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EVOLUTION, DARWIN, AND CATHOLIC BELIEF

In recent years there has been much discussion of the theory of evolution and its relation to Christian belief. This discussion has been particularly intense in the United States, but it involves theological and philosophical questions of fundamental importance to all Christians. Unfortunately, the discussion has often been conducted by people holding extreme positions and reported on by journalists interested primarily in sensationalism. As a consequence, confusion and misunderstandings abound. In this article I will attempt to clarify the issues and examine them from a Catholic point of view. Much of the confusion is created or compounded by ambiguous terminology. It is useful, therefore, to begin by clarifying terms, and most importantly the term "evolution" itself. The theory of evolution has several layers; and when people refer to "evolution" in the current controversies, it is not always clear to which layer they are referring. First, there is the evolution of species, the idea that the present species of plants and animals arose from other species by a gradual process, and that ultimately all of them came from a single original form of life. This is sometimes called the theory of "common descent", since it says that all living things descended from a common ancestor. Second, there is human evolution, the idea that human beings evolved in the same way and are thus part of the same branching tree of life. Finally, there is the Darwinian mechanism, the idea that evolution is driven by natural selection acting on random genetic mutations.

When discussing the second level, the evolution of man, one must further distinguish between a weaker and a stronger version. The weaker version says that human beings are the product of evolution at the physical level and does not presume to say anything about the spiritual dimension of man. The stronger version says that human beings are completely explicable in physical and biological terms,

and therefore entirely the products of evolution. The weaker claim is a scientific one and is supported by overwhelming evidence, whereas the stronger claim is a philosophical extrapolation that goes far beyond scientific evidence and is, indeed, highly debatable on scientific as well as philosophical grounds.

Serious confusion also exists about the meaning of the words Darwinism and neo-Darwinism. In a scientific context, the word Darwinism refers simply to the idea that the mechanism of evolution is natural selection, and the word neo-Darwinism refers to its modern form, which arose from its synthesis with the science of genetics in the mid-twentieth century. Many theologians and philosophers, however, understand these words to refer to atheistic and materialistic philosophies inspired by evolution. There are several reasons for this. In the first place, Darwin himself was a religious skeptic, and philosophers tend to look to the founder of a movement of thought for its authentic interpretation – they reason that if Darwin was a skeptic then Darwinism must be a skeptical philosophy. Moreover, it is more common to name philosophical schools than scientific theories after their founders. One does not refer to Newtonism, Maxwellism, or Einsteinism, whereas one does refer to Platonism, Thomism, and Kantianism. The word neo-Darwinism strengthens this impression: there are such things as neo-Platonism, neo-Thomism, and neo-Kantianism, but the prefix neo has never (except for neo-Darwinism) been attached to scientific theories. Finally, many biologists believe and proclaim that Darwinism does have atheistic and materialistic implications; so it is natural for non-scientists to assume that these philosophical conclusions do indeed belong to the meaning of the terms Darwinism and neo-Darwinism. Nevertheless, while it is natural for theologians and philosophers to use terms in this way, it causes misunderstandings that are both harmful and avoidable. For example, when Cardinal Schönborn publicly condemned "neo-Darwinism" several years ago, he intended to criticize only philosophical errors, but was widely understood by scientists to be attacking well-established scientific ideas.

Another source of confusion is the fact that several controversies over evolution are going on at the same time. The two major ones that involve religion are the Creationism-versus-evolution battle and the Intelligent Design-versus-neo-Darwinism battle. Creationism is not just the idea that the universe is created by God, which all Christians hold. Rather, it is a theological movement that rejects all three levels of the theory of evolution in favor of a very literal reading of the first chapter of the Book of Genesis. Some creationists accept that "microevolution" has happened, which makes limited changes, as in the shape of finches' beaks; but all creationists deny "macroevolution", which makes major changes, such as the evolution of birds from reptiles, or reptiles from fish. The struggle of creationism against evolution has very little intellectual interest in our day, since the evidence for common descent is overwhelming.

The second battle, the one between the so-called "Intelligent Design movement" (or "ID movement") and neo-Darwinism, is somewhat more interesting.

Again, some clarification of terms is necessary: All Christians believe that there exists an intelligent being who designed the universe and its laws. However, the Intelligent Design movement does not just say this; it makes specific claims about biology. It says that, while evolution may have happened, the Darwinian mechanism is not capable of explaining the degree and kind of complexity we find in living things. So, one can believe in an intelligent designer without agreeing with the distinctive claims made by the Intelligent Design movement. The Catholic Church, for instance, takes no position on those claims. One might ask why the battles over evolution have intensified in recent years. In the 1960s and 70s, even in the United States, one did not hear much about anti-evolutionism in its various forms. The recent flare-up of these debates is due largely to the agitation of two groups, aggressive atheists on the one hand and defenders of a certain narrow kind of biblical literalism on the other. Many "evangelical Protestants" (which in the United States refers to Protestant groups with a relatively "low" view of Church tradition and authority) are committed to this kind of biblical literalism, because they think it follows logically from the central Protestant principle of *Sola Scriptura*, i.e. that Scripture is the sole authority in matters of faith. Some evangelicals see such literalism as the only way to guard against liberal interpretations of Scripture on matters of faith and morals. Given that *Sola Scriptura* rules out any recourse to an authoritative tradition or magisterium to resolve theological disputes, they may well be right. And so for such evangelicals, accepting evolution would endanger their whole doctrinal system. (It should be emphasized, however, that not all evangelicals reject evolution, though surveys show that the majority of them do.)

On the other side, many atheists, such as the biologist Richard Dawkins, use Darwinism as a weapon in their war against religion – not just biblical literalism, but all religion. Evolution, they argue, has debunked the idea that man is a special creature made in the image of God by showing that we differ from other animals only in degree, not in kind. And it has demolished, they maintain, the idea of a divine Designer or Architect, by showing how things that appear to be designed can actually arise by blind natural forces.

