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The Metaphysical Status of the Embryo: Some Arguments Revisited

DAVID S. ODERBERG

ABSTRACT *This paper re-examines some well-known and commonly accepted arguments for the non-individuality of the embryo, due mainly to the work of John Harris. The first concerns the alleged non-differentiation of the embryoblast from the trophoblast. The second concerns monozygotic twinning and the relevance of the primitive streak. The third concerns the totipotency of the cells of the early embryo. I argue that on a proper analysis of both the empirical facts of embryological development, and the metaphysical importance or otherwise of those facts, all three arguments are found wanting. None of them establishes that the embryo is not an individual human being from the moment of conception.*

1. Introduction

Despite the sounding of occasional dissident voices, there is now a settled view among the majority of bioethicists concerning the status of the embryo. Debates about abortion and embryo experimentation, cloning, 'designer' babies, embryonic stem cell research, and related matters all proceed on the basis that the embryo's metaphysical and moral standing is now largely agreed. At the very most, where differences over metaphysics exist among the majority, they do not significantly affect the moral conclusions reached.

Central to the development of the established consensus has been the contributions of bioethicists such as Peter Singer and John Harris. In particular, in books such as *The Value of Life*[1] and *Clones, Genes, and Immortality*,[2] as well as in many papers, Harris has consistently and vigorously defended the view that the human embryo is not an individual human being, and that even if it were it would not be a 'person', yet it is 'persons' who matter morally. His arguments, like those of Singer, have become standard fare among supporters of the non-individuality and/or non-personhood of the embryo.

In contemporary philosophy consensus is hard to come by. That is why bioethicists, with some justification, pride themselves on the fact that they can present a united front to the public and cause their leading ideas to be so quickly accepted by policy-makers as the deliverances of experts who have reflected on these difficult issues to the greatest extent possible. Nevertheless consensus, no matter how solid, does not make for truth. When it comes to both metaphysics and morality, the dominant view among bioethicists concerning the status of the embryo is wrong. My purpose in this paper is to revisit some of the metaphysical arguments given prominence by Harris (among others) in rebuttal of the proposition that the embryo is an individual human being. Although metaphysics rather than ethics will be my primary concern here, the

former is an indispensable foundation for the latter, bioethics being no exception. Unless bioethicists get their ontology right, there can be no hope of proposing a plausible moral stance toward the embryo or anything else.

2. The Embryoblast and the Trophoblast

In several places,[3] Harris claims that human fertilization 'does not result in an individual' because the fertilized egg becomes a cell mass (the morula, three days post-fertilization[4]) that divides into the 'inner cell mass' or embryoblast, from which the embryo proper and foetus develops, and the trophoblast, from which extra-embryonic membranes, the placenta, umbilical cord, and other supporting structures develop.

Harris gives no details as to how the argument is supposed to work. The claim is that since the morula[5] is undifferentiated with respect to embryoblast and trophoblast, there can be no individual human being at this stage. This in turn appears to rely on the implicit claim that there can be no human individual prior to the stage at which what one might call the 'proto-body' of the embryo, the so-called 'embryo proper', comes into existence — this being the inner cell mass.[6]

But is Harris's implicit claim true? He omits to mention that the extra-embryonic structures (such as placenta and umbilical cord) developing from the trophoblast have exactly the same chromosomes as the embryoblast. They do not have the mother's DNA, moreover their development is directed by the embryo/foetus and they support its functioning. For these reasons alone they are correctly regarded as parts of the embryo/foetus.[7] Furthermore, as a standard embryology textbook points out,[8] the idea of a sharp distinction between embryoblast and trophoblast is questionable. It seems that the hypoblast — the layer of cells adjacent to the epiblast (from which the embryo's body develops) on the side facing the blastocyst cavity — is displaced to extra-embryonic regions, and though it gives rise to extra-embryonic structures such as the yolk sac and allantois, part of the yolk sac is incorporated into the primordial gut of the embryo, and the allantois is incorporated into the embryo as the median umbilical ligament which connects the apex of the urinary bladder with the umbilicus.[9] Hence it seems that there is intermingling between hypoblast and epiblast. If so, why should we exclude the likelihood of intermingling between embryoblast and trophoblast?[10] (Or at least between embryoblast and other supporting structures, even though the trophectoderm, which forms directly from the trophoblast, is as far as we know fixed.) Whatever the details, the point is that one cannot simply assert that before differentiation into embryoblast and trophoblast there is no human individual if, as a matter of fact, *after* differentiation the embryo is still directing or controlling what cells become structures of its body proper and what do not.

Clearly the processes of development at this stage are far more complex than Harris ever indicates. Might he not object, though, that by speaking of the embryo/foetus in contradistinction to the trophoblast this in fact lends support to his central point that no identification of an individual embryo/foetus can be made *before* the differentiation occurs? This objection carries no weight if we are clear about what we mean by expressions such as 'embryo/foetus' and 'embryo proper.' Thinking now of the *foetus* at a much later stage of development, when we use the term does it refer to the growing child with or without its placenta? Generally, 'foetus' refers to the child minus the parts

that are discarded at birth and not required for normal functioning outside the womb.[11] But there is nothing improper, ontologically speaking, from using the term to refer to the child along with its placenta, umbilical cord, and so on: we might do so in order to distinguish it, with all its parts, from the mother. The former use is more common, though, since we are usually more interested in the persistence and development of the child inside and outside the womb; for which purpose we use terms such as 'foetus' and 'embryo' to refer to everything that is not discarded at birth, namely the body of the child minus the parts needed only for gestation. This we can call the 'embryo/foetus proper' in order to clarify what it is we are referring to.

