

THE PONTIFICAL
ACADEMY
OF SCIENCES

Scripta Varia

100

Papal Addresses

*to the Pontifical Academy of Sciences 1917-2002
and to the Pontifical Academy of Social Sciences 1994-2002*

Benedict XV

Pius XI

Pius XII

John XXIII

Paul VI

and

John Paul II



VATICAN CITY
2003

*With Brief Biographies of these Popes,
Introductions and an Index*

PAPAL ADDRESSES

TO THE PONTIFICAL ACADEMY
OF SCIENCES 1917-2002
AND TO THE PONTIFICAL ACADEMY
OF SOCIAL SCIENCES 1994-2002



Address:

THE PONTIFICAL ACADEMY OF SCIENCES
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Joannes Paulus 1^o 5



The dome of St. Peter's seen from the courtyard of the Pontifical Academy of Sciences, Casina Pio IV



The Academy or the School of Athens by Raphael, in the Vatican Palace
'In those people you will have recognised your oldest predecessors in the investigation of both matter and spirit'
(Pius XII, Address to the Plenary Session of the Academy, 3 December 1939)

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PREFACE

On the four-hundredth anniversary of the foundation of the Accademia dei Lincei, it is a great honour for me to offer to the international scientific community this collection of addresses to the Pontifical Academy of Sciences given by Benedict XV, Pius XI, Pius XII, John XXIII, Paul VI and John Paul II. This volume brings together documents that were previously only to be found in different publications and some of them have been translated into English for the first time. In addition, it contains two detailed introductions, biographies of each Pope and an index which seek to guide the reader through a complex but vitally important terrain. This publication aims in particular to provide the reader with new perspectives on the marked development of closer ties between science and the Church over the last hundred years, a process characterised by the re-examination of the Galileo case during the pontificate of the present Pope, John Paul II.

The organisation of this volume enables the reader to observe how successive Popes have followed and understood the unfolding of modern scientific research, with its broad range of focus from the beginning of the universe and man's position within it to the origins of life and its evolution. These Pontiffs have demonstrated very keen interest in the subjects addressed by modern science and in an approach marked by openness and dialogue they have always sought to encourage men and women of science to continue on their paths of inquiry in the knowledge that nature is the first book of revelation of God.

These Popes have on many occasions expressed their appreciation of the work carried out by the Academy in analysing the dramatic advance of scientific knowledge, its consequences for modern man, and the opportunities it offers for the progress of human societies, especially the less privileged. The four-hundredth anniversary of the foundation of the Academy coincides with the twenty-fifth anniversary of the election of John Paul II. We thus take this opportunity to express our special gratitude to the present Pontiff for his constant interest in our activities. Indeed, over half of this volume is devoted to his more than forty addresses to the Pontifical Academy of Sciences.

Nicola Cabibbo
President of the Pontifical Academy of Sciences

INTRODUCTION

The year 2003 is the twenty-fifth anniversary of the papacy of John Paul II and the four-hundredth anniversary of the foundation of the Pontifical Academy of Sciences. As the Chancellor of this Academy, it is a pleasure and a great honour for me to introduce this volume, which brings together the addresses made by successive Popes of the contemporary scientific age to this institution over the last one hundred years (as well as other key papal documents on science). In these texts, the reader will encounter the views and teachings of Benedict XV, Pius XI, Servant of God Pius XII, Blessed John XXIII, Paul VI and John Paul II on the scientific condition of contemporary man and the value of science, the relationship between faith and reason, the central importance of the human person and the common good, the role of the Catholic Church in the world of science and technology, and the view expressed by successive Popes that the Academy is the 'Scientific Senate' of the Church and takes part in the Petrine ministry. The addresses are of interest to both general readers and specialists, and provide a clear picture of the Catholic Church's evolving relationship with a major field of human endeavour, through which, in constant dialogue with scientists, she provides answers and responses to new needs and challenges. These addresses have offered important reflections not only on the ethical and moral responsibility of the scientific activity of the Academicians, but also on the very meaning of scientific research and on its striving for truth and an increasingly profound knowledge of reality. Naturally, the forms of language employed have differed with the passing of these decades, and different emphases have been placed on the various questions and issues, but the attention paid to scientific work, and to the philosophical, cultural and anthropological dimensions which that work involves, has been unchanging. The reader will also be struck by how often the Supreme Pontiffs were ahead of their times and perceived dangers and proposed initiatives in an almost prophetic fashion. This volume also presents brief biographies of all these successors of St. Peter, so that the reader may have a clearer idea of the personalities who inspired the speeches and documents presented in this work.

The Academy as the Scientific Senate of the Holy See

Our first Pope, Benedict XV, in the wake of his famous letter of 1917 to the heads of the belligerent governments (with its call for a 'just and lasting peace' and a 'solution to the economic question'), believed, with great foresight, that the Academy could play an important role in contributing to the cause of progress and peace after the disruptions of the First World War. Pius XI, his successor, paid great attention to the Academy and to science during his pontificate. It was his conviction that the teaching of truth, a prerogative of scientists, formed a part of the Petrine mission; that modern science could be a providential path by which to draw near to God; and that the Academy would 'become an increasingly rich source of that beneficial charity which Truth is' (Address of 27 Dec. 1925). He gave the Academy its new buildings in 1923 and refounded the Pontifical Academy in 1936. At that time this institution was the Pontifical Academy of the New Lynxes (or 'dei Nuovi Lincei'), the descendant of the ancient Academy of the Lynxes (or 'dei Lincei'), which had been founded in 1603 by the learned Roman Prince, Federico Cesi, under the patronage of Pope Aldobrandini Clement VIII and the leadership of the renowned scientist, Galileo Galilei. With his *Motu Proprio*, *In Multis Solaciis* (28 Oct. 1936), Pius XI instituted the *Pontificia Academia Scientiarum* 'to promote ever more and ever better the progresses of the sciences', adding 'we do not ask anything more of them, for this noble goal and this sublime task constitute the service that we expect from men closely bound to the truth'. He defined its role by assigning to it the title of 'Scientific Senate' (*Senatus Scientificus*) of the Holy See, and ordered that its members were to be chosen 'without racial or religious discrimination'. Pius XI also bestowed upon it an autonomy of scientific research in its own field and personally attended most of its scientific meetings. His views on science and faith, and his related hopes for the future of the Academy, were expressed in detail in this *Motu Proprio*:

Amongst the many consolations with which divine Goodness has wished to make happy the years of our Pontificate, I am happy to place that of our having being able to see not a few of those who dedicate themselves to the studies of the sciences mature their attitude and their intellectual approach towards religion. Science, when it is real cognition, is never in contrast with the truth of the Christian faith. Indeed, as is well known to those who study the history of science, it must be recognised on the one hand that the Roman Pontiffs and the Catholic Church have always fostered the research of the learned in the experimental field as well, and on the other hand that such research has opened up the way to the defence of

the deposit of supernatural truths entrusted to the Church ... We promise again, and it is our strongly-held intention, that the 'Pontifical Academicians', through their work and our Institution, will work ever more and ever more effectively for the progress of the sciences. Of them we do not ask anything else, since in this praiseworthy intent and this noble work is that service in favour of the truth that we expect of them (*AAS* 28, 1936, p. 427).

It is still moving to read these addresses of Pius XI, pronounced with conviction, marked by great depth of insight, and imbued with his personal experience as an alpinist as well as quotations from Dante, Manzoni and other Milanese poets.

His Holiness Servant of God Pope Pius XII, who had helped his predecessor to refound the Academy and had represented Pius XI as his personal envoy at the time of its solemn inauguration, did not limit himself to the expression of lofty sentiments when attending its solemn academic gatherings, but also gave addresses of great scientific importance. In addition, he gave proof of his satisfaction with the institution by granting the title of 'Excellency' to the members of the Academy by an Apostolic Brief of 25 November 1940.

Forty years later, John Paul II once again emphasised the role and the goals of the Academy at the time of his first address to the Academicians, which was given on 10 November 1979 to commemorate the centenary of the birth of Albert Einstein:

The existence of this Pontifical Academy of Sciences, of which in its ancient ancestry Galileo was a member and of which today eminent scientists are members, without any form of ethnic or religious discrimination, is a visible sign, raised amongst the people of the world, of the profound harmony that can exist between the truths of science and the truths of faith ... The Church of Rome together with all the Churches spread throughout the world, attributes a great importance to the function of the Pontifical Academy of Sciences.

It was in this address that John Paul II formally called on historians, theologians and scientists to re-examine the Galileo case in detail, and asked them to do so 'in the faithful recognition of errors, by whomsoever committed, in order to remove the distrust that this case still generates, in the minds of many people, placing obstacles thereby in the way of fruitful concord between science and faith'. Galileo, it should be pointed out, became an early member of the Academy in the year 1610. Indeed, he was so proud of his membership that all his books and documents were signed 'Galileo Galilei lincaano'.

Reason and Faith

The addresses given by these five Popes to the Pontifical Academy of Sciences at its plenary sessions, study weeks and working groups constitute an unfolding spiritual discourse whose richness can be applied to contemporary conditions, and which express at the highest level the relationship that must exist between reason and faith, science and religion, the human person and the common good, and more generally, technology and morality. These Pontiffs have observed, first and foremost, that at the level of principle, the two truths of faith and of science can never contradict each other, and have emphasised that when this does occur it is the result of an erroneous reading of the Book of Nature or the Book of Divine Revelation. According to the biblical, patristic and theological tradition which was still espoused by Galileo, the one and the same God guarantees the intelligibility and reasonableness of the natural order of things, which constitutes the subject of research carried out by scientists, as well as the intelligibility of faith, which constitutes the object of investigation of Christian theology. This God, who created the Book of Nature, revealed Himself as the Father of our Lord Jesus Christ, and in him, of all men. It was in this perspective that John Paul II observed at a more detailed level that science and faith are complementary and that their relationship is best understood as a circle: faith and reason are like two wings on which the human spirit rises to the contemplation of truth. Science, for its part, can purify religion from error and superstition; and faith, for its part, can purify science from idolatry and false absolutes. They can draw each other into a more open world, a world in which both are active and synergetic. For this reason, the *habitus* of faith, when present in an illuminated and creative mind, can act to generate positive scientific research, a truth demonstrated by the fact that Galilean modern science was born in a Christian climate characterised by the increasing assimilation of the message of freedom placed in the heart of man by Jesus Christ. 'Galileo sensed in his scientific research', declared John Paul II in the first of his addresses to the Academy, 'the presence of the Creator who, stirring in the depths of his spirit, stimulated him, anticipating and assisting his intuitions' (Address of 10 Nov. 1979).

In order to overcome long-standing misunderstandings which caused a separation between science and faith during the modern age (described as a 'drama' by Paul VI), John Paul II delivered a speech to this plenary session of the Pontifical Academy of Sciences in which he announced the historic decision to establish a committee of historians, scientists, and theologians which would re-examine the Galileo case and present public opinion with a clear analysis of the facts as they had really occurred. The aim was not in a historical sense to acknowledge the inadvisability of the condem-

nation of heliocentrism carried out four centuries previously by the Sant'Uffizio (something which had already been effected in 1757 with the removal of the works in question from the list of prohibited books), but rather to ensure that the historical-philosophical context of that episode, as well as its implications at a cultural level, were made better known, thereby clarifying in a public way, comprehensible to everybody, what had already been clear within a narrower circle of intellectuals and experts. Thirteen years later, during the assembly of the Academy of 31 October 1992, Cardinal Paul Poupard, in the presence of the Holy Father, presented the report of this committee and commented on the work which it had carried out. This report conformed to the wishes of the Holy Father in giving a clear and precise picture of the whole Galileo episode, and constituted perhaps the most important opportunity of our times for a subsequent restatement of the proper and new relationship of cooperation between faith and scientific reason. It has been decided to include this document (the only one of which a Pope is not the author) in this volume because of its historical significance.

It may be said that the doctrine on the relationship between scientific reason and faith found its most recent form of expression in the address which John Paul II gave on 28 October 1986, the fiftieth anniversary of the Academy. He discussed the subject of 'revealed truth and empirically discovered truth' and observed that there is 'no contradiction between science and religion', although science needs to be in harmony with wisdom and ethics. 'Galileo himself did not accept a genuine contradiction between science and faith: both come from the same Source and are to be brought into relationship with the first Truth'. If divergences exist between the Church and science, 'the reason for this must be sought in the finitude of our reason, which is limited in its extent and thus exposed to error'. He then added that:

Christians have been led to read the Bible afresh, without seeking in it a scientific cosmological system. And scientists themselves have been invited to remain open to the absoluteness of God and to an awareness of creation. In itself, no field is barred to scientific investigation, provided that this respects the human being; it is, rather, the methodologies employed that bring the scientists to make certain abstractions and delimitations.

The Pope also observed that science must return from extreme specialisation to an overall view. He then declared that a 'new type of dialogue has now begun between the Church and the world of science'. In its pursuit of truth, science must serve culture and man; fragmentation should be avoided, and scientists, thinkers and theologians must combine in a common effort:

Science cannot neglect the fundamental questions concerning its role and its goal; it cannot close itself to *the universal*, nor to the knowledge of things as a whole, nor to *the Absolute*, even if it is unable by itself to answer the question of meaning.

... It may perhaps be difficult to ask all the specialists today to become philosophers, but the needs of contemporary culture spur you on strongly to contribute your indispensable participation in the *interdisciplinary researches in which scientists, thinkers and theologians must collaborate*.

The Pope observed that a cause of great concern was the ‘wrong use of the power that comes from science’. Referring to the discovery of nuclear energy, he said that ‘researchers have been at the origin of a moral crisis equal to no other in history, which can be overcome only by combining conscience with science, making the supremacy of ethics respected’. Stressing the need for peace among peoples, the Pope also mentioned the need for a ‘harmonious relationship for man and nature’ as a basic element of civilisation, and emphasised the importance of science in the field of ecology to protect the environment and improve the quality of life. The Pope concluded by praising the Academy, which ‘bears witness to the harmony between the Church and men of science’ (Address of 28 Oct. 1986).

The Cultural Values of Science

At its plenary session of 8-11 November 2002 on ‘The Cultural Values of Science’ suggested by the Academician W. Arber, the Pontifical Academy of Sciences discussed the various contributions made by scientific activity and education to the culture of mankind. All anthropologists agree that culture should be seen as a set of learned ways of behaving and adapting as opposed to inherited patterns of behaviour or instincts. In his address to the United Nations of 2 October 1979, John Paul II referred to Aristotle’s idea that: ‘While the other animals live by impressions and memories, and have but a small share of experience, the human race lives also by art (τέχνη) and reasoning (λογισμός)’.¹ Culture is a typical characteristic of man, who is not rigidly guided by determining laws which establish him within a given framework. On the contrary, he is a self-interpreting animal, a self-formed man. He never ceases to express himself and to give himself a name, and this development, at the centre of which man’s freedom is to be found, is called ‘culture’, which is different from nature. When did culture experience the transition to science? If by science we mean the knowledge

¹ *Metaph.*, I, 1, 980 b 21.

base built up by studies of nature in the form of a selfless search for truth, then it is possible to describe ancient Greece as the first home of science. This theoretical practice of the *sophoi* Greeks, later developed by the methods of Galileo and his heirs, constitutes a fundamental dimension of human culture. Since that time, this dimension has shaped human history and is now an irreversible part of man's destiny. At that plenary session, when meeting the Academicians, John Paul II observed:

even before speaking of the cultural values of science, we could say that science itself represents a value for human knowledge and the human community. For it is thanks to science that we have a greater understanding today of man's place in the universe, of the connections between human history and the history of the cosmos, of the structural cohesion and symmetry of the elements of which matter is composed, of the remarkable complexity and at the same time the astonishing coordination of the life processes themselves. It is thanks to science that we are able to appreciate ever more what one member of this Academy has called 'the wonder of being human'.

The Pope recalled, in addition, that 'science will help to unite minds and hearts, promoting dialogue not only between individual researchers in different parts of the world but also between nations and cultures, making a priceless contribution to peace and harmony among peoples' (Address of 11 Nov. 2002).

The Academy had already dealt with the 'Responsibility of Science'² during its 1988 plenary session. Recalling the words of his predecessors, John Paul II stated that the Academy must contribute to 'doing the truth' in accordance with the thought of St. John, 'he who *does* what is true comes to the light',³ inviting scholars to examine the results of their research 'in the light of the other sciences'. He concluded by affirming that the Church 'counts on your studies to confront the grave technical, cultural and spiritual problems which concern the future of human society' (Address of 31 Oct. 1988).

The Academy also dealt with 'Science in the Context of Human Culture'⁴ at a meeting in two parts held in 1990 and 1991. In the first, the Pope stressed the importance of science while, at the same time, insisting on the need for 'epistemological reflection on the meaning of science'. John Paul II also stated that, 'defending reason is a priority demand of every culture.

² *Scripta Varia*, 80, XIX-299 (Vatican City, 1990).

³ *Jn* 3:21.

⁴ *Scripta Varia*, 85, XV-503 (Vatican City, 1994).

Scholars will find no better ally than the Church in this struggle'. Moreover, the Pope insisted that:

The time has come to create a new bond between all people and groups of good will. We must combine the active forces of science and religion in order to prepare our contemporaries to meet the great challenge of integral development, which demands skill and qualities which are both intellectual and technical, moral as well as spiritual (Address of 29 Oct. 1990).

When addressing the participants during the second part of the meeting,⁵ in October 1991, John Paul II invited them to overcome the fragmentation of knowledge caused by specialisation, which 'often makes it impossible to see the human being in his ontological unity and to understand the harmonious complexity of his faculties'. Scientists can avoid this risk by developing a universal approach in which 'religion and science constitute elements of culture' and answer 'to God and humanity for how they have tried to integrate human culture' (Address of 4 Oct. 1991).

The Absolute Dignity of the Human Person

The pontifical addresses and documents of Benedict XV, Pius XI, Servant of God Pius XII, Blessed John XXIII, Paul VI and John Paul II collected together in this volume, express, in addition, the need for science and technology to constantly depend upon, and be related to, respect for the human person, for his dignity, and for his fundamental rights, because each man and each woman is created by God in His own image and likeness and is a person 'for whom Christ died'.⁶ The most advanced forms of scientific research and all the possible practical applications of science must, therefore, be at the service of man, who created science in order to continue the creative work of God and not to go against man, its own creator. 'Science does not exist except through and for man; it must leave the circle of research and pour itself out on man, and hence on society and history as a whole' (Paul VI, Address of 23 April 1966).

These Popes, 'experts in humanity' and seen by men and women of goodwill as the highest custodians of the meaning of the fundamental values of human life and their moral consequences, have expressed in their addresses to the Pontifical Academy of Sciences those guidelines, flowing from human reason illuminated by divine wisdom, which must be respected by science and technology to promote the specific human dimension of man, the well-being of society, and a wise relationship with the environ-

⁵ *Scripta Varia*, 86, XLIII-349 (Vatican City, 1993).

⁶ *Rm* 15:16.

ment, all directed toward the common good of the people of the world and of future generations.

The 1950s and 1960s witnessed an exponential growth and development of science connected with electronics and the conquest of space. This gave new impetus to industry and technological advance but also to nuclear armaments. In astrophysics, the discovery of new sensors and the development of radio-astronomy opened up the universe to new interpretations. Biology became directed towards the molecular study of genetics. In 1961, the Pontifical Academy of Sciences organised a study week on 'The Macromolecules of Interest to Biology', and in particular on nucleoproteins,⁷ a subject which was then of major importance for international research. On that occasion, when meeting the Academicians, Blessed Pope John XXIII reaffirmed the educational and cultural mission of the Church and the function of scientific progress in relation to the positive appreciation of the human person. The Pope recalled, in addition, that science is directed above all else towards the development and growth of the personality of man and the glorification of God the Creator:

Indeed, far from fearing the most audacious discoveries of men, the Church instead believes that every advance in the possession of the truth involves a development of the human person and constitutes a road towards the first truth, and the glorification of the creative work of God (Address of 30 Oct. 1961).

The year 1967 was marked by the publication of the Encyclical *Populorum Progressio*, in which Paul VI brought to the world's attention all the major problems inherent in the development of the Third World. This document also contained an appeal to engage in international scientific cooperation so that this could in all of its forms favour developing countries. It introduced the idea that scientific progress and advance must be guided by a 'new humanism, one which will enable our contemporaries to enjoy the higher values of love and friendship, of prayer and contemplation' (n. 20). In 1966 Paul VI had previously referred to these issues in his address to the Academy when he declared: 'In man's own interests, the Church desires at all costs to save that 'ability to contemplate and to wonder' to which a purely technical civilisation would be in danger of attaching little value' (Address of 23 April 1966).

In harmony with these wishes, the Academy thought it necessary to open itself further to working with the scientists of the Third World and, by 1968, was already holding a study week on 'Organic Matter and Soil Fertility',⁸ a

⁷ Cf. *Scripta Varia*, 22, XLIII-478 (Vatican City, 1962).

⁸ Cf. *Scripta Varia*, 32, XIII-1017 (Vatican City, 1968).

topic which dealt with the applications of science to agricultural production and the solution of the problems of hunger in the world. On that occasion, Paul VI affirmed that the Academy had also been founded:

to make the earth fruitful, producing bread for all its dwellers, to struggle against the sterility of desert wastes, to multiply agricultural products, to derive from man's labour easier and more abundant results, to make possible a victory over hunger which today still affects entire nations, to give hope and the means of subsistence to the ever increasing generations of men – such is your conquest, such your art, your mission, your crown! (Address of 27 April 1968).

Referring to the idea of Thomas Aquinas that the 'truth is the goal of the whole universe' (*finis totius universi est veritas*), John Paul II, for his part, in his Address to the Pontifical Academy of Sciences of 28 October 1986, made a number of very important statements on the role of scientific research in the defence and the advance of the human person. Three of them suffice to explain the spirit which has animated the meetings and discussions of the Academy, the goals it is expected to achieve, and the precedents it is supposed to establish:

This free search for truth for its own sake is one of the noblest prerogatives of man. Science goes astray if it ceases to pursue its ultimate end, which is the service of culture and hence of man; it experiences crisis when it is reduced to a purely utilitarian model; it is corrupted when it becomes a technical instrument of domination or manipulation for economic or political goals.

There is then what one can call a crisis of the legitimation of science, and it is therefore urgent to defend authentic science that is open to the question of the meaning of man and to the search for the whole truth, a *free science that is dependent only on the truth*. ... The man of science is called in a new way to *openness*. With all respect for the methodological requirements of abstraction and specialised analysis, one may never neglect the unified orientation of knowledge (Address of 28 Oct. 1986).

A study week on 'Science for Development in a Solidarity Framework',⁹ organised by the Pontifical Academy of Sciences, was held in October 1989. In his Encyclical *Sollicitudo Rei Socialis*, Pope John Paul II expressed the hope that those responsible for the good of society 'may become fully aware of the urgent need to change the spiritual attitudes which define each man's relationship with himself, with his neighbour, with even the farthest-flung human community, and with nature' (n. 38). Paraphrasing Pius XII's motto '*Opus iustitiae pax*', he suggested with the same

⁹ *Scripta Varia*, 82, LVI-200 (Vatican City, 1992).

precision and with the same biblically inspired boldness:¹⁰ *‘Opus solidaritatis pax’*. At the same time, we are aware today that four fifths of humankind do not enjoy the resources and the benefits of the other one fifth, and this is neither just nor moral. Therefore, any suggestions for future scenarios should bear in mind that we should comply not only with the laws of economy but also with the principles of justice and ethics, in a spirit of solidarity which underlines the interdependence of all the people of our world. The role of science could be fundamental in this context in order to overcome technical difficulties, to protect soil fertility from erosion, to control or eradicate endemic diseases, to find the solutions to difficult economic realities, such as foreign debt or the financing of new plans of development. In fact, when John Paul II met the participants he observed that: ‘solidarity is a grave moral obligation, for nations as well as for individuals’. Moving beyond merely political or economic readings of the contemporary situation and making a theological reading of its mechanisms or processes, the Pope spoke of ‘certain structures of sin’. He explained:

Two factors in particular have contributed to creating, fostering and reinforcing these ‘structures’, thus making them even more capable of conditioning human conduct: an exclusive desire for profit and the thirst for power which aims at imposing one’s own will upon others.

For the Pope, scientific studies can find the practical means by which to implement such new solidarity:

Their object is to analyse and study more intensively – making use of an interdisciplinary and scientifically tested approach – the cultural, economic and political causes of underdevelopment; to identify with a rigorous and precise analysis the processes that perpetuate underdevelopment; and to suggest models of development which can be considered workable in present historical circumstances. Such analysis seeks to indicate the ways and proper times to intervene, the conditions, means and tools necessary for passing from underdevelopment to a balanced development, that is, a ‘development in a solidarity framework’.

His Holiness made a special reference to the problem of international debt, which weighs so heavily on developing countries, and called for an equitable solution. He observed:

I have underlined the importance of this issue because, once it is dealt with equitably, competently and in a spirit of authentic solidarity, it has the potential to become a genuine symbol and model

¹⁰ Cf. *Is* 32:17; *Jm* 3:18.

of creative and effective resolve in the face of the other complex and pressing issues of international development. The solutions to these problems are neither simple nor close at hand; yet, once they are discerned with wisdom and courage, they foster hope for a world where solidarity would no longer be merely a word, but an urgent task and a conviction which bears fruit in action. The virtue of solidarity, practiced at a deep and authentic level, will demand of all parties both a willingness to be involved and a deep respect for others. Only in this way will the great potential resources of the developing countries *be transformed* into a concrete reality that has much to offer to the entire world (Address of 27 Oct. 1989).

Pope John Paul II was to continue to expound the views of the Magisterium of the Church on the dignity of the human person and the social order in his addresses to the Pontifical Academy of Social Sciences which he founded in 1994, all of which are printed in this volume.

The Priority of Peace

The Pontifical Academy of Sciences has demonstrated a particular interest in questions relating to war and peace. Benedict XV in the early decades of the twentieth century indicated that the subject of peace should be a primary concern of the Academy, and during the modern era there have also been a number of episodes where the Supreme Pontiffs have promoted initiatives in favour of peace of which the Academy or some of its members were protagonists. This was the case, for example, of the Academician Max Planck, who, in 1943, in a direct way with Pius XII (whom Max Planck knew well when the latter was still Cardinal Pacelli and a member of the Academy) undertook to warn the world about the risks of war connected with the use of armaments based upon nuclear fission. Thus it is that the Popes, and in particular Pope John Paul II, during these recent decades marked by a growing danger of world conflict, have conferred a high prestige on the initiatives of the Academy and, in line with them, have appealed to members of governments to work in an effective fashion to remove the danger of a new war.

In April 1980 the Academy organised a working group of Academicians and external experts to focus on the problem of nuclear armaments. A document was drawn up establishing some key points regarding the contemporary state of nuclear armaments and the dangers they represent. The group was received by John Paul II who was pleased with the work accomplished and spoke with the participants individually in a round table discussion about the main aspects of the report. The addresses by John Paul II at UNESCO in

June 1980 and in Hiroshima in February 1981 were in part based on data included in this report. The Academy undertook to find a way to collaborate with the world scientific community in highlighting the consequences of a nuclear war. The sacrilegious attack against the Holy Father in May 1981 made it necessary to postpone until October of the same year the meeting of a working group of Academicians and others, including one Soviet scientist, at the end of which a 'Statement on the Consequences of the Use of Nuclear Weapons'¹¹ was drawn up. This document was sent to the Holy Father, who decided that it was important to appeal to the conscience and sense of responsibility of the heads of states having atomic arsenals as well as those of the other nations. Indeed, the Holy Father, in receiving the participants, recalled the statement of 25 February 1981 on Hiroshima, which had stated that 'a pluridisciplinary study will certainly be for the heads of state a reminder of their tremendous responsibilities, giving humankind an ever more ardent thirst for harmony and peace'. In 1982 the Academy worked at an international level to promote peace through the publication of a document on nuclear arms¹² and dedicated its next plenary session to the subject 'Science for Peace'.¹³ In connection with that event, John Paul II appealed to members of government to work in an effective fashion in order to remove the danger of a new war and invited states to engage in nuclear disarmament ('Scientific Knowledge Should Build Peace', 12 Nov. 1983).

It may be said that the commitment of science to peace found its strongest expression in the address which John Paul II gave in November 1983 to the scientists who had convened for the plenary session on 'Science for Peace'. The Pope emphasised the importance of the role of science in building up peace:

Truth, freedom, justice and love: such, Gentlemen, must be the cornerstones of the generous choice of a science that builds up peace. These four values, the cornerstones of science and of the life of civilised society, must be at the basis of that universal call of scientists, of the world of culture, of the citizens of the world, which the Pontifical Academy of Sciences, with my full and convinced approval, desires to address to the world for the reconciliation of peoples, for the success of the only war that must be fought: the war against hunger, disease and the death of millions of human beings whose quality and dignity of life could be helped and pro-

¹¹ 'Declaration sur les conséquences de l'emploi des armes nucléaires', *Documenta*, 3, pp. 15 (Vatican City, 1981).

¹² Cf. 'Declaration on Prevention of Nuclear War', *Documenta*, 4, pp. 29, September 1982.

¹³ Cf. *Documenta*, 15 (Vatican City, 1983) and *Scripta Varia*, 65 (Vatican City, 1986).

moted with seven per cent of the amount spent each year for the incessant and threatening rearmament of the richest nations.

John Paul II invited the Academy to take part in this endeavour:

It is an irreplaceable task of the scientific community to ensure, as is your intention, Mr. President of the Pontifical Academy of Sciences, that the discoveries of science are not placed at the service of war, tyranny and terror. The intention to direct science to the promotion of justice and peace demands a great love for humanity. Every human virtue is a form of love. This is the case, in particular, of justice, which is love of neighbour, of individuals, and of peoples. Only the person who loves wants justice for the other person. The person who does not love seeks only to obtain justice for himself (Address of 13 Nov. 1983).

This document and appeal achieved a strong resonance in the United States of America and the Soviet Union. The present Pope, who made a major contribution to changing the political geography of Central and Eastern Europe and Latin America, has since continued to strive for the attainment of world peace and the avoidance of armed conflict. Naturally, the maintenance of peace among the peoples of the world is absolutely fundamental. For this reason, the Pontifical Academy of Sciences, which strongly wishes to continue its cooperation with the Pope in this sphere (especially after the events of 11 September 2001), hopes that the testimony of the many religious leaders who have twice prayed for peace at meetings in Assisi promoted by John Paul II, will help in its own way to establish peace, which is also a gift of God.

The New Cosmologies and the Theory of Evolution

The Pontifical Academy has devoted some of its activity to the topical question of the new cosmologies and to the theory of evolution. The close relationship between Pius XII and Georges Lemaître (later President from 19 March 1960 to 20 June 1966) enabled this Pontiff to have a more direct understanding in the early 1950s of the meaning of the new cosmological models which were by then beginning to become established in the scientific world, and the philosophical, or even theological, questions which at first sight appeared to be involved. In the addresses of Pius XII it is possible to encounter the impact of the thinking of this scientist and his new cosmology, and special reference may be made here to the address entitled 'the proofs for the existence of God in the light of modern natural science'. When Pius XII learnt that the latest results of cosmological research posited the existence of an initial event to explain the formation of the universe (the Big Bang), he declared:

It seems profitable, therefore, to re-examine the classical proofs of St. Thomas on the basis of the new scientific discoveries, especially those based upon the movement and order of the universe; to consider, that is, if and to what extent the more profound knowledge of the structure of the macrocosm and the microcosm contributes to the reinforcement of philosophic arguments.

For this Pope, thanks to the new discoveries of science, the beginning of history was not the work of the blind evolution of the universe or of some other force, but directly derived from a supreme and independent cause:

By means of exact and detailed investigations into the macrocosm and the microcosm, it has widened and deepened to a considerable extent the empirical foundation upon which the argument is based and from which we conclude a self-existent Being (*Ipsium Esse per essentiam*) immutable by nature. Further, it has followed the course and the direction of cosmic developments, and just as it has envisioned the fatal termination, so it has indicated their beginning in time at a period about five billion years ago, confirming with the concreteness of physical proofs the contingency of the universe and the well-founded deduction that about that time the cosmos issued from the hand of the Creator.

Creation, therefore, in time, and therefore, a Creator; and consequently, God! This is the statement, even though not explicit or complete, that We demand of science, and that the present generation of man expects from it. It is a statement which rises from the mature and calm consideration of a single aspect of the universe, that is, of its mutability; but it is sufficient because all mankind, the apex and rational expression of the macrocosm and the microcosm, is made conscious of its sublime Creator and feels His presence in space and in time, and, falling to its knees before His sovereign Majesty, begins to call upon the name *Rerum Deus, tenax vigor – Immotus in te permanens – lucis diurnae tempora – successibus determinans* (Address of 22 Nov. 1951).

Paul VI, as well, pointed out that the scientific study of the universe leads 'towards the invisible which is the source of the visible'. Such an observation elevated man and gave meaning to his existence by drawing him closer to God. The flight of Apollo 13 had been a part of this process: All of you have certainly followed, with apprehension and then with joy, the unfolding of this extraordinary undertaking. And you will undoubtedly make it a point to congratulate warmly with us the valiant astronauts who have escaped the dangers of this grandiose flight, and to render homage to all those who, by their studies, their

activity and their authority, have once again brought before the eyes of the world the limitless power of sciences and modern technology. You will also raise with us an ardent hymn of gratitude to God, Creator of the universe and Father of men, who, by these paths also, wishes to be sought after and found by man, adored and loved by Him (Address of 18 April 1970).

John Paul II once again chose the Pontifical Academy of Sciences as a qualified interlocutor to expound certain important reflections on the theory of evolution. Returning to, and developing, certain observations made by his predecessor Pius XII in the Encyclical *Humani Generis*, he now added that 'new knowledge leads the theory of evolution to be no longer considered as a mere hypothesis', thereby recognising 'that this theory has progressively imposed itself on the attention of researchers following a series of discoveries made in the various disciplines of knowledge', imposing itself also, therefore, on the attention of theologians and Bible experts (Address of 22 Oct. 1996).

Brain and Conscious Experience

In the course of this introduction, mention has often been made of the meeting on 'Brain and Conscious Experience', held in the Academy in 1964, which was organised by the Academician and Nobel Prize winner, Prof. John Eccles. The published proceedings of that meeting constitute a milestone in the literature of the field.¹⁴ The spirit that guided the participants in the study week was 'the search for truth', and the words spoken by Paul VI to the Academicians confirm this:

Who does not see the close connection between the cerebral mechanisms, as they appear from the results of experimentation, and the higher processes which concern the strictly spiritual activity of the soul? ... the soul of the scientist today is more easily open to religious values, and glimpses, beyond the prodigious achievements of science in the material domain, the mysteries of the spiritual world and the gleams of the divine transcendence ... these questions are beyond the domain of science, and in all ages man has confronted the question of his origin and destiny.

Paul VI recognised the new importance of the subject 'brain and conscious experience': 'seeing these words associated, it suffices to make clear that there you touch on that which is most specifically human in man, on that which approaches most nearly the mechanisms of his psychology, the problems of

¹⁴ 'Cerveau et expérience consciente', *Scripta Varia*, 30, XLVII-885 (Vatican City, 1965).

his soul'. The Pope concluded with a moving declaration of cooperation:

The Church is beside you in your labours, Gentlemen, you may be sure, and always ready to offer you the help of the lights of which she is the trustee, whenever your learned researches bring you to the threshold of those grave questions which transcend the domain of science (Address of 3 Oct. 1964).

Since then the Pontifical Academy of Sciences has continued to encourage research and the exchange of views in several sectors of neuroscience, organising meetings on: nerve cells, transmitters and behaviour, pattern recognition mechanisms, developmental neurobiology of mammals, mental deficiency, the artificial prolongation of life and the determination of the exact moment of death, the principles of design and operation of the brain, brain research, and the mind-body problem: epistemological and metaphysical issues.

The Academy, following this previous line of research on the brain, organised a study week on 'The Principles of Design and Operation of the Brain'¹⁵ in October 1988. John Paul II addressed the participants on the importance of this area of scientific research and added:

The results of research provide a better understanding today of the organic structures and processes which underlie the cognitive and affective operations of the human being. But beyond all empirical observation, there appears the mystery of the spirit, which cannot be reduced to the biological supports which come into play in the behaviour of the intelligent being open to transcendence. Confronted with what is now known about the brain, the believer cannot forget the words of the Book of Genesis: 'The Lord God formed men of dust from the ground, and breathed into his nostrils the breath of life'. In anthropological terms, the ancient narrative of creation brings out very well the intimate bond that exists between the physical organ and the spirit in man. Thus it was opportune that scientists compare the results of their experimental studies with the reflections of philosophers and theologians on the relationship between the spirit and the cerebral apparatus.

John Paul II went on to say that in the study of the human brain scientists should work together with philosophers and theologians to study the 'relationship between the spirit and the cerebral apparatus'. The Church encourages scientific research but science is not exhaustive in the study of reality: there remains the 'world of the mind, of moral and spiritual values'.

¹⁵ Cf. *Scripta Varia*, 78, XIV-589 (Vatican City, 1990).

There must therefore be a 'patient reintegration of knowledge'. The Pope thus observed:

Beyond the visible and sensible, there exists another dimension of reality, attested to by our most profound experience: this is the world of the mind, of moral and spiritual values. Above all, there is the order of charity, which binds us to each other and to God whose name is Love and Truth. Even with the frailty of his condition as creature, man still maintains the imprint of the original divine unity in which all perfections are united without confusion. In the visible world, these perfections appear dispersed and diminished, but they no less effectively recall, particularly in man, the image of the true unity of the Creator. This image is that of the Truth itself. Such are the characteristics of the overall synthesis which establishes the unity of knowledge and which inspires, by way of consequence, a unity and consistency of behaviour. It is a question here of a unity constantly to be built, according to the dynamic characteristics of life (Address of 31 Oct. 1988).

The Pontifical Academy of Sciences, following the wishes of the Popes, has studied, and will continue to study in the future, these various subjects of neuroscience, which certainly bear upon the most mysterious, and yet the nearest, part of ourselves.

The Moment of Human Death

The prolongation of life, which has been a constant concern of mankind, has been a topical question for many decades. Average life expectancy, especially in the West, has increased and will continue to do so. This is due to advances in medical knowledge and in immunisation, sanitation, epidemiology, biostatistics, etc. Instruments for the artificial prolongation of life (often run by computers) have become increasingly sophisticated, and to see them in hospital wards, intensive therapy units and the homes of affluent patients often provokes wonder. However, the current development of these techniques is rapidly generating greater and increasingly serious moral, scientific, social and economic problems. In 1985, the Pontifical Academy held a working group on 'The Artificial Prolongation of Life and the Determination of the Exact Moment of Death'¹⁶ in order to study, at a purely scientific level, the problems raised by the use of artificial methods for the prolongation of life. This working group attempted, in particular, to provide a definition of the exact moment of death. This latter

¹⁶ *Scripta Varia*, 60, xxv-114 (Vatican City, 1986).

question was particularly delicate in its repercussions not only in a juridical and theological sense, but above all in the determination of the legitimacy of removing organs for transplants, generally before such organs have suffered damage. The group of scientists who participated in that working group were unanimous in affirming, by way of conclusion, a series of points proposing that death takes place when: a) spontaneous cardiac and respiratory functions have irreversibly ceased, or b) there has been an irreversible cessation of all brain functions. The concluding document stressed the fact that brain death is the true criterion for death given that the complete cessation of cardio-respiratory functions leads very quickly to brain death. The document also contains other points to indicate instruments by which to establish the cessation of brain activity and deontological and ethical norms for organ transplants. On this occasion, when meeting the Academicians, John Paul II declared:

We are grateful to you, Ladies and Gentlemen, for having studied in detail the *scientific problems connected with attempting to define the moment of death*. A knowledge of these problems is essential for deciding with a sincere moral conscience the choice of ordinary or extraordinary forms of treatment, and for dealing with the important moral and legal aspects of transplants (Address of 21 Oct. 1985).

