

Studies of faith

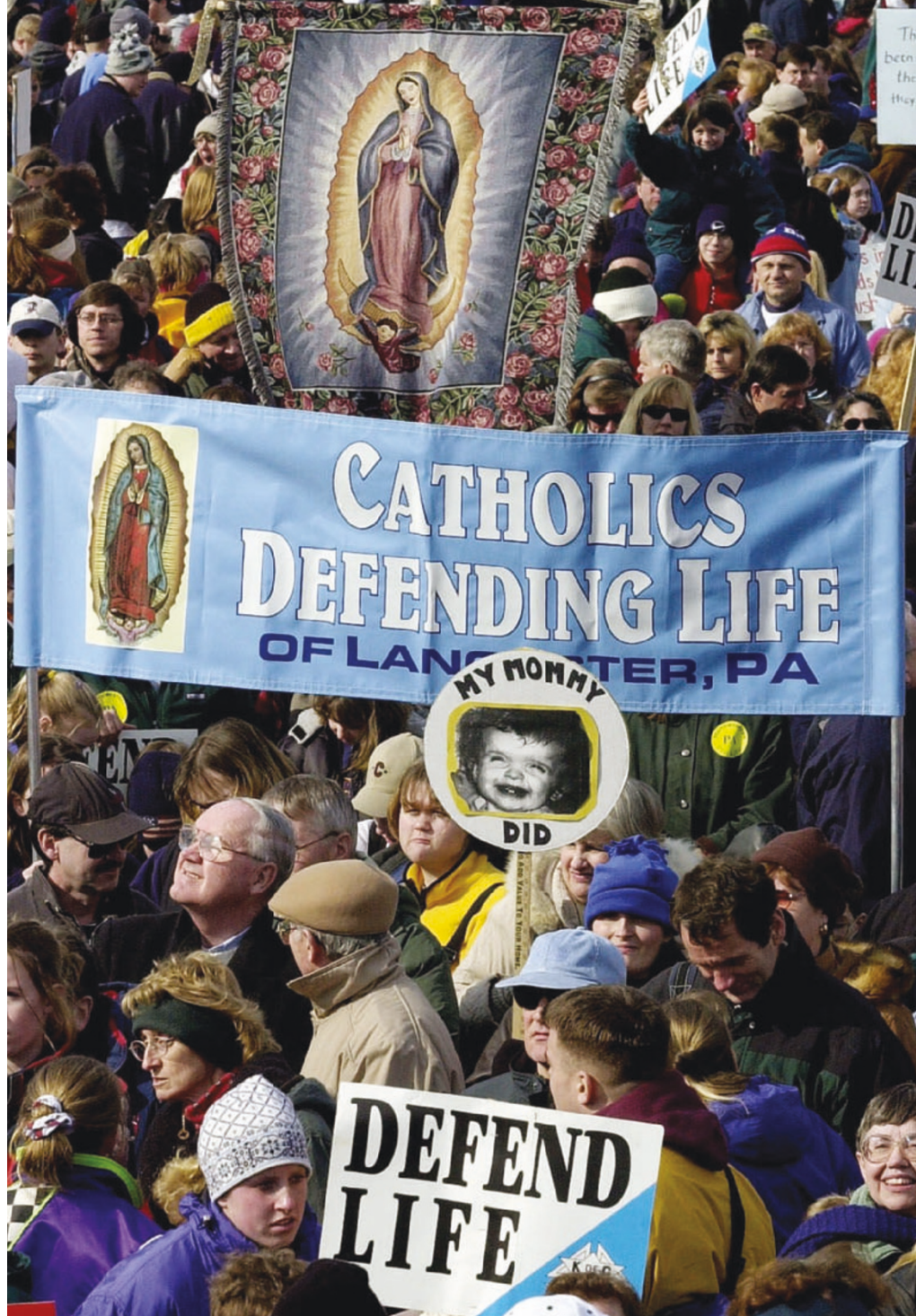
Embryonic stem-cell research is putting fresh strain on the already fractious relationship between science and religion. Tony Reichhardt explores how faith is shaping the ever-changing landscape of bioethics.

When Pope John Paul II addressed the Pontifical Academy of Sciences in 1992, he tackled yet again Galileo's famous battles with the Church four centuries ago. In his talk, entitled "Faith can never conflict with reason", the Pope was doing his best to mend fences. Although science and religion form "two realms of knowledge", he said, "the two realms are not altogether foreign to each other, they have points of contact".

Despite the Pope's optimistic words, the tension between faith and science never fully subsides. And as these realms regularly come into contact, over everything from Darwin to Dolly the cloned sheep, they sometimes collide with explosive force.