To make such a reference, however, is not to concede Harris's point: for it does not follow from the fact that we can distinguish between the *embryo proper* and the trophoblast at a certain stage that we cannot identify an *embryo* before that stage. Before such differentiation,[12] we are constrained to use 'embryo' to refer to all the matter that *will* separate into embryoblast and trophoblast, i.e. to use the term in the same way as we might use 'foetus' at a later stage only to refer to everything that is not part of the mother, i.e. the body of the foetus plus its placenta, umbilical cord, and all other later-discarded matter. The fact that in the case of the morula the matter has not *yet* separated into embryoblast and trophoblast in no way implies that the morula is not an embryo, where 'embryo' is used of necessity in the restricted sense just mentioned. And where we have an embryo, we have an individual human being. The somewhat surprising fact that parts of the extra-embryonic membranes are later incorporated into the embryo proper only serves to reinforce the claim that there is a single human individual prior to the early blastocyst stage, with its cells interacting in varied and complex ways, even though no 'embryo proper', i.e. embryonic body distinct from its later-discarded parts, can at that point be identified.

3. Monozygotic Twinning and the 'Primitive Streak'

Early on in the debate about embryo experimentation, the onset of the 'primitive streak' at around 14 or 15 days became a kind of totem for supporters of such research. It formed the basis of the Warnock Committee's recommendation in 1984 that research on embryos be prohibited after the appearance of the primitive streak, which prohibition became part of the legislative regime established by the Human Fertilisation and Embryology Act 1990 (sec. 3). The idea that there is no human individual prior to the appearance of the primitive streak is now a commonplace among bioethicists.[13] Harris endorses it without argument: 'A further complication is that the fertilized egg cannot be considered a new individual because it may well become two individuals. This splitting to become "twins" can happen as late as two weeks after conception.'[14]

Perhaps it is too harsh to say that he gives no argument. If there is one, the implicit major premise must be that if the fertilized egg may well become two individuals, it cannot be considered a new individual before twinning is no longer possible. Before evaluating the claim, note that Harris is keen to observe in this context that fertilization does not always give rise to an embryo but may, when the process goes wrong, give rise to a tumour such as a hydatidiform mole.[15] The only interesting conclusion to draw from this observation is the biological one that not all fertilization leads to conception.

Nothing, however, follows about the *normal* course of embryogenesis from observations about what happens when things go wrong. And because of twinning, not all conception results (at least directly) from fertilization. But isn't conception supposed to *be* fertilization, especially in the minds of those who defend the human individuality of the embryo? This would be a mistake, for conception is a metaphysical phenomenon and fertilization only one kind of biological manifestation of it. Here is a definition of conception that captures what it is we should be looking at in considering the relation between the coming into existence of a human being and the biological event typically associated with it:[16]

> Conception is that event, typically involving the union of sperm and egg, which consists in a change in the intrinsic nature of a cell or group of cells, where that change confers on the cell or group of cells, or on their descendants in the case of division, the intrinsic potential to develop, given the right extrinsic factors, into a mature human being.[17]

There is no room to address the issue of potentiality here, but for present purposes the important point to note is that the definition encapsulates the crucial distinction between the metaphysical phenomenon of coming into existence and whatever biological event is typically associated with and exemplifies it, thus leaving open the possibility that some other event may also fulfil that role. The slogan 'life begins at conception' can, then, be read in different ways. In non-philosophical use — what we might call 'ordinary parlance' — it means that the human being's coming into existence is typically manifested by the process of fertilization. A person uttering the slogan might not know about hydatidiform moles or even be aware of the way in which twinning occurs, but for them to avoid knowingly saying something false (or at least ambiguous) they must at least have an implicit grasp of how such phenomena are relevant to what they mean. In philosophical use, on the other hand, 'life begins at conception' states a necessary truth: not a tautology or a proposition whose truth depends solely on the meanings of the words used, but one that defines coming into existence in terms of a metaphysical phenomenon, namely the emergence of a new nature, an organizational unity that is not a part of its host but an individual that uses its host for the purpose of its own self-directed development into a mature member of its kind.

Where, though, does this leave the embryo before twinning occurs? For Harris and most other bioethicists, it cannot be an individual precisely because it might become two. Yet it is hard to see how this is supposed to follow. Before going further down this track, however, we should recall some of the biological facts about twinning. First, it is simply not true that twinning can only occur before formation of the primitive streak. It also occasionally occurs after this time, though as far as is known all cases involve deformity, such as Siamese twins or, rarely, foetus-in-foetu, where one foetus grows for a time inside the other, eventually dying; the host foetus is sometimes born alive and goes on to lead a normal life. But if the defender of the argument from twinning wishes to deny the embryo individuality before the primitive streak appears, during which time twinning can occur normally, why would she not make the same denial in respect of a post-14-day embryo? Why should the fact that twinning after 14 days would be abnormal make any difference?