The acts and conclusions of that working group were published in 1986 and enjoyed general agreement among doctors and scientists as well as amongst those who saw the beneficial aspects of organ transplants. However, among certain moralists and philosophers, questions and even strong opposition arose. For this reason, the Academy found it opportune, following the suggestion of the Congregation for the Doctrine of the Faith, to convoke a further meeting in December 1989 on 'The Determination of Brain Death and its Relationship to Human Death',¹⁷ with the participation not only of medical scientists, but also of philosophers, theologians and legal experts. This meeting aimed to study the scientific principles in greater depth within a wider cultural context that took into account the special nature of the human personality. On this occasion, Pope John Paul II stressed in his address to the participants that the task and responsibility of medical scientists must be that of indicating with certainty the signs of death. This teaching was in line with that of Pius XII, who, during an audience granted to anaesthetists in November 1957, stated: 'It is the task of the doctor ... to give a clear and precise definition of 'death' and of the 'moment of death' of a patient'.¹⁸ At a scientific level, four years of study

¹⁷ *Scripta Varia*, 83, xxvii-209 (Vatican City, 1992).

¹⁸ *AAS* 49 (1957) p. 1031.

and research confirmed the conclusions proposed in 1985 and upheld the criterion of brain death as determining the death of the human being. The Academy in the near future will probably return to this vital question.

The Human Genome

The project of the mapping of the human genome, with all its inevitable consequences, prompted the Academy to address itself to the question on two occasions: at a special international meeting of November 1993 on 'The Legal and Ethical Aspects Related to the Project of the Human Genome'¹⁹ and during its plenary session of October 1994 on 'Human Genome'.²⁰ In his address to the participants of the former, the Pope declared that research into the human genome must involve 'respect for the life and integrity of the subject'. He added that science could not answer all truths and that moral criteria for attaining what is good must be sought in the dignity of the human person. He went on to say that application of knowledge in this field could 'represent a formidable threat to the human being', stressing in particular that the human embryo could never be used as a 'pure object of analysis or experimentation' and should be 'recognised as a legal subject by the laws of nations lest humanity be endangered' (Address of 20 Nov. 1993). In his address to the plenary session, John Paul II observed that 'science alone cannot claim to account for the transcendent origin and ultimate purpose of human existence'. He also stressed that investigation into the human genome was legitimate but that the whole area had to be guided by certain basic moral norms: man was more than his mere genetic inheritance. The Supreme Pontiff then added that the results of such research should not be patented; that knowledge in this area should not be used to destroy embryos or marginalise those affected by a genetic disease; and that an individual has a right to his biological privacy. He concluded by emphasising that in this field legislation had to protect 'the human person and his genetic inheritance' (Address of 28 Oct. 1994). John Paul II has on many occasions offered his Magisterium on this important subject in many addresses to the Pontifical Academy for Life, which he himself founded in February 1994 and whose purpose is to study the questions and issues connected with the promotion and the defence of human life.

Tropical Diseases

Parasitic diseases in the tropics (especially malaria, schistosomiasis, filariasis, leishmaniasis and tripanosomiasis), which considerably reduce the physical

¹⁹ *Scripta Varia*, 91, xv-193 (Vatican City, 1995).

²⁰ *Scripta Varia*, 92, pp. 31-194 (Vatican City, 1998).

efficiency of the close to one hundred million persons affected, are one of the factors which limit the development of tropical countries. The Academy, faced with the difficulty encountered by science in finding effective preventive as well as curative treatments through the use of pharmaceuticals, turned its attention to the possibilities of using vaccination for immunisation against parasitic diseases. The working group which met in 1981 to study and discuss the 'Perspectives of Immunisation in Parasitic Diseases'²¹ stressed this approach. On this occasion, Pope John Paul II emphasised in his address to the participants that: the question of parasitic diseases, diseases which strike the poorest countries of the world, are a serious obstacle to the development of man in the harmonious framework of his physical, economic and spiritual well-being. The efforts to eliminate, as far as possible, the serious harm caused by parasitic diseases to a considerable part of humanity are inseparable from the efforts which should be made for the socio-economic development of those same peoples. Human beings normally need a basic minimum of health and material goods in order to be able to live in a manner worthy of their human and divine vocation. It is for this reason that Jesus turned with infinite love to the sick and infirm, and that he miraculously cured some of the diseases with which you have been concerned in these past days (Address of 3 Oct. 1981).

The field of the immunology of tropical diseases includes to some degree leprosy, a disease of bacteriological origin widely prevalent in tropical climates among the poorer parts of the population. Continuing its studies of cures for tropical diseases, which hinder development in the Third World, the Academy held a working group on 'Immunology, Epidemiology and Social Aspects of Leprosy'²² in May 1984. When meeting the Academicians, John Paul II praised the efforts of science to eradicate leprosy. In this and in other fields, scientists require the assistance of the Spirit and the benefit of high moral virtues in order to 'exercise the charity of knowledge'. It was the belief of the Pope that it may be possible to eradicate leprosy from our world before the middle of the new century. In order to achieve this, John Paul II finished with the following appeal:

I therefore call upon governments, international institutions and philanthropical associations to make increasing contributions to the work being done by research scientists, doctors and volunteers in order to free leprosy patients from their sickness and from their humiliating and tragic rejection by society (Address of 1 June 1984).

²¹ *Scripta Varia*, 47, XII-178 (Vatican City, 1982).

²² *Scripta Varia*, 72, x-212 (Vatican City, 1988).

In October 1985 the study week on 'Interaction of Parasitic Diseases and Malnutrition'²³ dealt with a very important global problem. Malnutrition and parasitic diseases are associated with economic, social and cultural factors, and it is clear that positive action can be taken in order to minimise or eradicate both. On this occasion, when meeting the participants, John Paul II likened men and women of science who are dedicated to helping those afflicted by sickness and malnutrition to the Good Samaritan. Scientists and physicians must place 'their skill and energy at the service of life' and thus must never engage in euthanasia. People should be allowed to die with dignity. Malnutrition is a major problem in the world and 'gives rise to diseases which hinder the development of the body and likewise impede the growth and maturity of intellect and will'. John Paul II thus emphasised:

the need to adapt and improve methods of cultivation, methods which are capable of producing food with all the elements that can ensure proper human subsistence and the full physical and mental development of the person. It is my fervent hope and prayer that your deliberations will encourage the governments and peoples of the economically more advanced countries to help the populations more severely affected by malnutrition (Address of 21 Oct. 1985).

The Problem of Cancer

The first study week of the Academy was held in June 1949 on the subject 'The Biological Problem of Cancer'²⁴ at a time when modern biochemical techniques made it possible to foresee the mechanism of cancerogenesis. In this context new ideas and new possibilities of research arose, and that meeting was an opportunity to experiment with the new and original formula for the study weeks proposed by the Academy. The success achieved helped to perpetuate the model which emerged from this meeting. Pius XII, in welcoming the participants, said:

These observations, experiments and investigations you know how to pursue assiduously and patiently, and of which the general public often takes little account. They will not, perhaps, give you noisy publicity, but you will merit, as your conscience tells you, the gratitude of generations to come (Address of 7 June 1949).

The problem of cancer was taken up again in October 1977 by the study week on the subject 'The Role of Non-Specific Immunity in the Pre-

²³ *Scripta Varia*, 61, xv-352 (Vatican City, 1986).

²⁴ *Scripta Varia*, 7, xiv-350 (Vatican City, 1949).

vention and Treatment of Cancer'.²⁵ This meeting fulfilled a wish of his Holiness Pope Paul VI, who had expressed the desire to see the Pontifical Academy of Sciences deal with the vital subject of cancer research. No one could imagine that the frail Pontiff who so kindly received the participants would shortly pass away. It is with great emotion that the Academicians remember his last direct contact with our activity and the prestige and strength with which he supported the work the Academy carried out during his reign. On this occasion, when meeting the participants, Paul VI declared that true scientists – all those who 'work in a worthy way' – further scientific knowledge 'according to the Creator's invitation', and 'under the responsibility of conscience' prepare 'technical progress in harmony with man's vocation and complete good'. Thus, in particular, the attempts to find cures for cancer, 'a terrible affliction', constituted a 'high service to humanity'. Paul VI told the Academicians:

You have concentrated your attention on non-specific immunity in this field. We ourselves attribute great importance to this work, for we share the anxiety of our brothers and Christ's ardent desire to see the sick relieved or cured of their infirmities The disease is all the more powerful in that its mechanisms seem closely linked with the normal processes of cellular reproduction, in which they create grave anarchy. In addition to surgical operations and radiological treatments which have already made great progress, at the risk, however, of acting on normal cells as well as on cells of cancerous tumours, you have wished to study the exploration of a new way, by utilising immunological and immunochemical means, to activate the defences of the organism or stop the proliferation of neoplastic cells (Address of 22 Oct. 1977).

A working group on 'Specificity in Biological Interactions'²⁶ was organised in November 1983 to shed light on certain biological processes which are basic to an understanding of the mechanism of a great number of the chemical reactions on which life is based. These interactions can cause the action of an enzyme on a specific substratum but also that between a molecule and a nucleic acid, which can produce carcinogenic phenomena as well as a blocking of the functions of the tumour cell DNA which constitutes the target for the chemotherapy of tumours. When meeting the participants, John Paul II observed that the Church supports the scientific quest for truth and hopes that scientists will be 'assisted by the sense of the divine'. He took Newton as an example, a scientist who 'saw in the Universe

²⁵ *Scripta Varia*, 43, xxxiv-589 (Vatican City, 1979).

²⁶ *Scripta Varia*, 55, xxxvi-318 (Vatican City, 1984).

the presence of God'. Knowledge should be used for the benefit of mankind, and the Pope asked men of science 'to raise knowledge to the level of love, to the level of charity and understanding: *sunt qui scire volunt ut aedificent et charitas est*' (Address of 12 Nov. 1983).

Today the problem of tumours could be easily solved if we had more knowledge, at a molecular level, of the mechanisms of carcinogenesis and antitumoral activities. The similarities and the differences in action between carcinogenesis and antitumorals were the subject of the study week on 'The Molecular Mechanisms of Carcinogenetic and Antitumoral Activities'²⁷ held by the Pontifical Academy in October 1986. John Paul II welcomed the Academy's constant commitment to combating cancer and observed that although the scientists present at the meeting came from the developed countries, the benefits of their work were 'intended for all the world'. The Pope added that:

The particular feature of this working group is to combine, in the same exploration and discussion, the mechanism of action of carcinogenic and anti-tumour agents, those which cause the terrible disease and those which help to cure it. The discussions thus bear on the suffering of man, but also on his efforts to find a remedy for it. Another striking feature of this working group is that it tries to go into the very fundamentals of the problem by investigating the molecular mechanisms of the events which are responsible for the action of the carcinogenic and anti-tumour agents (Address of 23 Oct. 1986).

The Pontifical Academy of Sciences, following the wishes of the Popes, has directed its attention toward cancer four times in its history, and will continue to study in the future the various aspects of this illness which destroys the organism of a great number of humans beings and is terrifying in the diversity of its forms.

Fresh Water

For the Presocratics, water was the principle of all things, and curiously enough it is only today that we have once again become aware that the survival of humanity and of all other species on earth depends upon the fate of water. Where water is absent, life is absent. Thus water, the common symbol of life for all mankind, valued and respected in all religions and cultures, has also become a symbol of social equity. The water crisis is mainly a question of the distribution of water, knowledge and resources rather than one of actual scarcity. One topic of theoretical interest, with notable

²⁷ Cf. *Scripta Varia*, 70, xx-490 (Vatican City, 1987).

possibilities of practical application, is the study of biological membranes which can serve as a model for the preparation of artificial membranes to be used in particular for the desalination of water. The importance of this problem led the Academy to organise a study week on 'Biological and Artificial Membranes and Desalination of Water'.²⁸ This meeting, which was held in April 1975, was attended by scholars from all over the world expert in the fields of both biological and artificial membranes. The purpose of the meeting was the establishment of an advanced model for artificial membranes based on knowledge of the mechanisms of the transport of water through biological membranes. Artificial membranes could be suitable for the production of large quantities of desalinated water, and in particular could meet the needs of the arid zones of the Third World. On that occasion, when meeting the Academicians, Paul VI recognised the new importance of the subject and made relevant recommendations. These recommendations centred around a number of key principles: the principle of prudence (or precaution) and the principle of participation (all individuals must be involved in water planning and management); the principle of solidarity, for water continually confronts humans (such activity is, in relation to present and future generations, a 'form of charity' which should take place within the framework of 'ecology'); and the principle of trust in the fact that nature has secret possibilities by which to achieve that development which is in the mind of the Creator. Paul VI thus declared:

As you can imagine, we will not go into the technical question, or into the possibilities of its application, which would probably still be premature. But we know that it is a question of a kind of important metabolism, which it is in the interest of mankind to discern, since the shortage of reserves of fresh water threatens to hinder its development. Let us just emphasise, in the more general field of scientific research, two attitudes which, it seems to us, should characterise the scientist, and especially the scientist who is a Christian. On the one hand, he must honestly consider the question of the earthly future of mankind and, as a responsible person, help to prepare it, preserve it, and eliminate risks; we think that this solidarity with future generations is a form of charity to which a great many men are sensitive today, in the framework of ecology. But at the same time, the scientist must be animated by the confidence that nature has in store secret possibilities which it is up to intelligence to discover and make use of, in order to reach the development which is in the Creator's plan. This hope in the Author of nature and of the human spirit,

²⁸ *Scripta Varia*, 40, xxxvii-901 (Vatican City, 1976).

rightly understood, is capable of giving new and serene energy to the researcher who is a believer (Address of 19 April 1975).

Energy

One of the most distressing questions which humanity must face before the end of this new century is the energy problem. As we all know, our civilisation is based on expendable energy. Every effort must now be made to use energy sources in a more effective and economical way and to use renewable sources in the same way. In 1980 the Academy held a study week on this subject, which is of great importance for the future of mankind. That this subject is complex and multifaceted is obvious from the title of the meeting: 'Mankind and Energy: Needs – Resources – Hopes'.²⁹ John Paul II received the participants and told them that this was one of the most serious problems faced by mankind. His Holiness then surveyed the history and the most important aspects of this question:

In the course of his history, man has developed the forms of energy that he needed, passing from the discovery of fire to ever richer forms of energy, and arriving finally at nuclear energy, which is staggering from so many points of view. At the same time, the progress of industrialisation has given rise, especially in recent times, to ever increasing consumption, to such an extent that some natural resources are becoming exhausted.

In discussing the question of energy, the Supreme Pontiff declared that mankind 'must look for new methods in order to use the resources of energy that Divine Providence has put at the disposal of man'. He pointed out that energy policy must 'promote ecological safeguards' and prevent harm to man:

I am sure that you will have considered in your discussions the rules that are necessary to eliminate the dangers that threaten, from far and near, those who are exposed to possible harm due to the use of certain sources of energy, and also always to promote ecological safeguards, the protection of fauna and flora, to avoid the destruction of natural beauty which fills the heart with admiration and poetry.

The Pope went on to say that the energy problem was not limited to questions of a scientific or economic order; it went beyond these limits and was complicated by the errors arising from the very context of the ethics and culture of each country:

The frustrations to which man is subject today due to excessive consumption on the one hand, and the energy crisis on the other, can be solved only if it is recognised that energy, whatever its form

²⁹ *Scripta Varia*, 46, xviii-719 (Vatican City, 1981).

or origin, must contribute to the good of man. Energy and the problems that it raises must not serve the selfish interests of particular groups which are trying to increase their sphere of economic and political influence, far less must it divide peoples, make some nations dependent on others, and increase the risks of war or of a nuclear holocaust.

Addressing the members of this study week on 'Mankind and Energy', John Paul II also referred to the most important general principle of this area: Energy is a universal good that Divine Providence has put in the service of man, of all men, to whatever part of the world they may belong, and we must think also of the men of the future, for the Creator entrusted the earth and the multiplication of its inhabitants to man's responsibility.

I think it can be considered a duty of justice and charity to make a resolute and persevering effort to husband energy resources and respect nature, so that not only humanity as a whole today may benefit, but also the generations to come. We are bound in solidarity to the generations to come. And I hope that Christians, moved particularly by gratitude to God, by the conviction that life and the world have a meaning, by unlimited hope and charity, will be the first to appreciate this duty and draw the necessary conclusions (Address of 14 Nov. 1980).

In 1984 the Academy held a study week on 'Energy for Survival and Development'.³⁰ The conclusions of this meeting were published in the form of a report which was sent to all the governments of the world. Reflecting the approach of the Pope, emphasis was laid on the need to supply energy to all the inhabitants of the globe. The meeting ended with an appeal, made on behalf of all poor countries, to the world's nations to cooperate in building a new planetary order of growth and development, in which energy must be seen as having a role of primary importance. The Academy will probably return to this vital question in the near future.

Food and Nutrition

The Pontifical Academy of Sciences has always been interested in scientific problems concerning development. This interest increased after the Encyclical of Paul VI, *Populorum Progressio*. It is known that among the principal factors which hinder or retard development are inadequate nutrition and malnutrition. The Academy has held a series of meetings to study

³⁰ *Scripta Varia*, 57, XIII-615 (Vatican City, 1986).

the possibilities of overcoming these difficulties. One of the topics discussed was agricultural production and its improvement as a basis for assuring food for everyone and thus for combating hunger in the world. From the first study week on 'The Problem of Oligoelements in the Vegetal and Animal Life' in 1955, the Academicians went on to one on 'Organic Matter and Soil Fertility' in 1968, on 'Modern Biology Applied to Agriculture' in 1983 and on 'Agriculture and the Quality of Life' in 1988. In the same way, recognising the nutritional and immunologic benefits of breastfeeding to infants and the health benefits of lactation to mothers, the Academy held a meeting in 1995 on 'Breast-feeding: Science and Society'. The last meeting in the field of food and nutrition was held in 1999 and was dedicated to 'Food Needs of the Developing World in the Early Twenty-First Century'.

In the 1950s, scientific progress called attention to the function of small quantities of elements which are active in natural substances and generally in vegetable and animal tissues. The study week on 'The Problem of Oligoelements in the Vegetal and Animal Life'³¹ was oriented principally towards the problems of plant growth, that is, the influence of oligoelements on the development of plants, with major emphasis on agricultural productivity and an important field of the earth sciences – pedology and edaphology. On that occasion, when meeting the Academicians, Pius XII recognised the new importance of the subject, stressed that scientists are dedicated to the study of natural phenomena, and observed that the:

created world is a manifestation of the wisdom and goodness of God, for all things have received their existence from Him and reflect His grandeur. Each of them is, as it were, one of His words, and bears the mark of what we might call the fundamental alphabet, namely those natural and universal laws derived from yet higher laws and harmonies, which the labour of thought strives to discover in all their amplitude and their absolute character. For this reason, men and women of science have the mission to be the discoverers of the intentions of God. It pertains them to interpret the book of nature, to describe its contents, and to draw the consequences therefrom for the good of all (Address of 24 April 1955).

In 1968, the Academy addressed itself to the subject of 'Organic Matter and Soil Fertility',³² which was recognised as one of the essential factors of agricultural productivity at a time when little was known about it. It was necessary to clarify the function of organic matter in the soil, and it was recognised that this must be regarded as the basic and irreplaceable factor of

³¹ *Scripta Varia*, 14, XLVI-615 (Vatican City, 1956).

³² *Scripta Varia*, 32, LXXII-1018 (Vatican City, 1968).

fertility. The results that were achieved stimulated subsequent research in this field, and in particular into the strategies to be adopted for tropical agriculture. On that occasion, when meeting the Academicians, Paul VI affirmed that the Academy had been founded to provide 'proof of the love and respect' the Church felt for the scientific world. He restressed the commitment of the Church to scientific inquiry and stated that it could contribute to the 'religious and Christian progress of mankind'. The Pope went on to say that science must 'tend towards the good of all mankind' and observed:

Your subject, which is 'Organic Matter and Soil Fertility', is completely directed towards the good of men, nay rather, towards the integral and mutual development of mankind which we invoked, just a year ago, in our Encyclical Letter *Populorum Progressio*. To make the earth fruitful, producing bread for all its dwellers, to struggle against the sterility of desert wastes, to multiply agricultural products, to derive from man's labour easier and more abundant results, to make possible a victory over hunger which today still affects entire nations, to give hope and the means of subsistence to the ever increasing generations of men – such is your conquest, such your art, your mission, your crown! (Address of 27 April 1968).

A series of study weeks on the basic problems of agriculture included the April 1972 meeting on 'The Use of Fertilizers and its Effects in Increasing Yield with Particular Attention to Quality and Economy'.³³ The meeting stressed one aspect of agricultural production, namely the importance of qualitative and economic factors as opposed to quantitative ones. In this context, the participants took up the question of fertilisers, which make possible an increase in the quantity and quality of production, a development sought by developing countries. As regards a better use of fertilisers, it was agreed that new innovative techniques should be used. This was, in fact, what subsequently took place. The question of crop yields is also of great importance in relation to world population growth, and therefore a more scientific and rational use of fertilisers has been necessary. Here the education of farmers in accordance with the new techniques has been of primary importance, but this problem has not yet been solved. On that occasion, when meeting the Academicians, Paul VI confirmed the nobility of the scientific endeavour and praised the positive achievements of technical advance, which should conform to wisdom. They could also provide solutions to major problems, such as 'the drama of world hunger', a subject of great importance to the Church:

To make food resources proportionate to the growing population of the globe, to overcome malnutrition, and finally to enable less indus-

³³ *Scripta Varia*, 38, XCI-1423, 2 vols. (Vatican City, 1973).

trialised countries, the producers of agricultural goods, to enter world commerce in conditions that are not too inferior: all these ambitions are human in the first place, and aim at meeting in a more satisfactory way the requirements of social justice, either between sectors of production in regions of advanced industrial civilisation, or between the latter and populations that are mainly agrarian.

Much improvement in this area had been achieved through the application of science to agriculture:

Unquestionable progress has been made, thanks to your work. The new rural generations are aware of the distance that still separates them from urban life, and the advantages that advanced technology offers the latter. If they do not benefit from them to the same extent, they receive the gleanings, and exploit them. Thanks to mechanisation, they have been able to cultivate wider areas. By using fertilisers, they have increased and sometimes doubled their yields. They have learned to have their soil analysed in order to know what it is best suited for. They aim at specialisation. Though their numbers are small, they are able to provide for the feeding of denser and more demanding populations. Agriculture, once traditional and following a customary pattern, gradually becomes expert and technical. The peasant is replaced by the rural cultivator.

But there remained a great deal to be done:

You will have to carry out, in the first place, a work of persuasion, by means of varied, but conclusive experimentation. For the peasant, even if uneducated, or even illiterate, believes in what he has seen. Your research will teach him not to exhaust a soil that is already too poor, by exploiting it excessively or in too primitive a way, to balance the rotation of his crops in order to be less the victim of climatic uncertainties, to adapt the use of fertilisers to the conditions of the land and the climate. One thing is certain: too large a part of the earth is not rationally exploited. The first act of the struggle against hunger consists in getting the soil to produce everything it can: this is part of your competence.

In conclusion, Paul VI said that:

If you succeed in convincing not only the farmer stooped over his desolate land, but first of all those in charge of the national economy, a great step forward will have been taken. Having improved his conditions of material life, the Indian, African, South American peasant will at least be able to acquire more fully the goods of the spirit to which he aspires, a culture that is not copied from others but is specifically his, which will allow him, too, to rise above himself and become more of a man (Address of 15 April 1972).

Since the neolithic period, some ten thousand years ago, agriculture has represented the main link between man and nature and constituted his principal source of food. The growth of humankind since then has been made possible by a parallel development of agriculture through a continuous input of experience and (later) of science and technology. At the present time, when hunger, malnutrition and famine still exist, the products of world agriculture could be sufficient to cope with the needs of humankind. This is especially the case in the poorer regions of the world, in particular in Africa and South America. The Academy organised a study week on 'Agriculture and Quality of Life'³⁴ in October 1988. The object of this meeting was to propose more efficient systems for tropical agriculture and resource management which would also defend the environment. John Paul II addressed the participants on the grave problem of hunger and malnutrition in the world and added that the question of development required 'above all a political will and action of an ethical and cultural nature':

The key to all human development is to be found in a generous effort of solidarity among all groups and all men and women of goodwill. With good reason did you stress that the necessary interventions with regard to this grave question should respect individuals and their own traditions, that is to say, they should go beyond the strictly economic and technical levels and take into consideration the principles of social justice and of the authentic development of the human person (Address of 31 Oct. 1988).

Following this appeal of the Holy Father, in January 1999 the Pontifical Academy of Sciences organised a study week on the subject 'Food Needs of the Developing World in the Early Twenty-First Century'.³⁵ This meeting gathered together agronomists, genetists, agrarian economists, demographers, and many others – almost thirty people from ten countries, many of whom belonged to important international institutions (FAO, the World Bank, the International Research Institute on Rice, the International Research Institute on Maize, etc.). The conference should be seen as following on from a similar initiative held in 1988 which examined the global developments of agriculture and quality of life. On this occasion, however, the focus was more specific, and concerned essentially the so-termed problem of 'hunger in the world' and the solutions which could be found to this problem in the realm of agriculture. A sensitive subject which gave rise to a certain anxiety was the attitude to be adopted towards biotechnology, and in particular towards genetic engineering. Quite apart from the technical aspects and the comparative

³⁴ *Scripta Varia*, 77, xxiii-343 (Vatican City, 1993).

³⁵ *Scripta Varia*, 97, xii-475 (Vatican City, 2000).

assessment of respective advantages and disadvantages, the tendency towards increased private investments in this area gave rise to concern. The need to examine the ways by which developing countries could gain access to these new forms of technology was deemed urgent. In general, this requires finding the right methods by which to balance general public interest with the search for gain by private individuals or companies.

During the plenary session of the Jubilee Year 2000, the Academy produced a 'Statement' on the use of 'genetically modified food plants'³⁶ to combat hunger in the world. This document expressed the concerns of the scientific community about the sustainability of contemporary agricultural practices and whether the techniques would be effective. At the same time, it stressed the need for the utmost care in the assessment and evaluation of the consequences of each possible modification, and on this point we cannot but recall the exhortation of John Paul II regarding biotechnologies made in his speech of 11 November 2000 on the occasion of the Jubilee of the Agricultural World: 'they must be previously subjected to rigorous scientific and ethical control to ensure that they do not give rise to disasters for the health of man and the future of the earth'. The document also expressed concern about excesses in the establishment of 'intellectual property' rights in relation to widely used crops – excesses which could be detrimental to the interests of developing nations. The Academy will devote an *ad hoc* meeting to the subject of genetically modified food plants in the near future.

Resources and Population

The question of food and nutrition is closely connected with that of resources and population. The Academy organised a study week on this very subject in November 1991. The papers and deliberations of this conference were subsequently published by Oxford University Press³⁷ and received a great deal of attention. In a closely argued address, the Pope observed that the 'relationship between the accelerated increase in world population and the availability of natural resources' was of great concern to contemporary society. He then stressed that 'human society is first and foremost a society of persons, whose inalienable rights must always be respected' and called for educational advance, an improvement in the condition of women, greater moral responsibility, the defence of the environment, and a 'redistribution of economic resources'. He emphasised, in particular, the importance of solidarity, upon which 'the solution to the questions with which you are dealing depends'.

³⁶ *Scripta Varia*, 99, xv-526 (Vatican City, 2001), pp. 516-526.

³⁷ 'Resources and Population', *Scripta Varia*, 87, xxiv-338 (Oxford, 1996).

Overall reform had to be based upon ‘personal renewal’, which was a task first of all for the family, which in turn had to adhere to a ‘balanced attitude towards procreation’ (Address of 22 Nov. 1991).

Breast-feeding: Science and Society

In his address to the international conference on population and development of March 1994, John Paul II referred to how ‘attention should be given to the positive benefits of breastfeeding for nourishment and disease prevention in infants, as well as for maternal bonding’. The Academy took up this question in its meeting on ‘Breast-feeding: Science and Society’³⁸ of May 1995. In his address to the members of the working group, the Pope observed that breastfeeding has both immunological and nutritional effects and can ‘create a bond of love and security between mother and child’ and added:

As scientists you direct your enquiry towards a better understanding of the advantages of breast-feeding for the infant and for the mother. As your working-group can confirm, in normal circumstances these include two major benefits to the child: protection against disease and proper nourishment. Moreover, in addition to these immunological and nutritional effects, this natural way of feeding can create a bond of love and security between mother and child, and enable the child to assert its *presence as a person* through interaction with the mother. All of this is obviously a matter of immediate concern to countless women and children, and something which clearly has general importance for every society, rich or poor. One hopes that your studies will serve to *heighten public awareness of how much this natural activity benefits the child and helps to create the closeness and maternal bonding* so necessary for healthy child development. So human and natural is this bond that the Psalms use the image of the infant at its mother’s breast as a picture of God’s care for man. So vital is this interaction between mother and child that my predecessor Pope Pius XII urged Catholic mothers, if at all possible, to nourish their children themselves. From various perspectives therefore the subject is of interest to the Church, called as she is to concern herself with the sanctity of life and of the family (Address of 12 May 1995).

John Paul II observed that the whole question was bound up with the sanctity of the family and concluded by observing that this issue brought out the urgent need for a ‘radical re-examination of many aspects of pre-

³⁸ *Food and Nutrition Bulletin*, vol. 17, 4, Dec. 1996 (United Nations University Press).

vailing socio-economic patterns of work, economic competitiveness and lack of attention to the needs of the family’.

The Environment

The protection of the environment is today a priority in research and action to avoid the disruption of the ecosystems forming the biosphere and thus the construction of an unlivable planet. In 1983, the Academy carried out a specific study on the damage done to the environment by the increase in carbon dioxide and by the thinning of the ozone layer (‘Chemical Events in the Atmosphere and their Impact on the Environment’).³⁹ Given that this topic merits the most careful attention and is one of very great importance at the present moment in the history and development of our modern world, concern about this problem was clearly expressed by Pope John Paul II in his address to the Academy:

The harmonious relationship between man and nature is a fundamental element of civilisation, and it is easy to grasp all the contribution that science can bring in this field of *ecology*, in the form of defence against violent alterations of the environment and of growth in the quality of life through the humanisation of nature (Address of 28 Oct. 1986).

The Pontifical Academy of Sciences, which since 1970 had been studying the scientific problems connected with ecology, followed the Pope’s suggestion and immediately organised a study week on ‘A Modern Approach to the Protection of the Environment’,⁴⁰ which took place on 2-7 November 1987. On this occasion, when meeting the participants, the Pope expressed the following clear principle:

Science is a human work and must be directed solely to the good of humanity. Technology, as the transfer of science to practical applications, must seek the good of humanity and never work against it. Therefore science and technology must be governed by ethical and moral principles.

As a consequence: ‘Theory aimed only at profit has produced in the last century a technology that has not always respected the environment, that has led to situations causing great concern by reason of the irreversible damage done, both locally and worldwide’. Many people have contributed to the attempt to protect the environment, but the skill and goodwill of individual experts and scientists cannot on their own solve this complex problem. For John Paul II:

³⁹ *Scripta Varia*, 56, XII-702 (Vatican City, 1985).

⁴⁰ *Scripta Varia*, 75, XXI-606 (Vatican City, 1989).

Profound worldwide economic and moral changes must be dealt with at the level of groups and communities and governments, which must include interregional and international exchanges and agreements. Fundamental to this action is educating people about the environment and creating an attitude of understanding, respect, and genuine goodwill (Address of 6 Nov. 1987).

The Academy returned to the subject of the environment in May 1990 in a study week on 'Man and His Environment',⁴¹ It focused in particular on how modifications to the biosphere – most of them the result of human activity – had reached a stage and a magnitude that were cause for the utmost alarm. When the Supreme Pontiff received the participants, he deplored the depletion of the 'earth's tropical biodiversity' and tropical forests. The unjustified search for profit was one factor behind these phenomena; the fight against poverty another; the consequences of Third World debt yet another. John Paul II argued that man was a steward of nature and his stewardship had to conform to divine will; thus 'ecological commitment' formed a part of man's 'responsibilities within God's designs' (Address of 18 May 1990).

Three years later the Academy established a working group to address the question of 'Chemical Hazards in Developing Countries'.⁴² The aim of the subsequent meeting was to obtain an overview of chemical pollution and concomitant health hazards in developing countries, and to discuss possible measures to protect the environment, the food chain, and human health and welfare. In his address to those taking part in the meeting, John Paul II stressed the harmful effects of chemical pollution, especially in developing countries, and observed that industrialised countries had a high moral duty 'to assist the developing countries in their efforts to solve their chemical pollution and health hazard problems'. In addition, the international community had to defend and promote the environment at a time when the balance of ecosystems was of great importance for the future of 'human survival and well-being'.

During a study week held in March 1999 on 'Science for Survival and Sustainable Development',⁴³ the Academy also dealt with the criteria of chaos and the fact that the interaction between life and the planet is governed by non-linear effects, where small causes and minor variations can lead to disproportionate consequences. John Paul II stated that:

People sometimes have the impression that their individual decisions are without influence at the level of a country, the planet or the cosmos. This could give rise to a certain indifference due to the

⁴¹ *Scripta Varia*, 84, xxxii-439 (Vatican City, 1994).

⁴² *Scripta Varia*, 90, xx-158 (Vatican City, 1996).

⁴³ *Scripta Varia*, 98, xxxii-427 (Vatican City, 2000).

irresponsible behaviour of some individuals. However, we must remember that the Creator placed man in creation, commanding him to administer it for the good of all, making use of his intelligence and reason. From this, we can be assured that the slightest good act of a person has a mysterious impact on social transformation and shares in the growth of all. On the basis of the covenant with the Creator, to which man is called to turn continually, everyone is invited to a profound personal conversion in their relationship with others and with nature. This will enable a collective conversion to take place and lead to a life in harmony with creation (Address of 12 March 1999).

The concern of the Academy with environmental questions was indicated once again in 2001 when it published, together with Cambridge University Press, a volume entitled *Geosphere-Biosphere Interactions and Climate*.⁴⁴ During this decade the Academy will continue to dedicate meetings and publications to the whole question of the environment, an issue which is becoming of ever greater importance to the future of mankind on the planet.

Outer Space

In the seventh book of Plato's *Republic* there takes place a dialogue between Socrates and Glaucon that is refreshing in its simplicity and yet captivating in its foreknowledge. The teacher and student agree that the study of astronomy should be pursued not only because it 'purifies' man's intelligence, obfuscated by daily burdens, but also because it helps humankind by bringing knowledge to military strategies, navigation, agriculture and weather prediction.⁴⁵ Space exploration characterised the last part of the twentieth century and has confirmed this idea, opening up new prospects for mankind at the beginning of the third millennium of Christian civilisation. In the present period of history, the use of space by satellites, and the exploration of the universe by means of spacecraft which transmit to earth the information obtained by closer observation, have been among the most important conquests of science and modern technology in expanding our knowledge about the universe. In October 1984, the Pontifical Academy of Sciences held a study week on the 'Impact of Space Exploration on Mankind'⁴⁶ to discuss this subject and to study future prospects. Naturally, some very important questions remain to be answered. For example, in our globalised world can the new space technologies help solve the growing problem of world hunger,

⁴⁴ *Scripta Varia*, 96, xxvii-302 (Cambridge, 2001).

⁴⁵ Plato, *Republic*, Bk. VII, 527d; cf. also 529b, 530b, 534a.

⁴⁶ *Scripta Varia*, 58, xxvi-364 (Vatican City, 1986).

remedy the present lack of infrastructures in the developing countries, and contribute to aid and education? Perhaps one of the central questions in this area is whom space belongs to, in particular because of the fact that property rights on the earth are based upon the notion of *res* – in space *res* does not exist. These important questions, and others, were discussed by John Paul II when he received the participants at the end of the meeting. The Pope rejoiced at the advances in man's knowledge about the nature of the universe, and in addressing to himself the question 'to whom does space belong?', he provided the following answer:

That space belongs to the whole of humanity, that it is something for the benefit of all. Just as the earth is for the benefit of all, and private property must be distributed in such a way that every human being is given a proper share in the goods of the earth, in the same way the occupation of space by satellites and other instruments must be regulated by just agreements and international pacts that will enable the whole human family to enjoy and use it. Just as earthly goods are not merely for private use but must also be employed for the good of neighbour, so space must never be for the exclusive benefit of one nation or social group. The questions of the proper use of space must be studied by jurists and given a correct solution by governments.

This new presence of man in space, with his satellites and other instruments, also involves other matters of a cultural, moral and political nature, as John Paul II pointed out:

One of the biggest tasks that can be carried out by the use of satellites is the elimination of illiteracy. About one billion people are still illiterate. Again, satellites can be used for a wider spreading of culture in all the countries of the world, not only in those where illiteracy has already been eliminated but also in those where many can still not yet read or write, for culture can be spread with the use of pictures alone. I hope that the scientific and technological progress which you are now discussing will cooperate in the spreading of a culture that will truly promote the all-round development of man.

Thus satellites should also be used to promote international dialogue and to support and defend the world's ecosystem. Equally, space technology must not be used by rich countries to 'impose their own culture on poorer nations'. A technology is required that will 'free the poor peoples and relieve oppressed nature, that will promote projects and agreements' (Address of 2 Oct. 1984). The impact of this address was attested to by the publication of an official document by the United Nations which this organisation distributed to all its member states.

A study week on 'Remote Sensing and its Impact on Developing Countries'⁴⁷ was held at the Academy in June 1986. Particular attention was paid, on the one hand, to the urgent need to set up a system of remote sensing for the developing countries, and on the other, to the economic, political and technical difficulties which hinder its realisation. When meeting the participants, John Paul II praised the advantages of the technique of 'remote sensing' and called for the application of modern technology to achieve a 'more just form of worldwide co-existence'. The resources of science could be employed to 'feed the whole human family' but the political will was often lacking. The resources of space should be utilised to unify 'the human family in justice and peace'. His Holiness concluded by affirming that national and international economic powers should serve everyone but especially those whose lives are 'particularly threatened and who need assistance to secure their very survival and the means of living in a way consonant with human dignity' (Address of 20 June 1986).

The Jubilee Plenary Session and Other Questions

During the 1980s and 1990s, the Academy held plenary sessions and study weeks on the questions of 'Persistent Meteo-Oceanographic Anomalies and Teleconnections',⁴⁸ 'Future Trends in Spectroscopy'⁴⁹ and 'The Emergency of Complexity in Mathematics, Physics, Chemistry and Biology'.⁵⁰ The subjects of artificial fertilisation, cloning, and genetic manipulation were also considered. These were subjects which increasingly involved issues of an ethical character (bioethics) and which drew scientists, philosophers and theologians together into dialogue. During these years, although the usual practice of involving various disciplines was maintained, the research and the debates of the Academicians were also directed in a special way towards reflection on the anthropological and humanistic dimensions of science.

