

trivial purposes. This insensitivity is based on, or at least justified by, a dualism between human beings and everything else, a dualism that is not supported by either scientific evidence or the Bible. Its strongest support is in philosophies that are inadequate for both communities. Critical reconsideration of our views of the world should open us to the actual evidence of our immersion in the natural world and our kinship with other creatures, and should reshape our practice to conform to what we know.

These are but two minor illustrations of the importance of a task on which far too little effort has been expended: the development of a world view that is at once Christian and scientific. Such a world view will necessarily be very different both from the one now dominant in science and from those that are expressed in most current theologies. Here and there individual scientists, philosophers, and theologians have made important contributions. Those who are personally both scientists and theologians have been particularly helpful, as the Pope has noted. But the task is enormous. The Church's stake, indeed, the world's stake, in advancing this enterprise is far greater than is generally realized. The work requires undergirding and support. It is hard to see any other ongoing source of such undergirding and support than the Roman Catholic Church.

For this reason, I rejoice that the Church held a Study Week to celebrate the tercentenary of Newton's *Philosophiae Naturalis Principia Mathematica*, that there is a Pontifical Academy of Sciences, that one of the Church's loyal sons has established a Center for Theology and the Natural Sciences, and that the Pope has spoken with wisdom and force about the need for unity. May the effort go beyond the exchange of ideas and mutual appreciation to a mutual transformation of two communities! May the Christian Church fulfill its calling to bring realistic meaning to a confused and fragmented world!

SCIENCE AND THEOLOGY

Avery Dulles, S.J.

Pope John Paul II's message occasioned by the Castel Gandolfo conference on Physics, Philosophy, and Theology deserves careful study.¹ One can hardly disagree with Ernan McMullin that "it is without a doubt the most important and most specific papal statement on the relations between religion and science in recent times."² The tone of the message is open, confident, and encouraging. Without preempting the prerogatives of working theologians, philosophers, and scientists to make their own applications, the Holy Father proposes a program that appears to be feasible, valuable, and even necessary for the good of all concerned.

The general position taken by John Paul II may be indicated by reference to the standard typology of the relationships between religion and the sciences: conflict, separation, fusion, dialogue, and the integration.³

Very clearly the Pope rejects the position of conflict, in which it would be necessary to choose either science or religion to the exclusion of the other. This rejection can take either of two forms. One form is a "scientism" such as that of Thomas Henry Huxley, who asserted in a lay sermon in 1866: "There is but one kind of knowledge, and but one method of acquiring it," namely science.⁴ By the universal application of scientific method, positivists believed, it would be possible to dispel the dark clouds of dogma and inaugurate a bright new era of free assent to universally acknowledged truth. This triumphalist variety of scientism is not yet dead. The periodical *Free Inquiry*, for example, promotes science and reason as opposed to faith and religion.⁵ The "scientific" program tends to reduce quality to quantity and to emphasize the technological aspects of life. But it also makes room for a certain mystical exaltation of science, to the point where it becomes a pseudo-religion, involving what the Pope in his message calls an "unconscious theology" (M14). Jacques Monod and Carl Sagan are sometimes cited, though not by the Pope, as examples of scientists who tend to extrapolate beyond the proper limits of their own discipline.

On the other hand, the Pope no less firmly rejects the alternative possibility – the religionism of those who oppose science in the name of faith. In this framework theology becomes, as the Pope warns, a pseudo-science (M14). This may be judged to have occurred in the case of the "creation science" taught by some American fundamentalists. The "creationist" position, as Gilkey and others have shown, is in fact anti-scientific.⁶ According to the sounder view, held by the Pope in his message, faith cannot do the work of science, nor can the Bible function as a textbook of astronomy or biology.