For Karen Dawson, who discusses this issue at length,[18] '[t]he possibility of conjoined twins and fetus-in-fetu occurring weakens the applicability of the concept of irreversible

individuality, as defined, and similarly the validity of using the proposed argument for segmentation [twinning] in ascribing moral status from even 14 days after fertilization.'[19] For her, moral status must therefore be based on something other than 'irreversible individuality', and one assumes Harris and others would agree that when it comes to morality, something other than mere 'ontological individuality', to use Ford's expression, must be the determining factor. But for present purposes what matters is the metaphysical implication of post-primitive streak twinning. It appears we do not yet know just *how* far into development an embryo or foetus must be before twinning of any kind, normal or abnormal, is physically impossible. It must be the case, though, that twinning is possible when the embryo or foetus has reached a stage where to deny it individuality would be a case of biological and metaphysical blindness. Yet if individuality is ascribed in such a case, why not ascribe it before 14 days? It is irrelevant that twinning then would be normal; so what other criterion could one use — size or shape?

Secondly, the only sense in which it seems that twinning is abnormal is that it is rare;[20] it does not appear to warrant ranking alongside tumourous growth after fertilization, so we cannot easily reiterate, as in the latter case, that faulty development has no metaphysical implications for the normal course of events.[21] Thirdly, though, we are profoundly ignorant about the factors that give rise to the possibility or actuality of twinning. It might be, for all we currently know, that twinning is caused by a random genetic or environmental change occurring after fertilization and early embryonic development have begun. This would make it no different, ontologically, to something more dramatic such as a freakish discharge of lightning that struck the mother and caused her gestating embryo to divide. But should we say, in the fanciful case, that there was ipso facto no human individual prior to the lightning strike? It is hard to see what the argument for this could be.

According to C. Ward Kischer, however, there is 'strong' evidence that twinning is determined at fertilization itself, hence that the individuality of the embryo that does not twin is also determined at fertilization.[22] Although 65–70% of cases of monozygotic twinning are due to fission of the inner cell mass, the other 30–35% are explained by division at the two- to eight-cell stage of cleavage, occurring two to three days after fertilization.[23] Kischer takes this to mean that twinning may well be determined at fertilization or else in early cleavage,[24] but his interpretation of the evidence is confused. If twinning is determined to occur at all — and here I mean *intrinsically* determined, i.e. by the very nature of the embryo — it will have to be at fertilization, not at any stage later (e.g. first cleavage). That is, *whenever* the twinning actually occurs, *that* it is determined to occur at all must be settled at fertilization, when all the genetic information is in place for twinning to be determined by that information and (perhaps) environmental factors.[25] We do not even have to regard the embryo, for the purposes of the present point, as a human individual, merely as a new unit of genetic information such that twinning, if determined at all to occur at some time, is so determined by the coming into existence of that information with the possible co-operation of environmental factors.

For suppose twinning were determined to occur at, say, first cleavage: in other words, *that* it will occur at some future time is determined at first cleavage. Call the determining event E, where E is the acquisition of some property by the embryo at first cleavage such that it is then determined that it will split into twins at some future time. What caused (and hence determined) E?[26] Either something or nothing. If nothing, then E

is uncaused, hence undetermined, hence random.[27] Since E is random, the twinning caused by E will also be random as far as its ultimate explanation is concerned, since it will have been caused by a random event. So it would not be accurate to state that in such a case the twinning, whenever it occurred, was truly determined at first cleavage, and if not determined then it could not have been determined at all. Suppose, on the other hand, that E was caused by some prior event E_1; then for the twinning to be determined, E_1 itself would have to be determined; and so on back in time until we reached a non-arbitrary point at which an event occurred that determined all the subsequent events leading to twinning. The only such principled point is fertilization, when all the intrinsic information is in place to determine whether the embryo will split into twins (with, perhaps, environmental events co-operating to produce the split).[28]

So twinning, if determined at all, will be determined at fertilization, though it may occur at various times, as the 30–35% statistic quoted by Kischer and others demonstrates. That statistic is, however, not strong evidence that twinning is determined at all, since it is equally consistent with twinning's being a random event brought about by chance genetic or environmental changes at some time before 14 or 15 days, thus making the situation no different in principle to the freak lightning strike mentioned earlier. The mere fact that a certain proportion of twinning events occur very early in development does not favour determination over randomness; maybe it is a brute fact that 30–35% of twinning randomly occurs in early cleavage.[29] Maybe there is another explanation altogether, namely that twinning is never intrinsically determined at fertilization, but is wholly extrinsically determined by some course of events beginning with the mother and affecting different embryos at different times after fertilization. Or perhaps some twinning is intrinsically determined at fertilization and some later by purely environmental events. All we know for certain, at present, is that during the period before the primitive streak appears, twinning is biologically *possible*. Whether it is random, or determined, and if the latter then by *what*, is a mystery.

The question is, what *metaphysical* inferences can be drawn from the various possibilities? It is worth making a jointly epistemic and ethical point first, namely that given our profound ignorance about twinning, we should give the benefit of the doubt to all embryos, even if there does exist an argument to the effect that embryos for which twinning is determined (a tiny minority, moreover) are not individual human beings. The ethical substance to the point is simple: if I am about to fire a gun at an unknown object, and am concerned only to avoid killing a human being, and there is at least a significant possibility that it is a human being, I should give the benefit of the doubt to the object. Similarly, if we are concerned to avoid killing human beings, and there is a significant possibility that some or all embryos are human beings, though some or all might not be if it is determined that they will twin, we should give the embryos the benefit of the doubt and not kill them. Of course Harris and others ultimately do not put much stock in an ethic that protects human beings as opposed to 'persons', but since he offers the twinning argument against individuality for those who think it matters, we may also show why, ethically, it does not matter given the current state of knowledge.