On the basis of the anthropological considerations offered by John Paul II for an epistemological view of science, in October 1998 the Academy addressed the subject of the 'Changing Concepts of Nature at the Turn of the Millennium'.⁵¹ This meeting took into account the contemporary challenges to this concept, fully bearing in mind, however, the trajectories and heritage of the

⁴⁷ *Scripta Varia*, 68, xxvii-676 (Vatican City, 1987).

⁴⁸ *Documenta*, 17, xix-663 (Vatican City, 1988).

⁴⁹ *Scripta Varia*, 81, xix-332 (Vatican City 1989; coedition with the Pergamon Press).

⁵⁰ *Scripta Varia*, 89, xvi-472 (Vatican City, 1994).

⁵¹ *Scripta Varia*, 95, xxxix-340 (Vatican City, 2000).

past. When John Paul II met the participants he cited his Encyclical *Fides et Ratio* and recalled the historical development of the concept of nature down the centuries to St. Thomas Aquinas. The concept of human nature has a biological basis but also a cultural aspect and to the knowledge of nature that we gain through reason must be added the knowledge gained by faith. The Pope stressed that 'this rational knowledge does not ... exclude another form of knowledge, based upon revealed truth and on the fact that the Lord communicates with men' (Address of 27 Oct. 1998).

In November 1999, a working group was convened on the subject of 'Science for Man and Man for Science', and the Jubilee plenary session of November 2000 was dedicated to the subject 'Science and the Future of Mankind'.⁵² The two meetings dealt with very similar subjects, indeed the first was intended to prepare the ground for the second. Both these meetings addressed two topics which the Academy had been subjecting to debate for some time. On the one hand, there is the original relationship that the human being has with science, which, as the work of man, should always be at the service of human development. On the other, there is science, which, even when it deals with topics which are not specifically human, has, and expresses, an idea of man. In his address to the participants during the Jubilee plenary session, John Paul II explained that it is reductive to limit reflection on the humanistic dimension of science understood as 'the ethical responsibility of scientific research because of its consequences for man', which might lead 'some people to fear that a kind of 'humanistic control of science' is being envisaged'. The humanistic dimension of science, on the contrary, 'involves bringing to the fore an 'inner' or 'existential' aspect ... which profoundly involves the researcher and deserves special attention'. For the Pope, '*Truth, freedom and responsibility are connected in the experience of the scientist*' and in the objectivity of reality. Thus the scientist's research involves:

a duty to serve more fully the whole of mankind ..., the ethical and moral responsibilities connected to scientific research can be perceived as a requirement within science, because it is a fully human activity, but not as control, or worse, as an imposition which comes from outside. The man of science knows perfectly, from the point of view of his knowledge, that truth cannot be subject to negotiation, cannot be obscured or abandoned to free conventions or agreements between groups of power, societies, or States. Therefore, because of the ideal of service to truth, he feels a special responsibility in relation to the advancement of mankind, not

⁵² *Scripta Varia*, 99, xv-526 (Vatican City, 2001).

understood in generic or ideal terms, but as the advancement of the whole man and of everything that is authentically human. Science conceived in this way can encounter the Church without difficulty and engage in a fruitful dialogue with her (Address of 10 Nov. 2000).

At the end of this meeting the Academy issued a Study-Document on the 'Use of 'Genetically Modified Food Plants' to Combat Hunger in the World', which was followed in November 2001 by a statement on 'The Challenges for Science: Education for the Twenty-First Century'⁵³ issued after the workshop held on the same subject. This statement stressed that education in science for all girls and boys is a human right, ever more so in the knowledge-based society of the future. This is because unlike the possession of material goods, knowledge, when shared, grows and develops and can contribute to the solution of the acute problems facing humanity (world peace, poverty, disease, food, water, energy, space and the environment).

With the authorisation of the President of the Pontifical Academy of Social Sciences, we have also decided to publish the papal addresses to this sister Academy. It can be said, in a general sense, that the Pontifical Academy of Social Sciences grew out of the Pontifical Academy of Sciences, which previously also covered the field of human sciences. Fully sensitive to the importance of the modern social sciences, John Paul II wanted to found a new Academy devoted to these new branches of knowledge in the same way that Pius XI had refounded the Pontifical Academy of Sciences. The President of the Pontifical Academy of Social Sciences since its foundation, Prof. Edmond Malinvaud, has written an introduction to the papal addresses to this new Academy, which is printed at the beginning of the second part of this volume containing the addresses of John Paul II to the Pontifical Academy of Social Sciences.

In expressing his admiration for, and in offering encouragement to, the brave pioneers of scientific and social research, to whom humanity owes so much of its current development, John Paul II, in his most recent Encyclical *Fides et Ratio*, urged them:

to continue their efforts without ever abandoning the *sapiential* horizon, so that scientific and technological achievements are wedded to the philosophical and ethical values which are the distinctive and indelible mark of the human person.⁵⁴

As we can readily understand from the events described in this introduction, there has often been a process of ebb and flow between the work of

⁵³ *Scripta Varia*, 104, XXII-292 (Vatican City, 2002).

⁵⁴ *Fides et Ratio*, Conclusion, n. 106.

the Academy and the Magisterium of the Popes. Indeed, this Pontiff and his predecessors have at times raised the conclusions of the Pontifical Academy of Sciences and the Pontifical Academy of Social Sciences to the level of teachings for the salvation of man.

Acknowledgements

In publishing these papal addresses and documents, which are offered in particular to the entire scientific community, the Pontifical Academy of Sciences wishes to express to the Supreme Pontiffs, their authors, its feelings of deeply-felt gratitude and profound admiration. In particular, the Academy wishes once again to thank John Paul II not only for his important addresses but also because, just as Pius XI gave it its new buildings, he has supported and followed their restoration, which, it is hoped, will be completed in 2003, when the Academy will celebrate its four-hundredth anniversary. In a recent letter written fifteen days before his death, which he hoped would be shown to the Holy Father, the Academician and Nobel Prize winner, Prof. Max Perutz, declared that his membership of the Academy had been a very great privilege because this institution was truly international in character and covered all the natural sciences during its deliberations, meetings and conferences. It was his strong hope that the Holy Father and his successors would continue to give the Academy their support. Remembering as we do this distinguished scientist in our prayers, let us make this our hope as well.

✠ Marcelo Sánchez Sorondo
Bishop Chancellor of the Pontifical Academy of Sciences

ADDRESSES
OF
HIS HOLINESS POPE BENEDICT XV



His Holiness Benedict XV



His Holiness Benedict XV

BENEDICT XV (1914-1922)

His Holiness Benedict XV (3 Sept. 1914-22 Jan. 1922) was born in Genoa on 21 November 1854, of an old patrician family. Giacomo Della Chiesa graduated as a doctor of civil law at Genoa University in 1875, and then studied at the Capranica College and the Gregorian University, Rome. After ordination on 21 December 1878, he trained (1878-82) for the papal diplomatic service at the Academy of Noble Ecclesiastics. From 1883 to 1887 he was secretary to Mariano Rampolla, then Nuncio to Spain. When Rampolla became Secretary of State and Cardinal in 1887, Della Chiesa remained with him, being promoted Under-Secretary of State in 1901 and continuing in this office when Rampolla was succeeded by Rafael Merry del Val in 1903. Pius X appointed him Archbishop of Bologna in 1907. Only in May 1914 did Pius name him Cardinal, and three months later he was elected Pope, at a time when Europe was plunging into armed conflict. Benedict XV's reign was inevitably overshadowed by the war and its consequences. While protesting against inhuman methods of warfare and the unethical application of science to the practice of war, he maintained strict neutrality and abstained from condemning any of the belligerents. In the early years of the conflict he concentrated on alleviating suffering, opening a bureau at the Vatican for reuniting prisoners-of-war with their families and persuading Switzerland to receive soldiers of any country who were suffering from tuberculosis. On 1 August 1917, however, he dispatched to the Allies and the Central Powers a seven-point plan proposing a peace based on justice rather than military triumph, but it failed to be implemented. His long diplomatic training thus failed to bear fruit. In addition he was allowed no part in the peace settlement of 1919, the Allies having secretly (Treaty of London: Apr. 1915) agreed with Italy that the Vatican should be excluded. He himself believed that the settlement was seriously flawed.

After the war, Benedict XV pleaded for international reconciliation (*Pacem Pulcherrimum Dei Munus*; 23 May 1920) and although critical of some of its aspects gave general support to the League of Nations. He worked to reconstruct Church-State relations in the new States which had emerged, and sent Achille Ratti (later Pius XI) as Apostolic Visitor to Poland

and Lithuania in 1919; in 1920 he also sent Eugenio Pacelli (later Pius XII) as Nuncio to Germany. Benedict XV was concerned about the new concordats which the freshly drawn map of Europe made desirable and devoted his last consistorial allocution (21 Nov. 1921) to this problem. His reign also saw a notable rise, from fourteen in 1914 to twenty-seven in 1922, in the number of countries which were diplomatically represented at the Holy See – they included Great Britain, which in 1915 sent a chargé d'affaires to the Vatican, the first since the seventeenth century. Relations with France, breached since 1905, were resumed and an ambassador extraordinary was appointed in 1921. Although Benedict XV himself found no solution to the Roman question, he prepared the ground for its later development. He put out feelers, through Secretary of State Pietro Gasparri on 28 June 1915 and Cardinal Bonaventura Cerretti in Paris in June 1919, which signaled the Vatican's readiness for a honourable settlement, gave his blessing to the Popular Party founded by Don Luigi Sturzo in January 1919, thereby effectively abolishing the *Non Expedit*, and lifted (May 1920) the Vatican's ban on official visits to the Quirinal (once the summer residence of the Pope, but since 1870 the official residence of the King of Italy) by heads of Catholic States.

On 28 June 1917, Benedict XV promulgated the new code of canon law which was in large part completed by Pius X and in September he appointed a commission to interpret it. Starting with his first Encyclical *Ad Beatissimi Apostolorum* (1 Nov. 1914), he also successfully called a halt to the bitter animosity between traditionalists and modernists. Like other Popes, he dreamed of reunion with the separated Churches of the East and the outbreak of the Russian Revolution made him think that the moment for this had arrived. To assist the process he established (1 May 1917) the Congregation for the Oriental Church and set up (15 Oct. 1917) the Pontifical Oriental Institute in Rome; on 5 October 1920 he also declared St. Ephraem, the Syrian exegete and theologian (c. 306-73), a Doctor of the Church. The war created a host of problems in the mission field and Benedict came to be called 'the Pope of missions', partly because of his constructive interest in them but also because of his letter *Maximum Illud* (30 Nov. 1919), in which he urged missionary bishops to push forward with the formation of a native clergy and to seek the welfare of the people among whom they worked rather than the imperialist interest of their own country of origin. Benedict XV died unexpectedly early, at the age of 67. Two years before, the Turks had erected a statue of him (by Canarica) in Istanbul which saluted him as 'the great pope of the world tragedy ... the benefactor of all people, irrespective of nationality or religion'.

According to testimony left by Padre Giuseppe Gianfranceschi, the subsequent President of the Pontifical Academy of Sciences and the New

Lynxes, Benedict XV was convinced after the war that science could play a vital role in world reconstruction, the achievement of peace, and the advance of civilisation. He believed that the Pontifical Academy could be an important instrument in this initiative, not least because of its international and interdisciplinary character. He agreed with Gianfranceschi's view that it should be renewed and enlarged, and made him President in 1921 with this project in mind. Benedict XV also thought that the Academy could prove useful in restoring international scientific relations after the severe disruptions of the Great War. His project to provide new material and economic support was frustrated by his early death, and it fell to his successor, Pius XI, to realise his ideas and plans.

1 AUGUST 1917

Note to the Heads of the Belligerent Peoples

At the height of the First World War Benedict XV addressed this open letter to the heads of the peoples engaged in this international conflict. However, this letter, which expressed to the full Benedict XV's horror at the carnage and slaughter of the Great War, failed to be acted upon at an international level. Although this initiative failed, in his own Vatican sphere of activity the Pope was able to promote a revival of the Pontifical Academy of Sciences. He believed that science could have an important role in securing reconstruction and progress after the war, and saw in the Academy a vehicle by which to bring together scientists from around the world in a common effort to achieve what he had called for in his letter: 'a just and lasting peace'.

From the beginning of our pontificate, amidst the horrors of the terrible storm which has fallen on Europe, we have sought three things above all: to preserve complete impartiality in relation to all the belligerents, as is appropriate to he who is the common father and who loves all his children with equal affection; to endeavour constantly to do all the most possible good, without personal exceptions and without national or religious distinctions, a duty which the universal law of charity, as well as the supreme spiritual office entrusted to us by Christ, dictates to us; and lastly, to engage in an assiduous commitment, as our peacemaking mission equally demands, to leave nothing undone within our power which could assist in hastening the end of this calamity by trying to lead the peoples and their heads to more moderate forms of counsel, to the calm deliberations of peace, of a 'just and lasting peace'.

Whoever has followed our work during the three unhappy years which have just elapsed has been able to recognise that we have always remained faithful to the intention of absolute impartiality and to doing good, and thus we have never ceased to exhort the belligerent peoples and governments to become brothers once again, even though all that we have done to attain this most noble end has not always been made public.

At the end of the first year of war, in addressing to them the most forceful exhortations, we also identified the road to follow to achieve a peace which was lasting and dignified for all. Unfortunately, our appeal was not listened to: the war continued fiercely for another two years with all its horrors; it grew worse and indeed it extended by land, sea and even air, where on defenceless cities, on quiet villages, on their innocent inhabitants, there descended desolation and death. And now nobody can imagine for how long these shared evils will multiply and become worse, whether for a

few more months, or even worse whether another six years will become added to these bloodstained three years. Will the civilised world, therefore, be reduced to a field of death? And will Europe, so glorious and flourishing, almost overwhelmed by a universal madness, rush to the abyss, to its true and authentic suicide?

In such a highly worrying state of affairs, in the face of such a grave threat, we, not for mere particular policies nor in response to the suggestion or interest of one of the belligerent parties, but moved solely by awareness of the supreme duty of the shared Father of the faithful, by the sighs of children who invoke our action and our peacemaking word, of the very voice of mankind and reason, raise once again the call for peace, and renew a warm appeal to those who hold in their hands the destiny of the nations.

But no longer to dwell upon the general, as the circumstances suggested to us in the past: we want now to descend to more concrete and practical proposals, and to invite the governments of the belligerent peoples to agree upon the following points, which appear to be the bases of a just and lasting peace, leaving to the same governments to apply them at a specific level and to complete them.

First of all, the fundamental point must be that for the material force of arms should be substituted the moral force of law; hence a just agreement by all for the simultaneous and reciprocal reduction of armaments, according to rules and guarantees to be established to the degree that is necessary and sufficient for the maintenance of public order in each State; then, instead of arms, the institution of arbitration, with its lofty peacemaking function, according to standards to be agreed upon, with sanctions to be decided against a State which refuses either to submit international questions to arbitration or to accept the decisions of such arbitration.

Once the supremacy of law has been established, let every obstacle to the ways of communication between peoples be removed through the true freedom and common use of the seas. This would, on the one hand, remove very many reasons for conflict, and, on the other, open up new sources of prosperity and progress for all.

With regard to the damage and costs of war, we do not see any other path than that of the general rule of an entire and mutual remission, justified, for that matter, by the immense benefits of disarmament; and this is even more the case because one cannot understand the continuance of so much slaughter solely for reasons of an economic character.

If in some cases special reasons are in opposition to this, these should be considered with justice and fairness.

But these peaceful agreements, with the immense advantages that flow from them, are not possible without the mutual return of territories which

are presently occupied. Therefore, with regard to Germany, there should be a total evacuation both of Belgium, with the guarantee of her full political, military and economic independence in relation to any power, and also of French territory; from the party on the other side there should be equal return of the German colonies.

With regard to territorial questions, such as those, for example, which cause strife between Italy and Austria, and between Germany and France, there is ground for hope that in consideration of the immense advantages of a lasting peace with disarmament, the conflicting parties will examine such territorial questions in a conciliatory frame of mind, taking into account, so far as this is just and practicable, as we have said on other occasions, the aspirations of peoples, and co-ordinating, where this is possible, their own interests with those shared by the great human community.

The same spirit of equity and justice should guide the examination of all other territorial and political questions, specifically those relating to Armenia, the Balkan States, and the countries which make up the ancient Kingdom of Poland, whose noble historical traditions and the sufferings it has undergone in particular during the present war ought rightly to enlist the sympathies of the nations.

Such are the principal foundations upon which we believe the future reorganisation of peoples should rest. They are of a kind which would make impossible the recurrence of such conflicts and would pave the way for a solution to the economic question, which is so important for the future and the material welfare of all the belligerent States.

In presenting them to you, who in this tragic hour hold in your hands the destinies of the belligerent peoples, we are animated by the dear and precious hope that they will be accepted, and that as soon as possible the end of this terrible struggle will be reached, a struggle which every day, even more, appears to be a useless massacre. All recognise, for that matter, that on both sides the honour of arms is saved. Here, therefore, our prayer: welcome the paternal invitation that we address to you in the name of the divine Redeemer, the Prince of peace! Reflect upon your most grave responsibility in front of God and all men! Upon your reflections will depend the peace and joy of innumerable families, the lives of thousands of young people, the very happiness of the peoples, which you have the absolute duty to secure. May the Lord inspire you in decisions which conform to His most holy will, and ensure that you, deserving the applause of the current age, will equally ensure that in future generations you will bear the name of peacemakers.

We in the meanwhile, fervidly joining ourself in prayer and penitence to all the faithful souls who sigh in peace, implore from the Divine Spirit light and counsel.

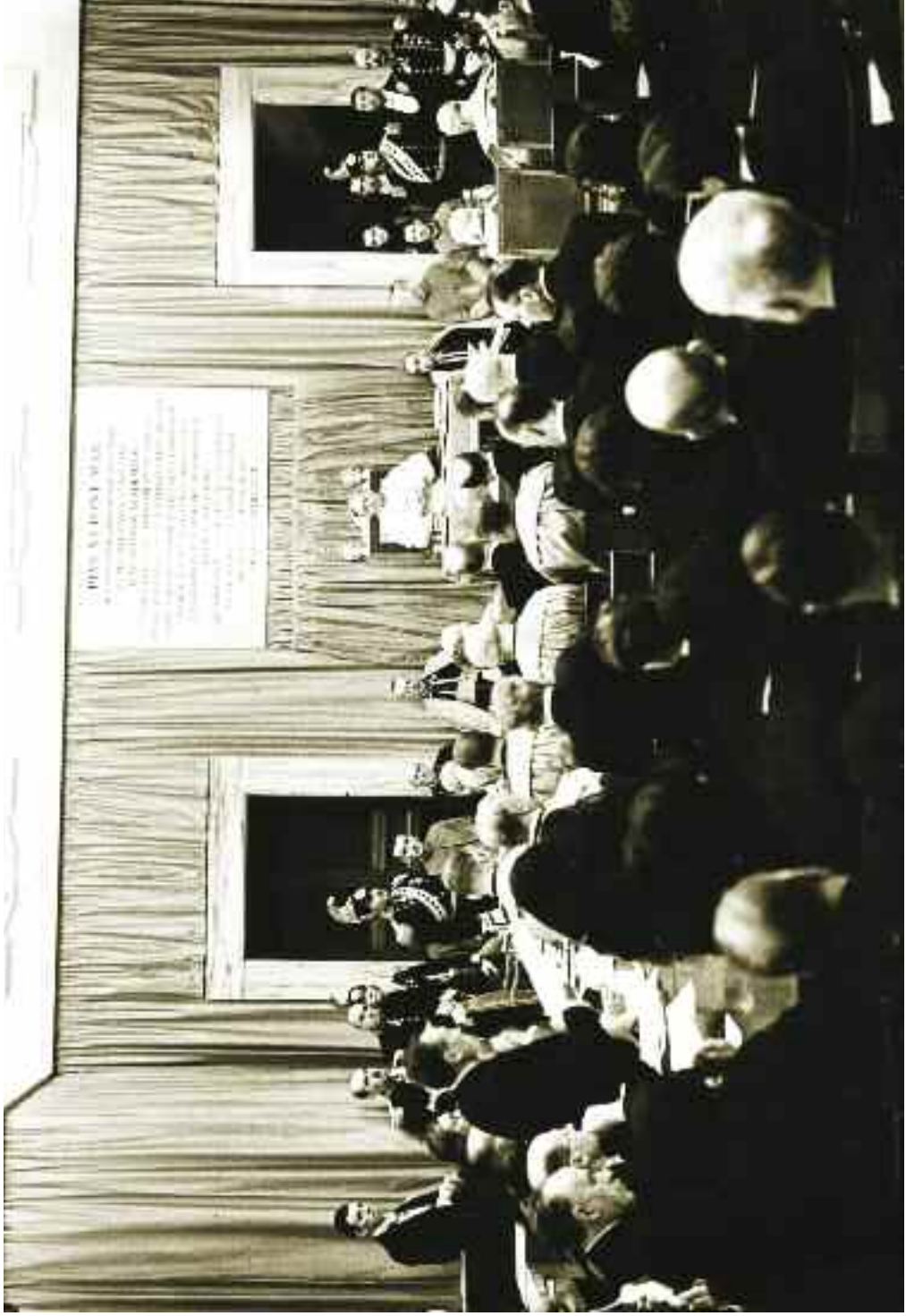
ADDRESSES
OF
HIS HOLINESS POPE PIUS XI



His Holiness Pius XI makes a radio broadcast from the Vatican on 12 February 1931, accompanied by Prof. Guglielmo Marconi, a Pontifical Academician, and Cardinal Eugenio Pacelli, subsequently Pope Pius XII



His Holiness Pius XI leaves the Pontifical Academy of Sciences,
Casina Pio IV, 30 January 1938



His Holiness Pius XI addresses the Members of the Pontifical Academy of Sciences, Casina Pio IV, 30 January 1938



His Holiness Pius XI addresses the Members of the Pontifical Academy of Sciences,
Casina Pio IV, 18 December 1938

PIUS XI (1922-1939)

His Holiness Pius XI (6 Feb. 1922-10 Feb. 1939) was born on 31 May 1857 at Desio, near Milan, the son of a silk-factory manager, Ambrogio Damiano. Achille Ratti was ordained on 27 December 1879 in the Lateran; obtained three doctorates at the Gregorian University, Rome; was professor 1882-8 at the seminary at Padua; and worked 1888-1911 at the Ambrosian Library, Milan. An expert paleographer, he edited the Ambrosian missal and published other works; in his spare time he was noted for being a keen mountaineer. Moving to the Vatican Library in 1911, he became its Prefect in 1914. In April 1918 Benedict XV, recognising his flair for languages, sent him as Apostolic Visitor to Poland, promoting him Nuncio and Archbishop of Lepanto in October 1919. He carried out his difficult mission with skill and credit, refusing to leave Warsaw in August 1920 when a Bolshevik attack threatened. Benedict XV then appointed him (13 June 1921) Archbishop of Milan and Cardinal, and the following year, at the conclave of 2-6 February, he was elected at the fourteenth ballot. Pius took as his motto 'Christ's peace in Christ's kingdom', interpreting it as meaning that the Church and Christianity should be active in, and not insulated from, society. Hence his inauguration in his first Encyclical (*Ubi Arcano Dei Consilio*; 23 Dec. 1922) of Catholic Action, i.e. the collaboration of members of the laity with the hierarchy in the Church's mission; his introduction of Catholic Action to numerous countries; and his encouragement of specialised groups such as the Jocists, a Christian youth organisation for workers. Hence, too, his institution of the feast of Christ the King (*Quas Primas*; 11 Dec. 1925) as a counter to contemporary secularism, and his employment for this purpose of the Jubilee years 1925, 1929, and 1933, as well as biennial Eucharistic congresses. The same theme, with different emphases, reappears in such Encyclicals as *Divini Illius Magistri* (31 Dec. 1929), on Christian education; *Casti Connubii* (30 Dec. 1930), defining Christian marriage and condemning contraception; *Quadragesimo Anno* (15 May 1931), reaffirming but going beyond Leo XIII's social teaching, and its supplement *Nova Impendet* (2 Oct. 1931), prompted by contemporary unemployment and the arms race; and *Caritate Christi Compulsi* (3 May 1932), a response to the contemporary world economic crisis. His numerous canonisations were also intended to promote the same religious ends.

They included John Fisher (1469-1535), Thomas More (1478-1535), John Bosco (1815-88), and Theresa of Lisieux (1873-97); he also declared Albertus Magnus (c. 1200-80), Peter Canisius (1521-97), John of the Cross (1542-91), and Robert Bellarmine (1542-1621) Doctors of the Church.

In dealing with political issues after the First World War, Pius was assisted by his able Secretaries of State, Pietro Gasparri (1922-30) and Eugenio Pacelli (1930-9; later Pius XII). To regularise the position and rights of the Church, he concluded concordats or similar agreements with some twenty States. In France he brought about a substantial improvement in Church-State relations, expressing in *Maximam Gravissimamque* (18 Jan. 1924) a practical accommodation on the difficult issues arising out of the Law of Separation of 1905. His most significant diplomatic achievement was the Lateran Treaty (11 Feb. 1929) which he negotiated with Benito Mussolini, Italian Prime Minister since 1922, which established the Vatican City as an independent and neutral State. For the first time since 1870, the Holy See recognised Italy as a kingdom with Rome as its capital, while Italy indemnified it for the loss of the Papal States and accepted Catholicism as the official religion of the State. As time went on Pius XI was increasingly worried about the threat of the new totalitarian States. His repeated efforts to check Soviet anti-Christian persecution had no effect and in *Divini Redemptoris* (19 Mar. 1937) he condemned atheistic communism as 'intrinsically perverse'. He negotiated (20 July 1933) a concordat with National Socialist Germany, but in the period 1933-6, because of its increasing oppression of the Church, he addressed thirty-four notes of protest to the Nazi government. The break came in 1937 when he ordered the Encyclical *Mit Brennender Sorge* (14 Mar.), denouncing repeated violations of the concordat and branding Nazism as fundamentally anti-Christian, to be read from all pulpits. In the twenties and thirties he protested several times against the fierce persecution of the Church in Mexico, and in April 1937 urged Mexican Catholics, when the situation had eased, to organise peacefully and promote Catholic Action. On 3 June 1933 (*Dilectissima Nobis*) he denounced the harsh separation between Church and State carried through in Spain by the Republican government. His attitude towards Italian Fascism, shaken in 1931 when Mussolini dissolved Catholic youth movements, dramatically hardened in 1938, when the regime adopted Hitler's racial doctrines.

Strongly committed to overseas missions, Pius XI required every religious order to engage in missionary work, with the result that the number of missionaries doubled during his pontificate. Following Benedict XV, he pressed on with developing an indigenous Catholicism, personally consecrating the first six Chinese bishops on 28 October 1926. This was followed

by consecrations of a native Japanese bishop (1927) and native priests for India, south-east Asia, and China (1933). In addition, the total of native priests rose during his pontificate from under 3,000 to over 7,000. He also founded a faculty of mission studies at the Gregorian University and a missionary and ethnological museum in the Lateran. His calls for reunion between Rome and Orthodoxy met with little response, but he was more successful in the attention he paid to the Uniate Churches of the east (i.e., the eastern-rite Churches in full communion with Rome). He also at first allowed, and then later approved, the conversations held between Catholics and Anglicans at Malines in 1921-6.

The first scholar-pope since Benedict XIV, Pius XI quietly eased the tensions arising from the Modernist debate. He considered the advancement of science and scholarship as a personal challenge as well as a part of the mission of his pontificate, and among other measures he modernised and enlarged the reading room of the Vatican Library; raised three of its most scholarly Prefects to the Cardinals' College; founded (Dec. 1925) the Pontifical Institute of Christian Archaeology; built the Pinacoteca for the Vatican collection of pictures; and moved the Vatican Observatory (equipped with new modern instruments) to Castel Gandolfo. He also instructed the Italian bishops to take proper care of their archives and radically reformed (*Deus Scientiarum*, 24 May 1931) the training and instruction of the clergy. His interest in modern scientific developments was reflected in his installation (1931) of a radio station in the Vatican City and he was the first Pontiff to use the radio for pastoral purposes.

Well informed about scientific research and eager to promote dialogue between faith and science at a moment when Positivism was advancing rapidly, Pius XI also refounded the Pontifical Academy of Sciences in 1936 with the idea that it would be the 'Scientific Senate' of the Church. Hostile to any form of ethnic or religious discrimination in deciding the composition of the Academy, he appointed over eighty Academicians from a variety of countries, backgrounds and areas of research, including such leading scientific figures of the day as: U. Amaldi, N. Bohr, A. Carrel, P.J.W. Debye, A. Gemelli, B.A. Houssay, G. Lemaître, G. Marconi, R.A. Millikan, T.H. Morgan, U. Nobile, M. Planck, E. Rutherford, E. Schrödinger, F. Severi, C.S. Sherrington, G. Vallauri, and P. Zeeman. Emphasising the need to develop the links between science and Christian humanism, he also made Cardinal G. Bisleti, Cardinal F. Marchetti Selvaggiani and Cardinal E. Pacelli (the future Pius XII), Honorary Members of the Academy. The goals and the hopes of the Academy, within the context of the dialogue between science and faith, were expressed by Pius XI in the *Motu Proprio* which led to its refoundation:

Amongst the many consolations with which divine Goodness has wished to make happy the years of our Pontificate, I am happy to place that of our having being able to see not a few of those who dedicate themselves to the studies of the sciences mature their attitude and their intellectual approach towards religion. Science, when it is real cognition, is never in contrast with the truth of the Christian faith. Indeed, as is well known to those who study the history of science, it must be recognised on the one hand that the Roman Pontiffs and the Catholic Church have always fostered the research of the learned in the experimental field as well, and on the other hand that such research has opened up the way to the defence of the deposit of supernatural truths entrusted to the Church ... We promise again, and it is our strongly-held intention, that the 'Pontifical Academicians, through their work and our Institution, will work ever more and ever more effectively for the progress of the sciences. Of them we do not ask anything else, since in this praiseworthy intent and this noble work is that service in favour of the truth that we expect of them'.

He was convinced that the truth was the highest form of charity, and he believed that the search for the truth was the principal task of the Academy. The importance he attributed to the refoundation was also reflected in his decision to locate the Academy in the sixteenth-century Renaissance villa, 'Casina Pio IV', situated in the Vatican gardens.

16 DECEMBER 1923

*'The Meaning of the Granting of the New Headquarters
of the Academy, Casina Pio IV'*

*Address to Inaugurate the Academic Year of the Pontifical Academy
of Sciences 'New Lynxes' and its New Buildings*

Pius XI stresses that science is 'true, most high wisdom'. Implicitly referring to the Church's commitment to such wisdom through her advancement of learning, he points out how the Academy is situated next to other institutions of learning of the Church (the Vatican Observatory, the Picture Gallery, the Archives, the Library, the Museum) and to a great centre of prayer – St. Peter's Basilica. Here, too, the human mind, through prayer, rises up, like science itself, to God.

Everything that we have seen and heard hitherto has filled our spirit with an increasing joy, the pure joy of the spirit that sees, that admires, truth in being; that admires the wonders of God in being and truth. All this has made us once again thank Blessed God, who inspired in us the thought of locating this – one can well say famous in the deeds of art – Casina Pio IV, our ancient and illustrious antecedent and fellow citizen who inaugurated it in 1591 and left it a real jewel of art, of a kind not frequent in so much completeness of architecture, we were about to say garden architecture, because it is a small villa, and it was exactly a small villa that was needed so that it could be suited to a garden... the thought, we were saying, of giving this small villa for the purposes of the work of our dear and glorious Pontifical Academy of Sciences, always of the New Lynxes.

We do not feel that we need to add anything else, except a word of sincere congratulations on all this glorious past, which today opportunely and rapidly has been re-evoked in our presence; a past which through various laborious and even distressing events, has been so full of fertile and luminous work; a past that finds confirmation and a worthy continuation in a present which is so much beyond any kind of praise, so that this continuation contains all the justification for, and trust in, a future which cannot but be worthy of such a past and such a present.

For that matter we must repeat rightly what the Ancients liked to say in their elegant search for harmony between words and things: *Est omen in nomine, est omen in loco.*

There is a hope and a wish in the name 'Lynxes'; the science of long sight, of farsighted and farseeing sight, always on the track of something that is beyond, further on, higher up; from the particular to the universal, from the effect to the cause, from the immediate causes to the remote causes, from the second causes to the primary causes, from the *Causa*

causarum, where your science, O beloved sons and most illustrious gentlemen, rises to the level and the substance of true most high wisdom, in which all treasures gather, in which all the treasures of our science acquire their highest appreciation, so as to be able to be rightly called: *Divitae salutis sapientia et scientia*.¹

Est omen in loco; a place of quiet. We have allowed ourself to congratulate ourself on this as well. This quiet, we were about to say mystical quiet, will also be useful in the meditation of the spirit, and thus in a deeper and clearer inquiry of the spirit itself. But even more the connections, the contiguity of this place, seem to us to have a special eloquence and contain a treasure of valuable promises, just as they contain the scientific pinnacles, that your, our, Academy had the happy idea of especially studying, drawing to them general attention. Contiguity: behind you, O beloved Academicians, there is the Vatican Observatory with its high-points of observation, of speculation and of calculation. In front of you, you have the Picture Gallery, the Archives, the Library, the Museum: all a treasure of science, of art, an incomparable mass abundant in treasures of every kind, and from which science and art will be able for a long time to draw sustenance. At your side is the really magnificent panorama of Monte Mario and the Via Trionfale, which announces to you new triumphs of science, and of truth as well.

On the other side the magnificent and always admirable cupola of St. Peter's, where, one would say, a supreme effort of art and of science wanted to bring nearer to the Creator, to the very feet of God, thought, the thinking and ascendant soul on the paths of the true; that magnificent monument to which are turned, and in which are gathered, the prayers of the whole Catholic world.

If, as we have heard with profound joy of the spirit, the most direct experiences also make thought the principal fulcrum of prayer, and these prayers correspond so well to the definition of prayer given by St. Thomas Aquinas himself, that great man whose centenary we have recently celebrated: *elevatio mentis in Deum*,² and given that the eyes of your science are turned towards, and open to, God, then it is fitting that this is in a place where with such a great mass and flight of prayer one rises to God.

It is with this happy wish and hope, and with this magnificent vision of past glories and of glories to come, that with heartfelt feelings we impart the Apostolic Blessing, which you ask of us, on your families, on everything you hold dear, that is to say – we feel this as clearly as you understand it – on your work, your successes, and your triumphs.

¹ Is 33:6.

² S. Th., II-II, 83, 13. Cf. Damasceno, *De fide orth.* 3:24.

14 DECEMBER 1924

*'The Mutual Kindred Tie Between Good and Truth'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

Pius XI praises the work of the Academy and observes that there is a mutual tie between good and truth, as the Academicians know because of their scientific activities.

The Holy Father said that after everything that had been shown to him and that he had heard, and in the subsequent communications and notes, which were so full of luminous rays and radiant hopes for the good not only of science but also of mankind, it seemed to him that there remained to him nothing else but to extend to his dear and good Academy all his congratulations, both on what, during this year of intense scientific activity, it had reaped in the field of study, and on all the treasures of good will that in the scientific world it was increasingly acquiring, and on the beautiful, valuable, new accessions as members, who today culminated in His Eminence Cardinal Ehrle.

In all this – the Holy Father continued – the suggestion and the core, the subject and the confidence of our good wishes, which in instinctive fashion come to add themselves to our congratulations, are a good thing. If the studies set in motion, the results obtained, the good will engendered, and the new strength of such valid new members come, so to speak, to the aid of our good wishes, then in an even more distinctive way will the Academy correspond to that high and noble scientific responsibility which has been now so suitably and deservedly remembered; so that to all the great reasons for trust in the beautiful, glorious, happy future of our dear Academy, many others will add themselves.

We are very happy that all this is taking place near to the Holy Jubilee Year, and to nobody present will this reference appear strange.

First of all, continued the Holy Father, the Holy Year represents for us in particular, a larger, warmer and more cordial assembly of the whole Catholic world; a union of prayers in conformity with our intentions, and naturally the good wishes that we extend to the Academy are a part of these intentions. But another reflection is even more comforting and very instructive. What is the Jubilee year if not a higher call, a more generous move towards a greater purification, a more sublime elevation, a more diligent search for, and practice of, good? And – as you know by happy experience – there is a mysterious mutual kindred tie between Good and Truth;

between them both there is an exchangeable correspondence and benefit. And thus the imminence of the Jubilee Holy Year is for you a trusting sign of an ever greater carrying out of good, to which you will give the best of your spiritual activity.

The Holy Father ended by saying that he wished and wanted his Apostolic Blessing, which he willingly imparted, to be once again a pledge and a sign, a new trust in the full carrying out of his intentions and his hopes and wishes.

27 DECEMBER 1925

'Truth as Beneficial Charity'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'

The Pope praises the Academy's search for truth and observes that Christ, who was the Word and Divine Truth, was a teacher who sent out his Apostles with the mandate to teach. The Church's historic commitment to learning is a part of the fulfilment of this mandate. His Holiness concludes by expressing the hope that the Academy 'will become an increasingly rich source of that beneficial charity which Truth is'.

What the good President said at the beginning of this really holy and blessed year is true. It has been a great, immense, celebration of Good, of really beneficial Good, of that Good, that is to say, which goes directly to souls and peoples. But also what takes place here, beloved sons, what you do, is also Good – the Good that is called truth, from which the Truth takes its name, form, appearance, but which is real Good, Good which is also specifically and valuably beneficial.

You brought to our mind – when you appeared to contrast truth, which you investigate, with good, in which Divine Goodness has enabled us to participate – of what the great Catholic writer, Alessandro Manzoni said about Federico Borromeo and the foundation of his dear 'Ambrosiana', which is also ours and so dear to us. This writer wrote: 'But think what a generous, judicious, benevolent, persevering lover of human improvement must have been the man who wanted such a thing, and wanted it in such a way, and carried it out amidst that ignorance and that inertia, that general antipathy for every scholarly application'. And yet today there are those who think that the money spent in that way constituted most beneficial alms.

But there is in this field an even higher and more sacred authority than the fine, pleasing, and kind figure of Cardinal Federico Borromeo.

There is God Himself who is called Truth. And that essential, divine generation that expresses all the perfection of the Divine Essence, the Word; and the Word means the Truth. And when God thought of saving the world it was the Word, it was Divine Truth, that came to save it. And when he was saving men, it was the title Teacher that most pleased him, and he accepted it and approved it: *Vocatis me magistrum et bene dictis; sum etenim.*¹ And when he sent out the Apostles to preach redemption to the world he gave them, before anything else, the mandate to teach: *Euntes*

¹ Jn 13:13.

docete.² This was really the cry of he who had said: the truth will make you free, *Veritas liberabit vos*.³

And thus it was that, in order to fulfil this very important part of their mission, the Roman Pontiffs, our glorious antecedents, so magnificently, so splendidly, and also so heroically, constantly acted to gather together in our admirable Vatican library those treasures of which you, Cardinal Ehrle, and we, after you, have been the fortunate custodians. When the Roman Pontiffs did this, they thought that they were carrying out a part, a very notable part, of their Apostolic Ministry.