Catholics, of course, don't agree with the philosophical assertions of Dawkins and his ilk; nor do we agree with the manner of biblical interpretation of the most literal-minded evangelical Protestants. So, what has the Catholic Church said about evolution? As far as official teaching goes, i.e. pronouncements of the magisterium, the Church said virtually nothing for almost a hundred years after Darwin published his theory in 1859. However, some sense of the general attitude of Catholic scholars and theologians toward evolution in the early days of the theory can be gotten from looking at the Catholic Encyclopedia, which as written in the first decade of the 20th century. Of course, this encyclopedia was not an official document of the Church's magisterium, but it was one of the outstanding products of Catholic scholarship at that time, at least in the English-speaking world, and it carried a *nihil obstat* and an imprimatur certifying that it contained nothing contra-

ry to Catholic doctrine. The encyclopedia contained an article entitled "Catholics and Evolution", which first summarized the theory of evolution as it stood at that time, and then said, "This is the gist of the theory of evolution as a scientific hypothesis. It is in perfect agreement with the Christian conception of the universe." An impressive book of Catholic apologetics called *The Question Box* was published around the same time. In a question-and-answer format it responded to hundreds of common objections to the Catholic Faith. This book sold several million copies, and seems to have been given to students in Catholic schools in the United States in those days – I have my mother's old copy, dating from her high-school days in the 1930s. In answer to the question on page 8, "May a Catholic believe in evolution?", the book said, "As the Church has made no pronouncement upon evolution, Catholics are perfectly free to accept evolution, either as a scientific hypothesis or as a philosophical speculation." What these books were speaking of in the sentences I just quoted was the evolution of species, i.e. of plants and animals. As far as the evolution of man was concerned, they insisted (as the Church still insists) that the human soul, being spiritual, cannot be reduced to matter or explained by any merely physical process, and that therefore evolution of the human soul is contrary to Catholic faith. On the evolution of the human body, however, they did not come to a definite conclusion. The encyclopedia admitted that it was "per se not improbable" that the human body had evolved, and noted that a version of this idea had "been propounded by St. Augustine". However, both books thought the scientific evidence for human evolution was weak, and observed that most theologians of that time had a negative view of the idea. Nevertheless, they admitted that there was no official Church teaching on the matter.

As far as the mechanism of evolution was concerned, little was said by either book. The idea that evolution was a natural process was not problematic, as far as the Church was concerned. This is an area where the Church's deep philosophical traditions served her well. Many opponents of evolution see Nature as being somehow in competition with God, so that the more we attribute to natural processes or natural causes, the less we can attribute to God, and *vice versa*. But the Church has never accepted this dichotomy. She has always understood that there are two levels of causality, called by the scholastic theologians "primary" and "secondary". God, acting vertically, so to speak, is the direct cause of every event in the physical universe – he is the "Primary Cause". At the same time, the events in the world have amongst themselves various causal relationships, which could be thought of as horizontal. This is called secondary causality. There is no contradiction or competition between the two; rather God's primary causality undergirds all secondary causality. As an analogy consider the play Hamlet. In that play Polonius dies because Hamlet stabs him through a curtain. However, it is also true to say that Polonius dies because Shakespeare wrote the play that way. So both the character Hamlet and the playwright Shakespeare are truly causes of Polonius dying in the play, but on completely different levels. Events in the play do have causal relationships to

each other; however, the play itself, every event in the play, and every causal relationship among those events exist only because the playwright ordained that they would. Analogously, one physical event causes another in the natural world because God has created a world in which such causal relationships exist. If fire burns wood, it is only because God creates a world in which there are such realities as fire and wood, and in which wood has the physical and chemical properties that it does.

This basic insight about primary and secondary causality is related to another insight of traditional Catholic teaching, which is that God in his divine nature is outside the flow of time. He sees from all eternity the whole pattern of history, which unfolds according to his plan. The idea of his having to intervene repeatedly to take care of unforeseen problems or that he is, as it were, "making it up as he goes along", is utterly alien to Catholic thought, which sees God as creating everything – past, present, and future – by a single all-seeing and all-encompassing act of his will. *The Question Box* used an analogy: "A billiard player wishes to send a hundred balls in different directions. Which will require greater skill – o make a hundred strokes and send each ball separately to its goal, or, by hitting one ball, to send all the ninety-nine others in the directions which he has in view?" The Catholic Encyclopedia put it this way: "If God produced the universe by a single creative act of His will, then its natural development by laws implanted in it by its Creator is to the greater glory of His divine power and wisdom." The encyclopedia then went on to quote Aquinas and Suarez: "St. Thomas says, 'the potency of the cause is greater the more remote the effects to which it extends'; and Suarez [says], 'God does not interfere directly with the natural order where secondary causes suffice to produce the intended effect.' "The Church has always taught that there is a natural order that comes from God, and the greater the powers and potentialities that God has implanted in Nature, the more it shows forth His power and greatness. To be sure, these old Catholic articles condemned radically atheist interpretations of evolution, which deny the existence of God or his providential governance of the world, as incompatible with Catholic belief. They sharply distinguished, however, such philosophical extrapolations from evolution as a biological theory. It may be asked whether these articles were out of the mainstream of Catholic thought at that time. It does not seem so. For example, John Henry Newman, later Cardinal Newman, wrote in a letter to the Rev. David Brown in 1874, "I see nothing in the theory of evolution inconsistent with an Almighty Creator and Protector." In 1868, he said, "The theory of Darwin is not necessarily atheistic. It may simply suggest a larger idea of divine prescience and skill." Even earlier, in 1863, he wrote in one of his notebooks, "There is as much want [i.e. lack] of simplicity in the idea of creation of distinct species as in that of the creation of trees in full growth whose seed is in themselves, or of rocks with fossils in them. I mean that it is as strange that monkeys should be so like men with no historical connection between them as the notion that there should be no course of history by which fossil bones got into rocks." Note that Newman wrote this only four years after Darwin published *On*

the Origin of Species. The great author of *Essay on the Development of Christian Doctrine* understood very quickly the plausibility of a developmental picture of the history of life on earth.

G.K. Chesterton was perhaps the most popular Catholic author of the early twentieth century. (He did not enter the Catholic Church until 1922, but his theology was essentially Catholic long before that.) In 1908, he wrote, in *Orthodoxy*, "If evolution simply means that a positive thing called an ape turned very slowly into a positive thing called a man, then it is stingless for the most orthodox. For a personal God might just as well do things slowly as quickly, especially if, like the Christian God, he were outside time."

The first official pronouncement of the Church on the subject of evolution did not come until 1950, when Pope Pius XII issued the encyclical letter *Humani generis*, in which he specifically addressed the question of the evolution of man. His central point was that one must distinguish the origin of the human body and the origin of human spiritual soul. The evolution of the spiritual soul, of course, he declared to be inconsistent with Catholic faith. On the evolution of the human body he took a very cautious stance, saying that Catholic scholars could investigate it as a "hypothesis" as long as they did not reach any conclusions rashly. Though he was obviously less convinced by the evidence than were scientists of that time, it is clear that he thought the matter was to be decided by the evidence and that he was willing to let the chips fall where they may.