More importantly, though, there is no good argument for the metaphysical conclusion that an embryo is not an individual human either because it might or must twin.[30] The mere fact that it might twin makes the case no different from that of the lightning strike. An embryo cannot be considered to lack individuality because something might

happen to it. Many plants are capable of being split into objects that are themselves plants and capable of continuing to grow as plants. Planarian flatworms can be divided and the divided halves continue to grow as individual worms. Cells that can divide are no less individual cells because of that possibility — they belong to exactly the same *kind* as their descendants. This includes cellular *animals* such as bacteria and amoebae.[31] Why, then, should human zygotes or early embryos be an exception?

Moreover, amoebae and most bacteria *always* reproduce by division, and yet they still all belong to the same kind — but we know that only a small minority of human embryos ever divide. So why should individuality be withheld from the latter whilst accorded to the former? We can be certain, moreover, that the reproduction by fission of amoebae and bacteria is determined rather than the result of a massive conjunction of chance events: it is part of their constitution. By parity of reasoning, therefore, even if humans *always* came into existence as twin descendants of embryos, and even if this were determined, the embryos would not thereby fail for human individuality. The parity could only be broken if it could be shown, for instance, that a given embryo (or class of embryos) did not share with its twin descendants the morphology or functionality of those descendants (mere difference of DNA would not be enough if the genotype was still *human*), such that the embryo was best classified as a kind of *precursor* to its twins, in much the same way as gametes are precursors to embryos but not themselves embryos. Yet this is precisely not true of human embryos, whatever the cause of their twinning.

Note that the twinning argument would receive no support from the idea that, at least for embryos determined to twin, and before such twinning occurs, there is not one human individual present at the same place and the same time, but two. Even if, *per impossibile*,[32] this were an available interpretation of the facts, the only ethical implication would be that destroying an embryo would, or at the very least might, involve destroying two human beings, not one. Again, the fact that we do not mourn the loss of a human being when twins are born gives us no insight into ontology. What twinning shows is that there are more ways for a human being to go out of existence than by dying.[33] Harris makes much of the fact that many embryos are lost through unknown miscarriage during the course of natural reproduction,[34] but it is as misguided to infer that what is lost are not human beings with the same moral standing as the rest of us as it would be to draw the same inference from the fact that every days thousands of people die of hunger and poverty alone and unknown. I am not trying here to draw implausible ethical parallels between radically different states of affairs, only to point out that it is mistaken to use such facts as reasons for diminishing the *metaphysical* status of embryos any more than of other humans. It may be that natural miscarriages are inevitable, and there may be sound reasons in nature why they happen; but what is lost are still individual human beings, just as it may be that certain severely deformed babies have an inevitably short life expectancy, and that there may be sound reasons in nature why this is so. They are no less human beings for that.

4. Totipotency

In the debate over embryonic stem cell research, much is made by its supporters of the alleged fact that, at least up to the three- or four-day morula stage, human blastomeres

are totipotent, that is, through culturing them as stem cells they can be caused to develop not only into any cell in the human body but into a new human being altogether, as happens in twinning. Hence at this stage, at least, there cannot be a human individual.[35] The argument goes along similar lines to the twinning argument, but has important differences that require separate consideration.

In particular, the fact that twinning is either possible or necessary for an embryo should not (as mentioned above) lead one to the absurd conclusion that there are two (or more) spatio-temporally co-located human individuals. Multiple occupancy in this sense is a non-starter. But if the totipotency argument works against the idea that there is a single embryo, it might be taken to support the positive view that there are *several* embryos, not precisely co-located but in close proximity to one another and enclosed within the zona pellucida. This might be one way of reading Harris when he states:[36] 'if the cells removed [from an early embryo] are totipotent (capable of becoming literally any part of the creature including the whole creature), then they are in effect separate zygotes, they are themselves "embryos", and so must be protected to whatever extent embryos are protected.' (Which will be hardly at all, according to his own theory.)

It is not clear why he places 'embryos' in scare quotes: either the totipotent cells are embryos or they are not. More importantly, his words are ambiguous inasmuch as he may be saying that the totipotent cells are separate zygotes only after they are removed, or he may be saying that even *before* they are removed they have this status. The latter interpretation would certainly lend support to the view held by him and others that the early embryo is not an individual. On this interpretation — and it may be the reason for the scare quotes around 'embryos' — what we take to be the embryo is really a kind of cluster of embryos, each member of which is capable of doing what the cluster is capable of doing, namely dividing and maturing. But then in what sense is the thing we take to be a single embryonic human individual really an individual at all? It may be a potential individual with human DNA, but that does not make it a human being any more than a fully differentiated somatic cell with human DNA is a human being. In short, the very totipotency of the embryonic cells belies the supposed unity and individuality of the embryo.

