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I

In many respects the current debate about embryo experimentation resembles the older debate about abortion. Although one central argument *for* abortion—the claim that a woman has the right to control her own body—is not directly applicable in the newer context, the argument *against* embryo experimentation remains essentially the same as the argument against abortion. This argument has two forms, one relying on the claim that from the moment of fertilization the embryo is entitled to protection because it *is* a human being, and the other asserting instead that the embryo is entitled to protection because from the moment of fertilization it is a *potential* human being.[1]

The first form of this argument will not concern us here;[2] our focus is on the argument from potential. Those who use this argument against embryo experimentation frequently describe the potential of the early *in vitro* embryo in terms identical with those used in the context of the abortion debate to describe the potential of the early embryo inside the female body. Teresa Iglesias, for example, writes: "We know that a new human

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1. For examples of the popular arguments against embryo experimentation, see *Test-Tube Babies*, ed. William Walters and Peter Singer (Melbourne: Oxford University Press, 1982), chap. 4.

2. One of us has discussed the argument previously: see Peter Singer, *Practical Ethics* (Cambridge: Cambridge University Press, 1979), chap. 6.

individual organism with the internal potential to develop into an adult, given nurture, comes into existence as a result of the process of fertilisation at conception."[3] But can the familiar claims about the potential of the embryo in the uterus be applied to the embryo in culture in the laboratory? Or does the new technology lead to an embryo with a different potential from that of embryos made in the old way? Asking this question leads us to probe the meaning of the term 'potential'. This probing will raise doubts about whether it is meaningful to talk of the potential of an entity independently of the context in which that entity exists and independently of the probability that that entity will develop in a specific way. In particular, we will argue that while the notion of potential may be relatively clear in the context of a naturally occurring process such as the development of an embryo inside a female body, this notion becomes far more problematic when it is extended to a laboratory situation, in which *everything* depends on our knowledge and skills, and on what we decide to do. This line of argument will lead us to the conclusion that there is no coherent notion of potential which allows the argument from potential to be applied to embryos in laboratories in the way those who invoke the argument are seeking to apply it.

We begin by considering how recent developments in reproductive technology force us to revise some previously universal truths about embryos. Before Robert Edwards began the research which was to lead to the IVF (*in vitro* fertilization) procedure, no one had observed a viable human embryo prior to the stage at which it implants in the wall of the uterus. In the normal process of reproduction inside the body, the embryo, or 'pre-embryo' as it is now sometimes called, remains unattached for the first seven to fourteen days. As long as such embryos existed only inside the woman's body, there was no way of observing them during that period. The very existence of the embryo could not be established until after implantation.

Under these circumstances, once the existence of an embryo was known, that embryo had a good chance of becoming a person, unless its development was deliberately interrupted. The probability that such an embryo would become a person was therefore very much greater than the probability that an egg in a fertile woman would unite with sperm from that woman's partner and lead to a child. It was also considerably greater than the chance that an as yet unimplanted embryo would become a child.

3. Teresa Iglesias, "*In Vitro* Fertilisation: The Major Issues," *Journal of Medical Ethics* 10 (1984): 36.

There was also, in those pre-IVF days, a further important difference between any embryo, whether implanted or not, and the egg and sperm. Whereas the embryo inside the female body has some definite chance (we shall consider later how great a chance) of developing into a child *unless* a deliberate human act interrupts its growth, the egg and sperm can develop into a child *only* if there *is* a deliberate human act. So in the one case, all that is needed for the embryo to have a prospect of realizing its potential is for those involved to refrain from stopping it; in the other case, they have to carry out a positive act. The development of the embryo inside the female body can therefore be seen as a mere unfolding of a potential that is inherent in it. The development of the separated egg and sperm is more difficult to regard in this way, because no further development will take place unless the couple have sexual intercourse or use artificial insemination. (This is, to be sure, an oversimplification, for it takes no account of the positive acts involved in childbirth; but it is close enough for our purposes.)

