

CHRISTIAN ETHICS, BIOETHICS, AND THE PROBLEMS OF DESCRIPTION

A. RICHARD CREIGHTON
Jos ECWA Theological Seminary

ABSTRACT

This paper examines the ethical challenges posed by two developments in biotechnology, as well as the role that Christian Ethics can play in enabling the church and society to respond wisely to these developments. The first ethical problem is the separation of four aspects of motherhood that can arise from the donation of DNA, the donation of mitochondria, surrogacy, and adoption. The second ethical problem arises from the advances in genetic engineering, which allow the production of human proteins in sheep's milk (which is useful in treating certain diseases). This paper argues that both these problems turn out to be problems of description. Drawing on the contributions of Oliver O'Donovan, Miroslav Volf, and Michael Polanyi, the paper advances an analogy from the study of fractals to help explain how descriptions can be true even before they are exact, and how descriptions can become progressively more exact without having to renounce their earlier iterations. These more exact descriptions form a prerequisite for an informed response to the ethical challenges of biotechnology.

KEYWORDS: Christian Ethics, Bioethics, Genetic Engineering, Tacit Knowledge, and Oliver O'Donovan.

INTRODUCTION

Modern developments in biotechnology are generating profound and novel ethical questions for society, the church, and the academy. Procedures such as mitochondrial transfer and genetic editing are reconfiguring traditional categories of human identity, and so Christian ethicists are faced with the challenge of how to offer faithful moral guidance in uncharted territory. Bioethics, as a field, often prioritises legal frameworks and pragmatic public policy concerns. Yet Christian Ethics, with its roots in theological anthropology and ecclesial tradition, brings unique resources to the table. This paper contends that some of the most urgent challenges raised by biotechnology are best understood not simply as questions of moral permissibility, but as deeper problems of description: how we name, recognise, and frame what we are seeing. Drawing on the work of Oliver

O'Donovan, Miroslav Volf, and Michael Polanyi, the paper seeks to equip the church with better tools for description—because before we can evaluate new practices rightly, we must first describe reality truly. This paper considers two problems in ethics—concerning, in turn, motherhood and sheep—which both turn out to be problems of description. We will also consider the groundwork required to respond to these problems, which will turn out to be about learning to describe reality better.

This paper adopts an interdisciplinary theological-ethical methodology that engages both descriptive and normative concerns. It proceeds by identifying two representative case studies from contemporary biotechnology—the fragmentation of motherhood and the creation of genetically modified animals—as test cases for moral analysis. Rather than resolving these issues purely in terms of moral norms or theological doctrines, the paper approaches them as problems of description, requiring conceptual clarity and epistemic humility. Drawing on Oliver O'Donovan's work on moral realism, Michael Polanyi's account of tacit and explicit knowledge, and Miroslav Volf's theology of truthful love, the paper integrates biblical, philosophical, and scientific perspectives. Analogical reasoning (notably the use of fractals) is employed to illuminate the epistemological task facing Christian ethicists: the movement from approximate understanding to more precise moral discernment, guided by Scripture, tradition, and the Spirit-led mind of Christ.

MOTHERHOOD: WHEN DESCRIBING SIMPLE THINGS BECOMES COMPLEX

Medical technology has a knack for making (seemingly) simple things complicated. Take the idea of motherhood. Until relatively recently in human history, the identity of a person's mother was, in principle, very simple.¹ Today that simplicity is more complicated. Consider the following hypothetical scenario.² One woman donates one of her eggs, with its DNA removed (perhaps for her mitochondria). A second woman donates her DNA to be inserted into the first woman's egg. The reconstructed egg is then fertilised in a laboratory and implanted in the womb of a third woman, who carries the baby to term. At birth, the baby is immediately given to a fourth woman, who adopts and raises the child.

The question: Which of the four women should be considered the child's mother, and why? This question is not trivial to answer—and we will not answer it fully in this paper—but perhaps an analogy from mathematics can help us lay some useful groundwork and so help us see that sensible advances towards some answers are possible.

Fractals as an analogy for created order

A fractal can be loosely defined as a geometrical figure that exhibits self-similarity on every scale—that is, each part of it exhibits a repeating pattern, which continues repeating no matter how far you zoom in on the figure. The easiest way to get a feel for fractals is to see some examples. Below is an example of one fractal, known as a Koch Snowflake. The diagram below is not actually a Koch Snowflake; rather, it is the first four steps in a process which, if iterated *ad infinitum*, would result in a Koch Snowflake. In each step, the central third of every straight line (represented in the lighter colour) is removed and replaced by two lines (like two sides of an equilateral triangle). This is then repeated, and repeated, *ad infinitum*.