The second major position that the Pope rejects may be called separationism. Some thoughtful Christians solve the problem by relegating religion and science to separate spheres. This kind of separation has become almost axiomatic in Protestant theology since Immanuel Kant, who confined the competence of theoretical reason to the order of phenomena, and regarded religious beliefs as deliverances of the practical intellect. Not only liberal theologians, such as Albrecht Ritschl and Adolf Harnack, but also Neo-Orthodox thinkers such as Karl Barth, Rudolf Bultmann, and Paul Tillich, accepted this division into two spheres. In our own day theologians influenced by Ludwig Wittgenstein frequently say, as does Richard Braithwaite, that religious language is not intended to communicate cognitive truth but to recommend a way of life and to evoke a set of attitudes. In a similar vein, George Lindbeck maintains that doctrinal statements are "communally authoritative rules of discourse, attitude, and action."⁷ In all these theories the dogmas of the Church, even though they may seem to describe objective realities, are reinterpreted as symbolic expressions describing the inner experience of the speaker or regulating the conduct of the worshipping community. Science, by contrast, is held to be informative and to make claims about objective reality. A peace between religion and science is achieved in these systems, but only at the price of depriving religion of its claim to say anything true about the world of ordinary experience.

John Paul II refuses to settle for a world divided into two cultures, humanistic and scientific, as described by C. P. Snow in his classic essay.⁸ Interaction, according to the Pope, is necessary for the proper functioning of both religion and science. Without it science can become destructive and religion sterile (M14).

For his program of unification the Pope gives several arguments. The human mind, in its quest for understanding, inevitably seeks to unify and synthesize. By unifying many data we are able to make sense of the whole (M9). Unity, likewise, is a demand of love. A fully inclusive human community is promoted to the extent that all the members are able to share, and profit from, one another's insights. Finally, the relational unity between science and religion is a demand of Christian faith, which sees all things as created in and for Christ (Col. 1:16-17) and as destined to be reconciled through him (Col. 1:20; Eph. 1:10). The Pope attributes the founding of universities by the Church to this faith-conviction (M10).

While repudiating separationism, which could be called a kind of methodological Nestorianism, John Paul II also rejects the opposite extreme of fusion, which might be compared with Monophysitism in Christology. Science, he warns, is not called to become theology nor is theology called to become science. Nor, finally, should both of them be swallowed up in some

tertium quid that would be a higher integration of both. The Pope wants each discipline to retain its own principles and its own identity while challenging and being challenged by the other (M7). He does not envision a disciplinary unity between theology and science.

Positively, then, the Pope accepts a fourth position – that of dialogue and interaction. In this relationship neither science nor religion should either seek to dominate the other or submit uncritically to the deliverances of the other. Yet each discipline should profit from, and contribute to, the attainments of the other. In a memorable paragraph the Pope explains:

To be more specific, both religion and science must preserve their autonomy and their distinctiveness. Religion is not founded on science nor is science an extension of religion While each can and should support the other as distinct dimensions of a common human culture, neither ought to assume that it forms a necessary premise for the other. The unprecedented opportunity we have today is for a common interactive relationship in which each discipline retains its integrity and yet is radically open to the discoveries and insights of the other. (M8-9)

To suggest what he has in mind John Paul II gives two historical examples. The early chapters of Genesis, he points out, borrow fruitfully from the cosmologies of the ancient Near East, which afforded concepts and images that, with the necessary purification, could well serve to communicate revealed truth. In the Middle Ages, theologians borrowed from ancient Greek philosophy a whole panoply of technical concepts such as form and matter, substance and accident. Although the Church made use of such concepts, and further refined them, in exploring the sacraments and the hypostatic union, "this did not mean that the Church adjudicated the truth or falsity of the Aristotelian insight; since that is not her concern. It did mean that this was one of the rich insights offered by Greek culture, that it needed to be understood and taken seriously and tested for its value in illuminating various areas of theology." (M11) This last statement has considerable theological importance, since Pope Pius XII has been understood as teaching that the Church did certify the truth of the principles of Aristotelian and scholastic metaphysics.⁹

Pope John Paul II then goes on to encourage contemporary theologians to appropriate insights from scientific methodology and from the philosophy of science. Without explicitly mentioning the particular system of Teilhard de Chardin, which some critics have judged to be deficient either

on scientific or on theological grounds, the Pope seems to encourage the adventurous spirit that motivated the great French paleontologist.