And therefore we congratulate you with all our heart on that great good that you do here, on that which we have heard or now hear, on what you have gathered together in all the luminous fields of truth; and wishing and hoping that this Academy will become an increasingly rich source of that beneficial charity which Truth is, we with all our heart impart to you, to your work and to everything that each one of you most holds dear, our Apostolic Blessing.

² *Mt* 28:19. Cf. *Mk* 16:15 f.

³ *Jn* 8:32.

19 DECEMBER 1926

*'The Contribution of the Catholic Church to Truth'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

The Pope fully agrees with the view that the Catholic Church has made more of a contribution to science and art than any other institution.

The Holy Father said that first of all he wanted to express the whole of his deep pleasure and also – not as a mere form of speech but sincerely – his gratitude at the magnificent Christmas present and new year that the Academy of Sciences had wanted to present to him and offer him.

He added that the President had spoken words full of truth and of magnificent, most beautiful grandeur when he said that no institution known by history had made, as much as the Church of God, the Catholic Church, this Custodian of the revealed word of the Faith, such a valuable contribution to science, to art. And thus it filled the Holy Father with very pure joy to be able to present to his Pontifical Academy of Sciences his congratulations on such a broad, such a beautiful, and such a solid contribution made by it to demonstrating and confirming this truth.

His felicitations went first of all to those whom he called his 'evident gold medals' and then to the whole of the Academy and to all those who contributed so effectively to its work and took part in its aims. And in the same way as the felicitations of the Holy Father were sincere and grateful, so he was confident in his hope and wish that his dear Academy would continue to progress increasingly actively, increasingly resolutely, along the very beautiful path that it was already honourably following.

With these felicitations, and with this hope and wish, His Holiness extended his greetings to the Academy and all the Academicians, to their work and their families, to all that they carried in their mindful thoughts and to the affections of their hearts, with their wish for his Apostolic Blessing, which he most willingly imparted.

18 DECEMBER 1927

'Science Orders Life'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'

His Holiness declares that 'sciences order life' and observes that scholars who understand this truth make a 'valuable contribution to life itself through their activity'. He holds up Alessandro Volta as a model believer and scientist, and praises the discovery of the wireless, an instrument placed at the 'service of Christian truth'.

The Holy Father expressed all his satisfaction at finding himself at this meeting, and at having heard so many important communications by scholars who loved science, but who did not become arid within it because sciences order life; and they understood the whole of the meaning of this word by making a valuable contribution to life itself through their activity.

His Holiness observed that this meeting was taking place in the reflection of the centenary, which had already taken place, of Alessandro Volta, just as a year ago the other inaugural sitting had taken place during the preparations for the celebration of the centenary itself.

The Holy Father was happy about the years of fertile activity of the Academy which had been described by the President with very comforting numbers, which had a meaning of high poetry, the poetry of truth. Referring to the already mentioned centenary of Volta, His Holiness said that he had followed its celebration with keen interest and although he had not been able, as he once had been able in the quiet of his 'Ambrosiana' library to leaf through the papers of that great figure, he had read again with great pleasure a few pages of the magnificent edition of his works which had been produced specifically to record that event.

His Holiness was happy about the celebration of this centenary both by the Academy and by the whole world: not only because Alessandro Volta was from Como, which was particularly near to his heart because it was the land of his forefathers; not only because in addition to being a great scientist he was a great believer, and he did not only inherit the faith from his parents but wanted to study, know and acquire it personally with a reaction which was especially violent because it took place during the century of the Encyclopaedia; not only because he was an apostle of this faith, both teaching the small catechesis to young people – as Como still remembers – and calling souls to the faith by example and through writing, souls such as Silvio Pellico and that other who in the profession of faith by Alessandro Volta found the convincing reason to profess the faith as well; not only for

all these reasons was the Holy Father happy about the centenary of Volta but also because his invention, later expanded and made valuable by other inventions which improved and developed it, by Pacinotti, and by Marconi, placed an instrument of wonderful speed at the service of Christian truth so that it could be spread much more easily than was the case previously. The Holy Father, as Head of the Catholic Church, appreciated every day the valuable benefits of this incalculable advantage and gave thanks to the Lord, giving also well-deserved praise for it to the great genius of Como.

With these thoughts and feelings the Holy Father ended his address and imparted to the whole of the Academy and in particular on all those present his Apostolic Blessing.

16 DECEMBER 1928

*'The Importance of the Academy and the Vatican Observatory'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

Pius XI praises the work of the Academy and the Vatican Observatory, and lauds the achievements of General Nobile.

His Holiness said that he would most willingly give in a little while his Apostolic Blessing that the Reverend Father Gianfranceschi, the so worthy President of the Academy, had asked for, and would bestow it on the very noble work of the Academicians, both past and future, that is to say in particular on what they proposed for the now inaugurated new academic year.

But he wanted first – and he could not but want – to say a few words first of all out of that duty which is always pressing as soon as it presents itself, to express gratitude for the action of devoted sons, for the thought of referring to, of remembering through the work of the new academic year (in the splendours, therefore, of the sciences which were so well cultivated), the thought and the memory of his priestly Jubilee, a thought and a memory which were really those of so many inestimable and invaluable benefits that Divine witness and mercy had bestowed upon him.

To these words of thanks he had to add, and he did this with real paternal joy, most sincere words of congratulations on the scientific merits that during the last academic year as well they had so nobly accumulated in the field of knowledge. The Holy Father himself had been able to gain an idea with a glance, albeit rapidly engaged in, a really furtive glance amidst all the other concerns that the Ancients classically called *negotia* (and specifically as regards letters and sciences), at the two volumes that had been presented to him in such a devoted and filial fashion.

He could not, however, not remember another volume which modesty had prevented Father Hagen from remembering, but which was a part of the scientific domain of the academic family and the Vatican family itself, and more specifically of the Vatican Observatory. He meant to say the last and really glorious volume of the astrographic catalogue by which the completion of the glorious work of the Vatican Observatory was announced to the scientific world, a work carried out in collaboration with so many other distinguished observatories throughout the world, some of which, it is true, preceded it, but in such small numbers that the arrival of this last volume of Father Hagen should not be put amongst the arrival of the good last but

amongst the arrival of the good first; and it was for this reason that the Holy Father was very happy to extend to him his most keenly-felt congratulations.

His Holiness also felt the need to add further words to say how pleased and happy he was to be able to express here as well the feelings that had been generated in his spirit by that great undertaking whose planner and he could well say without exaggeration heroic executor, General Nobile, was there present. Those feelings which had constantly animated him and which certainly animate those who have a sense of the things that are really beautiful, really great, and really worthy of praise; he meant to say the appreciation of really great and important scientific results, even though not intended, as is said, for the general public, even though not having the virtues to gain that easy applause which fortunate even though not very worthy and not very useful undertakings easily secure: he meant to say sympathy for all those noble endeavours which are wisely prepared and carefully thought through for other ends and noble goals; he meant to say sincere applause for the employment of the high and great virtues of constancy, tenacity, real strength, patience, heroic resistance, virtues for that matter so generous and beneficial, and with such devoted feeling remembered, the virtues of human solidarity, human benevolence, human and Christian charity to help very great needs and very pressing necessities; he meant to say the admiration that nobody had been able to deny, and would ever be able to deny, to one of those great actions which reach the highest forms of beauty and the sublime which can be encountered in life, the achievement which had made General Nobile, as it had been well said, the 'Crusader of the Pole'.

The Holy Father ended his address by imparting the Apostolic Blessing to all those present, and on all their kindly feelings and intentions.

29 DECEMBER 1929

'Intelligence and Faith'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'

The Supreme Pontiff bestows great value on the participation of the Academy in his priestly Jubilee and emphasises that science both studies the work of the Creator and is illuminated by His Light. The Pope dwells upon the central importance of uniting intelligence with faith and stresses the close connections between the two, observing that scientific study is a form of homage to the Almighty, whom he describes as the 'God of science ... the Light and the Truth'. He adds that 'science is for life'.

The Holy Father began by saying that within a short time he would give his Blessing that the President of the Academy of the New Lynxes had asked him for and he would give it by expressing in it all the sentiments that that very fine and solemn hour had suggested to his mind and his heart.

But to begin with His Holiness did not want to fail to demonstrate and express his pleasure, his congratulations, with regard to the fine, so very luminous and always useful work that his Academy had described to him: these congratulations he extended to the Academy, to all the members and to each individual member, and in particular to those members who during that session had enabled him to hear such interesting things, both in their short summaries, and with a vision of a point of view which was both of a broad perspective and summarising, and yet, he repeated, which were equally interesting.

The Holy Father was happy, at a more concrete level, about the important work and deliberations of the Academy that had been promoted and realised: important not so much and not solely because of their weight and number, but even more because of the contribution made by a large number of new collaborators. Because when the number of intellects amongst such well-known and firm friends of science and truth increases, it cannot be doubted that science and truth can only gain by this, and in a notable fashion.

The August Pontiff said that he was at one and the same time both happy and confused at the fact that an episode from his priestly life, of his personal life, therefore, should have given rise to these numerous, high and valuable contributions to truth and science as well. The Holy Father emphasised that he said 'as well' because it was also true that from all parts of the world, he was about to say from all strata of the world and of society, there had come to him on this occasion expressions of participation in his priestly Jubilee, and the events themselves had shared in this Jubilee: the Pope said this – he had to say this – out of a higher and deeper gratitude

to Divine Providence, to the Hand and the Heart of God, which, it seemed, had wanted to give an example to everybody, above everybody and by a much greater extent before everybody, by surrounding these events with so many beautiful and high things, as to increase in a disproportionate way the importance and the significance of his priestly Jubilee.

He hastened to say, however, that this participation of his beloved Academy of Science he placed amongst the most dear, the most appreciated, and the most valuable; and this was to say a great deal, he added, when the forms of participation had been so many, so fine, so valuable, all of which were appreciated by the paternal heart of the Father. However, he wished to place and he placed this participation of the Academy of the New Lynxes amongst the most beautiful and valuable, because it came to him from the most high supreme regions of intelligence and science; that was to say from the regions to which the Divine Intelligence of the Creator sent its most luminous and illuminating rays, rays of infinite light and splendour, because they come from the Being who is in Himself the Light. These heights are more beautiful and pleasant when, on the one hand, they are a reflection of the light of God and, on the other, a reflection of human light, which renders homage to God, so that intelligence is joined to faith. St. Paul said this as well when he declared that this was the highest homage that could be rendered to God: *Captantes omnem intelligentiam in obsequium Christi*.¹ And of these heights, with the truest sense of those materials of the creation and the material summits of the world, one could say with the poet: *Del mondo consacrò Jehova le cime!*

Such, therefore, were the feelings with which the Holy Father expressed his pleasure and his gratitude to the Pontifical Academy of Sciences of the New Lynxes and wished to bestow the blessing that the President had asked for. With this blessing he expressed, in addition, his most trusting and confident wishes and hopes for ever more beautiful, honoured and fertile work, and ever more useful research, discoveries and contributions, as regards science and truth, praying to the Lord that such work would make fertile and multiply – He who is the God of science, who is indeed He Himself the Light and the Truth. The Holy Father expressed these heart-felt wishes and hopes to the elected body of the Academy and to its individual members.

His Holiness, lastly, and this he did with smiling emphasis, was very happy to express other very special congratulations to the venerable Dean of the Cardinals' College, he was about to say to this always young veteran. He had been that early morning together with the Holy Father at a solemn but

¹ 2 Co 10:4.

not short event, indeed at one of the most solemn and longest of the holy events. And he had wanted to be present then as well, at this radiant hour of truth and science, perhaps to tell us that science is for life, indeed without 'perhaps': science is for life, because the science of life is the basis of all other sciences. Cardinal Vannutelli, on the following day, would attain forty years of cardinalship. So, to him, who had over the years fought so many and such triumphant battles, he could rightly repeat: *Ad multos annos!*

21 DECEMBER 1930

*'The Structure of the Universe Illustrates
the Infinite Wisdom of the Law-giver'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

The Pope declares that love for science forms a part of his ministry and stresses that science and faith provide each other with mutual support and aid. He also observes that the structure of the universe illustrates the infinite wisdom of the Law-giver. He emphasises his participation in the work of the Academy and refers also to the new Vatican radio station.

The Holy Father began by first observing that thanks from his beloved sons and Academicians were not due to him, but rather thanks were due from him to them because he was always amongst them and with them, unfortunately at great intervals apart, with great willingness on his part and even more with great satisfaction and pleasure.

He said 'unfortunately at great intervals apart' because they really seemed to him great intervals apart, and he with regret allowed them to be prolonged in this way, whereas he would have liked, instead, to be with them more frequently. Indeed, every time the Pope was amongst his Academicians he seemed to be no longer in breathable air, since, thanks to Divine Goodness, the air in which his life and activity took place was always most breathable; but it was yet different from that air of pure scientific splendours, of love for science, of care and interest for science, of the Academicians; a love and interest, however, that could not in any way be excluded from a ministry such as that of the Pope: completely for souls. Indeed, what would be love for souls without love for science, for that science which is not pure science but science for truth, science that illuminates (as indeed it may be said) truth, science which receives so many powerful forms of help from the Faith, and almost in exchange offers so much support to the Faith itself, as is known by those who are little learned, as is known, above all else, by those, such as scientists, who have studied so much? This they should well in particular understand, since to their most infinite investigations was revealed the wisdom of God the Creator, of God the Law-giver: that immense equally admirable wisdom, which both traces the trajectory of the astral spheres, of immense worlds, and, perhaps even more, which conceals, in the mystery of the infinitely small atoms, the wonders of so great, so precise, and so constant laws, such that one can really say that nothing that we see and which imposes itself on our sight by grandeur of scale, nothing that escapes our sight because of its infinite smallness and habitual unfathomable hiding,

nothing escapes an admirable law, indeed a network of laws which on its own is enough to illustrate not only the existence but also the infinite wisdom of the Law-giver.

For this reason, given the August Pontiff was amongst his sons, he really seemed to be able to cast off for the moment daily concerns and responsibilities and engage in a certain new great ascension, so much did they lead him upwards, to an elevated, splendid, incommensurable, atmosphere. In saying this he wanted to say how pleased he was within himself to be able to be periodically amongst those scholars, following where he was able their deliberations, appreciating the feelings that were expressed to him by their, indeed, his, Academy. This equally bore witness to his shared participation in their mournings, their joys, their glories: grave and really (at least in part) irreparable mournings, but which Divine Goodness had wanted to compensate for: for example, through dear Father Stein who had gone immediately to continue the work of his beloved dear brother, of such dear memory, Father Hagen, and to restore activity and voice (this had been announced a little earlier) to the Vatican Observatory. Nor, therefore, did His Holiness doubt that yet further acquisitions, increasingly beautiful and valuable, would be added to his valued Academy.

His dear Father Gianfranceschi had congratulated the Pope on what Divine Goodness had allowed him to do in one direction or another, and the Pope was really full of gratitude towards this Divine Goodness which had allowed him to give, after a certain fashion, a new and worthy seat to studies, to scientific investigations, in this his small or great State, as is said, and to have bestowed upon it things really advantageous in the field of science, such as the new telephone system and the new radio station. Indeed, in this regard, he was that much more happy to be able that day to point out to the Academy the welcome guest of that inaugural sitting: he meant Marquess Guglielmo Marconi, to whose studies, to whose care, to whose completely special commitment was owed that most beautiful radio station. The Pope had reason to be especially happy about it because of the special and important services that it could render the Holy See and specifically the government of the Catholic Church, but in addition because of those that it could render to the Academy and scientific activity, and Father Stein and Father Gianfranceschi were already very pleased when they thought of the happiness with which the voice of the Vatican Observatory could make itself heard by other observatories and take part in shared worldwide work.

These very beautiful observations well enabled those dear sons to understand with what feelings the August Pontiff saw that new year of their scientific activity open, an activity which offered the Holy Father such delicate and valuable fruits, such as those which Prof. Angelis d'Ossat had pre-

sented him with and promised in that geological analysis of the subsurface of his City of the Vatican, and in those cautiously and authoritatively expressed hopes that the Pope would at some time be in possession of a good local water supply; something that conformed to one of his wishes and to research which had not as yet born fruit, but which he would ensure would be begun again with renewed energy.

The Holy Father ended his address by expressing feelings and good wishes of every blessing for the noble scientific proceedings of the new year of his Academy and for everything that the Academicians were preparing and drawing near to doing. He always accompanied them, expecting from them fruits which were always equally valuable. And it was thus with all his heart that he proceeded to impart the Apostolic Blessing to the Academicians and those others present, and on all that they wished for, on their work, on their families and on all those dear things and dear people that they at that moment carried in their thoughts and hearts.

19 APRIL 1931

*'Science and Faith Come from the Same Author'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

The Pope refers to the fact that the Vatican Radio (whose director was also the President of the Academy) had just broadcast summaries of the proceedings of the Academy. He observes that he himself had given an address on that Radio and links together the two events: the first had been 'sacred to the Faith'; the second 'sacred to Science'. In this context he stresses with great force that there is no contradiction between science and faith because God is the 'sole author' of both.

We most willingly bestow upon you the asked-for Apostolic Blessing, but we wish first of all to express to you, dear sons, our pleasure and our congratulations regarding the fine 'scientific week' that today and now you are bringing to a close.

We wish, in addition, to congratulate the Academicians on this beginning, this opening up, that you have engaged in with respect to the Vatican Scientific Radio; our congratulations and our best wishes: best wishes which are as confident as the congratulations are deserved.

Our joy is great, our pleasure is true and profound, at the fact that we have been able to be with our sons, the Academicians, at this second inauguration of the Vatican Radio, after being present at the first inauguration of the station itself.

And we seem really to be able to speak of a second inauguration which is no less fine than the first. If, indeed, the first was the inauguration sacred to the Faith, the second was the inauguration sacred to Science. Then, the apostolic word of the Faith was broadcast; now the word of Science has been broadcast.

And Divine Scripture itself tells us how God is the author of the Faith, as He is the author of Science as well. The Vatican Council had one of its finest proclamations flow from this beautiful truth: there is, that is to say, no contradiction between Science and Faith given that the sole author of Faith and Science is God Himself. And by this was not only proclaimed the harmony between Faith and Science, but was in the same way recalled and proclaimed the infinite, most high harmonies between two worlds, two universes: one material, the other supernatural.

Our dear Academicians, at this fine meeting, have given to the Pope some foretaste of those beauties, those fresh and fertile harmonies, and we,

once again, thank them; and it is indeed in the contemplation of the two universes harmoniously conjoined, that we, with all our heart, wish to impart to those who are present and their noble work the Apostolic Blessing, wishing for the greatest successes, and the highest merits, for Faith and for Science.

20 DECEMBER 1931

*'The Conquests of Modern Science Demonstrate
the Harmony Between Science and Faith'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

Pius XI observes that the Vatican radio station is at the service of science and emphasises the harmony that exists between science and faith, as is demonstrated by every new conquest of science. He speaks out against those who assert the contrary.

He wished to say a few words before the asked-for blessings which he would with all his heart bestow: a word of gratitude to thank the Academy, the Academic Council and its high interpreter for feelings that were so highly and nobly pious and filial; a word of pleasure at all that he had heard: the gratitude, therefore, of the Father who feels that he is loved in such a filial fashion, the pleasure of the Father who sees himself so highly honoured in the honour of his sons who well deserved on the work carried out last year triple congratulations after the triple blessing, because of all the abundant flowers and fruits gathered in the field of science.

His congratulations were increased by a very special and profound note in referring to the initiative of his, and their, journal, *Nuncius Radiophonicus*. It had been received everywhere with great favour – His Holiness had received by no means few testimonies to this effect – and this had caused special joy because it represented in a certain true way the application and the employment of his radio station at the service of science, after the radio itself had so well, so perfectly and in all regards, served the word of the Faith. The harmony which existed between science, faith, and religion thus really seemed evident to His Holiness and seemed increasingly true and great, that is to say truth and charity, a harmony which with every new conquest of science was increasingly more luminously demonstrated. Whereas, instead, it happened that reference was made to presumed contrasts between faith and science, or one made science say that which science does not say, or one made faith say that which faith did not teach.

The Holy Father then wanted to repeat, to renew his felicitations to Prof. Enriques, who worthily had won and received the prize of his Academy. The membership of that Professor of the University of Padua made the August Pontiff think also that the saint of Padua, during his centenary year, was associated in a certain way with the triumphs of science and science gave to him its tribute. A tribute that was worthily deserved because the great performer of miracles in addition to being, as was known, the saint of affectionate intimacy with the Divine Infant, who was already smiling in his

imminent Christmas return, in addition to being the saint of miracles, that is to say really of the impossible, was also a real illustration of science.

This was demonstrated by his manuscripts which were so copious that they had greatly attracted the attention and the work of scholars; this was demonstrated by his great and prodigious eloquence which made it said of him while he was still alive: if every trace of the divine books were lost, Father Antony would be enough to keep them for everyone so great and truly phenomenal was his memory. And everyone knows of what wonders of holiness and science his life was made up, a life completely lived for God within a very great geographical vastness, from Lisbon to Padua.

The Holy Father wanted then to add another reflection, indeed a triple observation. The first of these concerned his own person. That day he had also had the joy of celebrating – and to him had come participations of joy from all parts of the world – the fifty-second anniversary of his priestly ordination: he was very happy to close that blessed date with his very dear sons.

Equally, on that day there was another coincidence. In the liturgy the eighth day of a festive date was none other than a prolongation of the date itself: now on that day fell the eighth day of the thirtieth anniversary of when for the first time – His Holiness said – his glorious Marconi sent the first decisive and so beneficial ‘s’ across the ocean. The Holy Father said that he was very happy to celebrate that date again with his Academicians at a meeting where only the physical presence (which would have been a crown of joyfulness and glory) of Guglielmo Marconi was absent, who nonetheless was there, in that elect assembly, with his mind and his heart, to evoke a memorable date not only for science but also for mankind.

The third observation of the Holy Father was drawn from the circumstance of the nearness of the holy Christmas festivities, the time of Christian good wishes. His Holiness greatly wanted to express them to his most dear sons, expressing his best wishes for an increasing diffusion of all the immanent good in their hearts, and hoping that the new scientific academic year would rival in a happy and fortunate emulation the years past, with marked results and fruits, corresponding to the triple satisfaction of that very fine day.

The August Pontiff then finally came to the imparting of the asked-for blessings which he wanted specifically to join with his best wishes for the holy festivities, praying to the Divine King of glory, of redemption, of truth, the King, therefore, of science, to accompany them with His divine graces.

The paternal Blessing was extended, in addition, to the persons of those present and their dear ones, to their work, to their aspirations in life and their goodness, to everything that they had brought in their thoughts and their heart, so that it could be blessed.

18 DECEMBER 1932

*'The Achievements of the Academy'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

The Supreme Pontiff gives a general address in which he praises the specific achievements of the Academy.

To the address of the President, to the communications of the Academicians, and to the gifts given to him by the whole of the Academy, the Holy Father condescended to answer, revealing how it was a good custom, always renewed by the wish of his sons, for the High Pontiff to address some words on the holding again of such a fine and really pleasant academic solemnity.

Rather than one word, the Holy Father wanted to say to his very chosen and dear children three words, which indeed he had on his lips and in his heart: a word of gratitude, a word of congratulation, and a word of good wishes.

A word of gratitude, first of all, for the great pleasure that his sons had given him by inviting him to their academic solemnity; and another expression of thanks for the gifts offered to him, especially for the three volumes of the 'Lincei' of the seventeenth century: a gift that much more enjoyed because it went into the academic library through the hands of the ancient librarian. A special thanks, a great expression of gratitude, His Holiness said to end up with, was to be directed to blessed God.

The second word, of congratulations, was then directed by the Holy Father to those worthy members who had gained, by their true merit, their seals of office. But such sovereign congratulations were not only for their seals of office but in particular for the admirable way in which they had known how to merit them.

Further congratulations, added the Holy Father, for those who at that very meeting, at that fleeting moment, had known how to be hosts to him in such a pleasing and instructive way. Congratulations, as well, for those who had worked on the academic 'proceedings', the testimony, which was really monumental, of their work, their efforts, and their successes.

The Holy Father said that he was happy and proud about such forms of testimony to his dear Academy, and he said that these seemed to him to be real guarantees of what the Academy was preparing for the future.

A particular expression of congratulations was then made by the Holy Father on the pleasing weight of work gathered in the *Nuncius*

Radiophonicus; it was really pleasing both because of the mode of communication, the language used, and because of the technical instrument, which took advantage of the latest discoveries of science.

To these first two expressions of gratitude and congratulations, the Holy Father then said that it was easy and pleasurable to add good wishes. And not only those that the hour – and one could even end with Dante because the evening was most clement – the sweet season, inspired near to the holy feasts of Divine Christmas and the year that was now very close. Not only those, but also those, and most cordial ones indeed, to everyone.

The best wishes of the Holy Father went further, broader and higher: they were for the new academic year which His Holiness hoped and wished would be similar to those already passed, and indeed would supersede them. At that moment, then, in the presence of the monumental testimonies of academic activity, the Holy Father could not fail to return to that which came to his mind every time that he was in front of something that was good and well begun, those words written by a holy and brilliant man, by St. Bernard: that the attempt rather than perfection is what is required of man. For the further reason that through the attempt, perfection can be reached by man. The Holy Father thus hoped and wished that all his dear sons would continue in their attempts at perfection, so that also of them one could say: ever more and ever better.

With this hope and wish the Holy Father terminated his address and imparted the implored Apostolic Blessing.

17 DECEMBER 1933

'The Growth of Truth Can Lead to the Growth of Charity'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'

Pius XI observes that charity always gains from what is acquired in truth and for this reason 'the Holy Church had never feared the truth'. He also stresses that the Apostles had been entrusted with a teaching and 'almost a scientific function' and adds that the Academicians, in their teaching of science, are themselves engaged in an apostolate. Speaking shortly before Christmas, he dwells upon the Three Wise Men of the Nativity and observes that they are an expression of science coming to render homage to the Deus Scientiarum Dominus.

The August Pontiff felt above all that it was his duty to thank his beloved sons for the true richness of the gifts of science which had been offered to him. He then hastened to add immediately what he thought about his solemn inauguration of this new hall, which had been added to the very beautiful, but unfortunately restricted, Casina Pio IV. It seemed to him that a more beautiful first use, a more suitable inauguration, a more promising opening, one could not have than in this treasure of great undertakings, of successes, of acknowledgements, even very great ones, of which this Pontifical Academy of Sciences had been the donor and the praiseworthy source.

For this reason, His Holiness thanked God first and foremost, the giver of every perfect gift, and then the Academicians, beloved sons, who were so skilled, for that flowering of studies and for those results which were not only praiseworthy but really fine, and useful specifically to the true progress and increase of science, in the range and riches of truth.

St. Augustine said this one day with one of the most beautiful and brilliant phrases that had ever been pronounced: *Dilantentur spatia charitatis*;¹ one might just as well say: *Dilantentur spatia veritatis*, not least because in the order of the things, in varying degrees in the short term, charity always gained from what was acquired in truth. It was for this reason that the Holy Church had never feared the truth, but she had made herself the herald of truth everywhere, always, and with all people.

To these good wishes and happy commencements of things, His Holiness only wanted to add two observations, which provided him with great comfort and joy. They were two circumstances, almost two falling rays of celestial light, which made this gathering of so many and such eminent personalities even more beautiful, as though a seal was being placed from on high, from on as high as one could conceive, above all these fine observations and hopes regarding the future.

¹ *Sermo*, 69, 1, 1.

The first circumstance revealed that the new hall was beginning its time – to use a common phrase – to count its years, from this Holy Year of the Redemption. And this was a good thing, a particularly good thing, because of the fact as well that the Divine Redeemer, who redeemed mankind with the sacrifice of all of himself, of his blood, of his life, even specifically in the act of finishing the Redemption, has remained the Teacher. And when he sent his apostles to preach the Redemption to the world, to apply it, he sent them out with a teaching, a doctrinal, function, one could say almost a scientific function: *Euntes docete*.² This was what his beloved sons, the Academicians, did, added the Holy Father, and he knew that in the teaching of science as well they had that most noble sentiment and a true, very high, intention to engage in an apostolate.

Another circumstance, which was equally beautiful and holy, indeed even more sweetly dear, was provided by the event of this Holy Christmas, to which they were now so near. This was a grateful and thankful remembrance, which under the guidance of an incomparable teacher and educator, the Church, calls the whole world in these days to the manger of Bethlehem, to that holy crib which, the Holy Father observed with so much consolation, was once again taking its place in our families, in our country, where so many people had already produced beautiful works of art and a language which spoke of such deep holy intimacy and holy accords, especially and above all on behalf of families.

In addition, the Holy Father thought once again of the holy crib, in response as well to the stimulus of the presence of those dear sons, because to the newly-born Redeemer were called the wise men, the kings, sovereigns and kings. And everybody knew how pious tradition saw in these most high worshippers of the humble newly-born Christ, people who were men of science, and in each of them saw *uno degli astri scrutator sovrani*.

This reference led the August Pontiff on to the subject, the starting thought, the subject of science, which also came to render homage to the newly-born Lord, who, small and forsaken as he was, was still and remained, as he was always to remain, the *Deus Scientiarum Dominus*.³ The Holy Father for this reason could not have had a more propitious and touching occasion to give, from the depths of his fatherly heart, to those who had gathered together, his most affectionate best wishes for the holy Christmas celebrations, which were so near, and for the New Year which was drawing nearer with them. With affectionate goodness he wanted to express all the good wishes that those beloved sons desired, and for everything and everybody that they carried in their hearts. And thus pronouncing his best wishes, he united them in a great blessing to which he added a prayer to the Lord to accompany that blessing with His own ineffable blessings, with all His favours.

² *Mt* 28:19. Cf. *Mk* 16:15 f.

³ Cf. for the phrase St. Augustine, *De Civitate Dei*, Bk. XVII, Ch. 4.

12 JANUARY 1936

*'The Academy is the Scientific Senate of the Church'
Address to Inaugurate the Academic Year
of the Pontifical Academy of Sciences 'New Lynxes'*

The Supreme Pontiff declares that the Academy is his 'senate of science' and observes that it is a vehicle for the spreading of the natural truths that faith seeks and promotes. He refers to a magisterium of science side by side with the Magisterium of Faith. In a reference to the troubled international situation and the threats to the cause of peace, he observes that peace is necessary to science just as science is necessary to truth: truth is what frees man from 'every evil'.

The Holy Father said that he was especially and doubly grateful and happy to be with his beloved sons from the Pontifical Academy of Sciences. Doubly pleased, he said, because he was not only inaugurating the new academic year but also, so to speak, the new President, Father Gemelli, who had, among other things, so opportunely called to mind the temporary but real merits of Msgr. Morano. Happy and grateful always to be among the members of his Academy for very important and profound reasons, it sufficed to say that while by the hidden divine plan the Magisterium of Faith rested with him, the magisterium of science could be perceived, in a certain sense, as resting with these beloved sons.

For this reason, His Holiness was also very happy to see, so well and so worthily represented at one time and in a particularly solemn occasion, his Sacred College, the Sacred College of Cardinals, which – and this was very well said – was his Hierarchical Senate: he was also able to say that the Academy of Sciences was his Academic Senate: and many could easily guess among the intentions of the Supreme Pontiff – alongside the intentions and preoccupations of science and the services which it could give and does give to Faith and truth – one could well have guessed that the Pope wanted to place within the scope of his Magisterium, that is the Magisterium of Faith, also a particularly chosen and efficacious instrument for the spreading of the natural truths that Faith not only does not exclude, but manifestly supposes, requires and demands.

The Holy Father had mentioned the new President: thus by doing so he implicitly honoured the memory of the preceding deceased President, the dear Father Gianfranceschi, so favourably, so honourably, so justly noted and appreciated not only by all the Academicians but by the whole world of those who study and know what constitutes hard and truly worthwhile work. Nor was it only the honoured and dear memory of Father

Gianfranceschi that His Holiness wished to evoke; he also believed the moment had come to recall actively and effectively the legacy of the great religious to the Academy: that is his intellectual heritage – or better his academic heritage because in this case it is in regard to the Pontifical Academy of Sciences.

Many times in his life, the dear Father spoke with the Pope about his almost fatherly ambitions concerning the beloved Academy; explaining how he would have liked it to be and how he would have shaped it and formed it according to those ideals of science and scientific culture which animated his whole spirit. And quite often too he explained his thoughts to the Pope and left these behind in his writings – which today are almost voices from the world beyond – so making his great hopes clearly understood, beginning with a hope for a larger and more comfortable home for the Academy. Beautiful, charming as dear Father Gemelli had described the Casina of Pius IV, but a little limited; so that it was right to say *dilatentur spatia* if not *charitatis* at least *veritatis*. His Holiness had immediately accepted that desire which was also his (perhaps in fact the wishes of the dear religious sprung from the desire of the Pope); and the present meeting hall, the room for many important gatherings, can, without a doubt be considered as the fulfilment of the first thought and desire of Father Gianfranceschi, fulfilled despite the proportions which the tyrannical poverty of space allowed.

But, Father Gianfranceschi's wishes went even further: and when, with all his refined filial piety he honoured, gladdened and consoled the Pope, he did not hesitate to imply that it would be a great, beautiful and useful thing if there were to be, so to speak, a spaciousness in financial means alongside the greater spaciousness of the new premises. And the Holy Father met with his wishes; he had thought of something which would help the financial condition of the Academy, if not the riches which it merited, then at least a reduction in its poverty, to allow it something greater in the scientific field of activity and above all in that very precious activity which consisted in stimulating the activity of others.

Yet all was not finished. Father Gianfranceschi worked out with particular care and with all delicacy that the scheme needed a new and more useful arrangement of the scientific personnel, of workers in this great task of science.

His Holiness was pleased to accept all these ideas and as he had already sought to accede to the wishes of the dear departed Father, so he also came to look – clearly with the advice and consultation of the new President – at the other and more important aspect, namely the rearrangement of the scientific personnel, of the scientific structure of the Academy. The Venerable Pontiff was happy to say that, with the help of Divine Prov-

idence and of good will, the Academy so dear to him seemed to be on a good road toward a definitive and complete reorganisation. Certainly, that would be the task – as has already been said – of the new President, with those means and that assistance which his qualities put at his disposal; but also the Pope put himself at his disposal for such a useful and important restructuring to give the finishing touch to the renewal of the beloved Academy. Without doubt, there would be difficulties, but there is no difficulty which good will cannot overcome. Clearly it would be up to him, the President, to regulate in the meantime, in the best possible way, the actual period of transition of the Academy until everything is supplied, finished and ready so that the Holy Father can usefully document what will be done. Probably, therefore, it will be the role of the President not to call the next session for February in the normal way, but, at the right moment, newly to convene the Pontifical Academicians for the new meeting.

All this clearly stated to these beloved sons that thought of the Academy was not in the mind of the Pope only when he had the true joy of being among them, but he often thought about it and followed it and was directly involved in the Academy. It suffices to say that the Pope holds his solicitude for the Academy as perfectly justifiable as he regards it as the magisterium of science alongside the Magisterium of Faith, the senate of science alongside the Hierarchical Senate.

It then seemed to the Venerable Pontiff that one could not meet in such a serene atmosphere, about such peaceful matters, for those pleasures of the mind which science obtains, without thinking about the thick, black menacing clouds upon the horizon: the national horizon and the international horizon in the largest sense of the word. Those beloved sons already had in mind what their Father, the Pope, felt; it really seemed to him that being concerned so peacefully and joyfully with what all the participants in the auditorium had brought together, well demonstrated – and not just in a manner of speaking – that despite the climate of gloomy clouds and despite the dangers which menaced on all sides, the Pope preserved a calm area within his soul which these tumults of external threats could not reach; and this confirmed that – as he had earlier already stated more than once – he always kept a hope which was a little optimistic (but not blindly or unjustifiably so), that from some part of this gloomy and menacing sky, the light could re-emerge and the rainbow of peace could be born and rise up, that peace, even that plenitude of peace – as the divine word so well says – based on justice and truth, that truth for which this meeting was called and for which all must live and work.

This peace, this need for national and international reconciliation – it is obvious – is necessary also for the benefit of study and science, to return to

it. It is science which seeks always to serve the truth. And the truth is the source of all good: truth will free us from every evil; *veritas liberabit vos*:¹ and God is Truth. And it is precisely in this Name, God, that the Pope called together the participants; and it is in His Name that he had given to them every true joy of the spirit: it is in His Name that the Holy Father wished to bless those present, their studies and all the persons and things dear to each one.

This blessing the Pope therefore wished to extend to all members of the great and truly noble family of scholars, from the greatest to the most humble of scientific workers; that science which expresses the most beautiful harmonies and the most magnificent wonders that can be imagined: there are no others which can race or compete with it save goodness and love.

¹ *Jn* 8:32

1 JUNE 1937

*Address of the Secretary of State, Eugenio Cardinal Pacelli,
Given on Behalf of His Holiness Pope Pius XI*

The Secretary of State (and future Pope Pius XII), Cardinal Eugenio Pacelli, gives an address on behalf of Pius XI who is ill. The Cardinal describes how the Supreme Pontiff regards the Academy as a 'Scientific Senate'. Pius XI also believes that science and faith, which at times seem to be in contrast, are not so in reality, and that faith, which is an act of homage by the intellect to the truth revealed by the Creator, is never more worthy than when it is 'illuminated by the splendours of sciences'.

Most Reverend Eminences, Excellencies,
Illustrious Members of the Academy,

No doubt you regret that the token and august dignitary, at this solemn inauguration of the Pontifical Academy of Sciences, is not the sovereign presence of the Supreme Pontiff. He was the one, who, in renewing the Old Institute of the New Lynxes, conceived and accomplished so greatly and nobly this outstanding Academy. Greater, I say, than your regret, is my own amazement and confusion at finding myself in the midst of you to represent him. He deigned this morning to entrust to me, so great an honour and office, in order to transmit to you, that paternal and apostolic welcome and greeting, which his heart and his thought pondered. He did this out of the high regard which he has of you, and in his ardour for the progress of the sciences, which he appreciates in you, such celebrated masters. To have seen you all present and assembled around him, his spirit would have exalted in a hymn of praise and thanksgiving to God, the giver of every good thing. But I know only too well what the office committed to me by his august goodness arouses in your souls, which are inclined towards every nobility of affection. First of all there is the yearning, more than knowing, to have a new confirmation of what has already been authoritatively announced, namely, the reason why his Person is not present in the midst of you, this much revered Father and Founder of the Academy, in the fortunate moment of its awaited inauguration.

The Holy Father, as I myself had the honour and joy of verifying this morning in the customary Audience, is feeling well, better than before. Yesterday, he was able to celebrate the Holy Sacrifice of the Mass. But all things considered, and only at the last minute, did he consider it more prudent, not so as to spare himself this effort and trial, but rather to deprive himself of the greatest and most desired pleasure he would have had in performing it.