Now consider what has happened as a result of the success of IVF. The procedure involves removing one or more eggs from a woman's ovary, placing them in culture medium in a glass dish, and then adding sperm to the culture. In the more proficient laboratories, this leads to fertilization in about 80 percent of the eggs thus treated. The embryo can then be kept in culture for two to three days, while it grows and divides into two, four, and then eight cells. At about this stage, if the embryo is to have any prospect of developing into a child, it must be transferred to a woman's uterus. Although the transfer itself is a simple procedure, it is after the transfer that things are most likely to go wrong: for reasons which are not fully understood, with even the most successful IVF teams the probability that a given embryo which has been transferred to the uterus will actually implant there and lead to a continuing pregnancy is always less than 20 percent, and generally no more than 10 percent.[4] (Figures quoted for pregnancies per transfer procedure may be higher, but this is because it is common to transfer more than one embryo; for our purposes the important figure is the probability that any given embryo will result in a child.) We should also note that if the embryo is allowed to continue to grow in culture much beyond the eight-cell stage, it is less likely to implant when

4. For these figures, see Ian Johnston, "IVF: The Australian Experience," a paper presented at the Royal College of Gynaecologists and Obstetricians Study Group on AID and IVF, November 1984, reprinted in *Hansard*, Commonwealth of Australia, Senate, Select Committee on the Human Embryo Experimentation Bill, 1985, report of hearings of 26 February 1986 (Canberra: Commonwealth Government Printer, 1986), pp. 560–87.

transferred. Embryos can be grown in the laboratory to the later blastocyst stage, when the cells are arranged as a hollow sphere and those which will form the embryo proper have become distinct from those which will form the extraembryonic membranes, that is, the chorion and the amnion. The blastocyst may then develop further, to the point at which it consists of hundreds of cells. No pregnancies, however, have resulted from embryos transferred at so late a stage of development. Nor, as yet, is there any prospect of keeping embryos alive and developing *in vitro* until they become viable infants. So although Edwards has reported keeping an embryo alive in culture for nine days,[5] with our present state of knowledge, such an embryo has zero probability of becoming a person.

In summary, then, before the advent of IVF, it would have been true to say of any normal human embryo known to us that, unless it was deliberately interfered with, it would most likely develop into a person. The process of IVF, however, leads to the creation of embryos which cannot develop into a person unless there is some deliberate human act (the transfer to the uterus) and which even then, in the best of circumstances, will most likely *not* develop into a person.

The upshot of all this is that IVF has reduced the difference between what can be said about the embryo and what can be said about the egg and sperm, considered jointly. Before IVF, any normal human embryo known to us had a far greater chance of becoming a child than any egg and sperm prior to fertilization. But with IVF, there is a much more modest difference in the probability that a child will result from a two-cell embryo in a glass dish and the probability that a child will result from an egg and some sperm in a glass dish. To be specific, if we assume that the laboratory's fertilization rate is 80 percent and its rate of pregnancy per embryo transferred is 10 percent, then the probability that a child will result from a given embryo is 10 percent, and the probability that a child will result from an egg which has been placed in a culture medium to which sperm has been added is 8 percent.

II

It has occasionally been suggested that there is no difference between the potential of the embryo, on the one hand, and the potential of the egg and

5. Robert Edwards and Patrick Steptoe, *A Matter of Life* (London: Sphere, 1981), p. 146.

sperm when still separate, but considered jointly, on the other hand.[6] But there has been little analysis of the notion of potential in the context of the *in vitro* embryo, and the suggestions made have not succeeded in dispelling the intuitive idea that there is a major difference between the potential of the embryo and the potential of the pair of gametes. To provide this analysis, we must ask what we mean when we refer to the embryo as a potential person.

An obvious place to begin our search for the meaning of this claim is the dictionary definition of the word 'potential'. The *Oxford English Dictionary* offers several meanings of the term, of which the following seems to be the most relevant to our present concerns: "Possible as opposed to actual; existing *in posse* or in a latent or undeveloped state, capable of coming into being or action; latent." Following the dictionary definition, it would seem that *at the least* we must mean that it is *possible* for the embryo to become a person. Possibility is a necessary condition for potentiality (whether it is also a sufficient condition is not something we need consider here). But what sort of possibility?

Philosophers commonly distinguish between logical possibility and physical possibility. It is logically possible, but physically impossible, for the authors of this paper to jump over the Empire State Building. It is both logically and physically possible for us to jump over a brick. It is not logically possible for anyone to be a biological parent without having any children.