The type of program suggested by the Pope is actually being pursued on a number of fronts. Several examples from the realm of cosmology may here be mentioned. Some are convinced that the "Big Bang" theory of cosmic origins provides a scientific confirmation of the Christian doctrine of creation – a view that the Pope mentions with the warning that "uncritical and overhasty use" should not be made of the "Big Bang" theory for apologetic purposes (M11-12).¹⁰ Others ask whether the scientifically predicted "cold death" of the universe, through the operation of the laws of thermodynamics, has something to say to Christian eschatology. Then again, it may be asked whether the "anthropic principle," according to which the universe seems to have been "fine-tuned" from its origins to produce and support human life, gives new relevance to classical arguments from design. Some theologians, moreover, believe that the principle of indeterminacy in Werner Heisenberg's quantum physics can be helpful in overcoming the dilemmas of freedom and necessity and in showing how Providence can act without violating the established order of nature. A number of theologians, finally, hold that Niels Bohr's principles of complementarity, according to which light exhibits both wavelike and corpuscular characteristics, could suggest new ways of dealing with mystery and paradox in theology. Yves Congar, for instance, asks whether the Eastern and Western traditions in Trinitarian theology should be seen as irreducibly different but complementary articulations of a mystery too rich for any one conceptual system.¹¹

It may be premature to give definitive answers to any of these questions. In the spirit of the Pope's letter we may say that it is proper for theologians to state whether, and under what conditions, they could accept or welcome the new scientific hypotheses, and to explore the ways in which such hypotheses can provide new imagery and vocabulary for speaking about traditional Christian doctrines. Theologians should, however, be on guard against a facile concordism that would link the doctrines of faith too closely with fragile scientific hypotheses. Conversely, scientists, while they should refrain from proposing their theories as deductions from doctrines of Christian faith, may allow their religious faith to suggest lines of scientific investigation that would not otherwise have occurred to them. Scientists who are also believers will be reluctant to accept scientific hypotheses, such as Jacques Monod's doctrine of "chance and necessity," as long as these hypotheses seem incompatible with Christian faith.¹² In this connection it may be pertinent to recall that Pope Pius XII in 1950 asserted that the theory of polygenism, in certain forms, was unacceptable "since it is no way apparent

how such an opinion can be reconciled" with the biblical and ecclesiastical teachings about original sin.¹³

One of the areas of dialogue suggested by the Pope concerns methodology (M11). Since early modern times it has been customary to accept a sharp contrast between the methods of science and theology. Blaise Pascal put the matter very strongly:

Authority alone can enlighten us in these [historical] matters. But such authority has its principal force in theology, because there it is inseparable from truth, and truth is unobtainable in any other way. Thus, to give complete certitude concerning matters most incomprehensible to reason, it is sufficient to show that they are found in the sacred books, and to demonstrate the uncertainty of things that seem quite evident, it is enough to point out that they are not contained in Scripture. For the principles of theology are above both nature and reason. Since the mind of man is too feeble to attain them by its own efforts, it cannot achieve such lofty understanding unless it is borne by an almighty and supernatural force.

But in matters that lie within the scope of the senses and of reason, the situation is far different. Here authority is useless; reason alone is in a position to know them. The two types of knowledge have their separate prerogatives. In the former area authority has all the advantage; here reason reigns in its turn.¹⁴

Developments in twentieth-century science and theology have shown this contrast to be exaggerated. Science is not committed to reason alone nor faith to authority alone. Each discipline works with a subtle combination of faith and experience, intuition and reason, imagination and deduction, personal insight and communal wisdom.

The role of faith in science has been strongly emphasized by Max Planck, among others. In an interview he put the matter very dramatically: "Anybody who has been seriously engaged in scientific work of any kind realizes that over the gates of the temple of science are written the words: *Ye must have faith*. It is a quality which the scientist cannot dispense with."¹⁵ Einstein, Eddington, Heisenberg, and Oppenheimer could easily be quoted to the same effect.¹⁶ The scientist has to act on the premises that an external world exists, that it is orderly, and that the mind has the capacity to grasp the order that is there. Further acts of faith are demanded for anyone to become committed to the scientific enterprise, to learn the current state of

the discipline, and to advance toward new discoveries. At each stage one must put one's own trust in some idea or principle that could conceivably be false – in other words, one must make an act of natural or scientific faith. Thus faith, in a broad and generic sense, may be seen as a bond between science and theology.

