... The newly created embryo can only develop inside the womb of a woman in the same way that all embryos and fetuses develop. Cloned children will be full-fledged human beings, indistinguishable in biological terms from all other members of the species. Thus, the notion of a soulless clone has no basis in reality," (p. 107).

** Van Blerkom, Jonathan, American Medical News, Feb. 23, 1998: [Expressing disbelief that some deny that human cloning produces an embryo]: "If it's not an embryo, what is it?" Dr. Van Blerkom said researchers' efforts to avoid the word "embryo" in this context are "self-serving."


The following were taken from web sites, full citation listed along with pertinent material:

** National Institutes of Health, Office of Science Planning and Policy, "CLONING: Present Uses and Promises", April 27, 1998. http://www1.od.nih.gov/osp/ospp/scipol/cloning.htm: "Cloning and somatic cell nuclear transfer are not synonymous. Cloning is the production of a precise genetic copy of DNA, a cell, or an individual plant or animal. Cloning can be successfully accomplished by using a number of different technologies. Somatic cell nuclear transfer is one specific technology that can be used for cloning."

"The Cloning of Humans (Prevention) Bill 2001," http://www.parliament.qld.gov.au/Parlib/Publications_pdfs/books/2001036.pdf: "Cloning can occur naturally in the asexual reproduction of plants, the formation of identical twins and the multiplication of cells in the natural process of repair. The cloning of DNA, cells, tissues, organs and whole individuals is also achievable with artificial technologies. ... The cloning of a cell or an individual may be achieved through a number of techniques, including: molecular cloning ..., blastomere separation (sometimes called "twinning" after the naturally occurring process that creates identical twins): splitting a developing embryo soon after fertilization of the egg by a sperm (sexual reproduction) to give rise to two or more embryos. The resulting organisms are identical twins (clones) containing DNA from both the mother and the father. ... somatic cell nuclear transfer: the transfer of the nucleus of a somatic cell into an unfertilized egg whose nucleus, and thus its genetic material, has been removed. A number of scientific review bodies have noted that the term "cloning" is applicable in various contexts, as a result of the development of a range of cloning techniques with varying applications."

Further references for: "The Single-Cell Human Embryo Possesses A Genome Specific For And Consistent With an Individual Member of the Human Species":

The human genome is not defined in terms of the nuclear genes alone, but in terms of the total DNA in the cell, including DNA found in the mitochondria outside of the nucleus in the cytoplasm. The following were
"A genome consists of the entire set of chromosomes for any particular organism, and therefore comprises a series of DNA molecules, each of which contains a series of many genes. The ultimate definition of a genome is to determine the sequence of the DNA of each chromosome." (p. 4)

"Genes not residing within the nucleus are generally described as extranuclear; they are transcribed and translated in the same organelle compartment (mitochondrion or chloroplast) in which they reside. By contrast, nuclear genes are expressed by means of cytoplasmic protein synthesis." (p. 81)

"In animal cells, DNA is found in both the nucleus and the mitochondria." (p. 10)

"The mitochondria also have ribosomes and a limited capacity for protein synthesis." (p. 18)

"The human genome is the term used to describe the total genetic information (DNA content) in human cells. It really comprises two genomes: a complex nuclear genome..., and a simple mitochondrial genome... Mitochondria possess their own ribosomes and the few polypeptide-encoding genes in the mitochondrial genome produce mRMAs, which are translated on the mitochondrial ribosomes." (p. 139)

"Fertilization age: dates the age of the embryo from the time of fertilization." (p. 23)

"In the female, sperm transport begins in the upper vagina and ends in the ampulla of the uterine tube [fallopian tube] where the spermatozoa make contact with the ovulated egg." (p. 27)
"The sex of the future embryo is determined by the chromosomal complement of the spermatozoon. (If the sperm contains 22 autosomes and an X chromosome, the embryo will be a genetic female, and if it contains 22 autosomes and a Y chromosome, the embryo will be a male.) ... Through the mingling of maternal and paternal chromosomes, the zygote is a genetically unique product of chromosomal re-assortment, which is important for the viability of any species." (p. 32)

"Early mammalian embryogenesis is considered to be a highly regulative process. Regulation is the ability of an embryo or an organ primordium to produce a normal structure if parts have been removed or added. At the cellular level, it means that the fates of cells in a regulative system are not irretrievably fixed and that the cells can still respond to environmental cues." (p. 44).