Another point that Pope Pius XII addressed was the question of monogenism versus polygenism; that is, whether all human beings were descended from a single original pair of humans or many. He said that Catholic scholars had to adhere to monogenism, but did not absolutely close the door to polygenism. He said "it is in no way apparent" how polygenism can be reconciled with certain Catholic teachings, in particular on Original Sin. But his precise wording is significant; he did not assert that these ideas could not be reconciled, only that it was „not apparent" how they could. Many Catholic theologians have been quick – too quick in my view – to toss monogenism overboard, because they think that the theory of evolution requires polygenism. They would be right, if the emergence of true human beings with spiritual souls were simply a matter of biological speciation. I will return to this very important question later in this article. The next notable Church statement on evolution did not come until 1996, when Pope John Paul II delivered an address on the subject to the Pontifical Academy of Sciences. Referring to the encyclical *Humani generis*, he said, "Today, half a century after the appearance of that encyclical, some new findings lead us toward the recognition of evolution as more than a hypothesis. In fact, it is remarkable that this theory has had progressively greater influence on the spirit of researchers, following a series of discoveries in different scholarly disciplines. The convergence in the results of these independent studies – which was neither planned nor sought – constitutes in itself a significant argument in favor of the theory." Of course, the Pope was not officially teaching

that evolution is true – the Church will never certify the truth of that or any other scientific theory, for this is beyond her mission and competence. It was simply the explicit acknowledgement of an obvious fact, namely that there was a great deal of evidence for evolution and significantly more than there had been in 1950.

Pope John Paul II in the same message reiterated what he called "the essential point" made by Pope Pius XII, namely that "if the human body takes its origin from pre-existent living matter, [nevertheless] the spiritual soul is immediately [i.e. directly] created by God." This has always been the essential point for Catholics. Evolution is a theory of how atoms came to be assembled in certain ways to form biological organisms. We human beings, however, are not just assemblages of atoms. We are also spiritual, in that we have rational intellects and free will, which cannot be explained merely in terms of the motions of atoms. That means that there is not just a difference of degree between us and other animals, but what Pope John Paul II in the same message called an "ontological discontinuity".

Another important document was issued in 2004 by the International Theological Commission, which is a body that advises the Congregation of the Doctrine of the Faith, at that time headed by Cardinal Ratzinger. The document, called *Communion and Stewardship*, was approved for publication by Cardinal Ratzinger. It analyses some of the philosophical and theological issues surrounding evolution. It stresses the same points made by Pius XII and John Paul II, but contains a great deal more. In particular, it argues that the neo-Darwinian mechanism of evolution is not incompatible with the Catholic doctrine of divine providence. I will come back to this important point below. We see from all this, that the Catholic Church and the best Catholic thinkers have never been caught up in anti-evolutionism. As I noted, that has largely been a fundamentalist Protestant phenomenon. There does seem to have been an increase of anti-evolutionism in Catholic circles in recent years. I suspect that part of this may be due to a weakened understanding by some Catholics of their own theological and philosophical tradition. It may also be a by-product of the fact that a significant number of evangelical Protestants have come into the Catholic Church in recent decades, and that many of them have brought anti-evolution attitudes with them.

In the rest of this article I will examine the reasons that many religious people reject or are uncomfortable with evolution. I am going to start with several theological objections to evolution that are rather flimsy, and then take up the more serious and subtle ones. The first flimsy theological objection to evolution is that it disagrees with the biblical account of creation. *The Question Box* answered this well: "*The Bible* is not a textbook of science, and, therefore, cannot rightly be quoted either for or against evolution. As Pope Leo XIII says in his encyclical *Providentissimus Deus*: 'The sacred writers did not intend to teach men these things, that is to say, the essential nature of the things of the visible universe'." One also should note that some of the Church fathers, including the greatest of them, St. Augustine, took many of the things in the book of Genesis in a figurative way. For instance,

Augustine did not take the Six Days of creation literally as a temporal sequence, but believed it more probable that the whole universe was created in one instant. St. Thomas Aquinas followed Augustine's view on this, saying that the idea of a temporally successive creation was more common and "superficially more in accord with the letter" of Scripture, but that St. Augustine's view was more "in accordance with reason", and that he (St. Thomas) therefore preferred it.

The second flimsy objection is that evolution takes away from human dignity, by saying that we are descended from apes. However, it is not clear why being directly formed from the dust of the ground is more dignified. An ape is certainly something higher, ontologically speaking, that dirt. In fact, *the Bible* in many places emphasizes that we are creatures of dust, precisely to show us our lowliness. For example, Psalm 103: 13–14 tells us that "As a father pities his children, so the Lord pities those that fear him. For he knows our frame; he remembers that we are dust." And Ecclesiastes 3: 18–20 says that "the sons of men themselves are beasts. For that which befalls the sons of men befalls beasts; one thing befalls them: as one dies, so dies the other; yea, they all have one breath; so that a man has no preeminence above a beast: for all is vanity. All go unto one place; all are of the dust, and all turn to dust again." Our special dignity, then, comes not from our physical origin, but from our spiritual nature. Only in the account of man's creation do we find it said that "God breathed into him, and he became a living soul". That is, only on man did God confer a spiritual nature in some way resembling His own, so that only human beings are said by Scripture to be made in the image of God. As it happens, science agrees with the Bible that we came from dust. Billions of years ago there were just particles and dust from which condensed all stars and planets and living things. Whether we came from dust very quickly as portrayed in Genesis or through a slow process as described by science is really theologically irrelevant, as Chesterton observed. Our bodies are taken from the dust and they will return to dust. The third flimsy objection is that evolution implies that there is only a difference of degree between man and animals. However, that conclusion would only follow it we deny what John Paul II called the „essential point": that man has a spiritual soul as well as a body.

The fourth flimsy reason is that evolution is "naturalistic". This is an important point for Phillip Johnson, one of the founders of the Intelligent Design movement and the author of several popular anti-darwinist books, such as *Darwin on Trial*. Johnson seems to think, or fears that others will think, that explaining things naturally rather than supernaturally leaves God with less to do. Strangely, people who make this objection to evolution rarely raise the same objection to the natural explanations of phenomena that are given in astronomy, geology, physics, or chemistry; the naturalism they find in biology seems to disturb them much more. In any event, we have already seen the fallacy involved in this point of view, namely failing to distinguish between primary and secondary causality.

None of these objections to evolution should have any force for Catholics; and indeed historically they have had almost none. So now let us turn our attention to the more serious criticisms, of which there are at least four. One is that the Darwinian mechanism of natural selection has undercut or destroyed the traditional „argument from design" for the existence of God. The second is that the role assigned to chance in Darwinism is incompatible with the Catholic doctrine of divine providence. The third is that the theological accounts of man's creation and fall contrast with the history of human origins found through paleontology and genetics. The fourth objection, raised mostly by Thomist philosophers, is that Darwinian evolution eliminates teleology from biology.

