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IDENTIFYING THE ORIGIN OF A HUMAN LIFE

[A submission to the Standing Review and Advisory Committee established by the Victorian Infertility (Medical Procedures) Act, 1984]

The Search for A Marker Event for the Origin of a Human Life

In December 1986, press reports of the possibility of the Standing Review and Advisory Committee giving approval to projects involving embryo experimentation, on the basis of a determination that a human life did not begin until the process of fertilization had reached at least twenty hours, led the Centre's Committee to convene a Working Party to prepare this submission as a preliminary conclusion to work which has been one of the Centre's projects since 1981.

The newspaper reports were uninformed about the legal status quo in Victoria, particularly with regard to the relevant sections of the Infertility (Medical Procedures) Act (especially sections 6(3), 6(4), and 6(5). The legal issues were, however, the subject of a submission by the legal member of the Working Party, Mr. Joseph Santamaria, and we will not comment further on them in this context. While the legal status quo may not give rise to questions concerning the precise timing of the coming into existence of a being who would enjoy the protection of the law, it would seem to be a topic which is relevant to the concerns of the Standing Review and Advisory Committee.

The question which vexed us, as no doubt it has troubled the Standing Review and Advisory Committee, is the biological and philosophical determination of a precise biological event before which there is only a sperm and an egg and after which there is a being which is of moral and jurisprudential significance.

The Centre has in the past defended the philosophical opinion that a new human individual comes into existence when the process of the fusion of sperm and ovum results in a single unified entity which is so organized as to have the capacity to develop as the kind of being which would normally have that collection of attributes which we describe as human — especially the ability to doubt, reason, enquire, affirm, understand, love, etc.[1].

We endorse the view held by the Senate Select Committee on the Human Embryo Experimentation Bill that the embryo is a "genetically new human life organised as a distinct entity oriented towards further development", that "the stance and behaviour proper to adopt towards it would include not frustrating a process which commands respect because its thrust is towards the further development of a biologically individuated member of the human species"[2], that the law should protect all such individuals from harmful non-therapeutic experimentation, and that where doubt exists, the presumption should always be in favour of life.

The problem for us was to determine when a distinct entity with the capacity to develop as a human individual comes into existence, and this involved achieving an accurate account of the relevant events of the fertilization process.

A Description of the Process of Fertilization

Fertilization follows insemination (the bringing together of sperm and ovum) and the attachment of a number of the sperm to the zona pellucida. The sperm proceed to penetrate the zona by a mechanism which is thought to involve the proteolytic digestion of the zona by enzymes located on the inner acrosomal membrane and the physical activity of the spermatozoon.[3]

The next stage is the eventual penetration of the zona pellucida by a single sperm which then attaches itself to the cell membrane, at which time the cell-membrane changes (via the migration of cortical granules to the periphery of the ovum) so as to prevent the penetration of other sperm, the latter then being absorbed into the zona pellucida. Linda Mohr and Alan Trounson (Op. Cit.) describe this process in the following way:

> "After penetration of the zona pellucida, the spermatozoon enters the perivitelline space (PVS) prior to fusion with the oocyte. Physical activity of the spermatozoon may then cease and the oocyte plasma membrane engulfs the sperm head, drawing the entire spermatozoon into the ooplasm in a process similar to phagocytosis. No supplementary sperm are seen in the PVS of monospermic ova, although several can be seen in the PVS of polyspermic ova . . .[4]. Sperm binding to the oocyte plasma membrane triggers release of the cortical granules, the contents of which prevent further penetration at the level of the inner zona and plasma memberane . . .[5]".

Ruth E. Fowler and R. G. Edwards describe the process in the following way:

> ". . . the ultrastructural changes occurring in the gametes at fertilization are now known in some detal. The outer acrosomal membrane and plasma membrane fuse and vesiculate as the spermatozoa pass between the cumulus cells, changes that probably facilitate the release of hyaluronidase and other enzymes . . . Different enzymes are evidently released from the spermatozoon for its passage through the zona pellucida . . . The plasma membrane in the postnuclear cap of the spermatozoon fuses with the plasma membrane of the ovum to effect entry of the spermatozoon."[6]

Thus the process of the penetration of the cell membrane may be described as a process in which the sperm cell-membrane and the ovum cell-membrane open to one another so that the contents of the head of the sperm are released into the ovum cell. The sperm cell ceases to be identifiable at this point, its tail and membrane being absorbed into the membranes of the ovum, and its contents mixing with the contents of the ovum.

Following the absorption of the sperm cell contents into the ovum, the ovum is still undergoing maturation with the process of meiosis, by which the cell becomes haploid, coming to completion.[7] The process of meiosis is completed when the second polar body is expelled leaving the ovum in a haploid state, with its chromosomes reorientated on the metaphase spindle. A nuclear membrane then forms around the female chromosomes to create the female pro-nucleus[8].