His absence is, consequently, an act of violence, which the Holy Father has done to his heart, and to his burning desire to reply to your no less eager expectation. But his absence is at the same time, and please allow that he may say so, a respectful homage to science, to that science which delves into the secrets and hidden limits of the strengths of human nature, so as to ensure a precious health recovered and strengthened. It is a respectful homage, which is both an honour for you and your knowledge, while at the same time it is a witness of esteem to the dictates of a science, which he has, if you like, intended to live up to with the institution of this Academy. In doing this he is mindful of the precept of Sacred Scripture: *Honora medicum propter necessitatem, etenim illum creavit Altissimus*.¹ God is the Lord of medicine too, and Lord of all the sciences; and the greatest example of this faith is the submission of a Pontiff. A Pontiff who wishes to live up to the word of He who watches over the precious life of the Common Father of the Christian people, so as to conserve his health. This is the good health, as has been restored to him by God, of an illustrious and sincere Watchman, who taxes his mind with his immense thoughtfulness for all the Churches, under the weight of his eighty years. He does not decline the work, and on the subject of work, he does not decline the pain, not even that pain of being unable to be with you himself, so sacrificing to God a yearning, whose accomplishment was so greatly desired and awaited by him. It was the desire to declare inaugurated this Scientific Senate, conceived and created by him, for the progress of science and human investigation, for the honour of the Apostolic See, that beacon of truth and salvation, for the knowledge and glory of that God, by the power of Whom all things were made, and without Whom nothing was made, of what has been made in heaven, on earth, and in the depths. It appeared to the Supreme Pontiff in all its brilliant light, as the powerful streams of the natural and rational sciences, and the great river of revealed wisdom springing forth from the same divine fount and descending to man. Since this latter wisdom springs from the deepest source, it is inaccessible to reason, but not to faith, and yet it is no less certain and true. When those sciences, wherever they may seek and meet the truth, from whatever part of the created universe, from the heavens, from the oceans, from the earthly abysses, are set free and shine upon the human genius, they may prepare and build the entrance hall of the temple of faith, the steps of the *Sancta Sanctorum*, behind the veil of which the secrets of the divinity lie hidden and throb. All nature is ordained to man, and the end of celestial motion, affirms Saint Thomas, is ordered to man, as to an ultimate end in the genus of generable

¹ *Si* 38:1.

and mobile beings.² But man in his turn is ordained and orientated towards that image and likeness, which signifies in him the face of God, and towards that glory which the heavens proclaim; towards that truth which the hand of God left as a fingerprint when he created the world and every thing, towards that greater truth which exalts the human genius beyond the stars and remains forever.

The words themselves of the August Pontiff will be worth much more than the poor expressions with which I had hoped to interpret his mind, and these I have the great honour of communicating to you. They are the very same words, which he would have wanted to speak to you, if he had been present here in person today. They are his words, in thought and heart, which will remain for all the days to come, with the solemn seal of apostolic authority and the foundation of the Pontifical Academy of Sciences.

His Holiness would have no doubt recalled an often encountered passage, one of the most serious that are contained in the Divine Books, and which appropriately regards the men of the Church, which can easily mean pupils and teachers of the faith and in general of the truth: *Quia tu scientiam repulisti, ego repellam te.*³ The Holy Father would have added that, in this the summit of his life, in this fullness of years which God wished to concede to him, it seemed to him not inopportune and not alien from his office, to also give further proof of the weight, which he gives to those divine words, showing himself not only completely alien to the rejection of science, but careful in fact to call it to himself, and to possess it for himself. For this reason, His Holiness thought that an excellent way of achieving this aim, would be to call around himself, your most worthy persons, illustrious members of the Academy, you who so well represent so great a science, in, it could be said, a universal approval.

It is true that there are some things in which science and faith seem to express irreconcilable difficulties and contrasts. But this apparent lack of reconciliation cannot be so in reality for the Holy Father, nor for the person who reflects for a little while on the fact that science is the research of the truth as it is found in the natural revelation of the created world, and faith is the homage shown by the created intellect to the truth directly revealed by the Creator. So it is evident that this homage shown by the created intellect to the direct revelation of the Creator will never be more worthy of both creature and Creator as when it is illuminated by the splendours of sciences. This conviction has inspired the Holy Father, and has greatly cheered his heart in the institution, or restitution which may be intended of

² *Contra Gentiles*, Bk. III, Ch. 22.

³ *Ho* 4:6.

this Academy, to which you, illustrious members of the Academy, come to bring the contribution truly sought after, of your names, of your science, of your works.

The good Father Gemelli, among the many to whom the Holy Father is always most grateful, has seen to replacing the Academic insignia of each one of you, and his Holiness feels sure that you will not regret it. The August Pontiff was reserving for himself the pleasure of delivering with his own hand the so-called Annual Medal, which I now give to you through his precise mandate. It is by now, as is well-known, the traditional custom of the Holy See to dedicate a special mint of the Pontifical Medal, the recollection of which is considered the most important event of the year. The Holy Father, for his part, has considered that his and your Academy – no less yours than his – was precisely the event which this year deserved such a dedication. You, yourselves, for your part have inspired the composition of it for him, personifying (as has already been said) science so worthily: You have recalled more vividly to his mind the great images of those great spirits which truly seem sent by God the Creator to reveal more amply the splendours of science, and likewise those upon whom it truly pleased Him to impress the most far-reaching footprint of the Creator, His Spirit.

The Medal, which I am about to hand over to you in the name of the Holy Father, imparts everything to you and better than any one word could, presenting you with easily recognisable images, since they are historical: Volta, Michelangelo, Leonardo da Vinci. Their scientific contribution needs no reminder, since you are among the greatest knowers of it: Volta with the wonders of electricity, Leonardo with the universality of his scientific genius, Michelangelo, a master not only in literature, but also in true and proper science with the wonders of his sacred and profane, civil and military architecture. The Holy Father did not even wish to remind you of these things. He reserved rather for himself and for you the satisfaction of recalling in the great Volta, the catechist of children in his parish at Como, in Michelangelo, the builder of Saint Peter's cupola, in Leonardo, the wonderful multiple scientific spirit who left in his will a legacy of Masses to be offered for his soul, the most concise, most comprehensive, most profound manner of professing even in detail all the truths of his catholic, dogmatic and practical faith.

Whereupon, the Holy Father thought he would end his words, and the expression of all his satisfaction and paternal recognition for your presence, by indicating to you in these three great men, a great threefold warning, a magnificent threefold programme, and a most glorious threefold example.

Such is, O Illustrious Members of the Academy, the August Message. Allow me, therefore, to gather into a garland all the glory of your hard

work and your merits, and present them with you as an offering, to the heart of the Supreme Pontiff, so that he may find in them, along with the perfume of all his most joyful hope, the balsam of his missed presence, which is personified in his spirit and his will, which today gives perennial life to this Pontifical Academy.

And with this, in the name of the Holy Father, I declare the first academic year inaugurated and open.

30 JANUARY 1938

*'The Words of Christ 'Vos Estis Lux Mundi'
May be Applied to the Academicians'
Address at the Solemn Audience Granted
to the Plenary Session of the Academy*

The Pope praises the scientists Marconi and Hertz, both believers, whom he holds up as examples to be followed. As a librarian he had come into happy direct contact with science. Faith and science should not be separated, but should, through their 'essential unity', work 'for the good of souls, for the good of intelligences'. The scientific ability to investigate the created world is God-given and involves the quest for truth. In this endeavour, the supernatural light of faith does not contradict, but aids, the light of sciences.

The Holy Father began his speech by heartily congratulating Prof. Bjerknæs on the magnificent things he had said, and on having come from such a distant place – from Oslo, where the Pontifical Academy also had a fellow. Although geographically speaking Oslo, in Norway, was far away, it was necessary to add at once that spiritually it was not far from the heart of the Pope, from the Vicar of Jesus Christ. Nor was it far scientifically speaking, as the illustrious professor had come specially from that extreme northern part of Europe to speak in the elect and solemn gathering. Thus, if only by his association with the subject of that meeting, he rendered his country very close.

The presence of Prof. Bjerknæs was truly valued. He was a scholar and a collaborator of Hertz who was, so to speak, one of the spiritual fathers of Marconi. Although he died after a short life, 37 years, Hertz had already followed a road to which he was very happy to be called and predestined. This was so because Hertz saw above and before himself Him who had called and chosen him: the God, that is, who rules nature, that God who has enclosed in nature and in his most secret beings the splendours of wonderful light. This was true also of Marconi. In the same manner did Marconi see the wonders of creation, as the late scientist had effectively shown very often. Also at the eve of his departure from this life, when the signs of death were already upon him, he repeated at a Pontifical Audience in Castel Gandolfo his gratitude to the Holy Father for having accepted his scientific work in service of the Holy See. Both scientists remind one of what the great German poet, Schiller, wrote: *soll das Werk den Meister loben – doch der Segen kommt von oben*:¹ the work should praise the master, but the blessing comes from above. Truly we find ourselves here before two of the greatest works to which human activity was ever called by the Creator – the blessing of God has descended on them so clearly and so manifestly, and is splendidly glorious and glorifying.

¹ *Das Lied von der Glocke.*

The August Pontiff was therefore extremely grateful to the professor from Oslo who had given such a delightful and enjoyable hour, with such learned and authoritative words and with a comment so appropriate to the theme of that meeting. The Holy Father had always followed the work of Marconi in its developments, and had seen it unravel itself little by little. And the professor, furthermore, came precisely from those regions where the work of Marconi rendered inestimable service, not any more under the bright sun of Rome, nor under the warm skies of Italy, but in the middle of the ice, and in polar night, evidently useful even for the material salvation of those peoples trapped in the snares of a dangerous navigation at sea, useful in their situation with the means at their disposal.

His Holiness repeated his acknowledgements to Prof. Bjerknes, turning to him and saying in German that he thanked him for having desired to be present despite the discomforts of the long journey. And together with a warm welcome he extended to him a special greeting for his country so that on his return the scientist could announce that the Pope, the old Pope, always thinks of the Norwegians, and despite his inability to do much, earnestly desires to contribute towards their well-being, and their lives. Together with the greetings that the Supreme Pontiff sent to everyone, but particularly to the old and to the children, the beloved Academician could also assure his fellow citizens of the blessing of the Holy Father, who loved them dearly and prayed constantly to God for them.

Speaking again in Italian, the Holy Father said that he truly could not see what might be added to the beautiful and distinguished things already said, and for which he had been present. Indeed it all made one think that not only had the great spirit of Marconi returned in that meeting but that he had also gently fanned his ardour. The Supreme Pontiff was glad to be able to testify to it that to the beloved Marconi he owed the assurances and expressions of a fervent, of a particular, true, filial devotion; and also to his frank and sincere happiness at having been able to place the fruits of his research and of his scientific study at the service of the Holy See, which is to say at the service of truth in the highest, widest, most beneficent sense of the word. Nor could the Holy Father fail to repeat his acknowledgements for all the testimonies of profound devotion that the great scientist repeatedly sought to give to the Person of the Vicar of Jesus Christ.

What then should he say to those beloved Academicians from Italy and abroad who had gathered together to procure a true festival of intelligence and of sciences? What could he say which would return thanks to them, although he knew that everything which came from the mouth of the old Father was made lovable to them by their filial piety? He wanted first to record that the presence of the beloved members and fellows of the Pontif-

ical Academy of Sciences aroused in his spirit one of the most beautiful hours of his life. It should not seem out of place to recall that sublime hour since it is of hours such as these that the mercy of God had granted to him to spend before the grandiosity and majesty of nature by himself, as the great Hertz and Marconi had spent hours alone in which their genius was called to contemplate incomparable magnificence. The Holy Father wanted to recall an unforgettable night, spent at above 4600 m: a night full of light, a true image of the luminous night that surrounds the created world and before which great minds alone, like Marconi and Hertz, invoke and will always invoke greater splendours of other firmaments: that light which, at least in part, evoked the mystery of creation.

Thus he found himself, as it were, in the middle of an assembly of giants: about him there were in fact more than ten peaks, all above 4000 m. They made one think of the inspired image of the prophet Habakkuk, since those great mountains like giants seemed to raise their arms to heaven, so seeming even higher: *Dedit abyssus vocem suam, altitudo manus suas levavit.*² The Holy Father had never before seen the words of the prophet come true in such a real way: mountains amongst the greatest mountains which soared up with fresh impetus towards new summits, towards the abysses of the heavens.

His Holiness was sure that more than one of those present would not have found the recollection out of place: what a great school of sciences a high mountain is! Quite apart from other teachings, the mountains say at once what great abundance of riches these rocky masses tear up from the depths of earth to launch themselves into the depths of heaven. It was all a complex of forces, of hidden and as it were secret actions in the immense workshop of nature, which prepare the verdant dowries of the hills and the beautiful waves of the waters. Certainly those beloved sons, those great scientists, are called to contemplate such singular wonders, and to an exceedingly beneficent end.

Apart from that recollection, the August Pontiff felt himself united to the beloved Academicians also for another reason. It had pleased the Lord of everything that he should have spent many days, and among them the most beautiful of his life, in libraries. These long stays had given him a certain familiarity with their names. From their works it had seemed to him many times that their intelligence, their genius, the researches of their studies seemed to flame out just like those peaks to which he had referred, which lift up their arms to heaven. How many of the beloved participants at that meeting were often with the Pope, with the old Librarian, on his daily journey along the long rows of library shelves which stretched for kilo-

² *Hab* 3:11.

metres about him! They, the scientists with their respective works, their famous names, their vast researches with which they honour the sciences and the activities of their various countries! And how many could remember in that moment, on the other hand, that the Pope of today is the old friend of books, of the writers and creators of books, and of those who are and who want to be workers for the development of the human sciences!

These recollections gave a way to reflect on a splendid passage of the gospel, which recalls an exalted mission and responsibility. It was a passage that the Sacred Liturgy proposes very often and which had been read only a few days before. In it is the Lord Jesus, God Himself, who speaks first, as is easily understood, to His Apostles and to their successors: to the agents therefore not of science, but of faith. Nevertheless, those divine words can be applied, after the men of faith, to those of the sciences because they come from God, the Lord of the sciences: *Deus scientiarum Dominus*.³ God does not want a separated faith and science, and even less that they should be in conflict. Rather through their own essential unity, He wants them working for the good of souls, for the good of intelligences.

Faith and sciences. To faith belongs that word which the Divine Master says and repeats: *Vos estis lux mundi: ... neque accedunt lucernam, et ponunt eam sub modio, sed super candelabrum ut luceat omnibus, qui in domo sunt*.⁴ You are the light of the world: ... and a lamp is not lit to put it under a bushel but on the lampstand, so that it might give light to everyone in the house. These words, His Holiness repeated, are directed above all to giving the command, the preaching, the teaching of faith: the teaching of those truths which are indispensable for everyone, even to those to whom to speak of the necessities of science becomes cruel derision because they do not have, nor will have, the predisposition for it. And yet they have need of truth, of that essential truth which Hertz and Marconi, and all those who through the created world see the work of the Creator. The truth which releases the mystery from the created world, the truth of faith. But equally these words can be applied to those who dedicate themselves to those other truths that come as subsidiaries, in help and in service to the Faith itself. Therefore, these words can also be applied to the Academicians, to the men of sciences: *Vos estis lux mundi*. Indeed, the hand of God has not lit the light of sciences in all, as it has in them, nor has it given the intellect of all a far-sighted gaze. They have received the privilege of such an outstanding light, and for this reason they must use it for the good of the world.

³ St. Augustine, *De Civitate Dei*, Bk. XVII, Ch. 4.

⁴ *Mt* 5:14.

It is true that all the discoveries of sciences up to now, before the immense vision of the created world, are slight. Thus one could repeat with the great scientist Golgi, speaking of the present, and alluding precisely to the discoveries already made: *ignoramus*, and giving a glance to the future: *ignorabimus*. But the contemplation of the created world is nevertheless a delight. Scientific research of its treasures, up to yesterday only descriptive, one might say, and more than ever mechanical, has today become a true unceasing investigation dealing with all the created world. It is clear, therefore, that God has given us the ability to investigate not just matter, its structure and composition, but also the nature, the mystery of the created world, with the research of such splendours to which sciences arrive little by little, and at the heart of which is at last the splendour of the Truth.

Concerning this, the great Christian poet Alessandro Manzoni saw two categories in the created world: that of the most useful things, whose usefulness is immediately obvious, and the other of things which seem superfluous, but which nonetheless concur to celebrate the glory of that Truth. He described the first, saying:

To Him who is hidden in every plant of the earth
from which is made every thread of your clothes
and which provides chemical substances
that makes pine strong against the wind,
that makes the willow pliable
that makes the larch and alder waterproof.

And then he continues with the second category:

If you are haughty, ask Him why,
on a deserted beach, swept by savage breezes,
there should grow a silent flower,
which explains before Him alone the glories of His canvas,
and which releases the incense of its perfume,
from the deserts up to the heavens, and then it dies.⁵

There are therefore created things whose usefulness is so evident, so clear, that they do not need explanation: to that category belong the high intelligences of the scientists which, for this reason, must spread beneficial light around them. On the other hand, there are other created things which, one might say, have been made just for the pleasure of making them, of seeing them, of saying of them that which the great poet has said so effec-

⁵ *Inni Sacri, Ognissanti*, 15-36.

tively with insuperably beautiful verses, inviting people to perceive the work of God.

It is with good reason that those illustrious academics, who more directly cultivate the research of truth, belong to the first category. So it can be seen why that which the Gospel said of the Apostles can be applied also to them: *Luceat lux vestra*.⁶ They in their search for the ultimate reason, in their creation, in their very being in the world, must always be a light, a great light, for all.

The Holy Father had already alluded to this elevated idea, this magnificent observation. He intended to apply it firstly to himself, and to all those who share with him the apostolate of Faith: we are in this world, he said, to be the light which saves, the supernatural light of Faith which surpasses all others. A light which does not contradict but aids the light of sciences, helping it in a unique and indescribable way to explain the universe. Thus to him and to those who with him inherit this apostolate of Faith apply above all the divine words: *Vos estis lux mundi*. But next he insisted upon applying them also to those scientists of his Academy, which the hand of God has called to investigate the splendours of the created world, giving the light of scientific truth which concurs to unveil in ever greater visions and reflections the uncreated Truth. Thus the Word of God is also valid for them: *Vos estis lux mundi*. There shines in them that true light of scientific research which continually brings great benefit to humanity, but then rises to the source of all those truths. It is in fact the hand of God which has arranged these studies, the same hand that lit the geniuses of Marconi and Hertz. It awakens the energies of the beloved Pontifical Academicians so that they be a light to those who do not dwell in the Father's House. Therefore, so that the terrible vision the Apostle to the Gentiles had, if only for a moment, be not realised for any of them, every great intelligence such as theirs, needs to thrill in the research of the full truth, lest there be an intelligence created by God, illuminated by God, which stops at the created and does not rise to the Creator. To such an intelligence would be applicable that grave and logical penalty alluded to by the Apostle himself with the fearful words: *ita ut sint inexcusabiles*,⁷ as if to say that they cannot have an excuse for not having known the Artificer, the Creator, after having known the work, the creature. It is true that the limits of excusability and inexcusability are among the most difficult to comprehend in this area of the unknown, of the inscrutable, even for the greatest intelligences. Only that

⁶ Mt 5:16.

⁷ Rm 1:20.

God who is Truth, who is all Truth, who calls all creatures to truth, who gives them the means for following truth, only that God sees these limits with certainty, even if the Apostle has spoken of inexcusability.

After these reflections, the Holy Father added that he had wanted above all to say something useful for himself and for the souls of all those who work for the apostolate of faith. But then he wanted also to rejoice with all those present in that great hour, that great gift which God had granted him: an hour of light, an hour of truth. It was an exquisite gift, one of the greatest genuine participations of his own perfections, because God is Truth. *Ego sum veritas*.⁸ In these words is contained everything that the August Pontiff wanted to and could say to exalt the beloved Academicians' opportunity of having received from God such riches, such light of truth, such zeal for the search for truth. And since *Deus veritas est*, the most intimate, most supreme, most beneficent, most extensive participation to which God could elevate, is the constant quest for truth.

With these thoughts His Holiness went on to impart his blessing to all those present, wishing that it remain with them and with their intentions in that moment and always.

⁸ *Jn* 14:6.

18 DECEMBER 1938

*'The Complex Subject of Science is the Reality of the Created Universe
which Reflects the Perfection of the One and Triune God'
Address at the Solemn Audience Granted
to the Plenary Session of the Academy*

In his last address to the Pontifical Academy, Pius XI dwells at length upon the nature and purpose of science. He observes that the subject of science is the 'reality of the created universe' and that scientists through their research draw near to 'incomparable heights'. He describes the joy he had experienced in contemplating nature from mountain peaks (he himself was a mountain-climber) and remarks that scientists in their work share similar 'spiritual delight'.

The Holy Father began his speech by saying that he intended to address not only a word of blessing to the participants but also, as was to be expected of a father, to express an affectionate greeting to the eminent and elect sons he had about him – the honourable members of the Sacred College and the delegation of Cardinals, and also those others recommended to him for various reasons, but for the most part on account of scientific knowledge which owed so much to their work. They themselves – he did not hesitate to say – owed much to their subject because of the pure, worthy, truly elevated joys which only science, the study of truth, can give. It was this point which led His Holiness to address a special speech to the cultivators of science, to scientists of such great merit and distinction.

The Holy Father continued saying that we are in an era in which it is difficult to avoid the influence of the age: *Dies mali sunt*¹ – they are not favourable towards serene things. However, all should be grateful to the Church, the great Mother and Teacher who suggested and presented a special subject for that meeting, itself called to illuminate and make sweeter our spiritual horizon. She had even almost prepared it by a happy combination of time and place (and we know Who it is that ordains these coincidences!). All ought to be grateful to the Church that the meeting was taking place towards the end of Advent, that is, towards the Vigil of Christmas – the great and beloved solemnity, itself a source of sweetness, joy and teaching for all, including scientists. The Sacred Birth which is about to be celebrated is the scientist's great feast, it is the particular solemnity of the cultivators of science. There were good reasons for it being so, and, having around him such illustrious scholars, the Holy Father wished to recommend it as such.

What exactly is science? What is the subject of this science to which they dedicate themselves with such success? The complex subject of science, of all the sciences, is the reality of the created universe. Whether we

¹ St. Augustine, *Sermo* 84.

are considering the depths of space, the reaches of the sea or the gigantic mountains, or whether we work with invisible dust, the most minuscule and impalpable organism, we are always in the sphere of the created, the ambit of the universe. The birth of Jesus Christ is, as the Church remembers it with her affection and in her continuous worship, the Birth of the Divine Word made flesh and appeared amongst us: *Verbum caro factum est et habitavit in nobis*.² See how these beloved sons come to meet the Creator of the object of their sciences. He it is Who has prepared for each and every one of them the object of their studies in all the minute and varied characteristics of the various branches of the diverse disciplines. In a special way at this time the Church opportunely recalls every day in the Sacred Liturgy all over the world, this great and grandiose truth: the great truth which returns in all its immense richness on the occasion of the Christmas Mystery. Christmas is the birth of the Incarnate Word, the Divine Word, of Whom the Evangelist spoke so effectively. The human eye has truly never seen so far, closed if you like to the natural light, but open to the supernatural and divine light. The Apostle John wrote the stupendous words *In principio erat Verbum, et Verbum erat apud Deum, et Deus erat Verbum. In ipso vita erat*.³ The human mind has certainly never been raised so high in its thought. Never have human words expressed such exalted concepts. With such an expression it seems, so to speak, as if the widest possible edge is lifted off on the Mystery of the Divinity, the mystery of the Intimate Being itself of the Divinity.

In principio erat Verbum: words which at once express the thought – and what would words be without thought? We distinguish the mental word, the spoken word, the verbal word – *in principio erat Verbum*. The word was in the heart of the divinity, He was Himself the Divinity, He enjoyed all the Divinity. The thinking Divinity, the thought Divinity, as our poor and feeble way of speaking would say. The Word which tells God its essence, its being. *In ipso vita erat*: behold the procession of life, of thought, of affection; behold the Holy Spirit, that Spirit in which, through which, God – as our great poet said *loves Himself and smiles: O luce eterna che sola in te sidi – sola t'intendi, e da te intelletta – e intendente, te ami e arridi!*⁴

God concedes to all of us to see something of such sublime splendours: *O luce eterna che sola in te sidi!* Does the Mystery perhaps vanish before this inundation of light? No, the Mystery remains! But when mistaken notions are refuted what beauty and what things take their place. The idea, for example, of those who argue that God needed to create the world to

² *Jn* 1:14.

³ *Ibid.* 1:1.

⁴ *Paradiso*, Canto XXXIII, 124-126.

remove Himself from the tremendous solitude of His eternity. It is rather a matter of a most beautiful eternity: The Father, The Son and The Holy Spirit: a divine infinity of life in a threefold infinity of reality, of personality.

If that might seem a digression it was on the contrary fully within the theme originally proposed, and the Holy Father was pleased to explain it with gracious stress. *Et Deus erat Verbum*, he continued, *omnia per ipsum facta sunt*.⁵ All this universe was made by Him, through Him: therefore everything was made through this Word, the expression of a mental word of a thought which was never considered so luminous, profound, extensive. It is a divine thought: it is God Who thinks Himself: *O luce eterna che sola in te sidi – sola t'intendi, e da te intelletta – e intendente, te ami e arridi!*

Everything was made through the Word, through the great Artificer of the universe. No force or beauty can be added to this expression, but it is not surprising that elsewhere the same Divine Word explaining the immense beauty of creation says of God: *Omnia fecit in pondere, numero et mensura*.⁶ It is like going into an immense laboratory of chemistry, of physics, of astronomy! Few indeed can admire the profound beauty of such words as well as those who make sciences their profession.

In pondere: you who weigh the stars – His Holiness explained – and calculate the specific weight of bodies and even of atoms; *in numero*, you who number tiny microscopic things, and count the years of light; *in mensura*, you who, as you weigh the stars, so you measure the astronomic intervals between them, and the oceanic distances. No one can understand better than you the exactness of these words: that everything is made by God *in pondere, numero et mensura*.

Because of the origin of the world in this Divine Word, through whom everything was made (*per quem omnia facta sunt*), is not reflection on such a sublime truth worthy not just of the most diligent attention, but also real devotion from the men of science? Here there is not involved just the common piety of each individual Christian: No! To be a scientist, to be one who sees beyond the material surface of things, is enough to elevate oneself to incomparable heights, and to approach such magnificence.

Omnia per ipsum facta sunt ... in ipso vita erat. It was something the August Pontiff did not believe superfluous for his beloved sons to hear: even if they were not his own words he had recalled them hoping that in this way he might respond to the pleasing thoughts they had expressed. Something which would be accepted and adapted to their intelligences, and find its proper place in their daily studies in which the universe reveals

⁵ *Jn* 1:3.

⁶ *Ws* 11:20. Cf. St. Augustine, *Sermo* 8; *Conf.*, Bk. XIII.

itself and points to this Word *per quem omnia facta sunt*.

He then returned to the other phrase of Sacred Scripture that concerned the work of the Word of God through all that is created: everything was made in *pondere, numero et mensura*. The created world receives weight, number and measure through the hands of God. This is true for everything: for the greatest as much as for the smallest. But furthermore, Sacred Scripture also takes care to describe to us everything in the world which is of consolation and delight. In the book of Wisdom, the Word of God is spoken of again. It takes its very name from the divine Wisdom and is described to us as the *Verbum mentis*, the 'thought word'. It is identified in the omnipotent work of creation, about which wisdom itself is pleased to raise up incomparable praises.

It is a delightful passage.

Ab aeterno ordinata sum: from all eternity I have been constituted. This is the first point of contact with the expression of John: *In principio erat Verbum*. Thus also, *Nondum erant abyssi et ego iam concepta eram*: I had already been generated even before the abysses existed. The Divinity thought itself and the Divine Wisdom was conceived and generated. *Necdum fontes aquarum eruperant*: and the springs of water had not yet gushed forth; *necdum montes gravi mole constiterant*: nor had the mountains risen in their great mass; *adhuc terram non fecerat et flumina, et cardines orbis terrae*: He had not yet made the earth, nor the rivers, nor the foundations of the world: before all things and before everything I existed.

After this introduction, the Holy Book continues with a style which is both wonderful narration and admirable poetry. When the hand of God was forming the whole creation, I, His Wisdom, was there. *Quando praeparabat caelos aderam; quando certa lege, et gyro vallabat abyssos*: when He prepared the heavens, when He fixed the depths in the regular pattern of their limits, I was present. *Quando aethera firmabat sursum, et librabat fontes aquarum*: when He set the atmospheres above and arranged the springs of water; *quando circumdabat mari terminum suum, et legem ponebat aquis, ne transirent fines suos; quando appendebat fundamenta terrae*:⁷ when He surrounded the sea with its boundary, and set a law for the waters so that they would not pass beyond their limits; when He fixed the foundations of the earth; – *cum eo eram cuncta compones*: with Him I was arranging all things.

The Poet was surely thinking of this when, comparing the earth to a ship safe on its anchors, he exclaimed: *dei caeli – nei lucidi porti – la terra si celi attenda sull'ancora – il cenno divino – per novo cammino*.⁸

See how much the Holy Bible tells us with regard to this divine uncre-

⁷ Pr 8:24-29.

⁸ Giacomo Zanella, *Sopra una conchiglia fossile* (1864).

ated Wisdom of the Word *per quem omnia facta sunt!* How could we approach such an inspired passage without a profound sense of admiration? And not that here only the visible universe is mentioned. There is besides the supernatural universe which is not seen, but which exists with all its sublime realities. Nevertheless at the simple consideration of the basic fact of the visible universe one is spontaneously brought to celebrate the latter, the time beyond life and death, and the glories of its Author and Creator, to arrive at that radiant end justly referred to by the same poet as: *Veggenti e non veggenti – unica notte involve; e d'altri fermenti – esce l'alba, che solve – del creato il mistero – e ci posa nel vero.*

A most consoling reality, the Holy Father explained, which causes a hymn to the Divine Wisdom to spring up in our soul. A hymn to the Divine Word for these intimate relations of the Divine Being with the divine work. *In principio erat Verbum ... et Deus erat Verbum ... omnia per ipsum facta sunt: ... in ipso vita erat.* What light is shed by such thoughts. What splendours which make the soul rise up from the created world to higher, vaster, more incommensurable realities!

The Holy Father himself, the old priest and old mountain climber, remembering some episodes from his youth, was pleased to recall that right on the highest peak he had reached, he had fully understood the meaning of some texts of Sacred Scripture. On one occasion at 4630 m. amid other summits of similar size, the inspired image of the prophet Habakkuk appeared to him in all its brilliance. These enormous heights like giants seemed to lift their arms up to heaven thus seeming still bigger and still higher: *Dedit abyssus vocem suam: altitudo manus suas levavit.*⁹ The Holy Father had never before seen the words of the prophet realised in such a vivid way: mountains among the greatest mountains seeming to soar up as if alive, with a self-renewing force, towards new more daring heights, towards the depths of the heavens.

The August Pontiff was pleased to mention these elevated considerations. He knew how the beloved sons about him would have shared with him the great spiritual delight that followed. He wished that the Lord would make the interior life and the life of study of each one enjoy some abundant rays of that *luce intellettuale piena d'amore; – amor di vero ben, pien di letizia; – letizia che trascende ogni dolzore.*¹⁰ It is true, the Holy Father continued, that love and supernatural light were spoken of here, but it is also true that one arrived at it by lingering a little at the marvellous concept of the visible universe. The Holy Church herself, teacher of faith

⁹ *Hab* 3:11.

¹⁰ *Paradiso*, Canto XXX, 39-42.

and truth, invites us to this. It is precisely with that faith, with that truth, that we can come closer to the infinite light of God: *O luce eterna, che sola in te sidi – sola t'intendi, e da te intelletta – ed intendente, te ami e arridi!*

With these thoughts the Holy Father renewed his wishes that the participants could have a Holy Christmas, and that they might enjoy it as they merited. In the ineffable presence of the great Mystery of the Incarnation of the Word of God he wished to repeat all his other paternal desires for each and everyone. He hoped that from it an intense and beneficent light might break forth and spread into all the areas they wanted, with many good gifts for everyone and everything they had in their minds and hearts at that moment.

ADDRESSES
OF
HIS HOLINESS POPE
SERVANT OF GOD PIUS XII



Cardinal Eugenio Pacelli, a Member of the Academy, addresses the Members of the Pontifical Academy of Sciences, Casina Pio IV, 1 June 1937, on behalf of Pius XI



His Holiness Servant of God Pius XII addresses the Members of the Pontifical Academy of Sciences, Casina Pio IV, 3 December 1939



His Holiness Servant of God Pius XII with Father Agostino Gemelli, O.F.M., President of the Academy, and Msgr. Georges Lemaitre in the Pontifical Academy of Sciences, Casina Pio IV, 3 December 1939



His Holiness Servant of God Pius XII meets the Members of the Pontifical Academy of Sciences, 20 May 1957

SERVANT OF GOD PIUS XII (1939-1958)

His Holiness Pius XII (2 Mar. 1939-9 Oct. 1958) was the son of a lawyer and descended from a Roman aristocratic family of jurists. Eugenio Maria Giuseppe Giovanni Pacelli was born in Rome on 2 March 1876, attended a state secondary school, and studied at the Gregorian University, the Capranica College, and the S. Apollinare Institute, Rome. Ordained priest in April 1899, he entered the papal service in 1901, and from 1904 to 1916 was Cardinal Gasparri's right-hand assistant in codifying the canon law; for several years he also taught international law at the Academy of Noble Ecclesiastics. In April 1917 Benedict XV appointed him Nuncio in Munich and titular Archbishop of Sardes, and in June 1920 named him Nuncio to the new German Republic. These were busy years for during the First World War he had to negotiate with the imperial government about Benedict XV's peace plan (1917), while after the war he agreed concordats with Bavaria (1924) and Prussia (1929). Appointed Cardinal on 16 December 1929, he succeeded Gasparri as Secretary of State on 7 February 1930, and as such was responsible for the concordats with Austria (June 1933) and Germany (July 1933). Although Berlin took the initiative in the latter, Hitler's repeated violations of it and the deteriorating position of the Church in Germany led to increasing difficulties for the Holy See. In the meantime, Pacelli, an accomplished linguist who had earlier travelled to Britain, paid official visits to Argentina (1934), France (1935 and 1937), and Hungary (1938), and an extensive private one to the USA (1936). While Secretary of State, he was appointed a Honorary Member of the Pontifical Academy of Sciences in 1936.

With the Second World War threatening, he was elected at a one-day conclave at the third ballot on 2 March 1939. No Secretary of State had been chosen since Clement IX, but he was the best-known of the Cardinals, and possessed the gifts and experience that seemed suitable to the moment. Pius XII saw himself as the pope of peace and until 1 September 1939 he strove to avert war by diplomatic means, on 3 May calling for an international conference to settle differences peacefully and on 24 August making a radio appeal to the world to abstain from resort to war. Until Mussolini's entry into the war on 10 June 1940, he worked to keep Italy out of the con-

flict. He achieved none of these aims but through his efforts and presence Rome was treated as an open city. In his allocution of Christmas 1939 he had laid down the five principles essential for a just and lasting peace. They included practical and spiritual disarmament, the recognition of minority rights, the right to life, the right of every nation to independence, and the creation of more effective international institutions to defend and promote peace. Although convinced that Communism was even more dangerous than Nazism, he did not endorse Hitler's attack on Russia. Throughout the war he supervised, through the Pontifical Aid Commission, a vast programme for the relief of war victims, especially prisoners of war; and when Hitler occupied Rome on 10 September 1943 Pius XII made the Vatican City an asylum for countless refugees, including numerous Jews.

Unaffected in his teaching office by the war, Pius XII published two major Encyclicals while it was still under way. In *Mystici Corporis Christi* (29 June 1943) he expounded the nature of the Church in terms of Christ's mystical body, while in *Divino Afflante Spiritu* (30 Sept. 1943) he permitted the use of modern historical methods by exegetes of Scripture. Closely linked with the former was *Mediator Dei* (20 Nov. 1947), which called for the intelligent participation of the laity in the mass. In 1951 and later he reformed the entire Holy Week liturgy, while in *Christus Dominus* (6 Jan. 1953) and *Sacram Communionem* (19 Mar. 1957) he standardised relaxations of the Eucharistic fast and the holding of evening masses which wartime conditions had made necessary. Always Marian in his piety, he defined the dogma of the bodily Assumption of the Blessed Virgin Mary into heaven in *Munificentissimus Deus* (1 Nov. 1950) and devoted *Ad Caeli Reginam* (11 Oct. 1954) to her royal dignity, leaving open, however, the question of her mediation and co-redemptive role. He was the first to appreciate the Marian importance of Fatima. A conservative note was sounded in *Humani Generis* (12 Aug. 1950), which warned against the accommodation of Catholic theology to current intellectual trends.

Politically, Pius XII condemned Communism, threatening (e.g. 1 July 1949 and 28 July 1950) members of the party and its promoters with excommunication, and concluded accords regarding the position of the Church with Salazar's Portugal (18 July 1950) and Franco's Spain (27 Aug. 1955). In the moral field, he condemned, with Germany in view, the notion of collective guilt (24 Dec. 1944; 20 Feb. 1946), and any kind of artificial insemination (29 Sept. 1949). In *Miranda Prorsus* (8 Sept. 1957) he sought to lay down guidelines for the audio-visual media, instruments which he used in an extensive and innovative manner in order to communicate with the faithful around the world. Pius XII canonised 33 persons, including Pius X. He also created an unprecedentedly large number of Cardinals, 32 in 1946 and 24 in

1953, drawing them from many countries and reducing the Italian element to one-third. Although the Church suffered severe restrictions and losses during his pontificate, it also made striking advances, the number of dioceses rising from 1,696 in 1939 to 2,048 in 1958, with hierarchies being established in China (1946), Burma (1955), and several African countries. He also sought to encourage relations with the Uniate and Orthodox Churches of the east. Tall, slender, somewhat ascetic in appearance but friendly in manner, he made a profound impression on the millions who flocked to Rome for the Holy Year of 1950 and the Marian Year of 1954, and on the thousands who attended his innumerable audiences.

As a Honorary Member of the Pontifical Academy of Sciences and the person who delivered the inaugural address of the first assembly of the Academy on 1 June 1937, Pius XII evinced a strong interest in the workings of the institution throughout his pontificate. At a time when research was achieving extraordinary results in its investigation into the structure of matter, energy, cosmology, nature, and the function of cells, and new theories were rapidly developing to keep pace with scientific results, Pius XII's main concern was constantly to prove to the Academicians that there was no conflict between science and faith. Following the strong wish of his predecessor to build bridges between faith and reason, and eager to promote the cause of hard science, he acted to ensure that the Pontifical Academy was a 'Scientific Senate' of the Holy See by seeking and securing constant information from it about scientific and technological questions of the day.