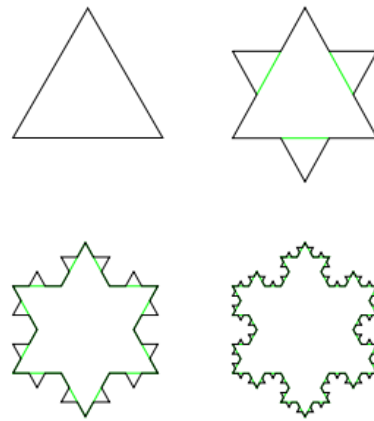


Figure 1: A Koch Snowflake (Wikicommons, 2015)

This Koch Snowflake works as an analogy for created order in two ways: the first emphasises what we don't know; the second emphasises what we do know. First, we cannot exhaustively know a Koch Snowflake in all its intricate detail. Any part of the Snowflake that you enlarge always reveals more detail than you can master. You cannot hold the whole thing in your imagination; there is always more of it to know.³ Secondly, however, you can know a Koch Snowflake approximately. You can quickly grasp the overall shape of the Snowflake. Even the fourth iteration in the diagram above gives a sense of what it is like.

Created order exhibits fractal-like characteristics. Some specific examples are clearly fractal-like: trees and ferns exhibit self-similarity at different scales. But the fractal-parallel also holds more generally: we can grasp created order approximately (and truly), but not exhaustively. We can always know better what we already know in outline.

Fractals and Motherhood

Thus, fractals, perhaps surprisingly, can help us with our questions about motherhood. We already know important, central truths about motherhood. This knowledge may be approximate rather than exhaustive, but it is valid. However, the truth and validity of our (approximate) knowledge about motherhood can mislead us into thinking that the concept of motherhood is uncomplicated. Recent medical science shatters that illusion by separating various aspects that humanity never previously knew were separable.

The facts of scientific discovery pose new questions to us, but questions that our existing knowledge can help us to address. These include the following three sets of questions. Firstly, is it good, in general terms, for these different aspects of motherhood to be separated?

Secondly, if it is not good in general terms, is it still good in some circumstances? (Perhaps to achieve some other good, or to avoid some other evil)? Historically, we have accepted this regarding adoption and have distinguished biological mothers from adopted mothers. For example, if the (biological) mother dies in childbirth or abandons the baby, we would normally see adoption as a positively good thing. However, it is in the presence of problematic circumstances like death or abandonment that adoption becomes a good outcome. Mainstream ethics has not recommended large-scale adoption as a general norm because we do not see adoption as a good thing in its own right; we see it as a good response to certain problematic circumstances. Should we accept a parallel distinction in other problematic circumstances? For example, if a mother has a hereditary disease of the mitochondria, and someone is willing to donate a healthy egg, is that permissible to avoid the disease? Or if a prospective mother is currently childless because she has a problem with her womb, such that she keeps having miscarriages, can another woman volunteer to carry her embryo to term?

Thirdly, regardless of whether separating these different aspects of motherhood is good or not, how should we view the separation if it has already happened? For example, is there any hierarchy in these motherhoods (mitochondrial, DNA, surrogate, adoptive)? If so, what and why? Or does it depend entirely on circumstances? (If so, what circumstances, and why?) If a four-way (doubly-donated+surrogate+adopted) motherhood arrangement was entered, but then, when the child was born, each woman wanted to claim it as her own, who should the child go to, and why?

These questions are new, and they are not simple. However, they are not radically new, and they are not impossible to answer. Our existing knowledge of motherhood and created order and Special Revelation in general, provides us with

the basis from which to begin answering these questions, and with the tools necessary for tackling them. We can know better what we already know in outline.

HOW CAN WE RIGHTLY DESCRIBE THE WORLD?

The medicine-producing sheep is an achievement of biotechnology.⁴ This genetically modified sheep produces a human protein in its milk, which allows doctors to treat some forms of lung disease (namely, cystic fibrosis). The sheep can make this protein because the sheep has been modified to include the human gene needed to make the protein. This advance brings real benefits to lung disease patients. But it also represents, in microcosm, some crucial ethical conundrums. And these conundrums, before they are anything else, are conundrums of description.⁵

Consider one such conundrum, a conundrum of eating. It has long been a mainstream view that the eating of mutton is ethically permissible (though not a universal view, as various vegans and vegetarians through history could testify). It has also long been a mainstream view that the eating of human flesh is ethically impermissible (though, again, not a universal view, as various cannibals through history could testify). But what happens if the sheep is genetically modified to include a single, protein-producing human gene?