The first of these objections to the compatibility of Darwinism with religion has been argued very vociferously from the atheist side by the zoologist Richard Dawkins. He notes that for a long time people believed that the intricate structures of living things proved that they were the products of an intelligent designer, but we now realize that they are the products of the blind forces of nature, and specifically of natural selection. Dawkins concedes that living things do indeed have all the earmarks that we normally associate with design: complexity, functionality, and interdependence of parts. But Darwin showed us how things that appear to be designed may actually not be. Dawkins calls such things "designoids". By showing that no designer of living things is necessary, Darwin made it possible for the first time, says Dawkins, to be "an intellectually fulfilled atheist." Even if one were to grant to Dawkins that living things are designoids, it would not mean that Darwin had destroyed the argument from design for the existence of God. To begin with, there is not just one kind of design argument, but at least three, which I shall call the cosmic design argument, the providential design argument, and the biological design argument. The cosmic design argument points to the orderliness and lawfulness of the cosmos as a whole. The providential design argument points to the way the various parts of the cosmos work together harmoniously for some good end, such as the sustenance of life. The biological design argument points to particular living things, and to the complexity of their organic structure. Of these, it is only the biological design argument that can be said to have been destroyed, or at least weakened, by Darwinian evolution. The other two versions of the design argument are alive and well. Indeed, I shall argue that the cosmic design argument has been enormously strengthened by modern scientific discoveries and is likely to be strengthened further by future discoveries. Not only are they more robust, but the cosmic and providential design arguments are also more ancient and more fundamental than the biological one, which is a relative newcomer to the theological scene. We can see evidence of this in four passages taken from the *Old Testament* and early Christian writings that speak of God as the designer of the cosmos. The first is from the *Old Testament Book of Wisdom*, which was written by an Alexandrian Jew of the 1st or 2nd century B.C., responding to the challenge posed to the Jewish religion by the sophisticated philosophy and science of the *physikoi* of ancient Greece.

It contains this eloquent passage, which just as well could have been addressed to the physicists of today: "For all men were by nature foolish who were in ignorance of God, and who from the good things seen did not succeed in knowing Him who is, and from studying the works did not discern the artisan; but either fire, or wind, or the swift air, or the circuit of the stars, or the mighty water, or the luminaries of heaven – the governors of the world – they considered gods. Now if out of joy in their beauty they thought these things to be gods, let them know how far more excellent is the Lord than these; for the original source of beauty fashioned them. Or if they were struck by the might and energy of these things, let them from these things realize how much more powerful is He who made them. For from the greatness and the beauty of created things their original author, by analogy, is seen. But yet, for these men the blame is less; for though they have indeed gone astray, they perhaps seek God and wish to find him. For they search busily among his works, but are distracted by what they see, because the things seen are fair. But again, not even these men have an excuse. For if they so far succeeded in knowledge that they could speculate about the world, how did they not more quickly find its Lord?" (Wisdom 13: 1–9)

The second passage is from the Letter of Clement to the Church in Corinth, written in Greek ca. 97 A.D. It is one of the earliest Christian documents aside from the *New Testament* itself. In it, Clement, the fourth pope, is arguing that peace and harmony within the Church are to be obtained by submission to God's will and laws, and he cites the harmony of nature and its obedience to God's laws as teaching this lesson: "Let us turn our eyes to the Father and Creator of the universe. Let us contemplate Him with understanding, noting with the eyes of the spirit . the total absence of friction that marks the ordering of His whole creation. The heavens, as they revolve beneath His government, do so in quiet submission to Him. The day and the night run the course He has laid down for them, and neither of them interferes with the other. Sun, moon, and the starry choirs roll on in harmony at His command, none swerving from his appointed orbit. Season by season the teeming earth, obedient to His will, uses a wealth of nourishment to spring forth for man and beast and every living thing upon its surface, making no demur and no attempt to alter even the least of His decrees. Laws of the same kind sustain the fathomless deeps of the abyss and the untold regions of the netherworld. Nor does the illimitable basin of the sea, gathered by the operations of His hand into its various different centers, overflow at any time the barriers encircling it, but does as He has bidden it... The impassable Ocean and all the worlds that lie beyond it are themselves ruled by the like ordinances of the Lord. Spring, summer, autumn, and winter succeed one another peaceably; the winds fulfill their punctual duties, each from its own quarter, and give no offence; the ever-flowing streams created for our well-being and enjoyment offer their breasts unfailingly for the life of man; and even the minutest of living creatures mingle together in peaceful accord. Upon all of these the great Architect and Lord of the universe has enjoined peace and harmony."

The third passage is from the famous Letter to Diognetus, written in the early part of the second century. It contains this statement about Christ and Creation: "The Almighty Himself, the Creator of the Universe, the God whom no eye can discern, has sent down His very own Truth from heaven, His own holy and incomprehensible Word, [the] Artificer and Constructor Himself, by whose agency God made the heavens and set the seas their bounds; whose mystic word the elements of creation submissively obey; by whom the sun is assigned the limits of his course by day; and at whose command by night the obedient moon unveils her beams, and each compliant star follows circling in her train. Ordainer, Disposer, and Ruler of all things is he; of heaven and all that heaven holds, of earth and all that is in earth, of sea and every creature therein; of fires, ether, and bottomless pit; of things above, and things below, and things in the midst. Such was the Messenger God sent to men."

The last passage I will quote is from a work of apologetics written to non-Christians by the Latin writer Minucius Felix around the year 200 A.D.: "If upon entering some home you saw that everything there was well-tended, neat, and decorative, you would believe that some master was in charge of it, and that he was himself much superior to those good things. So too in the home of this world, when you see providence, order, and law in the heavens and on earth, believe that there is a Lord and Author of the universe, more beautiful than the stars themselves and the various parts of the whole world." Over thirty examples are given in these passages of phenomena that point to a divine "Artisan", "Architect and Lord", "Artificer and Constructor", "Lord and Author", "Ordainer, Disposer, and Ruler", and designer of the universe. Of these examples more than half are taken from astronomy: the heavens, the orderly movements of the sun, moon, stars, and other "luminaries of heaven", and the alternation of day and night. Most of the other examples are non-living things on earth: the elements, fire, wind, mighty waters, fathomless deeps, the sea and ocean, and the cycle of the seasons. Only three references are made to living things: "man and beast and every living thing", the creatures of the sea, and the "minutest of living creatures"; and these references make no mention of the complexity of their structure. Thus, the biological design argument is missing from these passages. One finds primarily the cosmic design argument, with its focus on the beauty, order and lawfulness of the cosmos. (Note the many references to the laws, decrees, and ordinances, with which God governs the universe.) One also sees the providential argument, with its emphasis on the harmoniousness ordering of the whole cosmos toward the sustenance of life. Though even this is found in only two lines: "the teeming earth, obedient to His will, causes a wealth of nourishment to spring forth for man and beast and every living thing upon its surface, and "the ever-flowing streams created for our well-being and enjoyment offer their breasts unfailingly for the life of man." There is no mention at all in these passages of individual living things or their bodily structure as pointing to design. (This is not to say that the biological design argument is completely lacking in early Jewish and