Pius XII gave eight papal addresses to the Academy in which he dwelt at length upon major contemporary issues and offered strong doctrinal and moral guidelines for their resolution. Pius XII's ideas on science were very clear. Addressing the Academy in the session of 1955 he said: 'The duty of a scientist is to understand God's design, to interpret the Book of Nature, to explain its contents and to draw from it consequences for the common good'. The Pope's statement that the experimental method cannot be influenced by philosophical assumptions and that the autonomy of science and of scientific interpretation is legitimate must be underlined. These words enlightened the Church in a field which had caused misunderstandings in the past that had not yet vanished. Indeed, in his first meeting with the Pontifical Academy of Sciences, Pius XII affirmed the freedom of scientific research: 'To you noble champions of human arts and disciplines the Church acknowledges complete freedom in method and research'. This statement expressed a new vision of science, which Pius XII was to reaffirm in all the allocutions given during his Pontificate. Today it can be regarded as the synthesis of an important moment in the history of science and phi-

losophy. The secrets of the microcosm and macrocosm revealed by scientists were considered by the Pontiff as evidence of the Creation. To take into consideration only laws of statistics was a common error of our times: 'such universal order is not and cannot be the result of absolute blind necessity nor even of fate or of chance and scientists must look for a law which is established by the Mind that rules the Universe'. This was to foreshadow those points of view on the principle of causality, which was to be thoroughly developed in the 1960s, and put forward by some scientists as the only explanation for the order of the whole universe and for the origins of life. When Pius XII learnt that the latest results of cosmological research proposed the existence of an initial event to explain the formation of the universe, he said: 'Creation in time and therefore a Creator and therefore God. Although still implicit and incomplete these are the words we wanted to hear from Science and that the present generation is waiting for'. This address had a great impact on the scientific world of the time and even today it is widely quoted in works of epistemology. It demonstrated a renewed interest on the part of the Church in scientific questions.

As regards scientific discoveries used as destructive weapons, when addressing the Pontifical Academy of Sciences in 1941, at the time when 'the war tears the world to pieces and employs all available technological resources to destroy', Pius XII reminded those present that in the hands of man science can become a double-edged weapon capable both of curing and killing. In this period, the Pontiff attentively followed 'the incredible adventure of man involved in research into nuclear energy and nuclear transformations' through personal contacts with scientists and the reading of scientific works. In particular, in response to a suggestion made by Max Planck, he warned the world about the imminent dangers of atomic war and in his address to the Pontifical Academy of 1943 appealed to world leaders to act together to secure its prevention: 'Although it is still unconceivable to take technical advantage of such an unforeseen achievement, it does break the ground for multitudes of possibilities which make the setting-up of uranium reactor no longer a utopia. It is, however, essential to prevent the process from taking place as an explosion because otherwise the consequence could be catastrophic not only in itself but for the whole Planet'. Unfortunately the United States had already passed the experimental stage and two years later the first nuclear bomb was dropped on Hiroshima. In 1948 Pius XII admitted sadly that nuclear energy had been employed for destruction and death: 'The nuclear bomb, the most terrible weapon that the human mind has ever conceived'. The tragedy of Hiroshima made him realise that a future conflict, to which science would make its contribution, would be fatal to the world: 'What calamities a

future conflict would hold in store for mankind, if it proved impossible to stop or slow down the use of every new and sophisticated scientific invention'. His appeal then followed: 'We should mistrust the science whose main objective is not love'. He was not just thinking of nuclear weapons, but also of the whole arsenal of sophisticated systems, from missiles to chemical, biological and conventional weapons which were the result of the use and development of scientific research. He was adamant in his views and declared: 'Each branch of science governed by scientists worthy of the name and you in particular tends towards the realisation of love for your fellow-men'. Taken in itself each branch of science leads to love, he said when Marconi was still alive, and added: 'As regards practical applications, it practices love for men at whose service it places itself to provide them with every kind of good things'. His concerns about nuclear energy as a war weapon increased after its use against Japan. For this reason, he repeated the view that it is possible to make an immoral and barbaric use of the most beautiful achievements of science. He was also keen to stress that reason led to faith and that science led to a perception of transcendence. In his address of 21 February 1943, for example, he declared: 'you seek the law, which is precisely an arrangement of reason of One Who governs the universe and has fixed in it nature and the movements of its unconscious instinct'.

Foreshadowing a later initiative taken by John Paul II with his public return to the Galileo case, Pius XII was to write in the marble plaque he placed specially in the Academy, to commemorate the role played by Pius XI in the refoundation of the Academy, that Galileo had been a leader of the scientists who had established the Accademia dei Lincei, the precursor of the Pontifical Academy of Sciences.

Pius XII appointed forty-one new members of the Pontifical Academy of Sciences including such distinguished scientists of the time as: E.V. Appleton, L. de Broglie, E.A. Doisy, A. Fleming, O. Hahn, W.C. Heisenberg, W.R. Hess, C.J.F. Heymans, M.T.F. von Laue, L. Ruzicka, F. Severi, A.W.K. Tiselius, and A.I. Virtanen; and also made Cardinal Maglione and Cardinal Pizzardo Honorary Members. Reflecting his interest in research, he also promoted important excavations (1939-49) under St. Peter's aimed at identifying the Apostle's tomb.

3 DECEMBER 1939

'Man Ascends to God by Climbing the Ladder of the Universe'
Address to the Plenary Session of the Academy

Pius XII affirms that the Academy had been his predecessor's 'greatest achievement'. He observes that science is the exploration of the truth to be found in the created universe and states that 'man ascends to God by climbing the ladder of the Universe'. The Church is a 'friend of Truth' and down the centuries has been the promoter of learning and culture, not least because every kind of art and science 'serves God'. Thus it is that the Church upholds freedom of scientific research. He emphasises that reason is the servant of faith and faith exalts reason: they aid each other.

It is with great joy that we are here amongst so many eminent Cardinals, members of the diplomatic corps, distinguished teachers, scientists, and mathematicians in order to open the new academic year at the Pontifical Academy of Sciences. It was in a similar meeting held in this very hall on a different occasion that you heard us convey to you the message of our incomparable predecessor Pius XI, when he was unable to come in person due to ill health. His glorious name is now written in indelible letters both in the annals of history as well as in the beginning of the life of this Academy of sciences which he founded. While its structures and name may sound new, in its nature, its intentions, and its aim, this Academy reminds us of, and brings to a more modern and universally scientific level, the old and illustrious Accademia dei Lincei, which had already been renovated by Pope Pius XI, our illustrious predecessor.

It is to Pius XI, who was present in this very hall a year ago – a hall which now contains his venerable portrait – that our thoughts, containing both sadness and reverence, now turn. We greatly admired in his mind and heart those powerful and daring elevations of the spirit, of thoughts concerning the past, present and future. They cloaked his throne with the splendour of the highest piety, self-sacrifice and kindness, and with a great expansion of faith, ecclesiastical knowledge and the results of scientific investigations. This Academy, entrusted by him to the care of the distinguished President, Father Gemelli, is his greatest achievement. For him, it represents the conquering of a pinnacle surrounded by the great mountain range of the sciences, where truth raises high her brow above the valleys and plains which divide the various countries: where Truth, which ascends from the chasms of the earth and sea and descends from the skies so as to assemble illustrious scientists, your great researchers and their voice of wisdom, to sing the hymn of human reason to the signs left in the universe

by the Creator when heaven and earth were completed with all their array.¹ As Saint Augustine tells us, God, having created the universe, did not abandon the world² but kept man's thoughts in his counsel. While maintaining the universe in existence and motion, God left it to men to dispute amongst themselves without their being able to discern God's full project.³ God has given fallen man this task of understanding this great enigma;⁴ the enigma of the unknown God working in creation, to which Paul the Apostle pointed when addressing the Epicurean and Stoic philosophers in the Athenian council of the Areopagus. Paul stated that this unknown God had created the whole human race on the entire earth so that they could find their way towards God since He is not far from any of us.⁵

The enigma of creation has for centuries stretched the intellect of all peoples; the various solutions proffered have filled the schools of the academy; volumes have filled both ancient and modern libraries; attempts to find the solution to this enigma have been the cause of disputes between wise investigators of nature, of matter, and of the spirit. These labours, these lessons, these volumes, these battles are nothing other than the searchings for the truth hidden deep in the enigma itself. Whatever else, asks the Genius of Hippo, whatever else does the human soul desire if not the truth?⁶

Yes, your souls, illustrious Academicians, crave and search for the truth, which throbs in all we see, hear, smell, taste, touch and feel in all its many ways, and follow in our thought through the maze of weights, of numbers, of measures, in the visible and invisible movements, where she stirs, transforms herself and where she both shows and conceals herself; it is here that truth challenges our acumen, our machines, our experiences and where she often threatens to elude our instruments and devices which are the marvellous product of our human resources. Such is the vigour, the allurements, the beauty and the impalpable life of truth, that she breaks free from the appearance of that immense reality which surrounds us.

Reality speaks to us and communicates her word to us through the wonderful senses of our nature moulded out of flesh and spirit. It is this reality which we seek through the immeasurable ways of the universe. We are neither responsible for creation nor are we the creators of Truth: neither our doubts, nor our opinions, nor our carelessness, nor our negations can

¹ *Gn* 2:1-2.

² St. Augustine, *De Genesi ad Litteram*, Bk. IV, Ch. 12, n. 22; *PL* 34, 304.

³ *Si* 3:11.

⁴ *Ibid.* 1:13.

⁵ *Ac* 17:18-27.

⁶ St. Augustine, *In Ioannis Evangelium*, tract. XXVI, n. 5; *PL* 35, 1609.

alter it. We are not the measure of the truth of the world, nor of ourselves, nor of the high destiny to which we are called to participate. Our human investigations measure the truth found by our scientific implements and instruments and various machines; they are able to transform, capture and dominate the material offered to us by nature but they cannot create her; our minds have to remain faithful in following nature just as a disciple does with his master from whom he learns his work. When our intellect does not conform to the reality of things or is deaf to the voice of nature, it raves in the illusions of dreams. How well did the greatest Italian poet put this:

Nature takes her course from the sublime intellect and its art ... there shalt thou discern how your art, as it best can, follows her like a pupil with his master; we may call this art of yours God's grandchild, as it were.⁷

But not only is our art God's grandchild but so is truth with regard to our intellect. Since in the ladder of the known truth it finds itself, so to speak, down here on the third descending step under nature and under God. One can find nature situated between God and us. One cannot separate the truth of nature from the infallible mind of the Creator who sustains it both in its being and in its actions and so it is able to measure the truth of things in reality. What is accidental both to nature and to things is the truth which our weak intellects attribute to them as a result of our contemplations and investigations; our minds do not, as some people once believed, possess innate ideas at birth; it is through the senses that one begins to gain knowledge of those things perceived in their external sensible accidents and qualities; so that through these external phenomena our intellect can come to an internal knowledge of things, even of those whose accidents are completely perceived through the senses.⁸ And so man's genius, when it is not blurred through prejudice and error, comes to understand that, in the same way that nature, whose truth is measured in the Divine mind, is the daughter of God, so too is the truth of our sciences, arrived at in our own minds, the grandchild of God.

Do not then be surprised if we discourage you, who are the scrutinisers of nature and of sensible things, who bring out the hidden truths lying latent in nature, according to the great principles of the Stagirite, that *cognitio nostra incipit a sensu*; it is this principle which allows us to understand the following stanza given by God to that stranger called man; a stranger to

⁷ *Inferno*, Canto XI, 99-105.

⁸ *Contra Gentiles*, Bk. IV, Ch. 1.

the most beautiful of created things and to the face which looks at the sky while looking after it; a stranger to the

hand which feels all and holds all, which solidifies through art, and, with boldness and readiness, raises cities and knocks down mountains;

a stranger too to the spirit, image of the eternal; a spirit which each of you who knows that admirable prison of muscles and bones, nerves and veins, blood and fibre, must recognise in himself that nobility and grandeur and be able to exclaim before every fallen son of Adam that, amongst the tumult of sufferings, he still conserves the traces of his former self:

Still from the summits of the divine origin do I recognise the signs in you; still beautiful and great despite your downfall.⁹

Man ascends to God by climbing the ladder of the Universe: the astronomer, when reaching the sky, footstool to the throne of God, cannot remain an unbeliever before the voice of the firmament; from beyond the suns and astral nebulae emanates the thought, followed by the love and adoration, which sails towards a sun which illuminates and gives warmth not to the clay of man but to the spirit which animates him.

Such then is the joy of knowing and learning, even a little, of the measureless sea of truth which surrounds us, we who are vagabonds in the little ship which is our life and whose only compass is our intellect. But in this intellectual cruise:

Worse than in vain does any quit this shore to fish for truth, the fisher's art unknowing – He'll not return the same man he was before.¹⁰

With the joy of knowledge, you, elected geniuses, add the art of the search of truth, and then return to your studies and laboratories, rich in the thought which is the result of having conquered an enigma, so as to add to the admirable treasure-store of science. This is the way of human progress, a difficult avenue to take, marked by the footprints of the most audacious heroes of research from Thales, Aristotle, Archimedes, Ptolemy, from Galileo to Bacon, to Leonardo da Vinci, to Copernicus, to Kepler, Newton, Voltaire, Pasteur, Curie, Hertz, Edison, Marconi and one hundred more names that one could add; and to you who, having received the flame of

⁹ V. Monti, *La Bellezza dell'Universo*.

¹⁰ *Inferno*, Canto XIII, 121.

investigation and knowledge, will pass it on with greater brilliance to even younger heroes, who are not afraid of the stumbling blocks and the risks of the way nor are they fearful of the funereal monuments erected to the glorious souls who have died along its path. Training is father to research: 'With a small spark one achieves a great flame'. To the discoveries of your predecessors one can add, and thereby amplify and correct, the new fruits of current researchers, prodigies of the physical sciences and of pure and applied mathematics, which have the effect of both astonishing and altering our present-day world, a taste of more prodigious wonders to come. The mysteries of truth, which for centuries have been hidden and buried in the universe, are gradually unfolded by you; you hasten to penetrate the very atom in an attempt to penetrate, in a more intimate way, our knowledge of the constitution of bodies; you both awaken and reveal forces, unknown to our ancestors, and then both capture these forces and then channel them where you desire; you then spread the news throughout the world and, together with the world, you prepare yourselves to show us the true image of our brothers and the world; you challenge eagles for the kingdom of the winds and beat them in flight and height gained.

We believe that this marvellous ascension of man to the skies above city, valley, and the mountains of the world was granted by God to the genius of man in our century so as to remind him one more time that from the threshing floor, whereon fierce deeds are done,¹¹ man can ascend to God by that same way down which things descend. In this way, just as all the perfections of things descend in an orderly fashion from God, the supreme head of all beings, so, with man, starting from inferior things and then climbing step by step, he can advance in his knowledge of God, the First Cause, always greater and more noble than any of His effects. The truth which inferior things communicate to you in all their variety and diversity is not that which *odium parit*, but is the truth which rises above the divisions and disagreements of souls, and unites geniuses in fraternal accord and in a love of the truth. A truth loves another truth and, like sisters, daughters of the same mother, Divine Truth, they embrace in the presence of God. In you, perspicacious investigators of nature, our predecessor of venerable memory recognised the great friends of truth; you are bound in fraternal affection by your love of science and this makes you, in the midst of all the battles that fill the earth with blood, an important sign of that union of peaceful intentions which does not threaten the frontiers of the mountains, rivers, seas, nor oceans.

¹¹ *Paradiso*, Canto XXII, 151.

As a friend of truth, the Church both admires and encourages the advance of knowledge, together with that of the arts and of all things, and sees it as a beautiful and good thing to exalt the spirit and to promote good. Is not the Church herself the cause of divine progress in the world and the mother of the highest intellectual and moral progress of humanity and of the civilised life of the nations? She advances throughout the centuries, master of truth and virtue, fighting against errors, and not against those who err, not tearing down but building up, planting roses and lilies without uprooting olive and laurel trees. She looks after and often sanctifies both monuments and temples of Roman and Greek paganism. If in her museums there no longer exist admirers of Mars and Minerva, in her monasteries and libraries they speak still of Homer and Virgil, Demosthenes and Cicero; nor does she disdain to recognise that alongside the eagle from Hippo and the son from Aquino stand Plato and Aristotle. The pursuit of the sciences is encouraged in the universities founded by her; she calls on mathematics and astronomy to correct the ancient methods of measuring time; she calls on all the arts which are marked with the splendid sign of truth to emulate in honour of Christ the basilicas of the Caesars and to go beyond them with vertiginous domes, ornaments, pictures, and with images which will render eternal the names of their creators.

Every form of art and every type of science serves God because God is *Scientiarum Dominus* and *docet hominem scientiam*.¹² Man has in his greatest school only two books. In the book of the universe the human mind searches for the truth of the good things created by God; in the book of the Bible and of the Gospels the human intellect, together with his will, search for a truth which is beyond reason, sublime as is the intimate mystery of God and only known to Him. At the school of God, philosophy meets with theology, the divine word with the science of palaeontology; light is separated from darkness, the earth¹³ during its orbit around the sun eternally fixes upon the gaze of God and of man. The goodness of God, as that of a mother, almost approximates a human language¹⁴ so as to remind man of the sublimity which He manifests to him in a school of sister truths which exalt him and make him, in the study of nature and of faith, a disciple of God. Such a school is also created by the Church in her Magisterium. Is not reason the servant of faith, which renders to her '*rationabile obsequium*'¹⁵ as a foundation and defence, which emanates from the mark of the

¹² *Ps* 93:10.

¹³ *Si* 1:4.

¹⁴ Cf. *1 Th* 2:7.

¹⁵ *Rm* 12:1.

divine likeness in order that she may be made more beautiful? And faith, in her turn, does she not exalt reason and nature, inviting all the multifarious creatures of the universe to bless the Lord, from the skies to the earth, with the canticle of the three children in the flames of Babylon? And you see the Church in her ceremonies blessing the work of human reasoning and intellect, the literary activities and libraries, the schools and laboratories, the telegraphs and railways, the sources of electricity and aeroplanes, the trucks and ships, furnaces and bridges, and all that the human mind and his ability for creation renders to the truthful and healthy progress of life and of human society.

No, it needs to be stated that the honour paid to faith does not humiliate reason but renders it honour and sublimity, since it is the greatest boast of the progress of human civilisation to facilitate the spreading of the faith throughout the world. Faith is not arrogant, she is not the tyrant of reason, nor does she contradict it; the stamp of truth is placed by God both on faith and reason. In fact, each aids the other, since right reasoning demonstrates the basis of our faith, and, through her light, clarifies her terms, and faith defends reason from error and teaches it many things. So we have little doubt that it will only honour this Pontifical Academy of Sciences if we recall what the great Vatican Council defined when it stated:

It is therefore far remote from the truth to say that the Church opposes the study of human arts and sciences; on the contrary, she supports and promotes them in many ways. She does not ignore or despise the benefits that human life derives from them. Indeed, she confesses: as they have their origin from God who is the Lord of knowledge,¹⁶ so too, if rightly pursued, they lead to God with His grace.

To you, however, noble champions of the various disciplines of the human arts, the Church recognises your freedom of method adopted or research undertaken, a freedom upon which our immortal predecessor, Pius XI, founded this Academy, knowing full well that the same Council went on to add:

Nor does the Church in any way forbid that these sciences, each in its sphere, should make use of their own principles and of the method proper to them. While, however, acknowledging this just freedom, she seriously warns lest they fall into error by going contrary to the divine doctrine, or, stepping beyond their

¹⁶ Cf. 1 S 2:3.

own limits, they enter into the sphere of faith and create confusion.¹⁷

In these words of the universal sacred senate of the Catholic Church are to be found all your rightful scientific freedoms and the highest promise for the advantages which you have brought to the life of society which the Church herself uses for her mission in the world. It is praiseworthy of the sciences and of their admirable inventions if the herald of Christ anticipates the seasons, foretells whirlwinds and storms, flies over valleys and mountains, visits both hot and cold countries at great speed, shortens the length of trips, and becomes both doctor and healer of bodies so as to give new life to souls. It is fitting praise to your incomparable colleague, the late lamented Marconi, that our paternal word and blessing is able to be heard beyond seas and oceans, bringing both our affection and hopes to distant peoples. Is therefore not science worthy of all our respect and honour?

It is this admirable and legitimate bond of the sciences with faith, this vestibule which the sciences and the arts erect at the entrance of the temple of faith, an image which already for centuries has amazed the world in the Vatican Hall of the Segnatura where science and faith face and illuminate one another in the sublime light of the thought and paint brush of the incomparable painter Raphael from Urbino. You will certainly have paused to admire the scene named after the school at Athens. In those people you will have recognised your oldest predecessors in the investigation of both matter and spirit, in the contemplation and the measurement of the skies, in the study of nature and of man, in mathematical calculations and learned discourses. The search for truth both animates and gives colour to those countenances and they seem to speak one to another of the many speculative and practical sciences, of their many late nights in study; their faces betray a certain concentration of thought debating with itself and concluding with the realisation of how little actual truth is surrounded by so much which was believed to be true so as to create a number of different worlds, not all of which could become reality. And you see Plato in that temple of science pointing to the sky as the source of knowledge and Aristotle, on earth, the two debating among themselves and not totally satisfied with their high conclusions. They know that the infinite thirst of the human intellect to embrace everything is never satisfied; they feel that beyond our nature here below there exists and reigns a supreme power of a non-visible world. They recognise within themselves an immortal spirit which pushes

¹⁷ Vatican Council, Sess. III, Ch. 4.

them higher but they are not aware of the Spirit which vivified and which would grant them the wings to ascend.

Before this scene and assembly of ‘great spirits’¹⁸ which great art has been able to offer us, we bow our heads and remain perturbed, remembering how bitter is the path of science and how dearly all of science pays for the hopes and longings of the human spirit. We are immortal beings created for another world, for a world not manifested to reason but to a world represented in the picture entitled the ‘Dispute of the Sacraments’ which hangs opposite to the ‘School of Athens’ painting. It would seem as if in the painting of the two life-like pictures the genius of Thomas Aquinas helped to guide the hand of Raphael, pointing out to him the three steps of knowledge which lead to God; the first is represented by the pursuit of the sciences through which man ascends from creatures to God with only the light of reason as an aid; the second, symbolised in the altar of the Blessed Sacrament, is both a synthesis and centre of a divine truth which transcends the human intellect and descends to us on earth through revelation; the third is revealed in the apparition of the celestial court, gathered around God, to the human mind which is raised in order to be capable of perfectly understanding the content of revelation.¹⁹ From science to faith; from faith to the intuitive vision of the First and most important Truth, Source of all Truth.

It is through these schools, one higher than the other, through which, step by step, one reaches the fullest satisfaction of the human intellect. In the school of nature, whilst the skies speak of the glory of God, corporal things on earth become our teachers. They may at first conceal what is their ultimate cause but through their shape and motion they in fact reveal it to our senses; mere matter which cannot even be conscious of its need to reveal itself to us. They speak to us with their beauty, with their order and with their strength and immensity. If you were to interrogate the stars, the sun, the moon, the earth, the sea, the chasms and all living things that move, they would answer you with the words of Augustine: we are not your God; seek beyond us *Non sumus Deus tuus; quaere super nos.*²⁰ O man, lost before the world, listen to Divine wisdom and do not make some mere material left-over into an idol which needs to be secured to a wall so that it will not fall down;²¹ do not pray to a lifeless object for the health of a sick

¹⁸ *Inferno*, Canto IV, 119.

¹⁹ *Contra Gentiles*, Bk. IV, Ch. 1.

²⁰ *Conf.*, Bk. X, Ch. 6, n. 9.

²¹ *WS* 13:15-16.

person, or for the life of someone dead; do not call on something which cannot even walk, to safeguard a journey.²²

Above the school of nature one finds the school of faith wherein one discovers the infallible teacher of the God who is both present and hidden in the Blessed Sacrament; an incarnation of Divine wisdom, Word of God, whose omnipotent voice teaches both ancient and modern philosophers the origin of the universe from a void; similarly this omnipotent voice sends the Apostles to teach all peoples a science which is beyond human reasoning and which cannot be refuted by any who challenge it.²³ It is this Word of the Father Who makes alongside the great Roman Pontiffs and the assembly of Fathers and Doctors of the Church, disciples of the greatest geniuses of poetry, of the sciences and of the arts and of the princes of the earth, the prayerful souls of the simple people of God. In that monstrence, one finds concentrated the whole of the Christian faith; therein lies present the very same God, the Truth and the Life who is pointed to in the skies by the Doctor with his arm raised near the altar.

And in the skies Raphael sublimates his own faith by attempting, with his brush, to create a Christ who resides over and beyond the clouds of faith and is found instead in the open splendour of the eternal and living light, sitting on the throne of the celestial amphitheatre surrounded by a crown of saints and angels, together with the Father and the Holy Spirit.

That sky is the sublime divine school; that throne is the chair of the Teacher of teachers *in quo sunt omnes thesauri sapientiae et scientiae absconditi*.²⁴ He is the wisdom of all things and of every divine mystery; He is the science of all created things, because all things were created for the Word and nothing was created that was not through Him.²⁵ Oh, when will we be allowed to reach those heights and become disciples of such a Teacher, to contemplate and listen to Him; and be present at His ineffable school and bathed in His divine light, with the eye of the soul, to come to know His teaching and art, cause and effects, matter, the formation and order of all that is in the sky and on earth, of all that comprises the world and nature; and, in the volume of the infinite and eternal ideas of the Divine Word, to be able to understand at one glance more than could be understood after one thousand years of study; to achieve this better than if we possessed the acumen of all the greatest geniuses of the earth and more

²² *Ws* 13:18.

²³ *Lk* 21:15.

²⁴ *Col* 2:3.

²⁵ *Jn* 1:3.

perfectly than if we were able to see things as they are in themselves: *Quando veniam et apparebo ante faciam Dei?*²⁶

Up there, in that most sublime and beatifying school, in the knowledge, through God, of all the human and divine sciences, man's insatiable longings to know and understand all the genera, the species and the virtues and the order of the universe will be satisfied. There the perfection of our physical nature will be combined with the perfection of our spiritual nature; in that house of Wisdom and science, which is inexhaustible and perpetual, one loses all the errors made in one's past life: as Vicar of Christ and Father to you all, we pray to God that we will all one day ascend to heaven and be granted the reward of our earthly labours. In that hall of supreme glory we will even forget the lofty depiction of Raphael's which was but a mere mortal dream and all our desires will finally be satiated. And, with the divine vision of Dante Alighieri, in his journey beyond the world to the empyrean and entering with eyes on 'that exalted light wherein, as in itself, the truth is known',²⁷ we will see

in that abyss how love held bound into one volume all the leaves
whose flight is scattered through the universe around.²⁸

²⁶ *Ps* 51:2.

²⁷ *Paradiso*, Canto XXXIII, 54.

²⁸ *Ibid.*, Canto XXXIII, 85-88.

30 NOVEMBER 1941

'God the Only Commander and Legislator of the Universe'
Address to the Plenary Session of the Academy

After dwelling on the creation of the universe and man, the Pope declares that true science 'never lowers or humiliates man'. Man's gift from God of the intellect allows him to engage in the scientific endeavour. Such investigation into the created world reveals the design of God, and the universe is a divine school of instruction. Referring to the Second World War, Pius XII adds that 'science can become a two-edged sword' bringing health or death. The 'blood-filled fields and seas' of that conflict are not what God wants of the use of science.

It is with great joy that we return to this hall of the Pontifical Academy of Sciences, amongst this distinguished gathering of Eminent Cardinals, illustrious diplomats and teachers of the highest repute. To be amongst you, Pontifical Academicians, worthy investigators of nature, of its many manifestations and of its history, who have been called together by our wise predecessor, Pius XI, to establish this important scientific institute. He had the wisest admiration for the progress of the physical sciences and the great depths which they are able to reach, greater in fact than the deepest crags which he was able to contemplate from the summits of the Alps. It is important to pay the greatest tribute to him which will only then render and amplify the honour paid to you, since he held you in the highest esteem and had a great appreciation of your academic worth. It was with the intention of rendering you honour that it was decided to grant you the title of 'Excellency', a title which is nothing but a recognition of the scientific excellency which you possess and which exalts you in the eyes of the world. The honour and the greeting which we give to you are first and foremost destined to your well-deserving and indefatigable President, but they extend also to those Academicians who have not been able to leave their countries and be present here due to the difficulties which we are all experiencing during this period. The joy which we feel at being present amongst such a learned gathering goes some way to dispel the bitterness experienced as a result of this conflict between nations, all of whom are dear to us; our greater debt for such comfort is due to God, to whom we daily raise our trusting hopes; being wise and good, and by giving us His light, and granting us health and forgiveness, He steers all things towards that end where His infinite compassion triumphs over His justice.

Our Lord, Omniscient God, Creator of the Universe and Man

It is to Him that we must raise our thoughts and hearts even here in this hall of science; because it is the same God who sustains the universe, the passage of time, the good and bad experiences of nations and remains at the same time the all-knowing God; *Deus Scientiarum Dominus*.¹ His infinite wisdom makes Him Master of both sky and earth, of angels and men; in Him, creator of the universe, one finds hidden all the treasures of wisdom and science.² It is in Him that one finds the ineffable knowledge of Himself and the infinite imitability of His life and beauty; in Him one finds the knowledge of birth and rebirth, of grace and health; in Him are to be found the archetypes of the admirable dances of the plants around the sun, of the suns in their constellations, of the constellations in the labyrinth of the firmament right up to the last islands in the sea of the universe. He moved from the centre of the inaccessible light of his eternal throne so as to create both earth and sky and, alongside Him, was to be found the Divine Wisdom, delighting in the role of architect;³ He addressed the void from the threshold of eternity with the power of His voice; and the void was overwhelmed and conquered with the appearance of the sky and the earth accompanied with the thunder of that all-powerful voice. *Ex nihilo nihil fit* is applicable and true concerning everything from the hand of man to every living creature, but it cannot be applied with regards to the voice of God; *ipse dixit, et facta sunt*.⁴ And in the same way as both sky and earth were created, the earth began as a formless void and God's Spirit hovering over the water;⁵ so, too, was man fashioned out of dust from the soil and God breathed into his nostrils a breath of life and thus man became a living being.⁶ Such then is the *macrocosm*, the universe of worlds, before the *microcosm* which is man;⁷ little man, a minuscule world of spirit, surrounds and covers, like an arc filled with light, the immense empyrean of mass matter which is beneath man because of its lack of spirit.

God, Teacher of man

That day in which God formed man and crowned his head with His own image and likeness, making of him the ruler of all living things in the

¹ 1 Reg., 2:3.

² Cf. Col 2:3.

³ Pr 8:30.

⁴ Ps 32:9.

⁵ Gn 1:1-2.

⁶ *Ibid.* 2:7.

⁷ S. Th., I, 91, 1.

sea, in the sky and on earth,⁸ the Omniscient Lord God became his teacher. He taught him agriculture, to cultivate and look after the delightful garden in which he had been placed;⁹ He drew to man all the animals from the field and all the birds of the air to see what he would call them and so man gave names to all the cattle, all the birds, all the wild beasts;¹⁰ but, despite being in the midst of so many living things, man felt sad and lonely and attempted in vain to find a face which looked like him and which would contain a ray of that Divine Image which shines out of the eyes of every son of Adam. Only from man could there come another man who would then call him father and ancestor; and the helpmate given by God to the first man came from man himself and is flesh from his flesh, made into a woman and called such because she came from man.¹¹ At the summit of the ladder of all that lives, man, endowed with a spiritual soul, was made by God to be a prince and sovereign over the animal kingdom. The multiple research, be it palaeontology or of biology and morphology, on the problems concerning the origins of man have not, as yet, ascertained anything with great clarity and certainty. We must leave it to the future to answer the question, if indeed science will one day be able, enlightened and guided by revelation, to give certain and definitive results concerning a topic of such importance.

Man's greatness

Do not marvel if, in front of you, you who have with so much acumen studied, researched, anatomised and compared man's brain with that of irrational animals, we exalt man whose face is bathed with that intelligence which is his exclusive inheritance. True science never lowers or humiliates man in his origins, rather it exalts and elevates him since it sees, compares and admires in each member of the human family the traces of the Divine Image.

Man is truly great. The progress made by him in the physical and natural sciences, in pure and applied mathematics, render him even more eager to secure greater and more certain advances. What is this progress if not the effect of the domination, even if limited and won at great experience, which he still exercises over inferior nature? And has the past ever witnessed a greater study, scrutiny and penetration of nature than the present? A constant research so as to understand nature's forces and forms so as to be able to dominate them, subdue them with his instruments and then utilise them for his own benefit.

⁸ *Gn* 1:26.

⁹ *Ibid.* 2:15.

¹⁰ *Ibid.* 2:19-20.

¹¹ *Ibid.* 2:23.

Man is truly great, but he was of an even greater stature at his origin. If he fell from his original greatness by rebelling against his Creator and left, an exile, from the garden of Eden, in order that the sweat from his brow would drop on his bread, food from the earth amongst brambles and thistles;¹² if the sky and sun, cold and heat, shelters and forests, if countless other labours, discomforts of abode and conditions of life would humiliate his face and body; if the remains of that empire granted to him over the animals are nothing more than a faint reminder of his former power and a small fragment of his throne; it is still true that he remains great amongst his ruins because of that Divine image and likeness which he carries in his soul and because of which God continues to express His satisfaction in mankind, the last achievement of His creative hand. God did not cease to love nor to abandon fallen man and then, in order to raise him up once more, He himself 'as men are and being as all men are and knowing our weakness and temptations, He did away with sin'.¹³

Man, the investigator of the universe and his achievements

Two gifts which raise man high amongst the world of celestial spirits and the world of corporeal beings, render man great despite his fallen nature. Firstly his *intellect*, whose eye spans the created universe and crosses the skies, eager to contemplate God; secondly his *will*, endowed with a freedom to act and decide, servant and master of man's intellect, which, to differing degrees, allows him to become the master of his own thoughts and actions before himself, before others and before God. Are these not the two magnificent wings which allow you to ascend to the firmament, O scanners of the skies, and which, throughout the night, keep you from sleep as you count the suns and stars, measure their movements, seek to discern their colours and discover their flights, meetings and collisions? You truly assume the stature of giants; with the broad vision of your telescopes you measure the number of the stars and you divide the spectrums, you pursue the vortices and the flashes of the nebulae and give them a name; but it is necessary for you to bow to Divine science, which is better able than you to fix the number of stars which exists and give each one its proper name, *numerat multitudinem stellarum, et omnibus eis nomina vocat*.¹⁴ The skies made of crystal have disappeared. The genius of Kepler and that of Newton were able to recognise in the sky the mechanical

¹² *Ibid.* 3:18-19.

¹³ *Pb* 2:7; *Heb* 4:15.

¹⁴ *Ps* 146:4.

actions found on earth; in the flame and light of those revolving worlds you were able to discover elements to be found on our own globe; and by binding in marriage sky and earth you were able to extend the Empire of physics which was already rich in her pure and applied mathematical experiments, and in her genius, investigations and courageous acts and which had the effect of promoting nuclear and atomic physics.

From the infinitely big to the infinitely small

In the depths of the firmament you are able to discover, during your 'astronomical nights', those 'supergalaxies' or 'nebular groups or masses' which – as one of your distinguished colleagues pointed out – 'go to make up a most prodigious phenomenon which helps us to make certain observations whose immensity goes beyond all intellects and imaginations':¹⁵ colossal families, each one formed by millions of 'galaxies', each one in itself an immense astral system which has a diameter of many thousands of light years and holds within itself millions of suns. Many of you are eagerly awaiting the none too distant inauguration of the huge reflector which is five meters in diameter and which stands on Mount Palomar in California. With this instrument the sphere of the exploration of the universe will be able to expand to a thousand million light years.

But from this infinitely big realm of research you also descend to explore the infinitely small. Who could have been able to imagine, one hundred years or so ago, the nature of those enigmas which are trapped in those minute particles which we call chemical atoms whose width is in the order of a tenth of a millionth of a millimetre. At that time one considered the atom to be a homogenous globule. The latest physics sees it rather in terms of a microcosm in the real sense of the word, in which one finds hidden the most profound mysteries. Despite the most sophisticated experiments and the employment of the most modern mathematical instruments, current research still remains today at only the start of its conquests in the knowledge of the structure of the atom and of the elementary laws which regulate its energies and movements. So, at present, the continual mutation and transformation of all material things appears more than ever to be the case, even when concerning the chemical atom which, for a long time, has been considered to be unchangeable and imperishable. Only one being is immutable and eternal: God. *Ipsi (caeli) peribunt, tu autem permanes; et omnes sicut vestimentum veterascent. Et sicut oportorium mutabis eos, et*

¹⁵ G. Armellini, *Trattato di Astronomia Siderale*, vol. III (Bologna 1936), p. 318.

*mutabuntur; tu autem idem ipse es, et anni tui non deficient.*¹⁶ 'The heavens ... pass away but You remain; they all wear out like a garment, like outworn clothes You change them; but You never alter, and Your years never end'.

In such a manner you seek, in the immense fields of experience, laws concerning matter and phenomena which create the unity, variety and the beauty of the universe.

The order of the universe revealing God's hand at work

Is the universe perhaps dumb when she presents herself to you? Does she not have something to tell you so as to satisfy the powerful inclinations of your intellects for a grand synthesis of the sciences? For a synthesis which is in accord with the order of the universe? The most important matter concerning the universe is the order which it manifests and which, in its entirety, both distinguishes and unifies it, runs right through it and links it in her various parts and natures which love and hate each other, repel and embrace one another, flee and then seek one another, combine and then separate from one another, and then conspire to steal the flash of lightning, the thunder and the clouds from the sky. During these very difficult times we are experiencing with a feeling of terror precisely such disturbances of the earth, sky and sea. It remains a thing to be wondered at that you know how each of these natures and elements in both organic and inorganic chemistry operates according to a different instinct owing to its own inclination and depends upon a principle without being conscious of the fact and conspires to achieve a particular goal without wanting necessarily to do so; in like manner the corporeal world, though it lacks a soul to inform and unify it, and also lacking understanding to govern and guide it, yet it is moved by reason as though it were something living and acts in a meaningful way as if this were its aim. Is this not the most evident demonstration of the fact that the world contains within itself the guiding hand of that invisible teacher which manifests itself in His work, He Who is the omniscient God, the God who orders the world with the greatest perfection?¹⁷ You search for the truth and the laws that sustain the synthesis of nature and creation, and of these laws you seek the reasons for them, rapt in wonder and lost for words before the movements of nature; in your hands and in your chains she tosses and turns and, at times, menaces you with an indomitable force which does not have its origin in you.

¹⁶ Ps 101:27-28.

¹⁷ Cf. Bartoli, *Delle Grandezze di Cristo*, Ch. 2.

Neither the genius, nor the will, nor the action of man, with his many machines and implements, can disturb the order in nature; he can reveal it, as indeed doctors and surgeons continually do with the use of a scalpel which reveals the heart and the brain, muscles and veins; the most intimate secrets of the human body are discovered, the ways of life and those of death, so as to help life to repel death. Let us, illustrious Academicians, lift our thoughts to the Master of the sciences; a Teacher not of a knowledge learned from somebody else but belonging properly to Him, creator of the very same matter which He puts before man so that his genius may contemplate and study it. Is there perhaps a contradiction between the investigation of physical nature and the human intellect? Between science and philosophy? There certainly exists a tension between those sciences which do not recognise the hand of God at work in nature and that philosophy which sees in the laws of this nature a manifestation of Divine reason which takes care of all and governs the universe. Does philosophy seek to be an ideal dream which confuses God and nature, which gazes longingly upon visions and illusions of idols drawn from the imagination? Is not philosophy rather the very discipline which keeps us firmly rooted in the reality of the things that we see and touch, and the search for the deepest and highest causes of nature and of the universe? Does not all our knowledge stem from our senses? Where do laws come from? Let us for a moment consider our life in society: do not all domestic servants working for one head of the family have a certain hierarchy amongst themselves while still remaining directly responsible to him? And the head of the family and all the other citizens, do they not also maintain a certain order amongst themselves and are they not also directly responsible to the head of the city; he then, in turn, and alongside other heads of the cities in a country, is responsible to the king or to the head of the state. The universe – as was already judged by Aristotle when recalling the thoughts of Homer¹⁸ – does not wish to be ruled arbitrarily. A great number of different people all issuing different commands is not a good thing; there should only be one commander; οὐχ ἄγαθὸν πολυχοιρανίη εἰς κοίρανος ἔστω, εἰς βασιλεύς.¹⁹

God the only commander and legislator of the universe. The order to be found in the multiplicity and in the diversity of created things

God is the unique commander and legislator of the universe. He is a Sun diffusing and multiplying the rays of His infinite light into all of cre-

¹⁸ *The Iliad*, 2:204.