Since something is logically impossible only if its assertion involves a contradiction, it is not logically impossible for a human blastocyst in a laboratory to develop into a person. But then, it is not logically impossible for a human egg to develop into a person either—parthenogenesis happens often in some species, and no logical contradiction is involved in imagining it happening in our species. So those who claim that the human embryo is a potential person, whereas the human egg is not, cannot appeal to the mere fact that it is logically possible for the embryo to become a person.

The sense of 'possibility' that lies behind these claims that the embryo, but not the egg, is a potential person must, therefore, be real, physical possibility. We must, however, further refine the relevant sense of physical

6. See, for example, Helga Kuhse and Peter Singer, "The Moral Status of the Embryo," in *Test-Tube Babies*, ed. Walters and Singer, pp. 56–63, and John Robertson, "Extracorporeal Embryos and the Abortion Debate," *Journal of Contemporary Health Law and Policy* 2 (1986): 63.

possibility. Does it refer to what is physically possible given the present state of our knowledge and technology? In that case, the eight-cell embryo in the laboratory may be a potential person, but a late-stage blastocyst in the laboratory, consisting of hundreds of cells, cannot be a potential person; we know that if we attempt to transfer such a blastocyst, it will simply be discharged from the uterus without implanting. This yields the result that two blastocysts, to all appearances identical in their internal properties, have entirely different potentials: one, because it has resulted from natural intercourse and has implanted in the uterus, is a potential person, while the other one is not because it is in a laboratory culture.

Such a result is counterintuitive, for it means that while the eight-cell embryo in the laboratory is a potential human being, the embryo loses that status simply by continuing to develop in the laboratory. But perhaps we could come to accept such a view. There are analogous situations in which we would also say that a being has lost the potential it once had. Imagine, for instance, a doctor monitoring a risky pregnancy. The doctor might observe a healthy fetus at one stage during the pregnancy, and say: "Yes, we have a potential person there." Gradually, however, the condition of the fetus may deteriorate to such an extent that it is evident that it will die before reaching the point at which a caesarean delivery could offer any hope of producing a viable infant. The doctor might then say that the potential for personhood has been lost.

This account of potentiality may appear to confuse potential with probability. So far, however, we have been doing no more than exploring a *minimum* necessary condition, suggested by the dictionary definition, for X to have the potential to become Y. That minimum condition is that it be *possible* for X to become Y. Once we accept that it is a present physical possibility, and not logical possibility, that is meant here, we cannot disregard the differences between the eight-cell embryo in the laboratory and those blastocysts which consist of hundreds of cells. These differences do mean that, given our present state of knowledge and technology, it is possible for the former to become a person, but quite impossible, in the relevant physical sense, for the blastocyst just described to become a person. If physical possibility in our present state of knowledge and technology is a necessary condition for potentiality, it follows that the blastocyst in the laboratory is not a potential person.

Given the implications of this view, it might be said that the relevant sense of 'physically possible' should *not* refer to the present state of our

knowledge and technology. If we should one day discover how to induce late blastocysts to implant, or if we should perfect laboratory development to such an extent that embryos can develop into infants without ever being transferred to a woman—the process known as ectogenesis—then late blastocysts in laboratories will be able to become people. Perhaps this is all the 'possibility' that is needed for an embryo to be a potential person.

This may indeed be the sense of 'possibility' which lies behind a proper attribution of potential; but it cannot help those who wish to distinguish the potential of the embryo from that of the egg alone. For if it is true that we may one day discover how to induce late blastocysts to implant, it is also true that we may one day discover how to induce parthenogenetic development in the human egg. (Scientists putting human eggs in culture media for IVF have reported seeing, on rare occasions, the beginnings of parthenogenetic development.)[7] So the same sense of 'possibility' which would allow the late embryo to be a potential person would also allow every human egg to be a potential person.

At one stage in the development of reproductive technology—roughly from 1983 until 1985—it might have been argued that the late blastocyst had a genuine possibility of becoming a person in a way that the egg did not. In 1983, human embryos were first successfully preserved by freezing, in a manner which made it possible for them to continue normal development after thawing. Until 1985, however, there was no known way of freezing human eggs which did not cause them damage so severe as to make continued development impossible. A blastocyst could therefore have been frozen to await discovery either of a technique for implanting it successfully in a uterus or of the means of developing it to viability in an artificial womb. A human egg could not have been frozen to await the development of a means of inducing parthenogenesis. Since 1985, however, it has been possible to freeze eggs as well as embryos. So if the combination of freezing and the possibility of future discoveries means that a laboratory blastocyst is a potential person, the same combination must now mean that an unfertilized egg in a laboratory is also a potential person.