At the same time as the haploid pro-nucleus from the ovum is being formed in this way, the male pro-nucleus forms following the decondensation of the sperm head and the construction of a nuclear membrane around the male chromosomes[9]. The cell at that stage consists of the cell-membrane, surrounded by its zona pellucida, and containing the two pro-nuclei and the cytoplasm which is a highly organized and compartmented structure, the major identifiable parts of which are the mitochondria, the lysosomes, the ribosomes, the endoplasmic reticulum and the golgi apparatus[10], as well as the microtubules and microfilaments and a large stock of appropriate acids and enzymes[11].

The two pro-nuclei, each containing a set of chromosomes, are drawn together, their membranes dissolve and syngamy occurs in the formation of the chromosomal pairs as the two sets of chromosomes come together on the metaphase plate for the first time.

The newly formed 23 chromosomal pairs are then copied in a process called "mitosis" in which each chromosome or double helix strand of DNA separates and serves as a template for the formation of a

complementary strand. Following this process of replication the two sets of chromosomes form two nuclei and then divide to become two separate cells — the first replication.

And so it goes on.

The Beginning of a New Human Life

What is clear is that there is life throughout the process, in the sperm, in the ovum and in the embryo. The crucial question for us is not when life comes into existence, for it is clear that life is simply continuous in the several processes which occur. The crucial issue for the distinction between contraception on the one hand and the destruction of a human life on the other, would seem to be the point at which **a** new human life comes into existence.

Until recently, we have simply referred to a new individual forming at fertilization. The more recent approach is to try to unpack the **process** of fertilization to determine more precisely when an individual comes into existence. The Victorian parliament and the draughtspersons for the Infertility (Medical Procedures) Act clearly had no such difficulty in mind and simply refer to "cause or permit to be fertilized" and "embryo" as though the terms were unambiguous.

In examining the stages as they are described above, we could see why syngamy may have attraction as a marker event for it is the first time that the chromosomes from the two gametes actually establish their pairs, and, also for the first time, the cell has a single unified nucleus. Since we are looking for unity and organization, these factors are compelling. A single unified entity exists at that stage which is so organized as to have the capacity to develop as the kind of being which has that collection of attributes which we describe as human, etc.

The question is, however, does it exist before that time?

We are confident that there is no such distinct entity organized toward further human development existing prior to the release of the contents of the sperm into the ovum. The sperm and the ovum are distinct entities prior to that stage and neither has the organization required for human development. They are distinct, even though proximate, and each needs to be fused with the other before further development can occur.

However, when the two membranes open to one another and the contents of the sperm are released into the ovum, the sperm loses its separate identity[12] and the ovum gains a capacity which it did not have while simply an ovum, that of developing as a human individual. Prior to that stage, it seemed to us, there is simply sperm and ovum, each having only a part of what it takes to develop as a human individual. After the release of the contents of the sperm into the ovum there is a great deal more.

The two cells (sperm and ovum) have become a single cell containing many interacting components which by their interaction have the capacity for organizing all the subsequent stages of human development.

The next stage is the stage at which the chromosomal pairing occurs and the genetic structure of the new individual is more apparent, but nothing new has been added that did not already exist in the cell before syngamy — the genetic constitution was already present within the cell. Prior to syngamy one could, if one were clever enough, ascertain whether or not the individual was male or female, eye-colour, hair-colour, and all the other genetically determined characteristics. There are already 46 chromosomes present, 23 from the mother and 23 from the father, and exact copies of each of these 46 will be produced in every cell of the adult. The organization which eventually makes syngamy occur is in place and working as soon as the contents of the sperm and the ovum commence interaction, following the release of the contents of the sperm into the ovum. Syngamy involves no new chemical process nor a shuffling of genetic material, it is little more than the juxta-positioning of the chromosomal pairs which already existed and had their places pre-determined before the juxta-positioning takes place.

The crucial point for us is when the ovum and sperm gain the complete capacity to develop as a human individual and the process of the development of a human life begins. The event which seems to be the best marker for that commencement of a life would be when the sperm and the ovum lose their identity in the mixing and interaction of their contents.

An ovum and a sperm separately are merely living cells, but following the mixing and interaction of their contents they are **a single living entity which has the organization** which will bring about not only syngamy, but all the other developmental events of a human existence. Neither the sperm nor the ovum had that capacity prior to becoming unified as a single cell.

Thus it seems true to say that a new individual comes into existence following the release of the contents of the sperm into the ovum and the radical change to the ovum and the sperm such that together they form a single entity which is so organized as to require only the provision of nourishment and a favourable environment for it to reach human adulthood

Syngamy is a state of greater resolution of the cell structure in the unification of its nucleus, but that resolution happens not by the addition of anything to the cell but through the organization which is already present in the cell. Syngamy is of significance only as the stage at which the chromosomal pairs complete their juxta-positioning, an event which was determined at the time that the contents of the sperm and ovum commenced interaction following penetration of the ovum cell-membrane. The argument for adopting syngamy as the point of origin of a new life would seem to depend on identifying the two pro-nuclei as separate entities rather than as parts of a single entity. This could only be done, however, if attention were not paid to the structural and organizational functions of the entire cell as an entity. Biologically, the nucleus and the pro-nuclei have no developmental capacity unless they form part of a cell. It would seem that it is the cell (including its nucleus or nuclei as part(s)), and the cell's capacity for human development which are crucial.