Some carnivores might become squeamish at this point. Others might argue that if it looks like a sheep, bleats like a sheep, smells like a sheep, and indeed tastes like a sheep, then it *is* fundamentally still a sheep—and thus mutton is still on the menu. But what happens if the case with a single human gene is replaced by a case with two human genes? Or four, or eight, or 16, or 32, ... ? What happens if the number of human genes in the sheep reaches 1%, but the sheep still looks, bleats, etc., like a sheep? What happens if the number of human genes reaches 5%, or 10%, or 50%, or 99.9%?

Our ethical intuitions (probably) tell (most of) us that, at some point, the eating of such a creature would become ethically wrong, and that the genetic engineering of such a creature in the first place would be morally reprehensible. Intuitions are a good start, but not always a good endpoint. Intuitions can be unreliable when confronted with novel situations, and when the intuitions of two people, or groups, clash, we need more than intuition to resolve the disagreement. (For example, consider the range of reactions to the first organ transplants, or the first aeroplanes, or the first ‘high-speed’ travel. We do not have to arbitrate on which intuitions are right to observe that there is a job of arbitration to be done, and that intuition by itself is not up to that job.) So, in our example, one more squeamish carnivore's intuition might tell them that the mutton is compromised as soon as a

single human gene is involved. Another less squeamish carnivore's intuition might tell them that one, or even a few, genes are OK. But squeam, or the lack of it, is not a robust basis on which to make such decisions; more is needed.

But what is the 'more' that we need? We might think that we need concepts to work with, and this is certainly part of the answer. Consider the conceptual definition of what counts, or doesn't count, as food. In terms of the scriptural witness, animal flesh was given as a legitimate food source in Genesis 9; human flesh was not. That sets up an immediate, transparent, and fundamental principle. But it does not immediately or transparently supply the tools for working out whether a specific hunk of flesh on a plate should be classified as human or animal. In former times, that task of classification was relatively trivial: a matter of observing the creature from which the flesh had been hewn. If the creature was human, the flesh was not food; if the creature was animal, then the flesh was food (or, at least, could be food, depending on the palatability of the animal in question; sheep, for instance, have generally been preferred to toads).

In future times, however, that task of classification could be significantly less trivial, as our (mostly) hypothetical human/sheep-hybrid example shows. And the scripturally-derived concept that animal flesh is food does not immediately help us to decide whether the medicine-gened sheep (or its various multi-human-gened cousins) still count as 'animal' or not. In other words, concepts help us to decide what to do with things once we have recognised and/or described them. But concepts do not directly⁶ help us to come up with those descriptions in the first place. Concepts do, however, provide some essential, indirect help for the task of description. A short foray into the work of Oliver O'Donovan will help us illustrate the usefulness and limitations of concepts for the task of description.

COMPETING DESCRIPTIONS AND CONCEPTS, AND MORAL DISAGREEMENTS⁷

This focus on the importance of descriptions is not new. Oliver O'Donovan (1996: 14) argues that competing descriptions underlie all major moral disagreements, and that the most profound disagreements, involving 'world-shaping' sins, are intimately connected with false descriptions.⁸ In this regard, O'Donovan commends the early church at a point where it is often criticised: its approach to slavery. He argues (2005: 248) that the church attacked slavery at its root, by countering the false description of human relations upon which it was based: the church taught its slave-members to 'regard their "masters" as brothers who depended on their help' and taught its slave-owning members to regard 'their' slaves as fellow-

slaves of one common Master in heaven, and fellow-brothers in the one family of God (cf. Ephesians 6:5–9; Colossians 3:22–4:1; Philemon 8–21). Replacing the false description with the true, in and of itself, undermined the credibility of the practice and began the process of its downfall (O'Donovan, 2005: 248, 263–66).

Similarly, O'Donovan (1989: 85–86) believes nuclear deterrence is an example of a doctrine built on unreality, but without that unreality making it inconsequential, because such charades can 'achieve a frightening solidity before the blast of reality scatters [them] to the winds.' O'Donovan's maintains two poles in tension: fantasy is not ontologically equal to reality, and it will not ultimately endure; yet fantasy, when it is believed and acted upon, can acquire great power to shape reality (temporarily). In part, this arises from the Augustinian principle that the love of some goods entails the refusal of others. Thus, the desire for fantastical goods implies the refusal of certain real goods; adopting a deterrence policy, for example, means forsaking certain other means of pursuing international peace, as well as, perhaps, making yet other means more difficult (O'Donovan, 1989: 86–87; Chernus, 1991: 18–20).