Today, with scientists manipulating the machinery of life as never before, the debate is in full swing. Nanotechnology, artificial intelligence, cloning, creationism and genetic modification (see 'A recipe for disaster?', opposite) all test the strained relationship between faith and advancing technology.

Today's frontline controversy — stem-cell research — has prompted a wide range of reactions from religious leaders, much of it negative. But the fundamental, religion-based belief in the sanctity of human life, even at the stage of an embryo, clashes in this field with another fundamental human desire: to alleviate suffering and cure disease. The debate does not leave room for simple answers, for individuals or society as a whole. Francis Collins, head of the US National Human Genome Research Institute in Bethesda, Maryland, and a devout Christian, has described himself as being "intensely



Ethical balance: Christianity's defence of the unborn child informs its position on stem-cell research.

conflicted" over stem-cell research. "It is a classic example of a collision between two very important principles," he says. The opposition to stem-cell research cannot be dismissed as merely 'anti-science'. Most religious traditions sincerely value medicine and science, and make a serious effort to reconcile scientific thinking with doctrine (see 'Science and the Vatican', page 669).

Where there's life...

This process of discussion and reconciliation may even be initiating a fundamental change. Some Catholics are beginning to hope that recent insights into developmental biology could move the Church from its 135-year-old position that human life

begins at conception — the main obstacle to it accepting the study of stem cells extracted from human embryos.

Much of the theological debate about stem-cell research centres on the question of when life begins. Some traditions, including most sects of Judaism and Islam, aren't troubled by this because they don't consider the early embryo fully human. Most Jewish Talmudic scholars, for example, argue that 'ensoulment' takes place 40 days or more into pregnancy, once the human form is roughly established. Before that, the embryo is described as 'water'. Israel accepts embryonic stem-cell research, and the Israeli Academy of Sciences and the Jewish Rabbinical Assembly, headquartered in the United

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States, have both come out in favour. Likewise, researchers at the Royan Institute in Tehran have developed stem-cell lines with the full blessing of Iran's supreme leader, Ayatollah Ali Khamenei.

According to Hinduism, life begins at conception. But this does not make for easy decisions on the ethics of stem-cell research. Destruction of an embryo could still be justified if it is considered to be an "extraordinary, unavoidable circumstance" and an act "done for greater good", says Swami Tyagananda, Hindu chaplain at the MIT Religious Activities Center in Cambridge, Massachusetts. Based on these criteria, many traditional Hindu priests are unwilling to condone the work, but it has not provoked much opposition in India, for instance, where embryonic stem-cell research is allowed.

The strongest objections come from Christian sects that regard the sacrifice of an embryo — even an undifferentiated clump of cells in a three-day-old blastocyst — as totally unacceptable. Embryos cannot be killed, they say, any more than Death Row prisoners can be used in lethal experiments, even if the goal is to relieve suffering in others.

Evangelical Christianity relies on a specific interpretation of scripture for its advice on this matter. Psalm 139: 13, for example, says: "For you created my inmost being; you knit me together in my mother's womb." In Jeremiah 1: 5 God tells the prophet, "Before I formed you in the womb I knew you," implying that Jeremiah had 'personhood' in God's eyes even before he was an embryo.

This roughly matches current Vatican thinking. The Catholic Church holds that human life is sacred from the moment of fertilization. But some Catholic theologians point out that the Church's view on the moral status of the embryo has changed over time, and may change again. In fact, scientific breakthroughs — the discovery of the

mammalian ovum in 1827 and the first microscopic views of developing embryos — helped to shape the Vatican's thinking. The findings informed Pope Pius IX's decision in 1869 to abandon the Church's moral distinction between early- and late-term abortions and to call instead for full protection of life from the moment of conception.

Today, the Vatican does not strictly claim that the early embryo is a person — only that it deserves respect as a potential human being, says Carlos Bedate of the Autonomous University of Madrid. Bedate has an unusual background as a Jesuit priest with a doctorate in molecular biology, and has served on a Spanish advisory committee for bioethics.



Religious views on stem-cell research hinge on when life begins: from conception to when the embryo looks human.

He thinks the ambiguity in Catholic thought could open a window for the Church's acceptance of embryonic stem-cell research. Recent advances in developmental biology have shown that an embryo's viability depends on the cellular environment as well as its own DNA, says Bedate. "We cannot consider that in the early embryo there is the entire information needed to complete the process of development," he says.