Unraveling the notion of potential is leading us in an unexpected direction, and one which will not be welcomed by those who oppose experimentation on human embryos while permitting experimentation on hu-

7. R. Edwards, and also A. Trounson, "Discussion on the Growth of Human Embryos *in Vitro*," in *Human Conception in Vitro*, ed. R. Edwards and J. Purdy (London: Academic Press, 1982), pp. 219-33.

man eggs.[8] The problem, however, is not with the analysis we have proposed, but with the attempt to develop a notion of potential which supports the idea that there is a sharp distinction between the potential of the embryo and that of either the separate egg or the egg and sperm when separate but considered jointly. Is there any way in which the notion can be restored to something more suitable to those purposes?

In a discussion of parthenogenesis, Warren Quinn suggests that in this situation the environmental agent producing parthenogenetic development can be treated as a prefertilization entity that is incorporated into the 'zygote' at the onset of development.[9] In this way, he seeks to preserve the view that even if parthenogenesis occurs, the egg alone is not a potential person; it becomes a potential person only when parthenogenetic development has been triggered. But Quinn's suggestion does not succeed in marking a distinction between the egg and the embryo. For the embryo also needs a specific environment if it is to develop; and if the particular environment which leads to parthenogenesis is allowed to count as an entity for the purposes of denying potential to the egg on its own outside that environment, then the particular environment which leads to development of the embryo must also be allowed to count as an entity, and we should deny potential to the embryo on its own outside that environment.

One might try to defend Quinn's analysis by claiming that the embryo has an *inherent* potential to develop into a person, whereas the egg needs an *external* trigger if it is to develop. At first glance, this appears promising; but on closer scrutiny the promise evaporates. Both the egg and the embryo have an internal genetic code which can, in the right environment, lead to the development of a human being. True, in the embryo the forty-six chromosomes are already present, whereas in the egg the twenty-three chromosomes which are present will need to duplicate themselves to form the forty-six chromosomes necessary for further development. But in neither case does additional genetic information have

8. As was recommended by the Victorian Government's Committee to Consider the Social, Ethical and Legal Issues Arising from *In Vitro* Fertilization, chaired by Professor Louis Waller. See the committee's *Report on the Disposition of Embryos Produced by In Vitro Fertilization* (Melbourne: Victorian Government Printing Office, August 1984). The subsequent Victorian legislation, the Infertility (Medical Procedures) Act of 1984, sec. 6, incorporates these recommendations by tightly restricting embryo experimentation while explicitly exempting experimentation on human ova.

9. Warren Quinn, "Abortion: Identity and Loss," *Philosophy & Public Affairs* 13, no. 1 (Winter 1984): 28.

to be supplied from an external source. In both cases, on the other hand, a great deal else does have to come from outside. In the case of the embryo in the uterus, this includes all the nutrients needed for growth; and of course in the case of the embryo in the laboratory, it also includes skilled human intervention to transfer the embryo to a uterus. In the case of the egg, skilled human intervention would also be required to induce parthenogenetic development. The difference seems to be one of degree rather than of kind.

It might be said that the induction of parthenogenesis marks a more radical change than that caused by the provision of nutrients because it marks the beginning of a new individual, and that in this respect parthenogenesis and fertilization are alike, while the subsequent stages of growth and development have a different, and lesser, significance. But why should we regard the egg after parthenogenesis as a different individual from the egg before parthenogenesis? The following reason can be offered: before either fertilization or parthenogenesis, the egg could develop into any number of different people, because it could be fertilized by any number of different sperm or develop parthenogenetically. After fertilization or parthenogenesis, the developing embryo can become only one person. (Because of the possibility of twinning this is not strictly true, but the contrast between an indefinite range of possibilities and a very limited range of possibilities remains.)