O'Donovan (1984: 5) is right to perceive that Christian eschatology guarantees that the tension between apparent reality (i.e., fantasy) and actual reality (i.e., truth) is only provisional. At the Eschaton, the correspondence between truth and appearance will be perfect; the new creation will include neither nuclear deterrence nor slavery. But O'Donovan (1984: 5) is also correct to argue that even before then, the 'irresistible pressure of reality' will make itself known, and so false representations of reality will always be vulnerable to this pressure. The fact that these representations are not true—and so do not correspond to reality—is their Achilles' heel, even if, as McGrath (2002: 209) recognises, this heel is often well-armoured with a culturally-endowed plausibility. True wisdom, by contrast, involves recognising how and why created order authorises our action in response to it (O'Donovan, 1994: 191), for a love based on fantasy is ultimately deceptive; love and truth must be coordinated. The difference in love between *Beauty and the Beast* and *A Midsummer Night's Dream* illustrates this. The love of Beauty for the Beast is admirable because she knows he is a Beast and yet comes to love him anyway. In contrast, Titania's love for Bottom is ridiculous (or repulsive) because she believes his monstrousness *is* beauty (O'Donovan, 1994: 236).

O'Donovan is not alone in his concern to separate love from fantasy. Miroslav Volf (1996: 258) reinforces the importance of both truth and love, arguing that love cannot be sustained without truth, and nor can community (though Volf prefers to speak of truth and 'the will to embrace,' Volf, 1996: 233–73). Volf (1996: 259) also warns against the false dichotomy of setting truth as faithfulness in

relationship over against truth as accordance with reality. Lies offend against both trust and veracity. Yet discerning the truth of a situation is not only an intellectual discipline; character matters also: 'the willingness to listen to truth depends on the way one lives.' Volf observes that Jesus, in explaining why his opponents fail to believe in him, declares that it was not despite him speaking the truth, but because he speaks the truth (1996: 269).

This need for truthful love explains O'Donovan's firm conviction (1996: 15) that true concepts are essential for any organised theory (in general), and for theology (in particular). Precisely because the same action or situation (such as a medicine-gened sheep) can look different to different observers (such as a squeamish carnivore, and unsqueamish carnivore, and a vegan), distinct concepts are required to differentiate the possibilities (such as 'human,' 'animal,' and 'plant'; and perhaps more) (O'Donovan, 1996: 15).⁹

Learning How to Rightly Recognise

But even when the correct concepts are available, the task of description, or recognition, still requires more than concepts. We may have the correct concepts available (say 'human,' 'animal,' and 'plant'), but given a selection of genetically-modified creatures in front of us, how do we decide which category to place each one in? Although recognition is an everyday occurrence, it is a hard problem to account for in theory. O'Donovan (2005: 18) argues that 'from the philosophical point of view, this is one of the most mysterious acts there is: it seems that it either happens, or it does not happen.'

Definitions cannot solve the theoretical impasse. Suppose you wanted to explain how to recognise the difference between a fish and a jellyfish. You might think that saying something like the following would do the trick: 'A fish has eyes, scales and teeth, whereas a jellyfish has tentacles' (cf. O'Donovan, 1994: 31–38). That definition may be sufficient in practice, but it is deficient at the level of principles, and this deficiency will become more problematic in more demanding situations. The deficiency in question is that this definition merely pushes the problem one step further back. In other words, this definition does not solve the problem of recognising instances of concepts; it merely introduces a second problem of the same type. To use it, someone already needs to know how to recognise eyes, scales, teeth, and tentacles; they already need to be competent at recognition. In O'Donovan's view (2005: 18), recognition should not be framed as a matter of inferring conclusions from concepts. He argues that the 'recognition of a *kind* in a *particular*' is not inferential at all; it is not a logical task, but a cognitive one.

Expertise, however, can be brought to bear on this cognitive task. O'Donovan

puts it this way: ‘But though recognition is unanalysable, it is not haphazard. We prepare for it by acquiring competence with the relevant moral categories. ... We learn to feel out the boundaries between categories, determining where one ends and another begins’ (2005: 18). In other words, given some pre-existing, relevant expertise in recognition, the addition of further concepts can further refine that pre-existing expertise. But concepts cannot *create* expertise in recognition in the first place. Recognition is a skill of practical interaction with created order and so can only be learned via practical interaction. We learn how to recognise from other people; we learn how to recognise *well* from others who are already *skilled* at recognition. We learn how to recognise a fish by being shown many examples of different types of fish, thereby building up a store of examples to work from. We also learn by then guessing whether new instances of creatures should be counted as fish or not, and being corrected by someone with more expertise than us. This process develops within us the cognitive capacity to recognise future examples accurately.