It is as well first to counter the misrepresentation of totipotency in the philosophical literature. Supporters of embryo experimentation represent totipotency as a state of affairs in which the zona pellucida is no more than a kind of fence within which are held a handful of cells, each undifferentiated, none of them 'knowing', as it were, what they want to be, yet all of them capable of developing into any kind of human cell or even a full human being. The characterization is superficial, and masks as well our continuing ignorance as to how and why cell differentiation occurs. The fact that the early embryonic cells do before long begin differentiating and specializing is consistent with the hypothesis that this is a random process (as I suggested earlier with regard to twinning): if there is randomness in nature, it may be random whether, for example, a given embryonic cell becomes or gives rises to a cell of the embryoblast or of the trophoblast. On the other hand, it is also consistent with the hypothesis that each cell is already programmed to develop one way or another, *even though*, if cultured outside the zona pellucida of that embryo, it might develop in some other direction. That is, given the *actual* setting within which the cell is located — within the particular zona, surrounded by other particular cells, all of them interacting with each other in ways we do not fully understand — that cell may well be determined to develop in one particular direction. In other words, 'totipotency' does not necessarily mean — and

probably does not mean — that a cell is capable of becoming anything its genotype allows no matter what the conditions in which it is set. Within the embryo, each cell may have its own programmed role from the moment of fertilization, whatever it might be capable of in another setting. If true, this supports the unity of the embryo.

There is, moreover, an underlying metaphysical point here, namely that being totipotent does not mean being wholly undifferentiated or indeterminate. Even if it is random as to which developmental pathways are followed by which totipotent embryonic cells, no such cell actually can, short of twinning or artificial manipulation, develop into an embryo in its own right. As argued earlier, however, what *might* happen to an embryo does not tell us what it *actually* is, and the same applies to an embryonic cell. From the time of fertilization, and absent any intrinsic or extrinsic faults, the zygote begins an inexorable process of development, as a metaphysical unity, towards being a mature member of its kind. That there is cell differentiation at all after fertilization is hardly a random matter, even if it is perhaps random *which* cells follow which differential pathways. Far from being indeterminate, the zygote is wholly determinate and 'knows' exactly what it wants to be, whatever might happen to it in the future. Similarly, in its actual context, and whatever might happen to it in the future (whether by twinning, or by artificial manipulation, or by some freak event), each totipotent blastomere within the zona pellucida, as part of the embryo, 'knows' exactly what it wants to be — namely, a part that gives rise to some differentiated developmental pathway or other. It is no more an 'embryo within an embryo' than a mature, adult somatic cell — a cell in my calf muscle, for instance — is either an embryo or part of an embryo simply because, in *other* circumstances, it might be used in cloning by nuclear transfer.

Again, the analogy with plants and other organisms is instructive. It is typical for plants to have totipotent parts in the sense that one can take a cutting from any part of a given plant and culture that cutting to develop into a full individual plant of the same kind as its parent. The same may be true of certain primitive organisms. But does that mean the plant is not an individual in its own right? What might the argument for this be? The organizational and developmental unity of the plant is fully given in the way its parts interact with each other, and is not undermined by the mere fact that, separated from the whole, a part could itself be cultured into a whole. Nor can the analogy be dismissed as highly imperfect or even irrelevant. Of course not all analogies between mammals and plants, or between plants and humans in particular, are going to have any relevance to a metaphysical issue. But in this case we are concerned with purely vegetative functions, i.e. the functions of growth and physical development, not with higher functions such as sentience, where the analogy with plants would break down, or rationality, where the analogy with other animals would break down. Therefore, if the proper interpretation of plant totipotency is correct, then the same interpretation should be given of human embryonic totipotency.

The same point can vividly be made by applying it to pluripotency. We now know that adult humans contain pluripotent stem cells throughout their bodies, and more sources of these are being found regularly. Yet it is incorrect to say, for example, that an adult olfactory stem cell that can be coaxed into becoming a nerve cell in a paralyzed patient[37] is now a nerve cell itself, or that a collection of such nasal cells found in close proximity is really part of the nervous system, or that such cells are anything other than olfactory cells contributing intrinsically to olfactory function as part of the nasal mucosa. All of which is compatible with their having the intrinsic potential, given the

right circumstances, to develop into other kinds of cell. For the same reason, totipotent embryonic cells are not embryos within embryos, or non-specific in their function: as parts of the embryo, they contribute essentially to its development, even if, at least at the morula stage, a given cell can be removed without destroying the embryo. (At the blastocyst stage removing such a cell does usually destroy the embryo.)

To make matters even worse for Harris and other deniers of embryo individuality, we have so far been speaking of totipotency in respect of embryonic cells as though it were a given, lumping together twinning and artificial manipulation, and engaging in a large amount of conjecture about just what embryonic cells can do outside their normal context. Such is often the way when philosophers — and for that matter theologians — discuss science. The truth of the matter, however, appears to be that embryonic stem cells are *not* totipotent in the sense in which Singer, Harris, Ford and others would have us believe. Embryonic stem cells do *not* 'have the capacity . . . to produce the whole (total) embryo and fetus with all its extraembryonic membranes and tissues.'[38] As molecular biologist and biochemist David M. Gilbert points out, embryonic stem cells are not totipotent because they have been removed from the supporting trophectoderm (the outer wall of the blastocyst from which the trophoblast is derived) and cannot recreate it themselves. Since the trophectoderm is essential for embryonic development, embryonic stem cells cannot themselves develop into a full embryo, even if they can develop into any tissue of the human body, thus making them merely pluripotent.[39] Hence when embryologists speak of 'totipotency', they should be understood as referring only to the capacity of early embryonic cells to form any kind of human tissue, not to their alleged ability to form on their own an entire human being. Absent this ability, whether we call such cells totipotent or merely pluripotent is a matter of indifference, as long as philosophers and scientists are both talking about the same thing and using the terms consistently. As far as the ability to form an entire individual is concerned — what we might call *ultimate* totipotency — that belongs only to the zygote and early embryo as a whole, by virtue of its intrinsic developmental capacity, which includes the capacity to twin.