Conversely, religious faith depends to some extent upon reason. Revelation could not be made except to a rational being, for a brute animal could not grasp the meaning or credibility of God's word. Theology, as a methodical inquiry into the significance and coherence of the revealed message, is eminently a work of reason.

Another link between science and religion is the authority of tradition in each discipline. Admittedly, many scientists since the Enlightenment have been in some ways hostile to authority and tradition. As Michael Polanyi reminds us, the founders of the Royal Society took as their device *Nullius in Verba*.¹⁷ But historians of science have clearly shown that tradition plays a role in science no less important than its role in theology. In his little book entitled *Tradition in Science*, Werner Heisenberg points out that the scientist relies heavily on tradition to supply the state of the question, the problems to be solved, and the concepts, paradigms and methods that may be helpful for the solution.¹⁸ In science, as in theology, development occurs gradually. Progress would not be possible if past achievements were not remembered and employed.

Just as continuity has its place in science, so, conversely, change is a factor in religious knowledge. The theologian cannot be content simply to repeat the words of venerated predecessors. New problems must be addressed with new information and new methods of inquiry. In theology, as in the natural sciences, there can be sudden breakthroughs or "scientific revolutions" in which whole areas are perceived from a radically new perspective.¹⁹

Theologians, quite evidently, operate within a community of faith. They receive their faith from the Church, carry on their reflections within the Church, and offer the results of their labors to the Church for appraisal. Scientists, similarly, do not work in isolated independence. Polanyi makes the point that neophytes in the sciences must join the scientific community and submit to a process of formation in which they learn by example and supervised performance. He writes:

This assimilation of great systems of articulate lore by novices of various grades is made possible only by a *previous act of affiliation*, by which the novice accepts apprenticeship to a community which cultivates this lore, appreciates its values and strives to act by its standards. This affiliation begins with

the fact that a child submits to education within a community, and is confirmed throughout life to the extent to which the adult continues to place exceptional confidence in the intellectual leaders of the same community.²⁰

The scientific community is less formally organized than the Church. But it has, in its way, a hierarchy of leadership. Ecclesiastical officials control the transmission of Christian doctrine not only by direct teaching but also indirectly, by a variety of means such as the supervision of seminary appointments, ordinations, and theological publications. So, likewise, the leaders of the scientific community exercise a kind of doctrinal authority not only by their own utterances but also through their influence on the curriculum of instruction, the bestowal of honors and degrees, university appointments, fellowships, and the acceptance of articles for scholarly journals. The capacity "to grant or withhold opportunity for research, publication and teaching, to endorse or discredit contributions put forward by individuals" is, according to Polanyi, "indispensable for the continued existence of science." Without such controls the journals would be flooded with rubbish and valuable work would be banished to obscurity.²¹

These similarities, to be sure, are not identities. As John Paul II insists, science and theology do have distinct methods. Unlike religious faith, assent to scientific truth does not depend on divine grace. Science does not rest on an unalterable deposit of faith; it does not look back to unique, unrepeatable past events as its essential basis. Nor does the scientific community have a magisterium that claims to be divinely assisted and capable of rendering, on occasion, infallible judgments. Nevertheless the analogies are sufficient so that it may be possible, as the Pope suggests, for each to learn from the other.

The dialogue between faith and science can produce palpable benefits to both. For one thing, each discipline, by maintaining contact with the other, is protected from certain errors and excesses to which, by itself, it would be prone. On the one hand, theology is liberated from a naive or fundamentalistic reading of Scripture, such as that which played a part in the condemnation of Galileo,²² and that which continues to thrive in "creation science." Through scientific education believers are able to overcome a superstitious or magical attitude that takes insufficient account of the established order of secondary causality. On the other hand, science is, as the Pope also remarks, purified "from idolatry and false absolutes" (M13). Pursued in isolation, the brilliant achievements of science can be destructive of higher values.

The mutual benefits flowing from dialogue are not only negative but also positive. This is apparent in the area of cosmology, on which the Pope

is chiefly commenting. The theological imagination has been immensely enlarged by the fresh vistas offered by contemporary physics and astronomy. Theologians no longer discuss the doctrines of creation and providence in the narrow framework provided by ancient myths and philosophic systems. Creation means far more when understood in terms of the "infinite spaces" that made Pascal shudder with religious awe.²³ Providence and salvation history take on a wholly new significance when seen against the background of the billions of years of cosmic existence postulated by contemporary science but undreamt of by Bishop Ussher and his contemporaries.