Furthermore, expertise in one realm of recognition does not necessarily create expertise in a different realm. Notoriously, expertise in recognising software bugs in computers does not automatically confer expertise in recognising emotional moods in other people (nor vice versa). To know how best to talk about this task of recognition, we will adopt a further distinction, one introduced by Michael Polanyi.

Explicit and Tacit Knowing

Michael Polanyi distinguishes between two types of knowing:¹⁰ explicit and tacit.¹¹ Explicit knowledge refers to that knowledge which we can specify in language. Tacit knowledge refers to our remaining knowledge, i.e., that which we have not specified, or perhaps cannot (entirely) specify in language.¹² Each type of knowing has its strengths and weaknesses; they can either reinforce or undermine each other. Consider the example of a child learning to keep their balance while riding a bicycle.¹³ This is normally a tacit process. After numerous attempts, the child will ‘get the knack’ of balancing, without being able to specify explicitly what they have done. However, this knowledge can be expressed explicitly using mathematics, as follows: suppose A is the angle of imbalance, and v is the velocity of the bicycle; to compensate for the imbalance, the rider must steer in curve on the side of the imbalance whose radius, r , is proportional to the square of the velocity divided by the angle of imbalance; i.e. $r \sim v^2/A$. The explicit and tacit forms of knowing are distinct, and may either inhibit, or complement, each other. No child learns to cycle by first learning the formula and then applying it; attempting to do so would probably inhibit the tacit process of ‘getting the knack.’ However, a company

that wanted to design a better bicycle (or motorcycle) might benefit greatly from using both types of knowledge: engineers might use the explicit formula to run computer simulations to test new ideas and construct new prototypes; test-riders might use their tacit knowledge to test-drive the prototypes.

Tacit and explicit knowledge can be mutually complementary or mutually inhibiting, depending on how they are used. Tacit and explicit knowledge can interact in other ways. Suppose we want to discuss a complex subject, of which we have substantial tacit knowledge, but limited explicit knowledge (e.g., learning to whistle, or to ride a bicycle). We can certainly use nuggets of explicit language to create a rough sketch of some of the specifiable features of the subject (e.g., ‘you just put your lips together and blow’ or ‘you lean into the corners’). These explicit nuggets can be enough to evoke our tacit conception of the whole complex subject, if we are already familiar with it. However, without that tacit familiarity, such explicit nuggets would be entirely inadequate to capture the whole nature of the subject in question (Polanyi, 1962: 169). They can be useful clues about where to search for the relevant tacit knowledge, but if these explicit nuggets are turned into paradigms, they can create problems.¹⁴ Polanyi (1962:169) argues that the tacit dimension of knowledge explains this discrepancy, as it enables us to:

evoke our conception of a complex ineffable subject matter with which we are familiar, by even the roughest sketch of any of its specifiable features. A scientist can accept, therefore, the most inadequate and misleading formulation of his own scientific principles without ever realizing what is being said, because he automatically supplements it by his tacit knowledge of what science really is, and thus makes the formulation ring true.

Polanyi sees the distinction between tacit and explicit knowledge illustrated in the legal practice of Common Law, where contemporary courts follow the example of previous courts that have decided on similar cases. Common Law allows for the possibility that judges may interpret their actions mistakenly (i.e., that their explicit understanding may be inferior to their tacit understanding), by laying down that a precedent is constituted ‘by the decision of a court, irrespective of its interpretation implied in any *obiter dicta* of the judge who made the decision. The judge’s action is considered more authentic than what he said he was doing’ (1962: 54). This practice illustrates that a person’s explicit reflection on their action may be flawed, without the action necessarily being invalid. However, flawed explicit knowledge is nonetheless problematic, since it runs the risk of distorting potentially superior tacit knowledge.

To return to our former examples: a fisherman who is good at telling one fish from another may well be better at doing the task than he is at *explaining how* he

does the task. You might learn more from watching him do it and starting to help him do it than asking him to talk you through what he does. In cases where expertise is established, tacit knowledge may be sufficient to do the task, and task-learning may be sufficient to pass that knowledge on.