Christian texts. Such an argument is perhaps implicit in Psalm 139: 14: "I will praise thee; for I am fearfully and wonderfully made: marvelous are thy works.") It seems that the emphasis on and even obsession with biological structure as evidence of a divine artisan or designer was a development of modern times, and especially the writings of the natural theologians of the eighteenth and nineteenth centuries, such as William Paley. Very revealing is a passage from the English historian Macaulay, written in 1840: "A philosopher of the present day . has before him the same evidences of design in the structure of the universe which the early Greeks had for the discoveries of modern astronomers and anatomists have really added nothing to the force of that argument which a reflective mind finds in every beast, bird, insect, fish leaf, flower and shell." Note that Macaulay begins by speaking of "the structure of the universe", and mentions astronomers along with anatomists, but when he concludes with examples they are all taken from biology, and in particular the bodies of living things or parts of them: "beast, bird, insect, fish, leaf, flower, and shell." Somehow, the biological design argument has come to overshadow the older versions. This shift toward the biological design argument and away from more traditional arguments was fateful: only two decades after Macaulay penned these words, Darwin published *On the Origin of Species*. Darwin suggested a mechanism by which the kind of complex organic structure seen in animals and plants could arise in a natural way. But Darwinian mechanisms cannot explain the orderliness and lawfulness of the universe, which is the basis of the cosmic design argument; nor can any other naturalistic mechanism. At first glance, it might seem otherwise. After all, there are many instances of order in the cosmos for which physics has explanations. The orderly motions of the solar system are a prime example. Johannes Kepler found several beautiful mathematical patterns in these motions: The orbit of every planet is an ellipse, with the Sun at one of its foci. These elliptical orbits all lie nearly in the same plane, and the planets all move around the Sun in the same direction. Each planet moves in such a way that the line between it and the Sun "sweeps out equalareas in equal times". And there is a precise algebraic relationship between the time it takes a planet to go around the Sun and its distance from the Sun. Every one of these beautiful Keplerian patterns was explained by Newtonian physics. It is believed that the solar system started as a swirling cloud of gas and dust, which condensed under the influence of gravitational forces. It can be shown fairly easily, using Newton's laws of gravity and mechanics, that such a condensing cloud tends eventually to form a Keplerian planetary system. Here it would seem that in the astronomical realm one is seeing highly intricate structure arising "spontaneously" from chaos and disorder, and form from formlessness. This is at least vaguely analogous to the way increasing organic complexity arises in the biological realm as a result of Darwinian mechanisms. Just as random genetic mutations fuel evolution, so random motions of particles in the primordial cloud of gas and dust gradually turn into highly organized patterns. The same kind of thing is seen in the growth of crystals: as a liquid crystallizes, the random molecular

motions of the liquid lead to highly symmetric structure. However, this appearance of order arising "spontaneously" from chaos, and form from formlessness, is an illusion. That is not how physics explanations proceed. In physics, the explanation of order at one level is always based on a more comprehensive and impressive orderliness that is presumed to exist at a deeper level. Kepler's laws of planetary motion, for example, were indeed explained by Newton; but that explanation appealed to deeper and more mathematically sophisticated and beautiful laws, namely Newton's laws of gravity and mechanics. Those Newtonian laws, in turn, were explained, to a large extent, by Einstein's even more mathematically sophisticated and beautiful theory of General Relativity. The same is true of the lovely patterns we find in crystals. These can be explained, indeed; but they are explained as coming from even deeper symmetries and principles of order at the level of atomic physics, and deeper order still at the level of quantum field theory. In physics, astronomy, and chemistry, order is not "explained away," order is not found to arise from mere chaos. Quite the reverse is true: it is always found that order at one level is explained by greater order at a deeper level. And so, as fundamental physics has progressed, we have more and more come to see that the laws of nature form a single, harmonious, and magnificent edifice of great subtlety, intricacy, and mathematical beauty. Indeed physicists think they have perhaps glimpsed the outlines of the truly fundamental laws of physics in something called superstring theory. A science reporter asked Edward Witten, a leading theoretical physicist, why he believed that superstring theory was likely to be right even though there is still no experimental evidence for it. Witten in exasperation exclaimed, I don't think I have succeeded in conveying to you its wonder, incredible consistency, remarkable elegance, and beauty." Witten is not religious, as far as I know. Yet even non-religious physicists marvel at the grandeur and beauty of the laws of physics. The mathematical ideas involved in superstring theory are so deep that even after twenty five years of intense study by hundreds of the world's most brilliant mathematicians and physicists, they feel that have barely scratched its surface. How great the mind must be that conceived such laws! The cosmic design argument is alive and well. Here is what one of the greatest mathematicians and mathematical physicists of the twentieth century, Hermann Weyl said in a lecture at Yale university in 1931, and what he said then applies with much greater force today: "Many people think that modern science is far removed from God. I find, on the contrary, that it is much more difficult today for the knowing person to approach God from history, from the spiritual side of the world, and from morals; for there we encounter the suffering and evil in the world, which it is difficult to bring into harmony with an all-merciful and all-mighty God. In this domain, we have evidently not yet succeeded in raising the veil with which our human nature covers the essence of things. But in our knowledge of physical nature we have penetrated so far that we can obtain a vision of the flawless harmony which is in conformity with sublime reason." There is another point to be made in reply to Dawkins. Again supposing that Darwinian mechanisms

are sufficient to explain the facts about evolution, the very fact that the universe is able to give rise to living things at all depends on the laws of nature and the structure of the universe having many special characteristics. Indeed, at least prima facie it seems that the laws of physics are in many ways designed to make life possible. I will give just a few examples. First, if the law of gravity depended on distance, not as the inverse square, as discovered by Newton, but as some other integer power, planets would not be able to orbit stars, and there would be no warm habitat for life. Second, the fact that life is possible in our universe is a result of the great richness of chemistry, which in turn is a result of the large number of chemical elements. There are almost one hundred naturally occurring chemical elements, and no fewer than twenty-five of them are required to make a human body. Almost all of the chemical elements were forged in the interiors of stars or in stellar explosions called supernovas. The forging of the elements depended on certain quite delicate balances between the various forces of nature. For example, if the so-called strong nuclear force were a few percent weaker, a nucleus called the deuteron would not be able to exist, and as a result practically none of the elements except hydrogen would have formed in any appreciable quantities. And if the electromagnetic force were stronger than it is, then the nuclei of many elements would be unstable. A third example is that the proton is slightly lighter than the neutron. Had the neutron been slightly lighter than the proton, the nucleus of hydrogen would have been unstable, making impossible the existence of organic molecules, almost all of which contain hydrogen. There are many features of the laws of physics that seem to be arranged to make life possible. These are called "anthropic coincidences". One can see in the anthropic coincidences support for what we called the providential design argument, i.e. the argument for the existence of God based on the harmonious ordering of the cosmos towards good ends, such as the sustenance of life. Thus, modern science has actually strengthened the two forms of the design argument that are most commonly found in early Christian writings. Only the relatively recent biological design argument can be said to have been affected by Darwinian biology. It should be noted that no mechanism analogous to natural selection can explain the intricate structure in the fundamental laws of physics that is appealed to by the cosmic design argument. Any explanation of the structure of these laws based on the idea that they evolved would be circular: for, if the laws did evolve by a natural process, then that process to be natural would have to be governed by laws of some kind, and those laws would themselves have a non-trivial structure needing to be explained. The second serious theological objection to Darwinism is that the role it assigns to random mutations is in conflict with the doctrine of divine providence. The word random spooks many people. It is sometimes used to mean pointless, arbitrary, or meaningless. A few years ago, Cardinal Schönborn of Vienna wrote an article in the "New York Times" in which he criticized "neo-Darwinism" for asserting that life arose from natural selection acting on random, and therefore "unplanned" and "uncaused" genetic variations. He said that to posit unplanned and uncau-