Open debate

A few Catholic theologians have spoken out in favour of human embryonic stem-cell research, including Jean Porter of the University of Notre Dame in Indiana, Margaret Farley of Yale University, and Christian Kummer, who trained as a zoologist and is now

director of an institute for scientific issues related to philosophy and theology at the Jesuit Faculty of Philosophy in Munich. Kummer says that they are free to voice these views without fear of censure from the Church. "Academic freedom is more pronounced than one would expect from knowing the Vatican's official positions," he says.

Bedate thinks that the Vatican may eventually be open to reconsidering the issue on the basis of new scientific understanding. But any formal change in the Church's position is likely to come very slowly, as Galileo's case once showed.

Arguments about the moment of ensoulment are crucial, but they are not the only

factor in religion-based objections to stem-cell research. As evangelical Christian Nigel Cameron, a bioethicist at the Institute on Biotechnology and the Human Future in Chicago, Illinois, told a US Senate committee in 2001: "It is by no means necessary to take the view that the early embryo is a full human person in order to be convinced that deleterious experimentation is improper."

The Church of England, for example, does not contend that early embryos are fully human. Yet they are "deserving of respect" nonetheless. In its guidelines on ethical investment, the Church concludes that "companies, a major part of whose business is engaged in the cloning of embryos (even for therapeutic use), should be avoided."

Another point of controversy is the source

A recipe for disaster?

If ever there was a technology that could get mankind accused of playing God, it is genetic engineering. As humanity mixes species with species and creates clones of creatures, religions have had to grapple with questions that could not have been foreseen when most religious texts were written.

The Bible can be used to argue both for and against genetic manipulation. In the Old Testament, lines such as "Thou shalt not sow thy field with mingled seed" (Leviticus 19: 19), and "Thou shalt not sow thy vineyard with divers seeds" (Deuteronomy 22: 9), have been used by some Christians as evidence that meddling with creation is unacceptable — although the same lines could be used to argue against traditional agricultural

practices. Others note that, according to Genesis, man was made in the image and likeness of God and given dominion over all living things, which would make genetic modification mankind's right.

The Catholic, Jewish and Islamic faiths generally see no need to ban genetically modified foods or vaccines for moral reasons. On a purely practical level, Jews and Muslims share the worry of whether their food contains any hidden genes from pigs or other forbidden dietary products.

In the Hindu tradition, food is believed to affect your physical and mental constitution and your karmic balance, says Cromwell Crawford, an expert in Hindu bioethics at the University of Hawaii at Manoa. Each Hindu must assess whether the motivation behind genetic engineering is a positive

desire to help feed the world or a negative one driven by commercial exploitation, he says, in order to determine its impact on body and mind.

Other religions also share this worry about how genetic engineering is used. But on the purest level of assessing the ethics of the technology itself, there is little to go on to decide whether mixing corn with bacteria is ok, but mixing mankind with mice is not. "There's no list of boxes to tick off to tell you when you have gone too far and changed the animal or plant into something fundamentally different," says Donald Bruce, director of the Church of Scotland's Society, Religion and Technology Project. "There is no commandment from God saying: 'Thou shalt not genetically engineer.' It's a judgement call."

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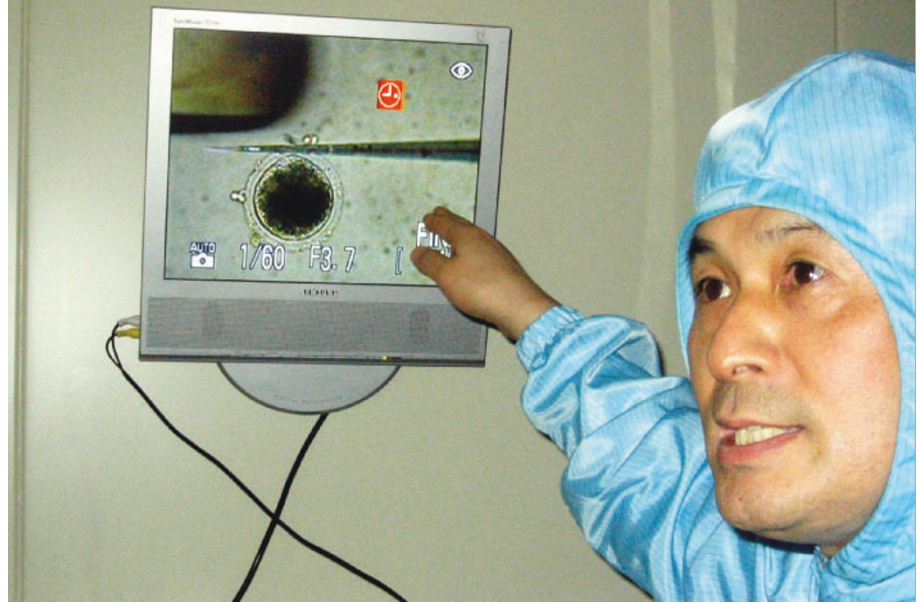
Opposite sides: many US Christians cannot condone research using embryonic stem cells (above), whereas Woo Suk Hwang in Seoul claims that his research is in line with Buddhism.

of the embryo. Some stem-cell researchers use embryos discarded from *in vitro* fertilization (IVF) clinics, whereas others clone new embryos to harvest their cells.