But in cases that move outside the bounds of traditional expertise—such as our sequence of sheep-human-hybrids—tacit knowledge, like intuition, is insufficient to deal with the novelty. Of course, explicit knowledge and its deployment of concepts are not sufficient either. What we need is a skilful interplay between the two. O'Donovan reaches for this interplay when he says that 'we learn to feel out the boundaries between categories, determining where one ends and another begins' (2005: 18). Talk of 'feeling out' boundaries are not rigorous or procedural, because there is no rigorous procedure which guarantees that, if you only follow its method, you will certainly arrive at the right answer to each seemingly novel ethical question.

Instead, we must think through the concepts as thoroughly as we can, and we must gain experience in applying those concepts to the real world. If we are to do this effectively, there must be feedback between those two tasks: sharpened concepts should aid our application to the real world, and the results of our application attempts should help sharpen our concepts.¹⁵

What does that mean for our sheep-human hybrids? First, it means hard work. To judge competently in these matters, one must develop the appropriate expertise. Theologically, that means careful thinking about the concepts of humanity and animal-kind, of creation order in general, and humanity's role in re-shaping creation order. Scientifically, it means gaining familiarity with the discipline of genetic engineering. One must have learned enough about both disciplines to 'have a feel' for how they operate, and to be able to subject that feel to critical analysis. We must develop both our explicit knowledge and our tacit knowledge. We must sharpen our conceptual understandings, and we must gain experience of—and expertise at—recognising particular categories.

Second, it should encourage us to be cautious and humble in our pronouncements about areas where we have not done the hard work. Arriving at proper ethical evaluations of these things is complex because the things are complex; we must understand them before we can evaluate them. No one individual can be expected to master all conceivable questions, and so humility and caution are appropriate responses for those areas we have not mastered.

Third, it should encourage us to be interdependent. We cannot master all these things individually, but—working together as the church—then corporately we could have sensible things to say about all of them, if we help one another.

Fourth, we can approach these issues with confidence. Scripture gives us

everything we need to be able to wrestle with these issues, and the task is not a new one. From the beginning of Genesis, when God presented Adam with the animals and asked him to name them, humanity has been called to creatively interpret God's created order. Our task is one of learning to call things by their proper name. We are not called to create order out of nothingness, but to recognise the order that God has already placed there—and to recognise which aspects of that order are most crucial to any given situation. We must do that with humility, but we can also do it with confidence because, as Paul says, we have been given the mind of Christ.

CONCLUSION

Advances in biotechnology compel Christian ethicists to engage not only with what is right, but with what is real. As the boundaries of biology become increasingly blurred, the church's task is not merely to react morally, but to respond theologically—with sound descriptions rooted in Scripture and creation order. This paper has argued that many of our contemporary bioethical challenges, whether in the realm of reproductive technologies or genetic engineering, should be approached as problems of description. Addressing such problems requires both theological depth and epistemic skill: a patient process of learning to 'feel out the boundaries' between categories, as O'Donovan puts it, guided by both conceptual clarity and recognitional expertise. The interplay of explicit and tacit knowledge, informed by faithful theological reasoning, allows us to approach novel situations with both humility and confidence.

Theologically, this process is underwritten by the church's reception of the mind of Christ (1 Cor. 2:16), which enables us to discern rightly even in complex or ambiguous contexts. Practically, this calls for humility in areas where our understanding is limited, collaboration across disciplines, and sustained formation in Christian virtue and vision. The recommendations implied throughout this paper may be summarised as follows: (1) train Christian communities in theological and moral discernment, especially regarding recognition and naming; (2) pursue bioethical reflection that integrates both technical literacy and theological imagination; and (3) cultivate communities of moral expertise capable of offering truthful, loving descriptions of the world. For it is only as we name things rightly that we may love them truly, and act toward them justly.

ENDNOTES

1. In practice, the question could be complicated. If mother and child were separated at birth, then the knowledge of the mother's identity could be lost. This practical problem might result in distress, but it remains a *practical*

problem arising from events; it is not a problem of the definition of motherhood *in principle*.