sed events as the origin of life, and human life in particular, is to deny a divine plan and divine providence. The cardinal was certainly right, at least to this extent: many influential expositors of evolutionary theory, such Dawkins, do put such an atheistic "spin" on Darwinism. They do go about claiming that it is an intrinsic part of Darwinian theory that evolution is an unplanned and unguided process. Indeed, I have seen this stated even in some biology textbooks that were used in American high schools. The fact, however, is that the word random as used in science does not necessarily carry any implication of "unplanned" and "unguided", in spite of the fears of some people and the claims of others. If it did, then those of us who believe in divine providence and that every event in the universe is encompassed in God's plan in some way would have to reject not only Darwinian evolution but much of modern physics, astronomy, and chemistry as well. For the word random is a basic term used in every branch of science. Fortunately, though, the word random as used in science is not just another word for unguided and unplanned. In fact, the words unguided and unplanned and their synonyms are hardly ever used in science. According to the standard Science Citation Index of the Institute for Scientific Information, there are only about 500 papers in all of the scientific literature in English that have the word unplanned in the title, most of them having to do with unplanned medical operations or unplanned pregnancies. There are only about 50 papers with the word unguided in the title; and most of them have to do with guided missiles. By contrast, there are over 50,000 scientific papers with the term random in the title. Random, unlike unguided and unplanned is a scientific term. It is used in discussing the motions of molecules in a gas, fluctuations in a quantum field, noise in an electronic device, statistical errors in a data set, and any other things in addition to genetic mutations. So what does the term random mean as used in science, if not unplanned and unguided? Basically, it means "having no systematic correlation" and therefore not predictable. Consider the example of a coin that is tossed many times. Because all the coin tosses are "independent" of each other, their outcomes are not systematically correlated with each other. That is why knowing how previous tosses came out gives no information about the next one. So mathematicians say that the outcomes form a "random sequence". Consider a second example. When my children were young, they liked to observe the license plates of the cars and trucks that passed us on the highway to see what parts of the country they were from. They would see one from Delaware, followed by one from New York, and then one from Maryland, another from New York, then Florida, and so on. There were, of course, probabilities involved in these sequences, as in any random process – as there are in coin tosses. One can say that driving in our part of the United States one is more likely to see a car from New York than one from California. Nevertheless, one cannot predict after seeing a sequence of license plates what state the next car will be from. So there is there is an element of randomness. Nevertheless, each car is where it is, at that particular time and that particular place, for some reason. Each driver has a plan and an itinerary; each is guided by some

map and schedule. Each driver's trip fits into the pattern of his life in some intelligible way. It is just that the events of one driver's life are usually not systematically correlated with the events of other drivers' lives. Consider a third another example. In a sonnet, there is a strict correlation among the sounds of the final syllables of the different lines. But in a passage of prose, the sequence of final syllables will exhibit randomness. That does not mean that the words in a passage of prose are not chosen or planned. They may have been chosen with great care. It is just that the author did not choose them with the intention of rhyming them. That is, he did not choose to impose on the final syllables of his lines of prose any systematic correlation. In the same way, God, though He planned the universe with infinite care may not have chosen to impose upon the motions of the different molecules in a gas certain types of correlations. The kind of randomness that we talk about in science could be called statistical randomness, to distinguish it from other, more philosophically loaded uses of the word random. The idea of statistical randomness is obviously connected closely with the ideas of chance and probability. However, the connection is rather paradoxical and subtle. The randomness of a sequence of coin tosses prevents one from predicting the outcome of any particular toss; but at the same time it makes it possible to use probability theory to make useful predictions about what is likely to happen in a long sequence of tosses. One can show, for example, that in a sequence of a million coin tosses the ratio of heads to tails is unlikely to deviate from 50–50 by much more than a tenth of a percent. The paradox here is that randomness is a lack of systematic relationship, whereas probabilities can be thought of as a kind of systematic relationship. That is why the concept of randomness is so useful in explaining things in science. Just as knowing that a sequence of coin tosses is random allows the mathematician to make statements about the averages of large numbers of tosses, knowing that the molecules in a gas are moving randomly allows the physicist to calculate numerous properties of a gas made up of many molecules. When large numbers are involved, "chance" can lead to a kind of necessity. (The resolution of the paradox is that probabilities are ideal frequencies of outcomes, around which the actual outcomes vary in an unsystematic and therefore unpredictable way. The unsystematic nature of the variations around the ideal frequency, means that in a long sequence the ideal frequency will be closely approximated.) It is a fact that statistical randomness, chance, and probability play a role in nature. Nature itself takes probabilities into account. Certain animals spawn vast numbers of offspring precisely in order to compensate for the fact that the chance of any one of them surviving is low – this is part of the unconscious "survival strategy" of the species. In the same way, so many sperm are sent off in search of the egg precisely because the chance of any one sperm accomplishing its task is exceedingly small. Nature "plays the odds", and it couldn't do so unless there were odds to be played. It is not clear why God should not make use of statistically random processes and probabilities to achieve his ends in evolution also. If God can so arrange things that many larvae are produced so that a few of them shall "win thro-