The process of fertilization may be defective or there may be other damage which results in the failure of the fertilized ovum to develop normally, such as the formation of an hydatiform mole, or in its failure to develop at al[13]. However, that the process of life may be interrupted is not unusual: illness and death can strike at any stage throughout life.

Similarly, the fact that contributions to the new cell by the sperm cell or the ovum cell may be traceable and identifiable is of little significance. Theoretically, at least, a geneticist could trace and identify the genetic contributions made to any human person by each parent.

We could find no grounds for asserting a precise hour at which a new individual comes into existence following insemination. Before penetration there is no single overall organization, so events depend on many chance factors or on the decisions of experimenters[14]. The timing would be dependant on the method of insemination used. For instance, the new procedure of attempting fertilization using immotile sperm (from a man who was infertile for that reason), would appear to bypass the stages at which the sperm penetrate the zona pellucida and attach

themselves to the ovum cell-membrane. In the latter case, the coming into existence of a new human life could be presumed to occur at an earlier time.

Finally, the fact that identical twinning can occur, and would do so after the formation of the first cell is of no more significance that the fact that theoretically a person can be cloned at any stage. Secondly, it would be of no more significance than ordinary parenting in which two people yield a third person. The fact that I can become a parent or may be cloned does not alter the fact that I am an individual. Similarly, that an embryo may later divide to form two embryos does not alter the fact that the original embryo was an individual which was either cloned (naturally) to form an identical twin, or died in the formation of two new individuals.

Given that a marker event is required, and given the presumption in favour of human life, we are convinced that a human life can be presumed to have come into existence in the events immediately following the release of the contents of the sperm into the ovum or 'sperm penetration'. In those terms, it would therefore constitute experimentation on a human embryo to experiment on the product of human insemination after the stage at which the contents of the sperm are released into the ovum. The principles enunciated by the Senate Select Committee would seem to have application at that stage.

1. See for instance the Centre's submission to the Senate Select Committee, especially chapter five which is included here as an appendix.
2. *Human Embryo Experimentation in Australia*, Australian Government Printer, 1986, Cat. N. 86 1509 6.
3. Linda Mohr and Alan Trounson "In Vitro Fertilization and Embryo Growth" in *Clinical In Vitro Fertilization* edited by Carl Wood and Alan Trounson, Springer-Verlag Heidelberg, 1984, pp. 99-116.
4. Sathananthan, H., Trounson, A. O. "Ultrastructural Observations on cortical granules in human follicular oocytes cultured in vitro", (1982) *Gamete Res* 5: 191-198.
5. Sathananthan, A. H. and Trounson, A. O. "Ultrastructure of cortical granule release and zona interaction in monospermic and polyspermic human ova fertilized in vitro" *Gamete Res* 6: 225-234, 1982.
6. Fowler, R. E., and R. G. Edwards "The Genetics of Human Development" *Prog. Med. Genet.* Vol. 9, 1973, p. 63.
7. "The second meitotic division in the oocyte is resumed as the spermatozoon enters the egg. Anaphase and telophase are completed rapidly, the second polar body is extruded, and two pronuclei are formed." (Fowler and Edwards, Op. Cit. p. 60).
8. Mohr and Trounson, Op. Cit. p. 107.
9. Ibid.
10. G. J. V. Nossal *Reshaping Life* Melbourne University Press, 1984, p. 8.
11. C. R. Austin, 'The Egg' in C. R. Austin and R. V. Short, *Reproduction in Mammals,* Book 1, *Germ Cells and Fertilization,* Cambridge University Press, 2nd Edition, 1982, pp. 49-53.
12. *Having a separate identity* is to be distinguished from *identifiability* and *capacity to be traced.* The point is that the sperm is no longer a whole but has become part of a whole.
13. Karen Dawson *The Age* 14/1/87.
14. Prior to the release of the contents of the sperm into the ovum and the interaction of the contents, there is a marked lack of precision. However, it is clear that once the contents of a single sperm have been released and commenced interaction with the contents of the ovum there is remarkable precision and the latter is excellent evidence of the organization which has come into existence. From that stage on events are predictable and the failure to develop further appears as a defect in an organized process rather than simply a result of a random or chance set of occurrences. Until that organization comes into existence, many chance factors are at work, as is shown for instance by the number of sperm that have entered the zona pellucida before one becomes the first to work its way through to the cell-membrane and attach itself to it.