2. This scenario is hypothetical only in the sense that I do not know of any case involving all four elements at once; however, cases involving 2-3 elements exist, so a case involving all four would not be impossible. For a recent account of how such scenarios are becoming technically feasible and ethically contested, see National Academies of Sciences (2020). Developments in gene editing, particularly through CRISPR-Cas9 technology, have made the separation of genetic and gestational motherhood more feasible than ever, and debates around the legitimacy of germline modifications have intensified globally. The report by the U.S. National Academies of Sciences (2020) reflects widespread concern that such technologies demand not only technical precision but moral clarity.
3. Assiduous readers might challenge the first half of this analogy on two fronts. First, one could say that the Snowflake *could* be captured precisely via a mathematical equation, and that you can hold the equation in your head. Second, that the Snowflake is too regular, and so as you imagine enlarging it, you can immediately imagine any enlarged version precisely. In my opinion, the first challenge fails, but the second succeeds. The first challenge fails because the knowledge summarised by the formula is highly compressed. It does not allow you to immediately grasp what enlargements would look like. The second challenge does, I believe, succeed, but only because the Snowflake is such a well-behaved fractal. This makes it a suitable example for readers who are unfamiliar with fractals. Fractal aficionados should substitute a more complex fractal—perhaps the Mandelbrot Set.
4. Harris (1997), Sandhaus (2004), and (less technically) Day (1996) give overviews of the earlier development of this technology. More recent advances are proliferating: see Kalds et al. (2019) for the transformation of livestock bioreactors from random pronuclear injection to CRISPR-driven precision editing with higher consistency. Li et al. (2024) describe the use of CRISPR/Cas9 to engineer goats that secrete antimicrobial human neutrophil peptide 1 (HNP-1) into milk, demonstrating the potential of targeted molecular design.
5. For a more recent, but also more technical, discussion of bioethical conundrums, see Baylis et al, who highlight that ‘a notable feature’ of public debate on genome editing is its failure to describe existing policy frameworks accurately—contributing to ethical confusion and policy inertia (Baylis et al.

2020, 365). Their analysis reinforces the argument of this paper: that ethical reasoning must begin with a true description of the world.

6. I have said that principles do not ‘directly’ help; they do, however, provide indirect help: principles can help us identify the categories we are working with (such as ‘human’, ‘animal’, and ‘plant’), which is a fundamental prerequisite for classification and description. Principles provide necessary help, but not sufficient help.
7. This section is adopted, in only slightly adapted form, from my PhD thesis.
8. As examples of the connection between description and world-shaping, cultural sins, O’Donovan mentions several false descriptions: ‘of sexual intercourse as merely physical encounter; of deterrence as a threat that does not commit one to consequent action; of a fetus as a piece of maternal tissue; of justice as the will of the majority.’ O’Donovan’s emphasis on the problem of false descriptions is related to, but more precise than, Augustine’s contention that ‘bad theology makes for bad morals,’ (Gregory, 2008: 91; cf. Augustine, 1998:19:21). For a detailed recent study of O’Donovan’s account of moral order, especially as it relates to biotechnology and public policy, see Trantor (2020:35-98).
9. Even secular discussions of bioethics are aware of the importance of moral description. Parens and Johnston (2021) argue that bioethical discourse must be reoriented toward human flourishing, not merely innovation, echoing O’Donovan’s call for descriptions grounded in moral order.
10. Polanyi prefers to speak of explicit and tacit ‘knowing’ (rather than ‘knowledge’), as he wishes to stress that human beings are personally involved in the process of knowing—something captured more closely by a dynamic participle than a static abstract noun. I will be less strict, using ‘knowing’ and ‘knowledge’ interchangeably.
11. Although Polanyi may not have been the first to discuss this distinction, he did coin the terminology of ‘tacit’ and ‘explicit,’ and he explored the distinction in detail. Hence, I shall concentrate largely on the discussions springing from his work.
12. There is no uniform agreement over the reasons for this inability to codify tacit knowledge (Gourlay, 2004: 90; Ray & Stewart, 2005: 321–22). However, since my discussion does not require an answer to this question, I shall not linger over it.
13. This example is one offered by Polanyi himself and is frequently quoted by others. (Polanyi, 1975: 41; Scott, 1996: 49).

14. Polanyi gives examples of such explicit nuggets which, while adequate to evoke the subject in question to those already familiar with it, are grossly inadequate as total descriptions, and which may inhibit further progress (Polanyi, 1962: 19, 166–69, 294–98). His examples include the tendency to formulate basic principles for the scientific enterprise in one of two ways: via secondary features (e.g., simplicity, economy, or usefulness) or in terms of probabilities and repeated events. Science does involve both proposed formulations, but neither is adequate as a formulation.
15. As we move further into an age dominated by artificial intelligence, the importance of integrating tacit and explicit knowledge will only grow. Curran (2024: 89-90) notes that Polanyi's insights into social knowledge have become even more vital in our data-dominated age, which displaces ethical discernment with systematised decision-making divorced from communal judgment.