In our view the fact that the embryo, but not the egg, has a uniquely determined potential does not suffice to show that the embryo is a different individual from the egg, or that it, but not the egg, is a potential person. Consider the analogy of a block of marble, rough-hewn from the quarry. In the hands of Michelangelo, it is a potential David, or a Moses, or a Pietà. Later, when the sculptor has chiseled it into the rough outline of a standing youthful figure, it can only become a David. Certainly, by working the marble in this way, Michelangelo has taken its development a stage further. The stage is significant because now the marble has the potential to become only one kind of sculpture (though of course there is still scope for great variation in many important details). Yet the marble is continuous in space and time with the original block. It is not a different piece of marble. That original block, we can now see, had the potential to be a David all along, and the fact that at an earlier stage it could also have become something else does not count against the claim that, even then, it was a potential David. Similarly, fertilization or parthenogenesis takes the develop-

ment of the egg a stage further, but the potential of the egg is retained. The resulting embryo now has the potential to become only one kind of person (though here too there is still scope for great variation in many important details).[10] Yet the egg had the potential to become this person all along, just as it had the potential to become, in different circumstances, any one of a wide range of other people. Potentiality is one thing; uniqueness is something quite different.

Although we have used the possibility of parthenogenetic development as a means of illustrating some of the problems of attempts to separate the potential of the late blastocyst from the potential of the human egg, our general analysis of the notion of potential does not rely on this. We could equally well have returned to the simpler case of the egg and sperm together in their culture medium prior to the occurrence of fertilization. For all the senses of 'possibility' that we have considered, it is no less possible for the egg and sperm in the laboratory to develop into a person than it is for the laboratory embryo, also in its culture medium, to develop into a person. One could even say the same about the egg alone, treating the presence of sperm as part of the environment necessary for further development, just as the presence of nutrients is necessary for the further development of the embryo.

A more promising approach to distinguishing the potential of the embryo from the potential of the egg and sperm in their culture medium is to acknowledge openly a link between potential and probability, by relating potential not to the bare *possibility* of the embryo's becoming a person, but rather to the *probability* that this will happen. This has the inevitable result that potential ceases to be an all-or-nothing matter, and becomes a matter of degree. Traditional defenders of the right to life of the embryo have been reluctant to introduce degrees of potential into the debate, because once the notion is accepted, it seems undeniable that the early embryo is less a potential person than the later embryo or the fetus. This could easily be understood as leading to the conclusion that the prohibition against destroying the early embryo is less stringent than the prohibition against destroying the later embryo or fetus. Nevertheless, some defenders of the argument from potential have invoked probability and degrees of potential. Among those who have spoken most openly of prob-

10. On the range still possible after fertilization, see Karen Dawson, "Fertilisation and Moral Status: A Scientific Perspective," *Journal of Medical Ethics* 13 (1987).

ability are the Roman Catholic theologian John Noonan and the philosopher Werner Pluhar. As Noonan puts it:

> As life itself is a matter of probabilities, as most moral reasoning is an estimate of probabilities, so it seems in accord with the structure of reality and the nature of moral thought to found a moral judgment on the change in probabilities at conception. . . . Would the argument be different if only one out of ten children conceived came to term? Of course this argument would be different. This argument is an appeal to probabilities that actually exist, not to any and all states of affairs which may be imagined. . . . If a spermatozoon is destroyed, one destroys a being which had a chance of far less than 1 in 200 million of developing into a reasoning being, possessed of the genetic code, a heart and other organs, and capable of pain. If a fetus is destroyed, one destroys a being already possessed of the genetic code, organs and sensitivity to pain, and one which had an 80 percent chance of developing further into a baby outside the womb who, in time, would reason.[11]

Pluhar is almost as explicit:

> if we allow a mere potential for simple consciousness to give rise to a prima facie right to life, then it seems that we must accord a similar right to the staggering number of gamete pairs that likewise have some such potential. . . . Clearly, however, the gamete pair's potential is vastly lower than that of the insentient fetus: even given absence of interference plus at most a modest amount of assistance, the probability of a given gamete pair's producing the individual that it has some potential to produce is so vanishingly small as to be totally negligible in practice.[12]

If, following Noonan and Pluhar, we take the probability that an embryo will become a reasoning being (or, in Pluhar's case, become sentient) as relevant to the potential of the embryo to become a person, it must follow that the potential of the laboratory embryo currently diminishes after the eight-cell stage, when the probability that the transferred embryo will result in a pregnancy begins to decline; and by the late blastocyst stage, on this view, the laboratory embryo has no potential at all. This may well be

11. John T. Noonan, Jr., "An Almost Absolute Value in History," in *The Morality of Abortion*, ed. J. T. Noonan, Jr. (Cambridge: Harvard University Press, 1970), pp. 56–57.