Perhaps it will become technically possible to manipulate an extracted embryonic stem cell into fusing with a separately extracted or synthesized trophectoderm, complete with all necessary membranes and cellular material, and thereby cause it to develop into an individual human being. None of this, however, would undermine the individuality of the embryo from which the cell was taken, or the status of the cell when located within the embryo as a part of that embryo contributing to its overall development. Nor would such a process be anything like either natural or artificially stimulated twinning, which demonstrates only the potential of the whole embryo to split, cells, membranes and all, and does not militate against its individuality, as I have argued. So it seems that, even if the philosophical argument from totipotency against individuality had any merit as applied to other organisms — as I have claimed it does not — the scientific ground has in any case been taken away from it as far as human beings are concerned.

5. Conclusion

I have examined three common arguments, found in Harris and many other bioethicists, against the metaphysical status of the embryo as an individual human being. Neither

the distinction between embryoblast and trophoblast, nor the potential for twinning, nor the argument from totipotency, undermines the proposition that the embryo is a human being, a full member of the same natural kind as both the author and reader of this paper. Moreover, there is good reason to think that philosophical discussions of totipotency are scientifically ill informed.

Yet these arguments reappear with disturbing frequency in the bioethical literature. Often they are barely presented as arguments, their conclusions being brought forward as established truths beyond dispute. There are other arguments as well, which I have no space to consider here. In particular, Harris and others regularly dismiss appeals to potentiality as providing no succour to defenders of the humanity of the embryo. In some respects they correctly identify mistaken appeals by such defenders, ones that are irrelevant or based on confusion about just what potentiality involves and how it affects both the metaphysics of the embryo and the proper ethical stance toward it. Full discussion of this issue, however, highlighting as well the confusions and mistakes in the discussions of those who, on considerations of potentiality, argue against the humanity of the embryo and against according it the right to life, must await another occasion.[40]

So must a full discussion of the embryo's moral status.[41] John Harris and others raise interesting and provocative arguments against according the embryo (and foetus) the right to life — arguments that are largely independent of the question examined here, namely whether the embryo is an individual human being. The point of the present paper is to caution against the role that inadequate metaphysics can play in distorting ethical debate. Bioethicists who do not ultimately care, for ethical purposes, whether the embryo is an individual or not, are bound nevertheless to cease using specious metaphysical arguments against those who do. That such arguments do not work is, for those who fall into the latter camp (such as myself), a matter of no small importance.

David S. Oderberg, Department of Philosophy, University of Reading, Reading RG6 6AA, UK. d.s.oderberg@reading.ac.uk

NOTES

1 (London: Routledge, 1985); hereafter *VL*.

2 (Oxford: Oxford University Press, 1998); originally published as *Wonderwoman and Superman: The Ethics of Human Biotechnology* (Oxford: Oxford University Press, 1992); hereafter *CGI*.

3 *CGI*, p. 47; *VL*, p. 11; '*In vitro* fertilization: The ethical issues', *Philosophical Quarterly* 33 (1983): 217–37, at 223. Note, however, that whereas in the second and third locations Harris speaks of the *embryoblast*/*trophoblast* distinction, by the time of *CGI* (and also the first edition, *Wonderwoman and Superman*), a number of years later, all reference to the *embryoblast* has disappeared in favour of the *embryo*/*trophoblast* distinction. It is not clear what new evidence prompted the change of terminology.

4 All references to numbered days of gestation should be taken as approximate.

5 Harris uses the term 'fertilized egg', but this is tendentious terminology and embryologically misleading when speaking of any stage later than that at which the sperm penetrates the egg. I will use the embryologically correct term for each stage, e.g. zygote, morula, blastocyst, etc. Harris's 'trophoblast argument' is supposed to apply to all stages prior to that at which the inner cell mass differentiates from the trophoblast, but for convenience I will speak of the morula only.

6 The claim is explicitly endorsed by Norman Ford, who asks: 'In short, how could the cluster of cells of the early embryo be an actual ontological human individual if it has not yet differentiated into the cells and tissues that will constitute the future embryo proper and those that will not be integral and constituent parts

of the embryo proper?' Norman M. Ford, *When Did I Begin?* (Cambridge: Cambridge University Press, 1988), p. 156.

7 Ford makes the strange claim, responding to Bernard Towers, that the placenta and umbilical cord are not 'living parts of the eventual [sic] embryo and foetus that are discarded when no longer needed — somewhat like deciduous teeth' because they '[have] no nerves, [are] insentient and [have] always been regarded as extraembryonic tissue': Ford op. cit., p. 156. But neither are there nerves or sentience in the foetus's hair or fingernails, yet these are parts of it. To add the qualification 'living' to 'part' just obscures the issue, since the hair and nails are growing, and there is no need for an object to consist entirely of living cells in order for it to be a genuine part of an organism. And 'extraembryonic' is ambiguous between 'located outside the embryo's body' and 'not part of embryo'. Ford evidently has the second meaning in mind, but this is just begging the question and anyway false about how embryologists regard the placenta and umbilical cord.