REFERENCES

- Augustine. (1998). *City of God*. (R. W. Dyson, Ed. & Trans.). Cambridge, UK: Cambridge University Press.
- Baylis, F., Darnovsky, M., Hasson, K., & Krahn, T. (2020). 'Human Germline and Heritable Genome Editing: The Global Policy Landscape.' *The CRISPR Journal*, 3(5), 313–324.
- Chernus, I. (1991). *Nuclear Madness: Religion and the Psychology of the Nuclear Age*. New York, NY: State University of New York Press.
- Curran, D. (2024). 'Polanyi's Discovery of Society and the Digital Phase of the Industrial Revolution,' *Theory, Culture & Society* 41, no. 3, 78-96
- Day, S. (February 9, 1996). 'Milking them for all they're worth.' *The Independent*. Retrieved from <http://www.independent.co.uk/news/science/milking-them-for-all-theyre-worth-1361499.html>
- Gao, Y, Wang, Y., Liu, Z., Hou, N, Du, X., Wang, Y., Zhao, J. and Wu, S. (2023). 'Molecular Breeding of Farm Animals through Gene Editing.' *Biology* 12 (6): 367.
- Gourlay, S. (2004). 'Knowing as Semiosis: Steps Towards a Reconceptualization of "Tacit Knowledge".' In H. Tsoukas & N. Mylonopoulos (Eds.), *In Organizations as Knowledge Systems: Knowledge, Learning, and Dynamic Capabilities* (pp. 86–106). Basingstoke, UK: Palgrave Macmillan.
- Gregory, E. (2008). *Politics and the Order of Love: An Augustinian Ethic of Democratic Citizenship*. Chicago, IL: University of Chicago Press.

- Harris, A. (1997). 'Towards an ovine model of cystic fibrosis.' *Human Molecular Genetics*, 6(13), 2191–2193.
- Li, D., Guo, R., Chen, F., Wang, J., Wang, F., & Wan, Y. (2024). 'Genetically Engineered Goats as Efficient Mammary Gland Bioreactors for Production of Recombinant Human Neutrophil Peptide 1 Using CRISPR/Cas9.' *Biology*, 13(6), 367
- McGrath, A. (2002). *A Scientific Theology* (Vol. 1: Nature). London, UK: T&T Clark.
- National Academies of Sciences, Engineering, and Medicine. (2020). *Heritable Human Genome Editing*. Washington, DC: National Academies Press. <https://doi.org/10.17226/25665>
- O'Donovan, O. (1984). *Principles in the Public Realm: The Dilemma of Christian Moral Witness*. Oxford: Clarendon Press.
- O'Donovan, O. (1989). *Peace and Certainty: A Theological Essay on Deterrence*. Grand Rapids, MI: Eerdmans.
- O'Donovan, O. (1994). *Resurrection and Moral Order* (2nd ed.). Leicester, UK: Apollos.
- O'Donovan, O. (1996). *The Desire of the Nations*. Cambridge, UK: CUP.
- O'Donovan, O. (2005). *The Ways of Judgment*. Grand Rapids, MI: Eerdmans.
- Polanyi, M. (1962). *Personal Knowledge: Towards a Post-Critical Philosophy*. London, UK: Routledge.
- Polanyi, M. (1975). *Meaning*. Chicago, IL: University of Chicago Press.
- Parens, E., & Johnston, J. (Eds.). (2021). *Human Flourishing in an Age of Gene Editing*. Oxford: Oxford University Press.
- Ray, T., & Stewart, C. (2005). 'Tacit Knowing, Communication and Power: Lessons from Japan?' In S. E. Little & T. Ray (Eds.), *Managing Knowledge: An Essential Reader* (2nd edition, 319–48). London, UK: SAGE.
- Sandhaus, R. A. (2004). 'α1-Antitrypsin deficiency: New and emerging treatments for α1-antitrypsin deficiency.' *Thorax*, 59(10), 904–909.
- Scott, D. (1996). *Michael Polanyi*. London, UK: SPCK.
- Tranter, S. (2020). *Oliver O'Donovan's Moral Theology: Tensions and Triumphs*. London: T&T Clark.
- Volf, M. (1996). *Exclusion & Embrace: A Theological Exploration of Identity, Otherness and Reconciliation*. Nashville, TN: Abingdon.
- Wikimedia Commons (2015). <https://en.wikipedia.org/wiki/File:KochFlake.svg> Accessed 31/12/2015.