12. Werner Pluhar, "Abortion and Simple Consciousness," *Journal of Philosophy* 74 (1977): 167.

an implication which opponents of embryo experimentation are happy to accept; they may say that this loss of the potential to become a person is one reason why it is wrong to keep human embryos alive in laboratories, or perhaps even why it is wrong to create them *in vitro* at all.

Accepting that there are degrees of potential associated with probability does, however, have other consequences which are less likely to be congenial to opponents of embryo experimentation. For on this view, contrary to what Noonan and Pluhar claim, the distinction between the potential of the embryo in culture and the potential of the gametes in the laboratory before fertilization becomes a difference of degree, and not a marked difference at that. Fertilization is, as we have seen, one of the relatively reliable steps in the *in vitro* fertilization procedure, with success rates commonly around 80 percent. Thus if we base degrees of potential on the probability that a person will ultimately result from an embryo, we cannot treat as crucially significant the line between the stage at which we have a set of gametes and the stage at which we have an embryo. At least so far as potential is concerned, the division between the stage at which we have an embryo in the laboratory and the stage at which we have an embryo implanted in the uterus is much more significant. Insofar as the argument from potential is important to the morality of experimenting on or disposing of an entity, we cannot support the prohibition of experimenting on or disposing of embryos while remaining unconcerned about how eggs and sperm are treated.

There are two possible replies to this argument. The first claims that to speak of the potential of the egg and sperm while they are still separate is nonsense, because they are two discrete entities, and hence cannot have a single potential. The second reply is Noonan's; it asserts that the distinction between embryo and gametes does mark a sharp distinction in probability, because the probability that an embryo will become a child is very great, whereas the probability that any *one* sperm will participate in fertilization is 1 in 200 million. We will consider these replies in turn.

The first reply fails because there is no reason why an entity with potential must consist of a single object, rather than of two or more discrete objects. There is, for instance, nothing problematic about the statement (made, let us assume, shortly before the battle of El Alamein) "Montgomery's army has the potential to defeat Rommel's army."[13] Yet Montgom-

13. The example is taken from a letter by Brian Scarlett (*Journal of Medical Ethics* 10

ery's army consisted of thousands of discrete individuals, spread over many miles of desert. We can even speak of the potential of entities which are spread across the entire planet—as Noah might have spoken of the potential of the raindrops falling all over the world to cause a great flood. So why should there be any problem about speaking of the potential of a set of gametes in a glass dish?

Noonan's reply faces several problems. One has been raised by Mark Strasser.[14] Why, Strasser asks, does Noonan focus on the probability that a given single sperm will participate in fertilization, and not on the probability of fertilization by any one of the sperm? This would, of course, provide a very different result: in the case of a normally fertile woman who has sexual intercourse without contraception during that part of her cycle when she is most likely to be fertile, the probability that fertilization will occur and result in a child is not greatly different from the probability that the newly fertilized egg will result in a child—certainly not different by the orders of magnitude Noonan suggests. Similarly, Noonan does not discuss the probability that the *egg*, rather than the sperm, will participate in fertilization. This also would give a very different result.

Even if Noonan can provide an answer to Strasser's objection, his position has, like other claims about the potential of embryos, become much more difficult to maintain in the light of new knowledge and new developments in reproductive technology. The initial difficulty is that Noonan's figures for embryo survival even in the uterus are no longer regarded as accurate. At the time Noonan wrote, the estimate of pregnancy loss was based on clinically recognized or stable, ongoing pregnancies. These pregnancies are about six to eight weeks after fertilization—embryonic heartbeat is detectable, menses has ceased, and enzyme assays will give reliable results indicating pregnancy. Currently such pregnancies are associated with a 15 percent loss through spontaneous abortion.[15] Though the total pregnancy wastage rate remains largely unknown, recent technical advances allowing earlier recognition of pregnancy suggest that this figure is an underestimate of total loss and represents an oversimplifica-

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[1984]: 217–18) arguing, in a different context, against the views of Peter Singer and Helga Kuhse on the potential of the embryo.