8 K. L. Moore, *The Developing Human* (Philadelphia: W.B. Saunders, 1982; 3rd edn.), ch. 7; the observation is repeated in the 5th edition (1993) by K. L. Moore & T. V. N. Persaud. The relevant passages from these editions are cited in C. W. Kischer & D. N. Irving, *The Human Development Hoax* (2nd edn., 1997; self-published, distributed by American Life League, Stafford, VA), pp. 41–3; hereafter *HDH*. Kischer is Associate Professor Emeritus, Cell Biology and Anatomy, University of Arizona College of Medicine. See also D. N. Irving, '"New Age" embryology text books: Implications for fetal research', *Linacre Quarterly* 61 (1994): 42–62. In the most recent edition of Moore and Persaud, it is again stated, though this time less explicitly, that there is not a sharp distinction between embryoblast and trophoblast, given intermingling between the cells of both: see Moore and Persaud, *The Developing Human*, 8th edn. (Philadelphia: Saunders Elsevier, 2008), p. 134. As Kischer and Irving point out, however, Moore/Moore and Persaud also, in their discussion of embryoblast and trophoblast early in the various editions of their book, somewhat contradictorily give the impression that such a clear distinction does exist; see the references in *HDH* and also *The Developing Human*, 8th edn., pp. 36ff.

9 *The Developing Human*, 8th edn., p. 134.

10 'Cell interactions occur between these two nascent populations of cells [embryoblast and trophoblast] that are essential for specifying their fate': G. C. Schoenwolf, S. B. Bleyl, P. R. Brauer, & P. H. Francis-West, *Larsen's Human Embryology* (Philadelphia: Churchill Livingstone Elsevier, 2008; 4th edn.), p. 43. This refers to what happens when differentiation occurs; it would be surprising if such interactions ceased *after* differentiation. On the embryoblast and trophoblast, see also P. Lee & R. P. George, *Body-Self Dualism in Contemporary Ethics and Politics* (New York: Cambridge University Press, 2008), pp. 126–7.

11 Let us leave aside for present purposes the question of ectogenesis, and confine our observations as to what is required for normal functioning to natural gestation.

12 Here I am assuming what is not presently known, namely that before separation into embryoblast and trophoblast no particular cells are already determined to become one or the other. There are good philosophical and empirical reasons for thinking the opposite to be the case, which would justify the claim that before observable separation there is still a real (if unidentifiable) distinction between the embryoblast or embryo proper (the mass of cells determined to come together and form the proto-body) and the trophoblast/trophoblastic cells. Needless to say, this would not aid Harris's case.

13 See, e.g., Ford, op. cit., pp. 170–7; P. Singer, *Practical Ethics* (Cambridge: Cambridge University Press, 1993; 2nd edn.), p. 137; M. Lockwood, 'Human Identity and the Primitive Streak', *Hastings Center Report* 25 (1995): 45; L. Silver, *Remaking Eden: Cloning and Beyond in a Brave New World* (New York: Avon Books, 1997), p. 43.

14 *CGI*, p. 47; also *VL*, p. 11; '*In vitro* fertilization', p. 223.

15 Caused, *inter alia*, by two spermatozoa fertilizing the egg and then fusing their pronuclei with no contribution from the egg nucleus, leading to a watery cluster or mass (hydatidiform, Greek 'watery'; mole, Latin 'mola', circular cake). For references in Harris, see *CGI*, p. 47; *VL*, p. 10; '*In vitro* fertilization', p. 223.

16 I am restricting the definition to the human case, but it can be suitably generalized, perhaps to cover all organisms.

17 For further discussion of this subject, see D. S. Oderberg, 'Modal properties, moral status, and identity', *Philosophy and Public Affairs* 26 (1997): 259–98, and *Applied Ethics* (Oxford: Blackwell, 2000), pp. 16ff. The quoted definition is from p. 21. See also Lee & George, op. cit., pp. 123–5.

18 K. Dawson, 'Segmentation and Moral Status: A Scientific Perspective', in P. Singer, H. Kuhse, S. Buckle, K. Dawson & P. Kasimba (eds.) *Embryo Experimentation* (Cambridge: Cambridge University Press, 1990), pp. 53–64, at 57–9.