The very practice of IVF has faced strict opposition from the Catholic Church on the grounds that it breaks the God-given connection between sex and procreation — a rule often voiced during discussions on the ethics of contraception. Most other religious groups, including evangelicals, see IVF as a good solution for infertile couples who want children. But that acceptance is now coming under greater scrutiny because IVF clinics frequently discard ‘excess’ embryos that are not needed for implantation. Although the issue hasn’t received the same attention as abortion, some Christian leaders have begun to speak out. “IVF kind of snuck up on evangelicals. We weren’t paying as close attention as we should have,” says Ben Mitchell, an bioethicist and evangelical Christian at Trinity International University in Deerfield, Illinois.

Fertile ground

In predominantly Catholic Italy, attempts to find a compromise on the issue have led only to new problems. The country passed a law this year legalizing IVF despite Vatican opposition. But no embryos can be destroyed — all have to be transferred to the mother’s uterus. This can increase the risk to mothers and even lead to miscarriages in the case of multiple pregnancies.



Other denominations, including the Unitarian Universalists, one of the most liberal of religious groups, take more umbrage with using custom-made embryos than the ‘left-overs’ from IVF. Although the Unitarian Universalist Association has no official consensus opinion on stem cells, its president, William Sinkford, offered his personal opinion in 2001 that there should be no ban on embryonic stem-cell research. But he added: “I would contend that no human embryos should be created specifically for stem-cell experimentation, thus turning human life and human reproduction into a commodity — surely a clear affront to our first principle affirming the inherent dignity of human beings.”

Perhaps this dignity seems all the more

affronted since the resulting experiments have not, so far, yielded life-saving results. Damien Keown, a specialist in Buddhist ethics at Goldsmiths College in London, sums it up: “Scientific curiosity seems to be the main factor motivating cloning experiments at present, and overall Buddhists are likely to be sceptical about the need for this curiosity to be satisfied at the price of destroying human life.”

When Seoul National University’s Woo Suk Hwang cloned human embryonic stem-cell lines earlier this year he cited his own Buddhist beliefs, saying that the experiments were a kind of “recycling of life” in line with reincarnation. Some Buddhist groups in South Korea, where Buddhists account for about a third of the population, supported

Science and the Vatican

Mariailuisa Lavitrano had been uncertain about what to expect. A pathologist at the University of Milan-Bicocca, Lavitrano had been invited to organize a series of scientific meetings at the Vatican about xenotransplantation and the genetic modification of animals. That was three years ago, and she is still surprised by the response she got.

"The cardinals wanted to know everything about the science," she says. "It was a fascinating debate and, frankly, I was not prepared for so much open-mindedness." After the meetings, the Vatican legitimized the transplant of animal organs into humans and the use of animals in medical research (E. Sgreccia *et al. Nature* **414**, 687; 2001).

Lavitrano's experience is not unique. The Vatican often seeks informed advice on questions emerging from progress in science and medicine. And many researchers who have been involved say that they are surprised by the high quality of scientific discourse with the cardinals. Despite the Church's reputation for nurturing anti-scientific tendencies — as recently as the 1960s, Catholic priests in training were asked to renounce 'modern errors' such as darwinism and the expansion of the Universe — the Vatican has long abandoned literal interpretations of scripture.

The Vatican takes regular scientific advice from the 400-year-old Pontifical Academy of Sciences in the Vatican City. The academy is made up of 80 eminent scientists from around the globe chosen by the academy itself. Each November they hold a scientific meeting, usually on a topic of their

choosing, or sometimes on a matter requested by the central administration of the Church; these have covered everything from birth control to cloning, genetic engineering and the origin of life.

The annual meetings conclude with an audience with the Pope. He and his officials then take this scientific advice into account when they draw up guidance notes and issue decrees on the Church's doctrine.

Pope John Paul II has shown a notable interest in science ever since he took over as head of the Catholic Church in 1978. "Scientists who have met him have always thought they were before a person really interested in their work and sincerely eager to learn from them," says Giuseppe Tanzella-Nitti, an astrophysicist at the Pontifical University of the Holy Cross in Rome.