"Blastomere removal and addition experiments have convincingly demonstrated the regulative nature (i.e., the strong tendency for the system to be restored to wholeness) of early mammalian embryos. Such knowledge is important in understanding the reason exposure of early human embryos to unfavorable environmental influences typically results in either death or a normal embryo." (p. 46)

"Some types of twinning represent a natural experiment that demonstrates the highly regulative nature of early human embryos ..." (p. 48)

"The relationship between the position of the blastomeres and their ultimate developmental fate was incorporated into the inside-outside hypothesis. The outer blastomeres ultimately differentiate into the trophoblast, whereas the inner blastomeres form the inner cell mass, from which the body of the embryo arises. Although this hypothesis has been supported by a variety of experiments, the mechanisms by which the blastomeres recognize their positions and then differentiate accordingly have remained elusive and are still little understood. If marked blastomeres from disaggregated embryos are placed on the outside of another early embryo, they typically contribute to the formation of the trophoblast. Conversely, if the same marked cells are introduced into the interior of the host embryo, they participate in formation of the inner cell mass. Outer cells in the early mammalian embryo are linked by tight and gap junctions ... Experiments of this type demonstrate that the developmental potential or potency (the types of cells that a precursor cell can form) of many cells is greater than their normal developmental fate (the types of cells that a precursor cell normally forms)." (p. 45).

** Elder, Kay T., "Laboratory techniques: Oocyte collection and embryo culture", in Peter Brinsden, (ed.), A Textbook of in vitro Fertilization and Assisted Reproduction , 2nd edition (New York: The Parthenon Publishing Group, 1999): "Surprisingly, fragmented embryos, repaired or not, do implant and often come to term. This demonstrates the highly robust nature of the human embryo, as it can apparently lose over half of its cellular mass and still recover." (p. 197)


... "[W]e 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." (p. 1)
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 [not the uterus]... resulting in the formation of a zygote containing a single diploid nucleus."

(p.1).


-- "The usual site of fertilization is the ampulla of the uterine tube [fallopian tube], its longest and widest part. If the oocyte is not fertilized here, it slowly passes along the tube to the uterus, where it degenerates and is reabsorbed. Although fertilization may occur in other parts of the tube, it does not occur in the uterus. ... Human development begins when a oocyte is fertilized." (p. 34)

-- "The embryo's chromosomes sex is determined at fertilization by the kind of sperm (X or Y) that fertilizes the ovum; hence, it is the father rather than the mother whose gamete determines the sex of the embryo." (p. 37)

The embryonic period proper ...occupies the first eight postovulatory weeks (i.e., timed from the last ovulation) ... The fetal period extends from eight weeks to birth. (p. 55)

Muller, Fabiola, and Ronan O'Rahilly. ibid. (New York: Wiley-Liss, 2001 ) "The term 'pre-embryo' is not used here for the following reasons: (1) it is ill-defined because it is said to end with the appearance of the primitive streak or to include neurulation; (2) it is inaccurate because purely embryonic cells can already be distinguished after a few days, as can also the embryonic (not pre-embryonic!) disc; (3) it is unjustified because the accepted meaning of the word embryo includes all of the first 8 weeks; (4) it is equivocal because it may convey the erroneous idea that a new human organism is formed at only some considerable time after fertilization; and (5) it was introduced in 1986 'largely for public policy reasons' (Biggers)." ... Just as postnatal age begins at birth, prenatal age begins at fertilization." (p. 88) "Undesirable terms in Human Embryology": "Pre-embryo"; ill defined and inaccurate; use "embryo" (p. 12).

**Recapitulation, the So-Called Biogenetic Law.** The theory that successive stages of individual development (ontogeny) correspond with ("recapitulate") successive adult ancestors in the line of evolutionary descent (phylogeny) became popular in the nineteenth century as the so-called biogenetic law. This theory of recapitulation, however, has had a "regrettable influence on the progress of embryology" (G. de Beer). ... According to the "laws" of von Baer, general characters (e.g., brain, notochord) appear in development earlier than special characters (e.g., limbs, hair). Furthermore, during its development an animal departs more and more from the form of other animals. Indeed, the early stages in the development of an animal are not like the adult stages of other forms but resemble only the early stages of those animals. The pharyngeal clefts of vertebrate embryos, for example, are neither gills nor slits. Although a fish elaborates this region into gill slits, in reptiles, birds, and mammals it is converted into such structures as the tonsils and the thymus. (p. 16)