19 Singer *et al.* op. cit., p. 59.
20 About 0.4% for spontaneous twinning; the rate is at least twice that for cases of assisted reproduction: see M. Schachter, A. Raziel, *et al.*, 'Monozygotic twinning after assisted reproductive techniques: A phenomenon independent of micromanipulation', *Human Reproduction* 16 (2001): 1264–9.
21 On the other hand, there is evidence of increased incidence of congenital abnormalities in monozygotic twins, so perhaps it is a mild case of faulty development: see 'Twin pregnancy' (author unknown), *Atlanta Maternal-Fetal Medicine* 2, 4 (1994) (at http://atlanta-mfm.com/body.cfm?id=48, accessed 13.6.08); G. Leblebicioğlu, S. Balci & A. Üzümcügil, 'Variable expressivity of congenital longitudinal radial deficiency and spinal dysraphism in monozygotic twins', *Turkish Journal of Pediatrics* 47 (2005): 390–2.
22 *HDH*, p. 28.
23 J. S. and M. W. Thompson, *Genetics in Medicine* (Philadelphia: W.B. Saunders, 1986; 4th edn.), p. 274 and Moore, *The Developing Human* (4th edn., 1988): 122–6, both cited by Kischer in *HDH*, pp. 28, 34, put the figures at 30%/70%. These are confirmed in L. Scott, 'The origin of monozygotic twinning', *Reproductive BioMedicine Online* 5 (2002): 276–84. Moore and Persaud in *The Developing Human*, 8th edn., p. 138 put the figures at 35%/65%.
24 *HDH*, p. 28.
25 Perhaps it is already settled by some property of the sperm and/or egg that will eventually unite to form the embryo, but then this opens up the question of whether it is determined that a given sperm and egg will unite, and we can safely skirt this thorny broader question for present purposes. My point is simply that if twinning is determined to occur, it cannot be *later* than fertilization. If environmental factors are also necessary, and these are not present at fertilization but obtain later, the determination to twinning at fertilization will be conditional only. In other words, it will be the case that the embryo is determined intrinsically to twin *on condition that* certain environmental factors obtain at some later time.
26 For simplicity I am taking it that all biophysical causation is deterministic. The point I am making can be enlarged to take account of probabilistic causation.
27 Again, omitting considerations of probability, I take it that a biophysical event is undetermined just in case it is random.
28 For simplicity's sake I allow for the possibility of some random event prior to fertilization that, say, causes the development of a gamete, which itself joins with another gamete at fertilization, and where twinning later follows, such that we could still legitimately say that the twinning was determined even though some random event existed prior to fertilization. As long as causation from fertilization onwards is transitive, and all the embryogenetic events are determined, this will be enough for us to hold that the twinning is determined at fertilization even though there might be some random event prior to fertilization: we would not be forced to say that *that* inexplicable event caused the twinning, hence that the twinning *itself* was undetermined. To go any more deeply into this question would take us too far into general issues to do with causation and explanation. The basic point is that it is non-arbitrary to choose fertilization as the point at which the future course of the embryo, including whether it will split, is determined, assuming its course to be determined at all.
29 Just as, were one to have a roulette wheel with 30% of slots black and 70% red, and the wheel physically operated like a normal one, it would be a brute fact that 30% of all throws landed randomly on black. (As far as we can tell. Again, let us leave aside the question whether there is true randomness in nature at all.)
30 For detailed discussion, see my 'Modal properties, moral status, and identity'. There, however, I focus on cases where twinning is possible but not determined.
31 Ford (op. cit., pp. 121–2) sees the analogy between zygotic twinning and amoebic or bacterial fission, though he dismisses the analogy with plants. He does not, however, come up with an argument showing either that zygotes, or amoebae and bacteria, fail for individuality.
32 See D. S. Oderberg, 'Coincidence under a sortal', *Philosophical Review* 105 (1996): 145–71. For a contrary view in respect of artefacts, see C. Hughes, 'Same-kind coincidence and the Ship of Theseus', *Mind* 106 (1997): 53–67. Even if one could, as one cannot, make the argument work for artefacts, this does not mean it works for natural objects such as embryos.
33 For the present discussion I am assuming the overwhelmingly likely position that a divided embryo ceases to exist altogether, since twinning before the primitive streak appears is generally symmetrical. There may be cases both before, and certainly after, where twinning is asymmetrical: perhaps some cases of foetus-in-foetu are like that. In these situations, no embryo or foetus ceases to exist, but there is a faulty or incomplete separation of an entity from it, where that entity may be more or less well formed as a human being.

34 Harris, 'The ethical use of human embryonic stem cells in research and therapy', in J. Burley & J. Harris (eds.) *A Companion to Genethics* (Oxford: Blackwell, 2002), pp. 158–74, at 164.

35 For a typical statement, see H. Kuhse & P. Singer, 'Individuals, humans and persons: The issue of moral status', in Singer *et al.*, pp. 67–8. See also: Ford op. cit., ch. 5; B. Smith and B. Brogaard, 'Sixteen Days', *Journal of Medicine and Philosophy* 28 (2003): 45–78.

36 'Ethical use': 163.

37 As has been demonstrated by research in various parts of the world. See, for instance, the work of Dr Carlos Lima of Portugal: C. Lima, J. Pratas-Vital, P. Escada, A. Hasse-Ferreira, C. Capucho & J. D. Peduzzi, 'Olfactory mucosa autografts in human spinal cord injury: A pilot clinical study', *Journal of Spinal Cord Medicine* 29 (2006): 191–203.

38 Ford op. cit., p. 212; see also p. 119 where he claims of the zygote that its 'first two daughter cells are totipotent — each one can develop into a complete living human individual'.

39 D. M. Gilbert, 'The future of human embryonic stem cell research: Addressing ethical conflict with responsible scientific research', *Medical Science Monitor* 10 (2004): RA99–103. This important point is missed by R. P. George and C. Tollefsen in *Embryo: A Defense of Human Life* (New York: Doubleday, 2008), pp. 12–13, where they briefly reiterate the common misconception about totipotency.

40 For a broader discussion of potentiality, and of its uses and misuses as applied to the embryo, the foetus, and the person, see my *Moral Theory* (Oxford: Blackwell, 2000), pp. 177–83, and *Applied Ethics*, pp. 32–40.

41 See *Applied Ethics*, ch. 1, and 'Modal properties, moral status, and identity', for contributions to such a discussion. See also Lee & George op. cit., and George & Tollefsen op. cit.