¹⁹ Aristotle, *Met.*, XII, 11, 1076 a 3.

ation; but no single image in creation can equal His. Similarly, when a man finds it difficult adequately to express a concept in his mind he solves the problem by using many words. So, in the multiplicity of creatures and in their very many natures one finds the different remains of the one divine image, differing in quality to the degree to which they are able to draw near to God. You who carefully study the nature of things, have you not perhaps found that their difference is one of gradations? From the geological strata, that of minerals and inanimate bodies you then move on to plants and from plants to irrational creatures and, finally, from irrational animals to man. Does not the very fact of such diversity dictate a certain inequality between things and that all should be graded in an ascending order? In this order and in these grades we see nature and her different forms brought forward according to their perfections and strengths. They are ordered according to their actions and their purposes, their reactions and their compositions, their substance and quality. From these we find their properties, their differing agents with their concomitant impressions and differing effects; they differ because God has made them such, determined and steered towards a particular goal and a particular action.²⁰ In this inherent necessity of things, which is nothing other than part of the Divine Plan to bring all things to particular end, in the same manner as an archer might direct his arrow to the appropriate goal, in this necessity lies the law of the nature of physical bodies, a law which is part of their very nature.²¹ In the same way as a man may imprint a certain manner of acting onto another man through the issue of a command, so too does God imprint all of nature with the principle of her actions;²² and for this reason the Whole Made Universe, God and Master of Science, the university of all things *praeceptum posuit et non praeteribit*.²³ So that – in accordance with the teaching of the great Doctor of the Church, Thomas Aquinas – when someone asks the reasons for a particular natural effect, we are able to offer the explanation that the cause was due to the natural property of the thing even though all is brought back ultimately to the will of God as first cause, wise teacher of all of nature. So if a person is asked for the reason explaining why fire gives off heat and answers that this is because it is part of God's will, he would in fact be answering correctly if he wished to discuss the issue in terms of first cause, he would, however, have answered badly if he intended to exclude all the intervening causes.²⁴

²⁰ Cf. *Contra Gentiles*, Bk. III, Ch. 97.

²¹ *S. Th.*, I, 103, 1 ad 3.

²² *S. Th.*, I-II, 93, 5.

²³ *Ps* 148:6.

²⁴ Cf. *Contra Gentiles*, Bk. III, Ch. 97.

All men are brothers attending the same Divine school

As God's creatures, the first cause also imprinted a sacred law within us, a sublime instinct, particular to man, which enables us to gain an immediate knowledge of God; desire 'which is a spiritual movement, and never rests until the object of its love makes it rejoice'.²⁵ If our flesh comes from the dust of the earth and is destined to return to it, then our spirit is immortal and, coming from God, it attempts once more to climb to God on the ladder of science but never actually managing to satiate its thirst for truth. The world is the Divine school, teacher of every science; when this school passes away we shall all remain face to face before God the Teacher. Let us then bow down before His wisdom since we can never overcome all the obstacles to a full knowledge of His wisdom; let us bow because of His great gift of this vast school-room which is filled with marvels and surrounded by even greater and immeasurable wonders; which were seen to be good once God had created them.²⁶ You yourselves have no doubts about it; you who have a better appreciation of the vastness of creation, the way and degree of perfection, the diversity and the beauty of the vast number of individual grades and the way in which their different weights determine their appropriate functions and operations; you who both love and magisterially promote the world of sciences. Is not also your science a brilliant reflection of divine science which one glimpses, at times clearly and at times obscurely, in the centre of things as they are in themselves? And yet, in the hands of men, science can become a two edged sword which can either bring health or death. Cast a glance at the blood-filled fields and seas and then ask yourselves whether it was for this that our provident and omniscient God made in His own image, redeemed him from his guilt and gave him new life with many graces from heaven; ask yourselves if God created such a developed intellect and warm heart so that man could then treat his brother as an enemy.

In the Divine school we are all brothers; brothers in our contemplation, in our study and employment of nature; brothers in life and in death; we pray before the crib of Our Lord, an infant who continues to love in silence, observes and then judges mankind which is tearing itself apart, that all men become brothers once more in love and in the victory of good in justice and peace over evil.

²⁵ *Purgatorio*, Canto XVIII, 32-33.

²⁶ *Gn* 1:31.

21 FEBRUARY 1943

'The Laws that Govern the World'
Address to the Plenary Session of the Academy

The Supreme Pontiff declares that scientists, in exploring the laws which govern the world, 'encounter God' and find regularity and order in the creation. He dwells at length upon the nature of natural laws and man's ability to understand them. Man, a spiritual being, also studies himself, and the sum of sciences may be seen as a 'hymn to God'. God is the author of both the laws of matter and of the spirit; divine love is at their centre. Lastly, in referring to the Second World War, the Supreme Pontiff declares that men must be moved by this love to achieve peace on earth.

THE LAWS THAT GOVERN THE WORLD

In this solemn assembly, honoured by the presence of Lord Cardinals, distinguished diplomats, persons of high rank, and men noted for their devotion to knowledge, our eye, once again, turns to you, most excellent members of the Academy, wise and untiring investigators of the universe. No doubt you never cease to admire the universe, if it is true what Plato puts in the mouth of Socrates and taught to his disciple Aristotle, that the feeling of wonder is most appropriate for the lover of wisdom, since without it, philosophy has no other beginning, whatever way it may be understood (in Θεαίτητος n. XI). You admire this universe from the outermost limits of the starry sky to the tiniest structure of the atom; and in the grandiose magnificence of the created world, you see the temple of order and of divine power. You know, you admire the immeasurable greatness of this universal machine. At the very least, the immensity of its boundaries, the multitude of its bodies and elements, the velocity of its movements, and the variety and beauty of its parts are to be appreciated. While – as we already observed in our last address to this Academy – the most wonderful thing to be considered is the disposition of order, which distinguishes and unites all, interweaves and links together, and harmonises the very same discordant irrational natures with so much fidelity and mutual bond. Although each is operating according to the different instinct of its own inclination, they all conspire to an end without wishing it, from a beginning without knowing it.¹ You contemplate, measure, study such a universal order: it is not, nor can it be, the fruit of absolute blind necessity, and neither can it be even of chance or luck: chance is a part of fantasy, and luck, the dream of human ignorance. In order, you seek a reason which intrinsically governs it, an arrangement of reason in a world which, even

¹ Cf. Bartoli, *Delle Grandezze di Cristo*, Ch. 2.

without life, moves itself as if it lived, and works by design as if it intended. In a word, you seek the law, which is precisely an arrangement of reason of One Who governs the universe and has fixed it in nature and the movements of its unconscious instinct.

Importance of the question

In this research of the laws which govern the world, you encounter God, and you investigate the traces left by Him, when He had accomplished the creation; and we admire your conquests in the immense fields of nature. The experimental investigations of the last ten years, which are certainly renewed with the studies and works of the end of the last century, boast discoveries of capital importance. One only has to think of the artificial transformations of the atomic nucleus, the splitting of the atom, and the wonders of the microcosm, revealed by the electron microscope. Scientific progress has led to the knowledge of new laws in the phenomena of nature, and clarified the question of the essence and value of physical laws with a new light. Today, there is not perhaps a problem, which may interest and occupy so much, the most eminent researchers of the modern world – physicists, chemists, astronomers, biologists and physiologists – and even the modern lovers of natural philosophy, as much as the subject of the laws which govern the order and action of matter, and of phenomena operating in our globe and in the universe. Indeed, fundamental questions are dealt with, whose solution is no less decisive for the object and aim of every natural science, as important also for the metaphysical comprehension, rooted in objective reality.

Changes in the concept of the physical law – dynamic and statistical laws

A true and rigid dynamic law represents a strict regulative norm of the existence and action of things, so as to exclude every exception of the natural order. Discovery by induction, from the examination and observation of many similar particular cases, allows one to forecast and more often still to calculate prematurely, in a deductive way, other particular cases in the ambit of their application. Examples of this include the law of gravity, the laws of reflection and refraction of light, the constancy law of weight relation in chemical combinations, and many others. But the concept of physical law has not remained the same; and it helps to follow the changes in its formation and valuation, which have occurred in the course of the last hundred years. At the start of the last century, the law of the conservation of mass was already known; knowledge of the relevant optical, electrical, and above

all physical-chemical laws followed. These discoveries were finally crowned by that of the general laws of energy. It is not to be wondered therefore, if, in materialistic monism, the law of mechanics be exalted as goddess on the altar of science, and at its absolute dominion come to yield not only the world of matter, but also the kingdom of life and spirit, subject and liege to the birth of materialistic monism. The universe therefore, was not different from the unmeasured empire of movement; and according to one such conception, as du Bois-Reymond exposes synthetically in his discourse *Über die Grenzen des Naturerkennens* (Leipzig, 1907), a universal mechanical formula had to exist, knowing which, a universal genius or ‘Laplacian’ mind, would be able to understand fully everything that happens in the present. Nothing then would be uncertain for him, with both the buried past and the furthest future presenting themselves clearly at his glance. This concept was also expressed by the great French mathematician Henri Poincaré, when he wrote: *Tout phénomène, si minime qu’il soit, a une cause, et un esprit infiniment puissant, infiniment bien informé des lois de la nature, aurait pu le prévoir dès le commencement des siècles.*² The postulate on ‘closed physical causality’ consequently would not allow any exception, nor any intervention in the course of physical activities, for example, the case of a miracle. But this postulate equals the old saying in which, given the cause, even a sufficient one, the effect comes about necessarily. The great Doctor, Saint Thomas Aquinas, with Aristotle, demonstrated this saying as false, because not every cause is such, even when it is sufficient, that its effect is not possible to prevent itself, at least for free human action. In other words: every effect necessarily has a cause, but not always a cause operating necessarily, there being also causes which act freely.³

And yet a man of Virchow’s ability uttered these serious words at the 47th annual assembly of German scientists and doctors: ‘A presumption of natural science is uncertain, unless we affirm that natural laws are absolutely effective in all circumstances, and are not liable to suspension at any time’. But Virchow had not seen all the circumstances of past events nor those to come; and his words were truly a presumption, as the scientific unfolding of the last ten years allows us easily to recognise. The crass materialism of the past has shown itself untenable, or has been transformed into that dark angel of light,⁴ which is cloaked with spirit or with pantheism. The affirmation of natural laws, not tolerating any exception, has been shaken to such an extent by the progress of exact science, that nowadays

² *Science et méthode*, p. 65.

³ Cf. *In libros Peri Hermeneias*, Bk. I, Ch. IX, Lect. XIV, n. 11.

⁴ Cf. *Ep* 6:12; 2 *Co* 11:14.

one falls into the other extreme of speaking only of intermediate rules, of statistical norms and laws of probability. Such thought is legitimate insofar as many laws of the sensible world or macrocosm show a statistical character – since they do not express the mode of behaviour of every single being, but the average process of an immense number of similar beings – and so they lend themselves to be treated by means of probability calculations.

But the will to see only statistical laws in the world is an error of our times, as one alienated from the nature of human genius, who

with his senses only, learns what
he later will do in the light of reason⁵

– it is the assertion that it could do completely without the old, rigidly dynamic conception of the natural law, and that it may have become empty of sense. In fact, the recent positivism riding in tandem with conventionalism has gone so far that it even puts in doubt the value of the causal law.

What is science?

This positivistic thought is now rejected with good reason by sound philosophy. What indeed is science, if not the certain knowledge of things? And how is it possible to acquire this knowledge, if the principles and the causes of things are not investigated, from which proceeds the demonstration of their existence, and of their nature and action? You observe, research, study and experiment with nature in order to understand its principles and intrinsic causes, so as to penetrate the governing laws of its constitution and action, to set in order the process of such laws, and to deduce from it a science with principles, causes and conclusions following through logical consequence. Consequently, you seek the regularity and order in the various kingdoms of creation; and which the investigating spirit of man has discovered in its great richness!

The system of natural laws

a) In the inorganic world

Behold indeed, even only because of hints, in the macrocosm of purely physical-chemical phenomena, the numerous particular laws of mechanics of solid, liquid, and gaseous bodies; the laws of acoustics and of heat, of electricity, of magnetism and of light; the laws of the progress of chemical

⁵ *Paradiso*, Canto IV, 41-42.

reactions, and of chemical equilibria in organic and inorganic chemistry. These particular laws are often elevated to higher and more general norms, so groups of natural phenomena, which at first glance seemed devoid of every internal relation, may be understood and recognised in greater number, as consequences of a superior law. Behold the laws of planetary motion to be connected to the universal law of gravitation. Have not the famous equations of Maxwell built a bridge between optical and electrical phenomena, and are not all natural phenomena in the inorganic world subordinate to the law of constancy and entropy? If until recently two constant laws were known – that of the conservation of mass and that of the conservation of energy – the most recent research has proved with ever more convincing facts and arguments that every mass is equivalent to a determined quantity of energy and vice versa. Therefore, the two ancient laws of conservation are, in effect, special applications of a more general higher law, which says: In a closed system, despite all changes, even where there is a considerable transformation of mass into energy or vice versa, the sum of both remains constant. This higher law of constancy is one of the keys the atomic physicist uses today to penetrate the mysteries of the atomic nucleus.

Such a scientific system of the macrocosm, rich in internal connections and well organised, contains beyond all doubt many statistical laws, which however, because of the multitude of elements – atoms, molecules, electrons, photons, etc. – are not, as regards certainty and accuracy, inferior to strictly dynamic laws. In any case, they are founded and anchored, as it were, in rigidly dynamic laws of the microcosm, although knowledge of the microcosmic laws is in its details still almost completely hidden from us, despite the formidable efforts made by recent research to penetrate the mysterious activity within the atom. Gradually these veils may fall; then the apparently noncausal character of microcosmic phenomena will disappear: a wonderful new kingdom of order, even in the smallest particles, will be discovered.

And these intimate processes of the investigation of the atom will appear as really surprising to us, not only because they open up before our eyes a world hitherto unknown, whose richness, multiplicity, and regularity seem somehow to vie with the sublime grandeur of the firmament, but also for the unpredictably grandiose effects that technology itself can expect from them. In this connection we cannot abstain from mentioning an astonishing phenomenon about which the Nestor of theoretical physics, Max Planck, our Academician, has written in a recent article of his, *Sinn und Grenzen der exakten Wissenschaft*.⁶ The curious transformations of the atom have for

⁶ In *Europäische Revue* (February 1942).

many years occupied only research workers in pure science. The amount of energy sometimes developed in it was undoubtedly surprising; but since atoms are extremely small, it was never seriously thought that they might become important even from a practical point of view. Today, on the other hand, this question has taken on an unexpected aspect as a consequence of the results of artificial radioactivity. It has in fact been established that in the splitting a uranium atom undergoes if it is bombarded by a neutron, two or three neutrons are freed, each of which may meet and smash another uranium atom. In this way the effects are multiplied, and it may happen that the growing number of collisions of neutrons with uranium atoms increases in a short time the number of freed neutrons and, proportionally, the sum of energy developed from them, to an extent so great that it is almost inconceivable. A special calculation shows that, by this reaction, a cubic metre of uranium oxide powder, in less than a hundredth of a second, develops enough energy to lift a weight of a billion tons to a height of 27 kilometres: an amount of energy which could supplant for many years the activity of all the great electric power stations in the world. Planck ends with the observation that, although the technical utilisation of such a tempestuous process cannot yet be envisaged, it nevertheless opens the way to serious possibilities, so that the thought of the construction of a uranium machine cannot be regarded as merely utopian. It is important above all, however, to prevent this reaction from taking place as an explosion, and to brake its course by apt precautionary chemical means. Otherwise, a dangerous catastrophe might occur, not only in the locality itself but also for our whole planet.

b) In the spheres of vegetative and sensitive life

If now from the boundless realm of the inorganic we elevate ourselves to the spheres of vegetative and sensitive life, we find there a new world of laws in the property, the multitude, the variety, the beauty, the order, the quality, and the utility of the various forces of nature that are part of our globe. Beside many laws of the inorganic world, we meet also special higher laws, laws peculiar to life, which cannot be reduced to the purely physico-chemical ones, so that it is impossible to consider living beings as mere sums of physicochemical components. Nature opens up to us here a marvellous new horizon; let it be enough for us to mention as examples: the laws of the development of organisms, the laws of external and internal sensations, and, above all, the fundamental psychophysical law. Higher spiritual life, too, is regulated by natural laws, for the most part of such a quality that to define them precisely becomes more difficult the higher they stand in the order of being.

Objective reality of knowledge

This admirable and ordered system of qualitative and quantitative, particular and general laws of the macrocosm and the microcosm, is today largely unveiled in its intricacy to the scientist's eyes. And why do we say unveiled? Because it is not projected or constructed by us into nature, thanks to some innate subjective form of consciousness or of the human intellect, nor is it created purposely on behalf and for the use of such an economy of thought and study, that is, to facilitate our knowledge of things; nor is it finally, the fruit or the conclusion of agreements or understandings among scientists studying nature. Natural laws exist, so to speak, incarnate and secretly operative within nature, and we, by observation and experiment, look for them and discover them.

It cannot be said that matter is not a reality, but an abstraction fashioned by physics; that nature is in itself unintelligible and that the world that can be apprehended by the senses is a world apart, where the phenomenon, which is appearance of the exterior world, gives us a vague notion only of the reality of the things it hides. No: nature is reality, recognisable reality. If things seem to be and are mute, they have, however, a language that speaks to us, that emerges from their bosom, like water from a perennial spring. This language is their causality which reaches our senses with the sight of colours and movement, with the sound of metals, the roar of whirlwinds, and the cries of animals, with the sweetness and the bitterness of honey and gall, with the scent of flowers, with the weight and temperature of their material substance, impressing upon us an image or likeness which is the vehicle for our intellect to lead us to the reality of things. Hence we speak not of the image or likeness of our intellect, but of the things themselves; and we can distinguish the phenomenon of the world of the senses from the substance of things, the appearance of gold from the gold itself, as the appearance of bread from bread itself, from whose substance we make food in order to assimilate it and identify it with the substance of the body itself. The movement of things toward us calls forth an image in us; without an image there can be no conformity of our intellect with real things, and without an image knowledge becomes impossible; and we cannot call anything true unless it has some equivalent in our intellect. The things from which our mind takes its knowledge provide measurements to our mind and to the laws we find in them and take from them; but they, in turn, are measured by that eternal divine intellect which embraces all things created, as the mind of the craftsman embraces every work of his art.⁷ What do the hand and the brain of the scientist do?

⁷ Cf. St. Thomas Aquinas, *De Veritate*, q. 1, a. 2.

They discover them, reveal them, distinguish them, and classify them, not like one who follows flying birds, but like one who is in possession of them, and is investigating their nature and intrinsic properties.

When, in 1869, Lothar Meyer and Mendeleev arranged the chemical elements in that simple scheme which today is recognised as the natural system of the elements, they were deeply convinced that they had found a regular order, based on their properties and internal tendencies, a classification suggested by nature, the progressive development of which promised the most penetrating discoveries regarding the structure and essence of matter. In fact modern atomic research began from that point. At the time of the discovery the so-called mental economy did not come into consideration, since that primitive scheme still showed many gaps; nor could it be a matter of convention, since the qualities of the matter itself imposed such arrangement. This is only one example among many, and therefore the most inspired scientists of the past and present have come to the lofty conclusion that they are heralds of a truth identical and the same for all peoples and races that walk the earth and look up at the sky; a truth resting, in its essence, on an *adaequatio rei et intellectus*, which is nothing but the acquired conformity, more or less perfect, more or less complete, of our intellect with the objective reality of natural things, in which the truth of our knowledge consists.

Confutation of phenomenalism

But do not be mistaken, like those philosophers and scientists who thought that our cognitive faculties know only their own mutations and sensations, so that they were induced to say that our intellect arrived at knowledge only from the images of things, and, therefore, that only the images of things, and not the things themselves, were the object of our science and of the laws we formulate with respect to nature. A manifest error! Are they not in all probability the same things, both those things which you interpret, and those things of which your science speaks, reasons, and discusses? Are we speaking to you yourselves, or to the images that are formed in our eye from seeing you present here? If consequently what you interpret and know were only the images of your sensations, it would follow that all your physical sciences, from the stars to the atom, from the sun to the electric lamp, from the minerals to the cedars of Lebanon, from microbes to man and to the medicines for his infectious diseases, would not deal with things that are outside of your mind, but only with those intelligible similarities which you contemplate inside your mind perhaps dreaming. Science, exalted by a Copernicus and a Galileo, a Kepler and a Newton,

a Volta and a Marconi, and other famous and distinguished investigators of the physical world that surrounds us externally, would accordingly amount to a beautiful creation of day-dreaming and a beautiful phantasm of physical knowledge; appearance would take the place of the reality and truth of things; and it would be just as true to assert as to deny the same thing. But no; science knows not dreams or images of things, but the things themselves through the images we receive from them, because, as the Angelic Doctor, following Aristotle, has taught, a stone cannot be in our mind, but the image or figure of the stone can – the image which it produces, a true likeness, in our senses and then in our intellect, so that by this likeness it can be, and is, in our mind and in our study, and makes us return to it and to reality.⁸ Even the recent research in experimental psychology testifies, or rather confirms, that these likenesses are not the mere product of autonomous, subjective activity, but psychic reactions to stimuli independent of the subject, coming from the things themselves; reactions in conformity with the different qualities and properties of things, which vary with the variation of the stimulus.

The images, therefore, which natural things, by way of light and heat, or by way of sound, taste, and smell, or by any other means, impress on the organs of our senses and which, through the inner senses, arrive at our intellect, are nothing but the instrument provided us by nature, our first teacher of knowledge, to make herself known to us; but it is no less true that we can examine, study, investigate this instrument and think about these images and how much they present to us of nature, and the way in which they become our sources of knowledge of the world which surrounds us. From the act of cognition by which our intellect understands a stone, we pass on to the act of understanding how our intellect understands a stone: an act which follows the first, since man, born without innate ideas, and without recollections of a previous life, enters the world devoid of images and knowledge – born and created, as We have already recalled, ‘with his senses only, to learn what he later will do in the light of reason’.

Conclusion

Admire, O probers of nature and of the laws that govern it, in the centre of the material universe the greatness of man, to whose first encounter with light, greeted by his infant wailing, God holds open the spectacle of the earth and the firmament with all the marvels to enchant

⁸ Cf. *S. Tb.*, I, 76, 2 ad 4.

him and attract his innocent eyes! What is this spectacle if not the fundamental and first object of all human knowledge, which embarks from there with thousands upon thousands of inquiries with which the teacher nature entices again and again the avidity of our senses? You wonder at yourselves; you scrutinise your inner acts, you withdraw within yourselves to seek their sources, and you find them in these internal senses, in these powers and faculties, which you make the object of a new science of yourselves, of your intimate rational nature, of your feeling, your intellect, and your will. And so we have the science of man and of his corporeal and psychic laws, anatomy, physiology, medicine, psychology, ethics, politics, and that sum total of sciences which, even with all its errors, is a hymn to God, Who, when He moulded man, breathed into him a vital spirit, superior to that of other living beings, making him into His image and likeness. Thus the material extrinsic macrocosm has a great deal to say to the spiritual intrinsic microcosm: one and the other in their operating power are supremely regulated by the Author of the laws of matter and spirit. But the changes of the spirit, which listens to the voice and the marvels of the universe, are sometimes terrible, sometimes give it vertigo, sometimes raise it powerfully and make it take strides, also in the progress of science, which are more gigantic than the regular movements of the planets and the constellations in the heavens, to the point of sublimating it from the material physical world of its study to the spiritual world beyond the created one to praise 'The Love that moves the sun and all the other stars'.⁹

This Love, which has created, moves, and governs the universe, also rules and directs the history and progress of all humanity, and guides everything toward an end, hidden from our thought by the mists of time, but fixed forever by Him for that glory which the heavens show forth and which He awaits from the love of man, whom He has permitted to fill the earth and subdue it with his labour. May this love arouse and direct the desire and the good will of the powerful and of all men to become brethren, to act in peace and justice, to be inflamed by the fire of the immense, beneficial charity of God, and cease drenching in blood and filling with devastation and tears this earth, on which all of us, under whatever sky, have been placed to struggle as the children of God, for an eternal life of happiness.

⁹ *Paradiso*, Canto XXXIII, 145.

8 FEBRUARY 1948

*'The Invariability of Natural Law
and the Supreme Government of God in the World'
Address to the Plenary Session of the Academy*

After dwelling on how scientists explore the general law of nature because man is endowed with an understanding soul, Pius XII refers to the creation of the atomic bomb, an example of man's scientific discovery, and expresses great worry about the 'most terrible weapon which the human mind has conceived up to date'. He goes on to say that scientists in exploring nature perceive the glory of God and detect the presence of a 'hidden and omnipotent hand'; this arouses both enthusiasm and humility. Divine wisdom, indeed, penetrates the whole of the universe and shines at its most radiant in heaven.

THE INVARIABILITY OF NATURAL LAW AND THE SUPREME GOVERNMENT OF GOD IN THE WORLD

Speculative sciences and practical sciences

As we are here with you, illustrious members of the Academy, to inaugurate the new year of this Pontifical Academy of Sciences, our thought cannot but return once again to our unforgettable and incomparable predecessor, the founder of this most noble scientific Institute, and remember him in those white vestments to which the white snow of the alps seemed a prelude and a greeting of paternal stature – the snow being pressed down one day with his bold and confident steps, risking dangers, abysses and storms, intent upon reaching not only the peaks of the mountains of nature, but also the summits of speculative and practical truth. As he climbed it seemed as if the mountains were rising with him and the fields were descending with him: *ascenderunt montes, descenderunt valles*,¹ – the mountains rose, the valleys sank down – and when he descended, he marvelled again at the whiteness of the Cathedral of his Milan, which was like a brilliant alpine mountain with spectacular peaks rising in the middle of the Lombard plains. You, too, have climbed the mountains of knowledge, of the speculative sciences, of calculation, of astronomy, of the vortices of the stars, and of the nebulae; and you have descended to the plains of the practical sciences using the thousands of forms of art, technology and experiment; for it is the great power of the human speculative intellect to be able to put its hand into practice and become a practical intellect, making the immutable laws and the materials of nature a guide and support for its actions, which are always regulated and sustained by the government and the providence of God.

¹ Ps 103:8.

Character and objective value of natural laws

But on our globe, under our eyes, man appears master and potent above all the natural living creatures – man, to whom God assigned the duty to multiply and to populate the earth and procure the bread on which he lives; therefore, it is not astonishing that the great philosopher Aristotle should compare the human soul to the hand, the organ before all other organs.² Everything, in fact, we owe to the hand: cities and fortresses, monuments, books of knowledge, of science, of art and poetry, the inheritance and the patrimony of libraries and of human civilisation. Similarly, the soul has been given to man, one might say, in place of all sorts of things so that he might procure, in some way, all these things, inasmuch as our souls can receive through the senses and intellect all the shapes or images of the things themselves. Realise then that we admire the hands and the intellects of the disciples of nature, which you are, in your schools, in your laboratories, in your offices, in your workshops, in your arsenals. But you are at the same time teachers, and you teach and project beyond yourselves, not the physical and intellectual forms of your souls, but by means of these, that which nature has caused and projected in your cognitive faculties. In your imaginations and in your minds, you form, invent and construct wonderful images and plans of devices, of instruments, of telescopes, microscopes and spectrometers, and of thousands of other means available nowadays to tame, harness and direct the natural forces; however your art does not create the material which is in your hands, but only modifies it with cognitive skill, and rules its action according to the laws which you have discovered for yourselves, combining and matching your practical and technical knowledge of the reality of things with your speculative knowledge of the same real things.

Thus the general law of nature which the scientist formulates with patient observation and diligence in his laboratory is much more and better than a mere description or intellectual calculation, which considers only phenomena and not the real substances with their properties. It does not stop at, nor is it satisfied by, the appearance and the image of senses, but penetrates into the depths of reality, searches and discovers the intimate, hidden forces of the phenomena, manifests their activity and relationships. It is therefore easy to understand that the knowledge of the laws of nature makes it possible for man to dominate the natural forces and place them at his service in the highly advanced modern technology. Only in this way can human thought elevate itself to understand how the regular order of the

² *De Anima*, III, 8.

spectroscopic lines, which the physicist observes and distinguishes today in his laboratory, will disclose perhaps tomorrow to the astrophysicist a deeper vision and knowledge of the mysteries of the composition and development of the celestial bodies.

Thus from the foundation of the law of nature, with the active help of modern technological means, and by the positive and true knowledge of the internal tendencies of the elements and of their effects in the natural phenomena, the scientist proceeds, against all difficulties and obstacles, to further discoveries, pursuing his research with constancy and perseverance.

The atomic era

The most grandiose example of the results of such intense activity seems to be found in the fact that man's relentless efforts have finally succeeded in reaching a deeper knowledge of the laws which concern the formation and disintegration of the atom, and in that way to master experimentally, up to a certain point, the release of the powerful energy which emanates from many such processes, and all this not in submicroscopic quantity, but in truly gigantic measure. The use of a great part of the internal energy of the nucleus of uranium, about which we spoke in our speech in this Academy on the 21st of February 1943, referring to a work by the great physicist Max Planck (who died recently), has become a reality and has had its application in the making of the 'atom bomb' or 'nuclear energy bomb', the most terrible weapon which the human mind has conceived up to date.

In this state of affairs we cannot refrain from expressing a thought which constantly weighs upon our soul, as well as upon that of all who have a true sense of humanity; and in this connection we recall the words of St. Augustine in his treatise *De Civitate Dei*, where he talks about the horrors of war, even of a just war: 'Of which evils' – he writes – 'if I were to narrate, as it should be, the many and manifold devastations, the harsh and cruel sufferings, although it would be impossible to do justice to the subject, when would we reach the end of the long dispute? Whoever considers with sorrow these horrible and fatal evils must confess their misery; but whoever endures them and thinks of them without anguish in his soul, much more miserably believes himself to be happy, because he has also lost human feeling'.³ But if the wars of that period already justify such a severe judgment of the Great Doctor, with what words should we judge at present

³ Bk. XIX, Ch. 7.

those which struck our generations and bent to the service of their work of destruction and extermination a technology incomparably more advanced? What misfortunes should humanity expect from a future conflict, if it should prove impossible to arrest or curb the use of ever newer and ever more surprising scientific inventions?

But putting aside, for the moment, the use of atomic energy in war, and in the confident hope that it will be directed instead solely to projects of peace, it must be considered a truly inspired investigation and application of those laws of nature which regulate the intimate essence and activity of inorganic matter.

In truth, properly speaking, this involves only one single great law of nature, which manifests itself above all in the so-called 'periodic system of the elements'. Lothar Meyer and Demetrius Mendeleev in 1869, on the basis of the scanty chemical data known at the time, cleverly suggested it and gave that system its first provisory form. It had, however, many lacunae and incoherences; its profound meaning was still obscure; nevertheless it suggested an intimate affinity between the chemical elements and a uniform structure of their atoms from equal subatomic particles. Later, the picture became clearer year after year, the defects and the imperfections disappeared, and the profound meaning was revealed. We restrict ourself here to remembering briefly some of the more important stages in this quest: the discovery of radioactive elements by the Curies; the atomic model of Rutherford, and the laws governing it as proposed for the first time by Bohr; the discovery of isotopes through the work of Francis William Aston; the first fragmentations of nuclei by means of natural alpha rays, and a short while later the synthesis of new heavy nuclei by bombardment with slow neutrons; the discovery of the transuranics proposed by Fermi, and the production of transuranic elements in large quantities, and among these first of all of plutonium, which constitutes the active part of the bomb, and is obtained in the gigantic 'Uranium Piles'; in a word, a coherent development and improvement of the natural system of the chemical elements in fullness and in profundity!

If, therefore, we embrace in one glance the result of this marvellous work, we see that it represents not so much a conclusion as the access to new knowledge and the principle of what has been called the 'Atomic Era'. Up to a short time ago, science and technology had been interested almost exclusively in the problems regarding the synthesis and analysis of molecules and chemical compounds; now, instead, the interest is concentrated on the analysis and synthesis of the atom and of its nucleus. Above all, furthermore, the work of scientists will have no rest until it finds an easy and sure way to govern the process of splitting the atomic nucleus, in order to

make its very rich sources of energy serve the progress of civilisation.

How amazing are the conquests of the human intellect, which scrutinises and investigates the laws of nature, carrying humanity with it along new paths! Could one envisage a more exalted concept?

The law of nature participating in the eternal law of God

But law means order; and universal law means order in great things as well as small. It is an order deriving immediately from the intimate tendencies innate in natural things; an order that nothing can create by itself or give of itself to itself, as no being can give itself to itself; an order that signifies the Order of Reason in a Spirit which has created the universe and on which 'depend Heaven and the whole of nature';⁴ an order which those tendencies and energies received as they came into being and through which both collaborate for a well-ordered world. This marvellous assemblage of natural laws, which the human spirit, with tireless observation and accurate study, discovered, adding victories upon victories over the occult resistances of the forces of nature, what else is it but an image, through pale and imperfect, of the great idea and of the great divine design, which in the mind of God the Creator is conceived as a law of this universe since the days of His eternity? Then, in the inexhaustible thinking of His wisdom, He prepared the heavens and the earth, and then, creating the light on the abysses of chaos, cradle of the universe also created by Him, He gave a beginning to motion and to the flight of time and of centuries, and called into being, into life and activity, all things according to their species and their kind, to the most imponderable atom. How rightly every intellect which contemplates and penetrates the heavens and weighs the stars and earth should exclaim, turning to God: *Omnia in mensura et numero et pondere disposuisti*⁵ ('You have disposed everything in measure and number and weight'). Do you not feel, within your souls, that the firmament which enwraps us and the globe which we tread narrate together with your telescopes, with your microscopes, with your scales, with your rules, with your multiform devices, the glory of God, and reflect, as you look, a ray of that uncreated wisdom which *attingit a fine usque ad finem fortiter, et disponit omnia suaviter*?⁶ ('Reaches mightily from one end of the earth to the other and disposes all things well').

⁴ *Paradiso*, Canto XXVIII, 42.

⁵ *Ws* 11:21.

⁶ *Ibid.* 8:1.

From this comes the closed unity of natural laws

The scientist almost feels the palpitation of this eternal wisdom, when his research reveals to him that the universe is formed as in one casting in the boundless foundry of time and space. Not only the starry heavens shine, composed of the same elements, but they even obey the same great and fundamental cosmic laws, always and wherever they appear, in their internal and external action. The same laws of gravitation and of the pressure of radiation determine the quantity of mass for the formation of the solar bodies in the immensity of the universe up to the farthest nebulous spirals; the same mysterious laws of the atomic nuclear regulate, through atomic composition and disintegration, the economy of the energy of all fixed stars.

This absolute unity of design and government which manifest itself in the inorganic world you find no less grandiose in the living organisms. What else does a simple look at the universal and common structure of the organisms and at the most recent discoveries and conclusions of anatomy and comparative physiology show you? Take the construction of a skeleton of a higher living being with analogous organs, and especially the disposition and function of sensitive organs – for instance, of the eye from the simplest forms to the very perfect visual organ of man; take, in the whole realm of living creatures, the fundamental laws of assimilation, metabolism, and generation. Does not all this indeed show a general and magnificent unified concept, realised and resplendent in various forms and in very many different ways? Is this not perhaps the closed and absolutely fixed unity of natural laws?

Yes; it is a unity closed with the key of that universal order of things against which, inasmuch as it depends on the first Cause of a Creative God, God himself cannot act; because, if He should do so, He would operate against His own prescience or His will or His goodness; now, in Him 'there is no change, nor the shadow of variation'.⁷ But if this order is considered dependent on secondary causes, God possesses its key and can leave it closed, or open it and operate beyond it. Could it be that God, in creating the universe, made Himself subject to the order of secondary inferior causes? Is not this order subject, indeed, to Him, emanating from Him, not as necessity of nature, but from arbitrary will? Hence He can act beyond the instituted order when He pleases; for instance, by working the effects of secondary causes without recourse to them, or producing other effects, to which they do not extend.⁸ Thus the Great Doctor St. Augustine wrote: *Contra naturam non incongrue dicimus aliquid Deum*

⁷ *Jm* 1:17.

⁸ Cf. *S. Tb.*, I, 105, 6.

*facere, quod facit contra id quod novimus in natura ... Contra illam vero summam naturae legem ... tam Deus nullo modo facit, quam contra se ipsum non facit*⁹ (it is not incongruous to say that God acts contrary to nature in as far as it is contrary to that which we knew in nature ... But just as He does not act against Himself, so in no way does He act contrary to that truly supreme law of nature). What works then are these? They are works of which God alone holds the key to their secret and which He reserved for Himself in the passage of time amid the particular order of subordinated causes, ‘subsequent works’, as the Divine Poet sang, ‘to which nature never heated the iron, nor beat the anvil’.¹⁰ Before such works, extraordinary either because of the substance of the fact itself, or because of the person in which they manifest themselves, or because of the manner and order in which they are accomplished,¹¹ people and scientists stand astonished. The miracle is born when the effects are manifest and the cause concealed. But the ignorance of the hidden cause, which astonishes the unbeliever, sharpens the eyes of the faithful and of the learned, who, within certain limits, know and measure how far the work of nature, with its laws and forces, reaches; beyond that point they see the work of a superior, hidden and omnipotent hand, that hand which created the universal order of things, and in the process of the particular orders of cause and effect marked the moment and circumstances of its marvellous intervention.¹²

Such a conception fills the scientist with enthusiasm ...

This divine government of the universe certainly cannot but arouse a feeling of admiration and enthusiasm in the scientist, who in his research discovers and recognises the traces of the wisdom of the Creator and supreme Legislator of Heaven and earth, Who with the hand of an invisible pilot guides all the creatures ‘to different ports – through the great sea of being – each one endowed with the instinct which carries it’.¹³ Yet what are the tremendous laws of nature if not a shadow and mere idea of the depth and immensity of the divine design in the grandiose temple of the universe? ‘The supreme privilege of the scientist’, wrote Kepler, ‘is to recognise the spirit and retrace the thought of God’. Often – we have to confess our human weakness – before the vision of things and the images of our senses,

⁹ *Contra Faustum*, Bk. XXVI, Ch. 3; PL 42, 481; cf. *S. Tb.*, loc. cit.

¹⁰ *Paradiso*, Canto XXIV, 101.

¹¹ Cf. *S. Tb.*, loc. cit., a. 8.