... (Fertilization is) the procession of events that begins when a spermatozoon makes contact with a secondary oocyte or its investments, and ends with the intermingling of maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote. The zygote is characteristic of the last phase of fertilization and is identified by the first cleavage spindle. It is a unicellular
embryo. (p. 19)
Although life is a continuous process, fertilization ... is a critical landmark because, under ordinary circumstances, a new, genetically distinct human organism is formed.... (p. 31)

... Fertilization takes place normally in the ampulla (lateral end) of the uterine tube. (p. 31)
"Biopsy of an embryo can be performed by removing one cell from a 4-cell, or two cells from an 8-cell, embryo. This does not seem to decrease the developmental capacity of the remaining cells." (p. 37).
The following were taken from web sites, full citation listed along with pertinent material.
"Carnegie Stages of Early Human Embryonic Development," http://nmhm.washingtondc.museum/collections/hdac/Select_Stage_and_Lab_Manual.htm The first 8 weeks of human development are called the embryological period. After eight 8 the embryo becomes a fetus, and after birth a neo-nate. There are various ways to determine the age and development of an embryo. It should be noted that age and stage are not the same thing. An age is a measurement of time where as stage of development is an assessment of the level physical development of the embryo. Like older babies and children, embryos will develop at varying rates, which may depend on a variety of factors in the embryos environment.


(1) (not carrot or frog enzymes and proteins), and genetically directs his/her own growth and development. (In fact, this genetic growth and development has been proven not to be directed by the mother, but rather by the embryo.)

(2) The human embryo begins to divide and grows bigger and bigger, developing through several stages as an embryo over an 8-week period. Several of these developmental stages of the growing embryo are given special names, e.g., a morula (about 4 days), a free blastocyst (about 4-5 days), an implanting blastocyst (about 5-7 days), a bilaminar (two layer) embryo (during the second week), and a trilaminar (3 layer) embryo (during the third week). But it is the very same human embryo who is progressing throughout all of these various stages of growth and development."

References:
• Holtzer et al., "Induction-dependent and lineage-dependent models for cell-diversification are mutually exclusive," Progress in Clinical Biological Research 175:3-11 (1985);
"Sutton and Boveri declared independently in 1902 that the behavior of chromosomes during germ cell formation and fertilization agreed with Mendel's principles of inheritance. In the same year, Garrod reported alcaptonuria as the first example of Mendelian inheritance in human beings. Many consider Garrod to be the Father of Medical Genetics. It was soon realized that the (single-cell embryo) contains all the genetic information necessary for directing the development of a new human
being (p. 12).


- Nuclear transfer technology was first employed in embryo cloning, in which the donor cell is derived from an early embryo, and has been long established in the case of amphibians. ... Wilmut et al (1997) reported successful cloning of an adult sheep ["Dolly"]. **For the first time, an adult nucleus had been reprogrammed to become totipotent once more, just like the genetic material in the fertilized oocyte** from which the donor cell had ultimately developed. ... Successful cloning of adult animals has forced us to accept that **genome modifications once considered irreversible can be reversed and that the genomes of adult cells can be reprogrammed by factors in the oocyte to make them totipotent once again**. ... Animal clones occur naturally.... For example, **genetically identical twins are clones** who happened to have received exactly the same set of genetic instructions from two donor individuals, a mother and a father. **A form of animal cloning can also occur as a result of artificial manipulation to bring about a type of asexual reproduction.** The genetic manipulation in this case uses nuclear transfer technology: a nucleus is removed from a donor cell then transplanted into an oocyte whose own nucleus has previously been removed. The resulting 'renucleated' oocyte can give rise to an individual who will carry the nuclear genome of only one donor individual, unlike genetically identical twins. The individual providing the donor nucleus and the individual that develops from the 'renucleated' oocyte are usually described as "clones", **but it should be noted that they share only the same nuclear DNA; they do not share the same mitochondrial DNA, unlike genetically identical twins** (pp. 508-509).

- Also similar work by, e.g., F. Mavilio, C. Hart.
- Also similar work by, e.g., R. K. Humphries, A. Schnieke.

The following were taken from embryology books, full citation listed along with pertinent material.

- Carlson, Bruce M. Human Embryology and Developmental Biology (St. Louis, MO: Mosby, 1994): "After the eighth week of pregnancy the period of organogenesis (embryonic period) is largely completed and the fetal period begins." (p. 407)
- Muller, Fabiola, and Ronan O'Rahilly. Human Embryology & Teratology 3rd ed. (New York: Wiley-Liss, 1994): "The embryonic period proper ...occupies the first eight postovulatory weeks (i.e., timed from the last ovulation) ... The fetal period extends from eight weeks to birth." (p. 55)