ugh" to adulthood, why should he not arrange that many genetic mutations should occur so that some of them shall "win through" to produce new and interesting creatures? One may use an analogy. If a man wants to see a straight flush dealt in poker he could make sure of it in different ways. He could take one deck and "stack it", i.e. introduce the right correlations among the cards in the deck, so that the straight flush is dealt. Or he could take a million shuffled decks – i.e. randomized decks – and deal a hand from each one of them. Then the chances would be overwhelming that a straight flush will be dealt in at least one of them. The question arises: In making plants and animals, did God stack the molecular and genetic decks, or did he shuffle them and use large numbers? Being God, he could have done it either way. Now one might object that God does not "play the odds", since he knows everything, past, present, and future. He knows from all eternity "what is in the cards". While that is true, the cards he deals, so to speak, may nevertheless appear to any statistical analysis to be random. God knows where every molecule in the gas is going to go. But the physicist is quite entitled to call those motions random in the statistical sense. *The Bible* itself speaks of chance. Ecclesiastes says, "I returned and saw under the sun, that the race is not to the swift, nor the battle to the strong, nor bread to the wise, nor riches to men of understanding, nor favor to men of skill, but time and chance happens to them all." Ecclesiastes is not saying that these matters are outside the control of God's providence, but simply that there is not a perfect correlation between being strong and winning or between having bread and being wise. One final note on this point is that the document *Communion and Stewardship* published by the International Theological Commission with Cardinal Ratzinger's approval in 2004, makes very clear that there is nothing incompatible between speaking of random genetic mutations in the context of Darwinian evolutionary theory and Catholic teaching on divine providence. This is a convenient point at which to make some comments about the Intelligent Design (ID) movement. The leading thinkers in that movement are Michael Behe and William Dembski. Behe is a Catholic and Dembski a Protestant. The ID movement does not object to the use of chance and probability to explain events in nature; far from it. In Dembski's famous "explanatory filter", only after one has shown that explanations of an event based on chance and the laws of nature are insufficient can one arrive at the conclusion that intelligent design is involved. Nor does the ID movement say that natural selection is inherently incompatible with theism or Christian belief. Even Phillip Johnson, the godfather of the movement, admits that God could certainly have used natural selection to produce animals and plants, if he had wished to do things that way. The ID theorists simply don't think that natural selection succeeds in explaining the degree and kind of complexity we actually see in the biological world. Let us return to the poker analogy. Suppose a group of people are playing poker and Mr. Smith deals himself a straight flush. A suspicion might arise that Smith has cheated. However, the mere fact that the cards turned up that way would not prove (or even show it to be probable) that Smith cheated. After all, mil-

lions of people play poker around the world and straight flushes are bound to turn up by the laws of probability. However, suppose that every time Smith deals the cards he gets very good cards. If this happened consistently over a long period, it would become harder and harder to believe that Smith's good fortune was just the result of randomly shuffled decks. On purely statistical grounds it would become increasingly difficult to deny that someone was somehow consciously and deliberately manipulating the deck to produce a certain outcome.

That is what the dispute between the Intelligent Design movement and neo-Darwinism boils down to. The neo-Darwinists say that the history of life is consistent with the genetic mutations that gave rise to it having been statistically random. The ID people, on the other hand, say that living things are complex in such a way that one can show by purely statistical arguments that someone has been consciously and deliberately "rigging the game" so that life would appear. Who is right? For myself, I cannot see how anyone can know at this point. It is clearly a matter to be decided my mathematical calculation; and nobody is in a position to carry out the required calculations. It does not take great mathematical sophistication to calculate the probabilities in poker. In evolutionary biology, however, it cannot be done unless the sequence of steps at the genetic level that were required to produce the complex structures in living things is known. And, even then, one would have to know, in quantitative terms, the selective pressures to which organisms were subjected throughout evolutionary history, and many other facts that are no longer accessible. Unfortunately, the biological community is very dogmatic and intolerant of any questioning on this subject. Many scientists act as though only fools could question the sufficiency of natural selection. But there have been scientists who were far from being fools who did question this. Werner Heisenberg described the views of Wolfgang Pauli, one of the giants of twentieth century physics, in these words: "Pauli is skeptical of the Darwinian opinion, extremely widespread in modern biology, whereby the evolution of species on earth is supposed to have come about solely according to the laws of physics and chemistry, through chance mutations and their subsequent effects. He feels that this scheme is too narrow." On the other hand, some advocates of the Intelligent Design movement claim far too much. They make arguments that are supposed to show that natural selection cannot explain certain biological structures. They speak of what they call "irreducible complexity". Certain biological structures are irreducible, they say, in the sense that all the parts of the complicated structure must be in place for it to function at all. If any such structure exists in biology, then it is clear that it cannot have evolved one small step at a time, as Darwinism requires, but must have arisen in one incredibly improbable step. The difficult thing to show, however, is that any particular structure is actually irreducibly complex.

A Roman arch might be considered the perfect example of irreducible complexity, since every stone must be in place for the arch to stand up. And, indeed, it is difficult to imagine how such an arch could be built one stone at a time. However,

it can be done by first building a wall one stone at a time, and then removing stones one at a time to leave an arch. Thus, as in magic tricks, a thing may seem impossible, but actually turn out to be easy once the trick is explained. Until we know all of Nature's tricks, we cannot be sure that there are irreducibly complex structures in biology.

The third serious theological objection that can be raised against evolution is that it does not seem to tally with the theological account of man's creation and fall. According to modern biology, the process by which a new species originates takes place gradually over many generations and involves an interbreeding population that is numerous, whereas the Church teaches that the creation of man happened at a sharply defined moment and that there were at first just two true human beings. There is no contradiction, however, if it is understood that the appearance of the first true human beings was not simply the emergence of a new biological species, as species are understood in modern biology.

The definition of "species" in modern biology is somewhat fuzzy, and there are not sharp dividing lines between species. For example, one commonly used theoretical criterion for two types of animals being of the same species is whether they would be able to interbreed to produce fertile offspring. But 'being able to fertilely interbreed' is not what mathematicians call an "equivalence relation", and therefore it does not allow the partitioning of animals into species that are sharply defined "equivalence classes". The problem is that there examples where animals of types A and B can fertilely interbreed, and those of types B and C can fertilely interbreed, but those of types A and C cannot. If A and C are different species, then to which of these two species does B belong? More generally, there can be a sequence of types of animals A1, A2, A3, etc, where types that are far apart in the sequence, such as A1 and A100 are unable to fertilely interbreed, but each type in the sequence is able to interbreed with the neighboring types. (There are well known examples of this, such as the Larus gulls. For the Larus gulls the sequence forms a closed cycle or ring. Such examples are therefore called "ring species".) Similarly, considering temporal sequences of animals, speciation is not understood to happen in such a way that an animal is of a different species than it parents, although two animals that are many generations apart may clearly be of different species.

Speaking purely biologically and of physical characteristics, therefore, it may be a difficult question whether a sharp dividing line could be drawn between human beings and their non-human ancestors. But the Church does not understand the difference between human beings and non-human animals to be purely biological and physical. The Church teaches that human beings have spiritual souls whose operations cannot be understood in terms of physics, chemistry, and biology alone. Presumably, a creature either has a spiritual soul or it hasn't. It therefore does allow the partitioning of all terrestrial creatures into equivalence classes, in fact two of them: the class of creatures not having spiritual souls and the class of creatures having them. This is the "ontological discontinuity" of which Pope John Paul II spoke.