"I remember the young Pope just a few years after his election sitting among a small group of scientists on a terrace of his private residence at Castelgandolfo, taking notes about contemporary cosmology," says Tanzella-Nitti. Perched on top of the same residence is an astronomical observatory that, partnered with a telescope in Arizona, is funded by the Vatican to the tune of US\$1 million a year.

The possibility of extraterrestrial life and intelligence, and the implications of cosmology for Christian ideas about the beginning and end of time, will be upcoming challenges for science-minded theologians, says Tanzella-Nitti. The Catholic Church, for one, should be well prepared.

Quirin Schiermeier

him. But most Buddhist scholars say the killing of an embryo at any stage violates a central tenet that living things should not be harmed. Cloning for reproductive purposes, on the other hand, does not require destroying the embryo and so does not in itself violate Buddhist precepts.

"The problem is not when life is started, but when it is stopped, as in therapeutic cloning," says Keown. "Dr Hwang is on shaky ground in claiming that Buddhism supports cloning, without careful qualification."

Protestants, who make up another third of South Korea's population, reacted strongly to the news of Hwang's experiments. Sixteen Protestant groups, representing 6,000 people — half of them doctors in the Christian Medical Fellowship — met in September to plan a campaign devoted to making the use of human embryos in research illegal.

But the extent to which religious opinion influences politics and laws varies dramatically from society to society. In Spain, where 99% of the population is Catholic, a law was recently passed to allow the use of IVF embryos in stem-cell research. But in Italy, which vehemently opposes the use of European Union funding for stem-cell research, the population is "much more reactionary on religious issues than the Church itself",

says Enrico Alleva, acting head of behavioural pathophysiology at the National Institute of Health in Rome. Alleva believes that this zeal, rather than formal Catholic doctrine, is at the core of the recent creationist movement in Italy (see *Nature* **428**, 595; 2004) and of other perceived 'anti-science' tendencies throughout Europe.

Body politic

Another place where religion has proved to be the driving force for politics is the United States. In November's election, President George W. Bush owed his victory in part to votes from his fellow evangelical Christians.

Evangelicals are not uniformly conservative in their political views — some oppose capital punishment, for example. But most evangelical leaders are strongly against embryonic stem-cell research. The Southern Baptist Convention, which represents the second largest US denomination after Catholics, says it relies on a "crass utilitarian ethic which would sacrifice the lives of the few for the benefits of the many".

Such statements have surely influenced the United States' rigid policy on stem-cell research, in which federal funding is limited for use on a few dozen pre-established cell lines, and cannot be used to establish new ones.

Does this reflect public attitudes? Polls reveal mixed opinions — although a lot hinges on the wording of the question. In July 2004, Catholics for Free Choice published a poll of 2,239 Catholics nationwide, and found that 72% supported "allowing scientists to use stem cells obtained from very early human embryos to find cures for serious diseases such as Alzheimer's, diabetes and Parkinson's".

But "polls on embryonic stem-cell research often fail to mention that the research requires destroying human embryos", says Richard Doerflinger, deputy director of the US Conference of Catholic Bishops Secretariat for Pro-Life Activities. In August the Catholic bishops released the results of their own poll. When given a choice between funding both adult and embryonic stem-cell research or only work that didn't require destroying an embryo, Americans preferred the latter by 61% to 23%.

Difficult question

Efforts to establish ethical rules on stem cells that transcend national and spiritual boundaries have proved remarkably unsuccessful. After years of delayed decisions, on 19 November the United Nations came to what was widely called a "compromise" position on cloning technologies — it adopted a non-binding declaration that asks member states to adopt legislation that respects "human dignity". In the end, this statement is likely to be interpreted in as many different ways as some lines from the Bible.

So scientists and theologians will continue to talk — and to disagree. At least one thing has changed in this debate since Galileo's day, for better or for worse: now, science is the orthodox worldview, in the industrialized world at least, and religion stands outside, raising objections. At bioethics conferences, says John Evans, a sociologist of religion at the University of California, San Diego, biologists rarely show any knowledge of theology. But "religious people are expected to have spent huge amounts of time learning all the science", he notes.

One thing is certain. Everyone agrees that fundamental ethical questions underlying stem-cell research, many of which transcend religion, need to be addressed. "The power of these new technologies is so great that we can no longer deal with them in a vacuum. This affects everyone across the board," says Kevin FitzGerald of Georgetown University in Washington DC, a Jesuit priest with PhDs in molecular genetics and bioethics. And stem cells are just the beginning. "The stuff that's coming down the pipe will make this look like child's play," he says. "Organic mixed with inorganic, one species mixed with another. Everything from the molecular level on up will be fluid." ■

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