14. Mark Strasser, "Noonan on Contraception and Abortion," *Bioethics* 1, no. 2 (April 1987): 199–205.

15. J. Grudzinskas and A. Nysenbaum, "Failure of Human Pregnancy after Implantation," *Annals of the New York Academy of Science* 442 (1985): 39–44.

tion of the real situation.[16] Estimates of the natural wastage at various stages of pregnancy can now be taken into account, and they provide startlingly different figures from those supplied by Noonan. If pregnancy is diagnosed before implantation (within fourteen days of fertilization) the estimated chance of a birth resulting is 25 to 30 percent.[17] After implantation this chance increases initially to between 40 and 60 percent,[18] and it is not until six weeks' gestation that the chance of birth occurring increases to between 85 and 90 percent.[19]

Noonan claimed that his argument is "an appeal to probabilities that actually exist, not to any and all states of affairs which may be imagined." We have now seen that the real probabilities are very different from what Noonan believed them to be. Once we substitute the real probabilities, Noonan's argument no longer supports the moment of fertilization as the time at which the embryo gains a significantly different moral status. Indeed, if we were to require an 80 percent probability of further development into a baby—the figure used in the passage from Noonan quoted above—we would have to wait until about six weeks after fertilization before the embryo would have the significance Noonan wants to claim for it. If, on the other hand, we simply look for the moment at which the chance of birth resulting becomes close to or better than 50 percent, that time would seem to be around the moment of implantation.

To cope with the development of IVF, some readjustment of the parts of Noonan's argument pertinent to gametes is also necessary. Most importantly, the figures for embryo survival are very different when we consider the laboratory embryo rather than the embryo implanted in a uterus; an embryo survival rate of 10 percent would be relatively optimistic, even in a proficient laboratory. In addition, Noonan estimates the probability that any one sperm will participate in fertilization as 1 in 200 million, based on the number of sperm in a male ejaculate. In IVF, however, only about 50,000 sperm are used to fertilize an egg, increasing greatly the chances that any one sperm will fertilize the egg.[20]

16. Ibid.

17. C. Roberts and C. Lowe, "Where Have All the Conceptions Gone?" *Lancet*, 1975, 1:498–99.

18. J. Muller et al., "Fetal Loss after Implantation," *Lancet*, 1980, 2:554–56.

19. D. Braunstein, "Chorionicgonadotrophin (HCG) and HCG-like Substances in Human Tissue and Bacteria," in *Pregnancy Proteins: Biology, Chemistry and Clinical Application*, ed. J. Grudzinskas et al. (London: Academic Press, 1982), pp. 39–49.

20. M. Mahadevan and G. Baker, "Assessment and Preparation of Semen for *In Vitro* Fer-

Perhaps Noonan's claim that there is a sharp difference between the embryo and the sperm, based on the probability of proceeding to the next stage of development, could survive these changes in the figures. The relevant figure for the embryo *in vitro* is now 1 in 10, and for the sperm participating in *in vitro* fertilization, about 1 in 50,000. This is still a very marked difference. The difference virtually disappears, however, if we focus on the egg rather than the sperm, or if, as Strasser suggests, we consider the prospects of a birth resulting not from a *given* sperm, but from *any* of the sperm in the seminal fluid.

In any case, the argument faces still one more difficulty. Scientists are at present on the brink of trying out a new means of overcoming male infertility caused by a low sperm count or sperm which is insufficiently motile. The egg will be removed and cultured as in the normal *in vitro* procedure, but instead of adding a drop of seminal fluid containing about 50,000 sperm, a single sperm will be microinjected under the outer membrane of the egg. This procedure has already been carried out with human gametes, although no attempt has been made to produce a pregnancy from the resulting zygote.[21] Problems may arise in the use of the technique to overcome male infertility, but assuming that it is successful, the unique genetic blueprint of the individual-to-be will be determined before fertilization; it will, to be precise, be determined at the moment when the single sperm has been selected for microinjection. So if we compare the probability that the embryo will become a person with the probability that the egg, together with the single sperm about to be microinjected into the egg, will become a person, we will be unable to find any sharp distinction between the two. Even the genetic blueprint will have been determined in both cases.

III

An Australian Senate Select Committee has recently discussed the question of the potential of the embryo in the context of human embryo experimentation. Its report, *Human Embryo Experimentation in Australia*, consists of a majority report signed by the chairman, Senator Michael

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tilization," in *Clinical In Vitro Fertilization*, ed. C. Wood and A. Trounson (New York: Springer, 1984), pp. 99-116.