The apparent conflict between the biological and theological account of human origins is not difficult to resolve, in light of these observations. A possibility that has suggested itself to many thinkers independently is that human beings originated in the following way: a gradual process of evolution, occurring over many generations and involving large populations, gave rise to an ancestral population of proto-human creatures nearly indistinguishable at the physical level from true human beings. Upon two of these creatures (if monogenism is correct), and upon all their descendents, God may have conferred spiritual souls. Originally, only those first two would have been human in the theological sense, but they may have lived among a much larger population that was of the same "species" as biologists currently think about species.

Interbreeding may have been possible between the fully human beings and their proto-human neighbors, who were physically practically indistinguishable from them. These proto-humans presumably would have been mentally far evolved beyond the level of any non-human primate that exists now. They would have been capable of extremely complex behavior and communication, which a casual observer may have had a hard time distinguishing from truly rational activity. That such interbreeding actually did occur is suggested by two considerations. First, there is the old puzzle of who the children of Adam and Eve married. Under the assumption of monogenism, if there was no interbreeding with creatures not fully human, then interbreeding with siblings or other close relatives must have happened. Second, there is the result of genetic research, which seems to indicate that there was never such a narrow "genetic bottleneck" in the human past that there existed a generation with only two individuals from whom all human genetic material today derives. There does seem to have been a very narrow bottleneck; but theoretical estimates are that the „ancestral population" of all humans at the time of that bottleneck numbered in the thousands. In other words, the evidence suggests that there was at the time of the first true humans an interbreeding population of several thousand. The only question is whether in the first few generations of true humans only a few members of this interbreeding population had spiritual souls (as in monogenism) or many or even all of them did (as in polygenism). One might wonder at the idea that two creatures could be biologically nearly indistinguishable, with one having a spiritual soul and the other not. Perhaps there were physical differences between the two types that were so slight as not to make fertile interbreeding impossible, but large enough to make an important qualitative difference at the mental level. Science knows of several phenomena where a virtually infinitesimal quantitative difference can result in dramatic qualitative difference. For example, there are "phase transitions" in physics, such as the transition between water and ice. Infinitesimally above the freezing temperature, H_2O is liquid, whereas infinitesimally below it, H_20 is crystalline. Perhaps the brain structure of true humans was only slightly different from that of proto-humans, but that difference was enough to cross a threshold into a new "phase" in which the physical substrate was

ready to receive a spiritual nature. Another issue that some have raised is whether Darwinian evolution is consistent with the Church's teachings about the fall of man and its consequences. How, some ask, can death be a consequence of the fall (cf. Romans 5: 12: "sin entered the world through one man, and death through sin"), if life-and-death struggle was a force that shaped the first man? To this, one need simply reply that the immortality offered to the first man and woman has always been understood by the Church to be a "preternatural gift", i.e. something that went beyond what was naturally possible for him. And when he forfeited this gift by sin, man simply reverted to the natural state of subjection to death that was the lot of his animal forebears. Similarly, some ask how lust and violence can be a consequence of the fall, if they were bred into us by evolution. The answer is that the "concupiscence" which resulted from the fall is not to be identified simply with the sexual instinct and such passions as anger, which are not evil in themselves, and which we undoubtedly have in common with animals (who, of course, are also not evil). Rather, concupiscence is the disorder whereby the control of reason over these passions was weakened. So it is quite consistent to say that the passions themselves had a biological origin and long pre-human history, whereas their subjection to reason (like reason itself) was a gift from above, a gift partly lost through sin. The fourth objection to Darwinian evolution, usually raised by Thomist philosophers, is that it eliminates teleology from biology. This is highly questionable, however. There is an obvious sense in which the eyes, optic nerves, and the visual cortex of the brain are "for seeing"; the reproductive system is for reproduction; the immune system is for immunity; the lungs are for oxygenating the blood; and the heart is for pumping blood; and this is not denied by modern biologists. It was, after all, modern biologists who named these systems the "immune system', the "visual cortex", and so on. In other words, these structures and systems have an "intrinsic finality", i.e. inherent directedness towards "ends" or goals. Of course, these goals are not conscious intentions on the part of the physical structures themselves. And Darwinism says that they arose through a natural evolutionary process that is itself unconscious and has no foresight. But this is not really very different from the way Aristotle would have understood the intrinsic finality in the biological world. Aristotle would not have said that the heart had a conscious intention to pump blood, or that an intelligent designer had fashioned the heart with conscious foresight in the same way a human artisan makes a tool. Even though the Darwinian mechanism lacks foresight, there is a form of teleology built into it. This is generally overlooked because people are looking for teleology in the wrong place. People see the "randomness" of the genetic mutations that fuel evolution as antithetical to teleology. But it is in the process of natural selection, not in the random mutations, that teleology plays a role. One can see this by asking a simple question: why are some mutations favored by natural selection and others weeded out? The reason a particular mutation may be favored is that it makes the eyes see better in some way, which assists the animal in its goal of finding food or mates or avoiding predators, which

in turn assists the animal in its goal of living and reproducing. Why, on the other hand, do species that take up residence in caves, gradually lose the ability to see? The reason is that a capacity for seeing light serves no purpose for animals living in total darkness, and so mutations that harm the faculty of sight are not selected against. In many cases, one cannot understand why natural selection selects as it does without bringing intrinsic finality into the explanation. Moreover, it has been suggested by respected evolutionary biologists, such as Simon Conway Morris, that evolution is channeled in certain directions. As is richly documented in his book *Life's Solution*, the evolutionary process has repeatedly stumbled upon the same "solutions" to the problems of survival – a phenomenon called "convergent evolution". Eyes, for example, have evolved independently several times in the course of life's history on earth. Another example is that marsupials in Australia and placental mammals elsewhere often show remarkable similarity, although evolving completely independently. It may be that "built into" the physics and chemistry of life are certain developmental pathways, and that the Darwinian mechanism is merely finding them, just as the meandering river always finds the sea. Finally, the "anthropic coincidences" show that the fundamental laws of physics and the structure of the universe cannot have an arbitrary form if life is to be a possibility at all. The universe itself seems to be ordered toward the possibility of life. In all these ways, teleology can still be seen in the biological realm after Darwin. And since God knew and willed from all eternity the whole pattern of created reality and its development, one can still affirm that the finality we see in nature comes from the intention of an intelligent agent. In an essay such as this, one cannot hope to address all significant theological questions raised by evolution. But this much, I hope, has been made apparent: Neither evolution nor the Darwinian theory of natural selection poses any danger to Catholic doctrine or the fundamental insights of traditional Catholic theology. The Catholic Church has never had a quarrel with the science of Darwinian evolution. Catholics are therefore free to follow the evidence wherever it may lead. That is what the Church has wisely taught and continues to teach.