Scientific cosmology, if enriched by the study of theological method, can gain a deeper realization of its own reliance on faith, tradition, community, and authority. Science can better understand its own nature and history by viewing its achievements in the light of religious thought. As the Pope remarks, science develops more successfully to the extent that "its concepts and conclusions are integrated into the broader human culture and its concerns for meaning and value" (M13). Insights of religious thinkers of the stature of Newman, Tillich, Teilhard de Chardin, and Rahner can help scientists to insert their findings into this broader framework and thus direct their labors to the well being of the human family.

Although the situation is still too fluid for solid syntheses to be achieved, the long warfare between sciences and theology may be coming to an end, and a new era of mutual friendship and collaboration may be at hand. The message of John Paul II, and the conference that occasioned that message, give substance to such hope.

Notes

1. The message of John Paul II will be cited in this article according to the norms of the editorial notes on the page of Contents.
2. Ernan McMullin, "Religious Book Week: Critics' Choices," *Commonweal* 116:5 (March 10, 1989) 149.
3. Many such typologies have been proposed; for example, that by Arthur R. Peacocke in his introduction to *The Sciences and Theology in the Twentieth Century*, edited by A. R. Peacocke (Notre Dame, IN: University of Notre Dame Press, 1981) xiii to xv. See also Ian G. Barbour, "Ways of Relating Science and Theology," in *Physics, Philosophy and Theology: A Common Quest for Understanding*, eds. R.J. Russell, W.R. Stoeger and G.V. Coyne (Notre Dame, IN: University of Notre Dame Press, 1988) 21-45. I am, in general, following Barbour's typology.
4. Quotation in Stanley L. Jaki, *The Relevance of Physics* (Chicago: University of Chicago Press, 1966) 499.

5. *Free Inquiry*, edited by Paul Kurtz, is published in Buffalo, NY, by the Council for Democratic and Secular Humanism.
6. Langdón Gilkey, *Creationism on Trial: Evolution and God at Little Rock* (San Francisco: Harper & Row, 1985).
7. George A. Lindbeck, *The Nature of Doctrine: Religion and Theology in a Postliberal Age* (Philadelphia: Westminster Press, 1984) 18.
8. C. P. Snow, *The Two Cultures and a Second Look* (Cambridge, Eng.: Cambridge University Press, 1965).
9. Pius XII, Encyclical *Humani generis* (*AAS* 42 [1950] 571); ET (New York: Paulist Press, 1950), nos. 48-49, pp. 14-15.
10. Pius XII in an address to the Pontifical Academic of Sciences in 1951 had maintained that modern science "has confirmed the contingency of the universe and also the well-founded deduction as to the epoch when the cosmos came forth from the hands of the Creator. Hence, creation took place in time: (*Catholic Mind* 50 [1952] 190). John Paul II has consistently been more reserved about the capacity of the physical sciences to establish or undermine the metaphysical and theological doctrine of creation. See John Paul II, "The Path of Scientific Discovery," *Origins* 11:18 (Oct. 15, 1981) 277-80. Stephen W. Hawking, in his *A Brief History of Time* (New York: Bantam Books, 1988) 116 and 141, hypothetically proposes a scientific theory according to which creation would have no beginning and thus no moment of creation.
11. Yves Congar, *Diversity and Communion* (Mystic, CT: Twenty-Third Publications, 1985) 74-76. Robert J. Russell, in his "Quantum Physics in Philosophical and Theological Perspective," in *Physics, Philosophy and Theology: A Common Quest for Understanding*, op. cit., pp. 343-74, at pp. 359-61, gives a number of other attempted applications of the principle of complementarity in the realm of theology.
12. Cf. Jacques Monod, *Chance and Necessity* (New York, NY: A. Knopf, 1971); also Leo J. O'Donovan, "Science or Prophecy? A Discussion with Jacques Monod," *American Ecclesiastical Review* 167 (1973) 543-52.
13. Pius XII, "Humani generis," *AAS* 42 (1950) 575; ET, no. 65, p. 19.
14. Blaise Pascal, "Preface sur le traite du vide," in *Opuscules et lettres (choix)*, ed. by L. Lafuma (Paris: Aubier, 1955) 50. My translation.
15. Max Planck, *Where Is Science Going?* (New York: W. W. Norton, 1932) 214.
16. For some testimonies see Stanley L. Jaki, "The Role of Faith in Physics," *Zygon* 2 (1967) 187-202.
17. Michael Polanyi, *The Tacit Dimension* (Garden City, NY: Doubleday, 1967) 63.