21. Personal communication from Dr. Ismail Kola, Centre for Early Human Development, Monash University.

Tate, with four other senators, and a dissenting report signed by two senators.[22] The majority report seems to take the notion of the potential of the laboratory embryo as unproblematic, stating that it works from the premise that "the embryo may be properly described as genetically new human life organised as a distinct entity oriented towards further development."[23] The majority clearly did not regard the egg in a similar light, for whereas they recommended the prohibition of destructive experimentation on human embryos, they made no such recommendation regarding experimentation on human eggs. They also made recommendations designed to reduce the incidence of embryo freezing, in view of the high risk of mortality for frozen embryos, encouraging instead the development and use of egg freezing.[24]

The dissenting report from Senators Rosemary Crowley and Olive Zakharov took a radically different view of potential:

> Any object or thing has an infinite number of possible future courses. For a non-sentient or inanimate thing, e.g. a rock, the particular future outcome that actually happens is determined by forces outside of itself. An embryo is like a rock in this respect—it cannot make decisions for itself. Its future is decided by others. It has potential only in virtue of decisions by others about it. If there is a clearly defined responsible party or parties their decisions determine the embryo's potential and that becomes the embryo's potential.[25]

This is a bold departure from the conventional view of potential, although it is not a great distance from the view that the potential of an entity to become a person is related to the probability that the entity will become a person. But Crowley and Zakharov have noticed something that is overlooked by straightforward attempts to identify potentiality with probability, and that is the role of human decision.

As we noticed earlier, whereas the embryo inside the female body has some definite chance of developing into a child unless a deliberate human act interrupts its growth, the egg and sperm can develop into a child only

22. Senate Select Committee on the Human Embryo Experimentation Bill, *Human Embryo Experimentation in Australia* (Canberra: Australian Government Publishing Service, 1986).

23. Ibid., para. 3.27.

24. Ibid., para. 5.13.

25. Ibid., para. D20.

if there is a deliberate human act; *and in this respect the IVF embryo in the laboratory is like the egg and sperm, and not like the embryo in the human body.*

Lurking in the background of discussions of the potential of the embryo is the idea that there is a 'natural' course of events, governed by the 'inherent' potential of the embryo, or as the majority report of the Senate committee might have put it, resulting from the "organization of the embryo as an entity oriented towards further development." For if it were not for this notion of a 'natural' course of events, why would the Senate committee not have noticed that the human egg is also "genetically new human life organised as a distinct entity oriented towards further development"? After all, the egg is human, not from any other animal, and it is also alive, not dead. Moreover, what the egg needs to continue its development is a sperm, just as what the embryo needs is a suitable environment, nutrients, and so on. Neither can develop without an external element, and both can develop with the right external element.[26] If we set aside the idea that the embryo will develop 'naturally' as opposed to the egg, which will develop only if a sperm is placed in proximity to it, what difference in terms of "orientation towards further development" remains?

We have seen, however, that this notion of 'natural' development—development not requiring the assistance of a deliberate human act—has no application to the IVF embryo. Hence those who wish to use the potential of the IVF embryo as a ground for protecting it cannot appeal to this notion of natural development; and for this reason, they find themselves in difficulty in explaining why the embryo in the laboratory has a potential greatly different from that of either the egg alone or the egg and sperm considered jointly. Crowley and Zakharov are correct to point to the crucial role played by human decision in determining the future of the embryo, and to focus, as they do in their dissenting report, on the question of who should have the responsibility of making this decision. (They conclude that it should be the woman or the gamete donors.)

The view of Crowley and Zakharov that an embryo has potential only in virtue of decisions by others about it amounts to the rejection of our common notion of potential, for it makes potential relative to the wishes and acts of human decision makers. Such a rejection of the common notion is

26. This point parallels that made in our earlier discussion of Quinn.

strongly supported by the difficulties we have found with it in examining a range of arguments which invoke the potential of the embryo as a reason for according it a special moral status, different from that of the egg or of the egg and sperm when separate but considered jointly. Whether these arguments succeed in establishing that in the normal reproductive situation the embryo has a potential different from that of the egg and sperm is a question we have left open. But even if these arguments are applicable to the normal situation, they cannot validly be applied to *in vitro* embryos and eggs and sperm. The new reproductive technology makes it necessary for us to think again about how our established views about the potential of the human embryo should be applied to the embryo in a laboratory.