18. Werner Heisenberg, *Tradition in Science* (New York: Seabury, 1983) chapter 1.
19. George A. Lindbeck, "Theological Revolution and the Present Crisis," *Theology Digest* 23 (Winter 1975) 308-19.
20. Michael Polanyi, *Personal Knowledge* (New York: Harper Torchbooks, 1964) 207. For discussion see Avery Dulles, "Faith, Church, and God: Insights from Michael Polanyi," *Theological Studies* 45 (1984) 537-50.
21. Michael Polanyi, *Science, Faith and Society* (Chicago: University of Chicago Press, 1946) quotation from p. 49.
22. A member of the commission appointed by Pope John Paul II has interpreted the condemnations of 1616 and 1633 as having merely disciplinary, rather than doctrinal, force. See Mario d'Addio, "Alcuni fasi dell'istruttoria del processo a Galileo," *L'Osservatore Romano* (March 2, 1984) 3. Further materials are presented in Paul Poupard (ed.), *Galileo Galilei: Toward a Resolution of 350 Years of Debate, 1633-1983* (Pittsburgh: Duquesne University Press, 1987).
23. Blaise Pascal, *Pensees*, no. 313 in *The Essential Pascal*, ed. Robert J. Gleason (New York: Mentor-Omega, 1966) 124. The reflections on the two infinities in no. 43, pp. 33-40, likewise exhibit the reactions of this religious genius to the dawning scientific consciousness of the age.

AUTONOMY IS NOT ENOUGH

Lindon Eaves

The Holy Father's message is a significant step forward in the relationship between science and Christian theology because it put to an end the Catholic Church's claim to hegemony with respect to the sciences. It should now be possible for theologians and scientists to engage more openly in that "critical-dialogic cooperation" for which theologians such as Hans Küng¹ have appealed. The message has been carefully and thoughtfully crafted and shows considerable sensitivity to the spirit of science.

A crucial passage in the message is that dealing with the autonomy of science and theology: "To be more specific, both religion and science must preserve their autonomy and distinctiveness . . . Each should possess its own principles, its pattern of procedures, its diversities of interpretation and its own conclusions . . ." (M8) Similar sentiments are to be found in the writings of widely different protestant theologians. Karl Barth writes: "If theology is to be ranked as a science, and lays claim to such ranking, this does not mean it must be disturbed or hampered in its task by what is described as science elsewhere . . ." (M2) Paul Tillich observes similarly: "Theology has no right and no obligation to prejudice a physical or historical, sociological or psychological, inquiry. And no result of such an inquiry can be directly productive or disastrous for theology" (M3) (emphasis added). In the latter passage Tillich draws out the implicit danger of the principle of autonomy articulated in His Holiness' message: namely that disciplines which are completely autonomous may also insulate themselves from criticism. The drawbridge of the theological castle may have been lowered, but its walls have still to be demolished. From a scientific viewpoint, the very point of contention between science and theology has been the willingness of theology to baptize science when it is convenient but to cry "autonomy" when the scientific questions have become too threatening. As the development of the sciences bears witness, the autonomy of the various disciplines within science is at best provisional and is only respected as long as the paradigms within disciplines are productive. However, significant shifts in paradigms and greater coherence in our models of reality have often arisen at those boundaries which are most painful: for example, on the boundary between the traditional biological sciences and the newer molecular sciences, or on the boundaries between the life-sciences and the behavioral sciences. The radical reconstruction of knowledge which accompanied the molecular breakthrough, forever associated with the names of Watson and Crick, is now, forty years later, being followed by a radical and sometimes painful reconstruction of university departments. Autonomy is at best provisional