¹² Cf. *S. Tb.*, loc. cit., a. 7.

¹³ *Paradiso*, Canto I, 112-114.

that thought becomes dim and retreats; but if the thought of God enters the work of the scientist, he does not confuse it with the movements or images he sees within or outside himself; and that disposition of soul to search for and recognise God gives him, in his laborious study, the proper enthusiasm and copious compensation for all the labours endured in the interest of research and discovery, and, far from making him proud and conceited, teaches him humility and modesty.

... but also with humility

Certainly, the more deeply the cultivator of knowledge and sciences pushes his research into the wonders of nature, the more he feels his insufficiency to penetrate and exhaust the wealth of the design of the divine construction and of the laws and norms which govern it; and you have heard the great Newton saying with incomparable beauty and emphasis: 'I do not know how I appear to the world, but to myself I appear like a child, who plays on the shore of the sea and rejoices, because he finds every now and then a smoother pebble and a less well-known shell than usual, while the great ocean lies before him unexplored'. These words of Newton, today, after three centuries, in the modern ferment of the physical and natural sciences, sound more than ever true. Of Laplace we hear that, while he was lying ill and the friends who were around him were remembering his great discovery, he replied, smiling bitterly: 'that which we know is small, but that of which we are ignorant is immense'. No less acutely did the illustrious Werner von Siemens, who discovered the principle of the self-excitation of the dynamo, attest at the 59th reunion of German scientists and doctors: 'The more intimately we penetrate into the harmonious order of the forces of nature, regulated by eternal, immutable Laws – and nevertheless profoundly veiled from our knowledge, so much so that we feel the more spurred to a humble modesty – the more restricted the sphere of our cognition appears to us, the more alive becomes our effort to attain more and more from this inexhaustible source of knowledge and power, and the higher grows our wonder before the infinite ordaining wisdom, which permeates all of creation'.

In truth our knowledge of nature is modest in extension and often imperfect in content. In a treatment of the electromagnetic theory of light one could read the words: 'Could it be that a God wrote these formulae?'. Certainly Maxwell's equations are clever; and they, like every similar advancement in theoretical physics, suppose and imply, so to speak, a simplification and idealisation of concrete reality, without which a fruitful mathematical treatment is impossible. So often today can one propose only

rules instead of laws, or only partial solutions instead of general solutions! Wherever a regular behaviour appears in the cooperation, at first sight without any rule, of innumerable particular phenomena, the scientist has to be satisfied with assigning the character and the form of the behaviour of the masses according to considerations of probability, and, ignorant of the dynamic basis for the particular, to formulate statistical laws.

The progress of science is incessant. It is true that the successive stages of its progress have not always followed the path which from first observations and discoveries leads directly to the hypothesis, from the hypothesis to the theory, and finally to the certain and unquestionable attainment of the truth. There are instead cases where the investigation follows a sort of curve; cases, in other words, in which theories that seemed to have already conquered the world and reached the apex of undisputed doctrines, acceptance of which brought esteem in the realm of sciences, fall again to the level of hypotheses, to remain perhaps, later, completely abandoned.

Notwithstanding, however, the inevitable uncertainties and deviations that any human effort brings with it, the progress of sciences knows no pauses nor leaps, while the researchers of truth pass on from one to the other the investigating torch, to illuminate and develop the pages of the book of nature, thick with enigmas. Just as in things which develop naturally, notes the Angelic Doctor St. Thomas, the perfect is reached little by little from the imperfect, so it happens to men concerning the cognition of truth. In fact, from the beginning they have conquered a little of the truth, and then step by step they have arrived at a fuller measure of it, not attributing the origin of the world and things in general to chance or to fortune; but intuiting the truth with more careful perspicacity, they deduced from the available indications and from reason that natural things are ordered by a providence. Indeed, how would one find the invariant and certain path in the motion of the sky and the stars and in the other effects of nature, if all this were not governed by a super-eminent intellect?¹⁴

Through new and broader avenues, humanity is advancing, but always like a pilgrim, towards a deeper knowledge of the laws of the unexplored universe, as it is spurred on by the natural thirst for truth; however, even after thousands of years, human knowledge of the internal principles of the moving forces of the growth and processes of the world, and even more of the design and divine impulse which penetrates, moves, and directs everything, will be and will remain an imperfect and pale image of the divine conception. In the face of the prodigies of eternal wisdom which, in the sea

¹⁴ St. Thomas Aquinas, *In Libr. Job.* Prolog.

of the living, governs everything with undeviating order and directs all things towards hidden harbours, the investigating thoughts of the scientist are blind and mute, and give way to that humble, admiring adoration that sees before it the marvel of creation, in which his hand was not present and which he cannot imitate, but in which his eye can discern a sudden flash of the power of God. Before the many inscrutable enigmas of the order and concatenation of the laws of the immensely great and immensely small cosmos, the human mind must repeat the exclamation: *O altitudo divitiarum sapientiae et scientiae Dei: quam incomprehensibilia sunt iudicia eius et investigabiles viae eius!*¹⁵ ('O the depth of the riches, of the wisdom, and of the knowledge of God! How incomprehensible are His judgments, and how inscrutable His ways!'). The scientist is fortunate, if in passing through the vast celestial and terrestrial fields, he knows how to read in the great book of nature and listen to the cry of its word, making manifest to men the footprint left by the divine step in creation and in the history of the universe! The footprints and the syllables written by the finger of God are indelible: footprints and syllables are the facts from which the divine is released into all minds; and the words of the Doctor of the peoples seem to be written especially for wise, investigating intellects: *Quod notum est Dei, manifestum est in illis: Deus enim illis manifestavit. Invisibilia enim ipsius a creatura mundi, per ea quae facta sunt, intellecta conspiciuntur, sempiterna quoque eius virtus et divinitas*¹⁶ ('What can be known about God is plain to them, because God has shown it to them. Ever since the creation of the world His invisible nature, namely, His eternal power and deity, has been clearly perceived in the things that have been made!'). In one of the inscriptions which decorated the tomb of the great astronomer Angelo Secchi on the day of his funeral it read: *A caeli conspectu ad Deum via brevis* (it is a short way from observing the sky to God).

Looking from this higher observatory at the world and the universe which are at the feet of God, it is not hard to understand how natural things act so unavoidably and conform without exception to the tendencies of their various natures, but which no natural tendency can oppose to the supreme Creator, Preserver, and Governor Who stands above the things sanctioned by Him and given to creatures, while He remains free for His own wise reasons to impede or change the effects and activities of such tendencies in a different direction for particular cases. In the presence of the marvellous reality of the cosmos, which the scientist contemplates, studies and scrutinises, the universal spirit devised by Laplace, with his formula

¹⁵ *Rm* 11:33.

¹⁶ *Ibid.* 1:19-20.

which, at least according to the concept of materialists, should also include events dependent on thought and on free will, appears as a utopian fiction; instead, infinitely real truth is that divine Wisdom which knows and measures every smallest atom with its energy, and assigns to it its place in the framework of the created world, that supreme Wisdom whose glory penetrates throughout the whole of the universe and shines with the greatest light in heaven.¹⁷

¹⁷ *Paradiso*, Canto I, 1 ff.

7 JUNE 1949

*Address to the Plenary Session and to the Study Week on the Subject
'The Biological Problem of Cancer'*

In discussing the ravages of cancer and the loneliness it can produce, the Pope warns against the 'temptations' of ending life. He expresses the strong wish that science will find an answer to this terrible scourge and urges the Academy to continue on this path. In expressing this hope he also stresses that this pontifical institution is 'always eager to serve the progress of science for the greater good of humanity'.

If the especially heavy duties which weigh upon our shoulders, particularly at the present time, deprive us, to our great regret, distinguished scholars and teachers, of the satisfaction of speaking to you at leisure, we cannot, however, resist the desire to welcome you and to tell you of the very friendly interest we take in your work. Because of its objectives it is a work of capital importance and it will surely be fruitful, thanks to your incomparable competence and to the methods of this academy.

Your work is concerned this year with the 'biological problem of cancer', that horrible scourge whose very name terrifies us, which incessantly ravages a notable portion of humanity; a dreadful scourge where surgical or radiological treatment in too many cases only postpones the fatal outcome. And until the end, what physical suffering, what moral anguish! In its internal forms, mysteriously hidden, cancer does not ordinarily show its presence until its progress has already made it nearly incurable. Little by little, it silently eats away at vital organs, in many cases rendering difficult or impossible any absorption or assimilation of food for which, moreover, it sometimes causes an insurmountable repugnance. And it pursues its work of destruction until all is consumed.

In other forms it openly devours the flesh of its victims; it disfigures them, mutilates them in so frightful a fashion that those who, moved by the tenderness of their affection or by the heroism of their charity, approach them, if they can overcome the natural repugnance they feel, are not always able to hide their reactions from the invalid. Those suffering from cancer even seek out the miserable loneliness from which they frequently suffer, by voluntarily shutting themselves up for fear of letting themselves be seen as they are. Deprived by this very isolation from any human consolation, their sadness sometimes leads them to the last extreme of despair, to the temptation of ending a life which only a firm faith in another life of eternal happiness helps them to bear with patience.

This evil appears all the more frightful when one is faced, as he is at least up to now, with the feeling that he is helpless, or nearly so. When from time to time someone imprudently announces news of a sensational discovery which will finally bring about a radical and definitive victory over this pitiless destroyer, there only follows, alas, for those who allow themselves to be deceived, or even ask to be deluded, a crueler and more profound disappointment than the many others that have preceded it.

How much more modest and, therefore, how much higher and surer is your ambition, gentlemen! In reality, a great many hypotheses have been brought forth and many theories have been timidly built up and discreetly proposed. They are certainly not to be belittled because, even if they are not verified, they open the door to new and more effective research. They mark, therefore, some progress, doubtless valuable, but of necessity very slow. You, who have applied yourselves for many years to the conscientious study of cancer, of its manifestations and symptoms, of its nature and its causes or, at least, of the conditions of its origin and development, aspire, each in his own specialty but in constant contact with each other, to continue your advance step by step toward the light which will enable you to seek more easily and to find, first, a remedy which prevents or which alleviates and, finally, one that cures cancer.

Observations carefully made, diligently collected and compared, even if they are not conclusive, nevertheless suggest useful reflections on the nature and possible action of various agents, cancerous, physical or chemical, on the role of the atmosphere, the sun, a man's profession or heredity in the appearance and growth of tumours and in the evolution of a cell from a normal to a malignant state.

These observations, experiments and investigations you know how to pursue assiduously and patiently, and of which the general public often takes little account. They will not, perhaps, give you noisy publicity, but you will merit, as your conscience tells you, the gratitude of generations to come.

It pleases us to praise here the initiative of our Pontifical Academy, under whose auspices you have begun your study week. Always eager to serve the progress of science for the greater good of humanity, it asks you to specify, following its standard methods, 'the points on which agreement has been reached, the points on which agreement could not be reached, the reasons why agreement could not be reached, and suggestions concerning the research that appears most likely to resolve the difficulties'. Your proper intentions and spirit could not, we think, be better expressed.

These are surely the things, distinguished scholars, that ought to encourage you to pursue your work with the confidence that it is not undertaken in vain. For your work tends, as your programme states with

modest assurance, 'to open up, on a scientific basis, perspectives looking towards a biological cure for malignant tumours'.

We wish for you, in your mutual work, happy and fruitful results, asking with all our heart for God's light and blessing on it.

18 DECEMBER 1949

*Address in St. Peter's Basilica on the Occasion of the
Unveiling of the Monument to the Supreme Pontiff Pius XI*

The Supreme Pontiff provides a survey of the many achievements of his predecessor. He stresses Pius XI's dedication to learning and culture, and emphasises how he had not only been dedicated to the sacred sciences and permeated by a zeal for the training of the clergy but had also been moved by a 'love for science' and 'a solicitude towards scientists' of all nations. This had been expressed in his giving a new life to the Pontifical Academy of Sciences 'which he liked to honour with his personal intervention and his words'. Pius XI had also encouraged many other institutions of learning and research.

While there fell the veil of the monument, which the piety of the Cardinals created by him had erected in the highest temple of Christianity in honour of the Supreme Pontiff Pius XI – a monument that Cardinal Nasalli Rocca in the name of the Cardinal's Commission has eloquently illustrated – an inexpressible and joyous feeling took hold of our spirit. This marble work will evoke in the eyes of the multitudes, who, more numerous than ever during this Holy Year, will gather in throngs beneath the vaults of this Patriarchal Basilica, the memory and almost the very living effigy of the august one who has passed on.

But only one monument can worthily represent his spirit: that of his teachings, of his examples, and of his works. That spirit, far from disintegrating with the bite of time, will appear to generation after generation as ever greater and ever more powerful.

Venerable brothers and dear children: forceful is our commotion. But how profound it is within us, and we, called by him to be a part of the Sacred College, while we venerated him as a Father and a Teacher, were far from supposing that in its inscrutable designs divine providence was preparing us to take from his hands, to be borne on our weak shoulders, the gigantic legacy that he left behind him!

It could seem that we, having been for a good nine years the humble but assiduous and devoted collaborator of his apostolic ministry through the happy and the stormy events of his pontificate, the witness to his substantial works, the confidant of his high thoughts, should be able to throw light on the most relevant traits of our immortal predecessor. Alas! Precisely because of such intimacy, the undertaking daunts us even more because of the immediate knowledge that we had of his incomparable greatness.

Greatness; yes, greatness indeed: *Factus est... Sacerdos magnus!*¹ He was always great: great because of the force and the clarity of his intellect, great because of his heart and his virtues, great because of the breadth of his thoughts and the height of his proposals, and great because of the exactness and the vigour of their practical implementation.

In Pius XI, future generations will admire the greatness of his intellect, the vastness of his knowledge, the variety and the agility of his aptitudes, the eminent superiority of the scholar, the doctor, and the pastor. This learning, this universal and yet profound culture – of which he was a model most difficult to imitate – was in his eyes a duty of the priest: ‘for the lips of a priest should guard knowledge, and men should seek instruction’.² What did he not do to promote such learning? Thus his tireless zeal for the training of the clergy, for the solidity and the perfection of their studies, whose fundamental programme he outlined in the Apostolic Constitution *Deus Scientiarum Dominus* (24 May 1931). But the esteem which his mind, open to the broadest horizons of knowledge, had for knowledge, did not confine itself to the sacred sciences; in these he venerated the word of God manifested to the world; in the profane sciences he revered the ray of light that God reflects onto the front of man created in His image and likeness.

Of them all he made himself the promoter and the patron, and his love for science flowed into his solicitude towards scientists, without personal distinction, or distinction regarding nations and civilisations – a solicitude which gave a new life to the Pontifical Academy of Sciences, which he liked to honour with his personal intervention and his words.

This is an example of his greatness in the practical implementation of his brilliant ideas. And how many others could one cite without moving beyond the field of intellectual life! Need one perhaps remember what he did to establish, refund, and organise universities, faculties, institutes and seminaries? To ensure – he himself having been a most expert librarian – the conservation of archives and libraries? To make it happen that the voice of the Vicar of Christ reached the far ends of the earth through a very modern radio station? To foster the cultivation of the arts through the new Vatican picture gallery?

Future generations will admire in Pius XI his greatness and sensitivity of heart, the purity and ardour of charity. I believe that of him one will never be able to say that science made arid or rendered lukewarm his refined sensitivity.

¹ 1 M 14:30.

² Ml 2:7.

His love for God appears through all his words, his writings, his works, in his doctrinal teachings, as indeed in their practical application. In them one sees at every moment the bursting forth of the spark, or the lighting of the great fire, of his love. One reads anew the forceful Encyclical *Miserentissimus Redemptor* (8 May 1928), with his invitation to atonement, and the Bull *Quod Nuper* (6 January 1933), by which he called the Special Holy Year of the Redemption, crowned at Lourdes at the feet of the Immaculate One. And what devotion towards the Virgin and Mother of God transpires in the commemoration of the Ecumenical Council of Ephesus and the liturgical feast, extended to the whole of the Church, of the divine Motherhood of Mary!³

What can one say about his charity towards men. He felt and carried within him all their suffering, all their misery, all their worries. The economic crisis, unemployment, the armaments race all inspired his Encyclical *Nova Impendet* (2 October 1931); and a few months later the first words of *Caritate Christi Compulsi* (3 May 1932) were sufficient to reveal to the world the depths of that great heart, subsequently tormented by the civil wars in Spain and Mexico, where 'brothers have killed brothers'.

Future generations will admire in Pius XI the greatness of his views and aspirations. High Priest, he had no other ambition than have God and his Christ reign in the world. He was rightly called the Pope of Catholic Action. He was this in the fullest meaning of the word, asking for the cooperation of everybody and in all forms. He wanted to establish this kingdom of God and Christ, to strengthen it, and to propagate it in individuals, in families, in nations and between nations, and in the whole of human society.

In order to establish it in souls through personal sanctification, he strongly promoted the practice of spiritual exercises; in order to establish it and make it shine forth in priests through priests, a few years earlier he had exalted the greatness of priesthood in his priestly Jubilee,⁴ published the magnificent Encyclical *Ad Catholici Sacerdotii* (20 December 1935), and inserted at the same time the fine votive mass of Jesus Christ, high and eternal Priest, into the liturgy.

In order to establish this kingdom in families, he strongly inculcated respect for the sanctity of marriage, *Casti Connubii* (31 December 1930), after, through *Divini Illius Magistri* (31 December 1929), fighting for the Christian education of young people.

³ *Lux Veritatis*, 25 December 1931.

⁴ *Quinquagesimo Ante Anno*, 23 December 1929.

Concerned to defend the rights of nations, the most wise Pontiff, just as with the Lateran Pacts he restored religious peace to Italy, so also with the almost simultaneous publication of three luminous Encyclicals did he reprove and condemn the attacks against the sovereignty of God and Christ. And turning his gaze beyond all national frontiers, the seas and oceans, while with perseverance and uprightness he worked to open the path to the return of dissidents to within the Mother Church, he provided through the Encyclical *Rerum Ecclesiae* (28 February 1926) for the development of missions amongst those without faith and for the perfect training of a native clergy.

The Father and Pastor of peoples, he multiplied his care in favour of peace between nations from the beginning of his pontificate with the programme-communicating Encyclical *Ubi Arcano Dei Consilio* (23 December 1922), in which he invoked the peace of Christ in the kingdom of Christ, until the day in which, amidst the deaf murmuring of the impending storm, his afflicted and tired voice urged the peoples of the world to be reconciled fraternally, and for the health and the peace of the world he made to God the offering of his valuable life.

Intent on founding the whole of human society on the kingdom of Christ, he made every effort and saved himself no trial in order to establish a Christian social order, confirming and completing the teachings of his predecessors with the Encyclical *Quadragesimo Anno* (15 May 1931), which will go down in history as being no less famous than *Rerum Novarum*, whose fortieth anniversary he commemorated.

Lastly, in order to make God and his Christ reign in the world and over the world, placing a crown on the work of Leo XIII, who had consecrated the world to the most holy Heart of Christ, and on the work of Pius X, who had dedicated his life to uniting all things in Christ,⁵ he solemnly proclaimed the kingship of Christ and instituted the feast of Christ the King, one of the most resplendent of the liturgical year.

We have done nothing else but outline the general features of the monument which Pius XI raised to himself through his life and works. They are enough, however, to allow us to see dizzy heights. We would now like to conclude our yet very inadequate picture by presenting the wonderful harmony of such sublime greatnesses.

It is that which Holy Scripture exalts in Wisdom, which *attingit ... a fine usque ad finem fortiter, et disponit omnia suaviter*. Strength and goodness. The strength of Pius XI was indomitable, inflexible, both as regards

⁵ Ep 1:10.

the upholding of the rights of God and of the Church in the sanctity of marriage, in the education of young people; in condemning the violation of these rights in the government of peoples or nations, or in outlining the limits of rights and of mutual duties in national and international social practice; and in reproving easy compromises, timid compliances, half-measures, forms of irresolution, and easy neutralities. There still ring out in our ears his unforgettable words: the greatness and the difficulties of our times do not allow any true disciple of Christ to be content with mediocrity. The memory of an evening is still alive for us, when he called us at an unusual hour to ask for our modest advice regarding a difficult problem which was causing him worry. We expressed that advice as best we could. He then exclaimed: 'you speak as the Secretary of State must speak. But we... we now have here' – and he pointed to the door with his finger – 'a great audience'. And raising his right hand he said: 'We know what we have to say'. He rose, went and spoke like an ancient Father of the Church. His vigour, his intransigence; there where compromise would have been prevarication, he made the most brazen tremble.

And nonetheless, even then, the severity of his requests was sweetened by an impeccable loyalty without passion, by an unchanging goodness. With what honest frankness he expounded the role that falls to the state in the education of young people! What sensitive understanding and what paternal compassion he expressed for the suffering and worries often connected with the full and faithful practice of conjugal duties! One could continue indefinitely this examination of his acts; one would always reach the same conclusion.

Present circumstances require neither less strength nor less goodness. We thus turn our gaze towards him; we hear the voice of his examples, and to him, in this hour which is specially dedicated to his memory, we present the solemn promise of our hearts.

O excellent Pontiff, the greatness and the seriousness, the cares and the suffering of the time in which Divine Providence wished to place our life and our work, do not daunt us. Harsh as it is, threatened by dangers, aggravated by forms of bitterness, we however love this time, we embrace it like the cross destined for us by the Lord from the beginning of time, and on whose rough hardness must be experienced the genuineness of our love, the firmness of our faithfulness, the absoluteness of our faith, the range of our intimate participation in the pain, the needs, and the mission of the Bride of Christ. Your words and your example are for us a stimulus and an encouragement to walk in the footsteps left by your energy and your intrepid activity, all consecrated to promoting the return to Christ of your generation. May the Lord give us the grace to calmly follow, as you did, the

invitation of the Master *Duc in altum*,⁶ with a strength if not equal than at least similar to yours, and to obtain from divine omnipotence that which goes beyond purely human power.

If the Lord so wishes, in a few days' time we will proceed to the opening of that Holy Door that the hand of Pius XI opened two times during his pontificate. We will do so with the strong trust that He who reigns in heaven and reigns over the destinies of peoples and above all the destiny of his Church, will concede to us, at this time of prayer and forgiveness, to experience the rich efficacy of his promise: *Qui petit accipit, et qui quaerit invenit, et pulsanti aperietur*.⁷

May he who is the King and the centre of all hearts be moved to move obstinate spirits, to open the ears of men to the infinite sweetness and mercy of his words: *Eccæ sto ad ostium et pulso*,⁸ so that by his victorious grace many of those who have so far been hostile to him and his Church, casting off the shadows of their errors, will come into the light of Christ *ut vitam habeant et abundantius habeant*.⁹

In this expectation and with this prayer, we willingly impart on you, venerable brothers and loved children, on all those who are united with us in spirit in the commemoration of our great predecessor, on all our sons and daughters spread on the face of the earth, on those above all else who in prisons and forced confinement, in torment and slavery, in oppression and humiliation, 'were counted worthy to suffer dishonour for the name of Jesus',¹⁰ in hoping and wishing for the most chosen celestial favours, our paternal Apostolic Blessing.

⁶ *Lk* 5:4.

⁷ *Mt* 7:8.

⁸ *Rv* 3:20.

⁹ *Jn* 10:10.

¹⁰ *Ac* 5:41.

22 NOVEMBER 1951

*'The Proofs for the Existence of God
in the Light of Modern Natural Science'
Address to the Plenary Session and to the Study Week
on the Subject 'The Question of Microseisms'*

In a long and often technical address, Pius XII dwells at length upon the structure of matter and the cosmos and the origins of the universe. He affirms that 'contrary to rash statements in the past, the more true science advances, the more it discovers God', and re-examines classical proofs of the existence of God on the basis of new scientific discoveries. A recognition of God as the Creator, 'a conviction shared by many modern scientists', should lead man to unite science with faith to achieve the progress of civilisation.

THE PROOFS FOR THE EXISTENCE OF GOD IN THE LIGHT OF MODERN NATURAL SCIENCE

We are grateful to the Almighty for a serene hour of happiness which offers us this gathering of the Pontifical Academy of Sciences, and gives us the welcome opportunity of meeting with a select group of Eminent Cardinals, of illustrious diplomats and of noteworthy personalities, and especially with you, Pontifical Academicians, who are truly worthy of the solemnity of this session; because in investigating and unveiling the secrets of nature and teaching men to direct their energies for their good, at the same time you preach, in the language of numbers, formulae and discoveries, the ineffable harmonies of the all-wise God.

Contrary to rash statements in the past, the more true science advances, the more it discovers God, almost as though He were standing, vigilant and waiting, behind every door which science opens. Furthermore, we wish to say that not only does the philosophical thinker benefit from this progressive discovery of God, achieved in the increase of knowledge – and how could he do otherwise? – but those also profit who participate in the new discoveries or who make them the object of their considerations. The genuine philosophers especially benefit from it, since, by using the scientific advances as a spring-board for their rational speculations, they can achieve greater security in their conclusions, clearer illustrations in possible obscurity, more convincing support in finding ever more satisfactory answers to difficulties and objections.

Nature and basis of proofs for the existence of God

Thus directed and guided, the human intellect moves to meet that demonstration of the existence of God, which Christian wisdom recognises in the philosophical arguments weighed through the centuries by giants of learning, and which is well known in the presentation of the 'five ways'

which the Angelic Doctor St. Thomas offers as the sure and expeditious itinerary of the mind to God. Philosophical arguments, we have said; but not for that aprioristic, as an ungenerous and self-contradictory positivism has accused them of being. They are based upon concrete realities ascertained by the senses and sciences, even if they acquire conclusive strength only from the vigour of natural reason.

In this manner, philosophy and the sciences develop with analogous and compatible methods, taking advantage of empirical and reasonable elements in different measures and working together in harmonious unity toward the discovery of the truth.

But if the primitive experience of the ancients was able to offer sufficient arguments to reason to demonstrate the existence of God, now, with the amplification and deepening of the field of experience itself, the imprint of the Eternal upon the visible world is all the more splendid and radiantly visible. It seems profitable, therefore, to re-examine the classical proofs of St. Thomas on the basis of the new scientific discoveries especially those based upon the movement and order of the universe;¹ to consider, that is, if and to what extent the more profound knowledge of the structure of the macrocosm and the microcosm contributes to the reinforcement of philosophic arguments. On the other hand, it is not unprofitable to see if and to what point these arguments, as is not infrequently affirmed, have been shaken by the fact that modern physics has formulated new fundamental principles, abolished or modified ancient concepts, whose meaning was perhaps in the past adjudged fixed and definite, as, for example, time, space, movement, causality, substance, concepts of the greatest importance for the question that now holds our attention. Rather than a revision of the philosophic proof, it is a question of scrutinising the physical bases from which those arguments derive – and we must necessarily limit ourselves to only a few for reasons of space. But there is no fear of surprises: science itself remains firmly grounded in that world which today, as yesterday, presents itself in those five ‘modes of being’ from which the philosophic demonstration of the existence of God takes its motives and force.

Two essential hallmarks of the cosmos

Of these ‘modes of being’ of the world which surrounds us, perceived with more or less understanding, but with equal evidence, by the philosopher and the common intelligence, there are two which the modern sci-

¹ *S. Th.*, I, 2, 3.

ences have sounded, verified, and probed wonderfully and beyond all expectation:

- 1° The *mutability of things*, including their beginning and their end.
- 2° The *teleological order* which stands out in every corner of the cosmos.

The contribution made by the sciences to the two philosophical demonstrations is truly notable; and upon them hinge and are constituted the first and fifth ways. Physics especially has contributed to the first an inexhaustible mine of experience, revealing the fact of mutability in the profound recesses of nature, where before now no human mind could ever even suspect its existence and amplitude, and furnishing a multiplicity of empirical facts which gave highly valid support to the philosophical reasoning.

We say support, because the very direction of these transformations, while verified by modern physics, seems to us to surpass the value of a simple confirmation and almost attains the structure and the level of physical argument which is largely new, and more acceptable, persuasive and agreeable, to many minds.

With equal richness, the sciences, especially astronomy and biology, have recently supplied to the subject of order such a wealth of knowledge and such an intoxicating vision, as it were, of the conceptual unity which animates the cosmos, and of the finality which directs its march, as to give to modern man in advance that joy which Dante imagined in the empyrean Heaven when he saw how 'all that is dispersed through the universe is united by love in the mind of God'.²

Providence has disposed that the idea of God, so essential to the life of each man, while it can be easily grasped by a simple glance at the world so that not to comprehend the voice of nature is sheer foolishness,³ shall receive confirmation from every deepening of the understanding and progress in the field of scientific knowledge.

We wish, therefore, to give a few rapid examples of the precious service which modern sciences render to the demonstration of the existence of God. We limit ourself first to the fact of mutations, revealing principally the amplitude, the vastness, and, as it were, the totality which modern physics meets with in the inanimate cosmos. Then we shall pause for a look at the significance of their direction, which has been also ascertained. It will be as though one listened to a concerto within the immense universe, which sings 'the glory of Him Who moves all things'.⁴

² *Paradiso*, Canto XXXIII, 85-87.

³ *Ws* 13:1-2.

⁴ *Paradiso*, Canto I, 1.

A) *The mutability of the cosmos*

a) *in the macrocosm*

It is truly astonishing at first glance to see how the knowledge of the fact of mutability has steadily gained ground in both the macrocosm and the microcosm as the sciences have gradually progressed, almost confirming with new proofs the theory of Heraclitus: 'Everything flows': πάντα ῥεῖ.

Daily experience demonstrates the enormous quantity of transformations in the world, near and far, which surrounds us, especially the local movements of bodies. But in addition to these true and actual local motions, multiform chemicophysical changes are equally easy for us to see, such as, for example, the mutation of the physical state of water in its three phases of vapour, liquid, and ice; the profound chemical effects brought about by the use of fire, the knowledge of which goes back to prehistoric ages; the disintegration of stone and the corruption of vegetable and animal bodies. To this common experience natural science was added, which teaches us to understand these and other similar events as processes of destruction or construction of corporeal substances in their chemical elements, that is to say, in their smallest parts, the chemical atoms. It further teaches us that this chemicophysical mutability is in no way restricted to terrestrial bodies, according to the belief of the ancients, but is extended to all bodies of our solar system and the great universe, which the telescope, and, even more, the spectroscope, have shown to be formed of the same kind of atoms.

b) *in the microcosm*

Against the indisputable mutability of nature, including inanimate beings, there arose the enigma of the unexplored microcosm. It seemed, indeed, that inorganic matter, as opposed to the animated world, was in a certain sense immutable. Its smallest parts, the chemical atoms, could certainly unite among themselves in the most various ways, but it seemed that they enjoyed the privilege of an eternal stability and indestructibility, issuing unchanged from every chemical synthesis and analysis. A hundred years ago, elementary particles were still believed to be simple, indivisible, and indestructible. The same was thought of the energies and material forces of the cosmos, especially on the basis of the fundamental laws of the conservation of mass and energy. Some naturalists considered themselves authorised to the extent of formulating in the name of their science a fantastic monistic philosophy, the inglorious memory of which is bound to the name of Ernst Haeckel, among others. But during his own times, toward the end of the last century, this oversimplified conception of the chemical atom was also upset by modern science. The

growing knowledge of the periodical system of chemical elements, the discovery of the corpuscular irradiation of radioactive elements, and many other similar facts have demonstrated that the microcosm of the chemical atom with dimensions in the order of one tenmillionth of a millimetre is a theatre of continual mutation, no less than the macrocosm.

Mutability in the electronic sphere

The character of mutability was first verified in the electronic sphere. From the electronic structure of the atom, irradiations of light and heat emanate, which are absorbed by external bodies in a manner corresponding to the level of energy of the electronic orbits. In the exterior parts of this sphere the ionisation of the atom is carried out as well as the transformation of energy and the analysis of chemical combinations. It was supposed, however, that these chemicophysical transformations still left one refuge for stability, because they had not reached the nucleus itself of the atom, home of the mass and the positive electric charge, by which the place of the chemical atom in the natural system of the elements is determined; and it almost seemed that the type of the absolutely stable and invariable had been met.

Mutability in the nucleus

But already in the early days of the twentieth century, the observation of radioactive processes which are referable, in a last analysis, to the spontaneous dissolution of the nucleus, indicated that such a type did not exist. With the instability of the known aspects of nature verified as far as its most profound recesses, there was one fact which left investigators perplexed, because it seemed that the atom was impregnable at least to human forces, since in principle all the attempts to accelerate or arrest the natural radioactive dissolution, even the splitting of the nonactive nuclei, had failed. The first rather modest splitting of a nucleus (of nitrogen) goes back a bare three decades, and only for the past few years has it been possible, after great efforts, to bring about, in considerable quantities, processes of formation and decomposition of nuclei. Although this result, which, in so far as it serves the purposes of peace, will certainly be a matter of pride for our century, can be considered only a first step in the field of practical nuclear physics, nevertheless, it lends weight to our consideration: the atomic nuclei are certainly, for many orders of magnitude, less active and more stable than the ordinary chemical compositions, but notwithstanding that, they are also in general subject to similar laws of transformation, and therefore mutable.

At the same time, it has been discovered that such processes have the greatest importance in the economy of the energy of the fixed stars. At the centre of our sun, for example, according to Bethe, a temperature which averages around twenty million degrees centigrade is reached, a recurring chain reaction in itself in which four nuclei of hydrogen are joined to a nucleus of helium. The energy which is thus freed compensates for the loss due to the irradiation of the sun itself. In modern physics laboratories also, it is possible to bring about transformations of nuclei by means of a bombardment with particles furnished with great energy, and with neutrons. This has been accomplished with the uranium atom, for example. In this connection, the effects of cosmic radiation should be mentioned, which can split the heaviest atoms, not infrequently giving off entire swarms of sub-atomic particles.

We wished to cite only a few examples, enough to place beyond doubt the definite mutability of the inorganic world, large and small: the thousandfold transformations of the forms of energy, especially in the chemical decomposition and combinations in the macrocosm, and no less the mutability of the chemical atoms as far as the subatomic particles of their nuclei.

The eternally immutable

The scientist of today, penetrating with his investigations more deeply into nature than his predecessor of a hundred years ago, knows that inorganic matter in its very marrow, in a manner of speaking, is stamped with the mark of mutability and therefore its being and its existence demand an entirely different reality and one that is by its nature immutable.

Just as in a painting in chiaroscuro, the figures stand out from the dark background, obtaining in this manner alone the full effect of modelling and of life, so the image of the eternally immutable emerges clear and resplendent from the torrent that carries away with it all the material things in the macro- and microcosms and whirls them into an intrinsic mutability which never stops. The scientist who stands on the edge of this immense torrent finds relief in that cry of truth with which God defines Himself:⁵ 'I am He who is', and Whom the Apostle praises as *Pater luminum, apud quem non est transmutatio neque vicissitudinis obumbratio* – the Father of lights, with whom there is no change nor shadow of alteration.⁶

⁵ *Ex* 3:14.

⁶ *Jm* 1:17.

B) *The direction of the transformations*

a) *in the macrocosmos: the law of entropy*

But modern science has not only enlarged and deepened our knowledge of the reality and magnitude of the mutability of the cosmos; it has also offered us valuable indications concerning the direction according to which the processes of nature are carried out. While a hundred years ago, especially after the discovery of the law of constants, it was thought that the natural processes were reversible, and therefore, according to the principles of strict causality – or, rather, determination – an ever-recurring renewal and rejuvenation of the cosmos was considered possible. With the law of entropy, discovered by Rudolf Clausius, it became known that the spontaneous natural processes are always related to a diminution of the free and utilisable energy, which in a closed material system must finally lead to a cessation of the processes on the macroscopic scale.

This fatal destiny, which only hypotheses, sometimes far too gratuitous ones such as that of the continuous renewal of creation, forcibly try to deny, but which instead comes from positive scientific experience, eloquently postulates the existence of a necessary Being.

b) *in the microcosm*

In the microcosm, this law, which is actually statistical, is not applicable, and furthermore, at the time of its formulation, hardly anything was known of the structure and behaviour of the atom. However, the most recent investigations of the atom and the quite unexpected development of astrophysics have made surprising discoveries possible in this field. Results can be mentioned here only briefly; they indicate that in the atomic and intra-atomic development a sense of direction is clearly noticeable.

In order to illustrate this fact it suffices to recall the already mentioned example of the behaviour of solar energy. The electronic structure of the chemical atoms in the photosphere of the sun gives off each second a gigantic quantity of radiant energy into the surrounding space, an energy that does not return. The loss is compensated for from the interior of the sun by means of the formation of helium from hydrogen. The energy which is thus liberated derives from the mass of hydrogen nuclei, of which in this process a small part (seven per cent) is converted into equivalent radiation. The process of compensation is carried out, therefore, at the expense of the energy which originally existed as mass in the nuclei of hydrogen. Thus this energy, in the course of billions of years, is slowly but irreparably transformed into radiation. A similar phenomenon occurs in all radioactive processes, whether natural or artificial. Here too, then, in the narrow confines of the microcosm

itself, we meet with a law which indicates the direction of evolution and which is analogous to the law of entropy in the macrocosm. The direction of spontaneous evolution is determined by means of the diminution of the energy utilisable in the structure and the nucleus of the atom, and up to now processes have been noted which could compensate or cancel this diminution by means of spontaneous formation of nuclei of high energetic value.

C) *The universe and its development*

In the future

If, then, the scientist turns his gaze from the present state of the universe to the future, however far off, he will be forced to realise that the world is growing old, both in the macrocosm and in the microcosm. In the course of billions of years, even the quantity of atomic nuclei, which is apparently inexhaustible, loses its utilisable energy and matter approaches, to speak figuratively, the state of a spent and wasted volcano. And the thought presents itself inescapably: if the present cosmos, today so pulsating with rhythm and life, is not sufficient to account for its existence, as we have seen, how much less will it be the case for that cosmos once the shadow of death shall have passed over it.

In the past

We now turn our eyes toward the past. In proportion to the distance in time to which we turn backward, matter is seen to be richer and richer in free energy and the theatre of great cosmic upheavals. Thus, everything seems to indicate that the material universe has had, in finite time, a powerful start, provided as it was with an unimaginable abundance of reserves in energy; then, with increasing slowness, it has evolved to its present state.

Two questions spontaneously come to mind:

Is science in a position to say when this powerful beginning of the cosmos took place? And what was the initial, primitive state of the universe?

The most noted experts in atomic physics, in co-operation with the astronomers and the astrophysicists, have put great effort into shedding light on these two difficult but extremely interesting problems.

D) *The beginning in time*

First, to cite some figures, which serve only to express the order of magnitude in the designation of the dawn of our universe, that is, its beginning in time, science has at its disposal several paths of investigation, each fairly independent of the other, though they are convergent, as we indicate briefly:

1. *The velocity of travel of the spiral nebulae or galaxies*

The examination of numerous spiral nebulae, carried out especially by Edwin E. Hubble at Mount Wilson Observatory, has demonstrated the significant result – though tempered by reserve – that these far-off systems of galaxies tend to rush away from one another at such speed that the space between two such spiral nebulae doubles in the period of about 1300 million years. If one looks back across the period of this process of the ‘Expanding Universe’ the conclusion is that from one to ten billion years ago the matter of all the spiral nebulae was compressed into a relatively narrow space, at the time of the beginning of the cosmic processes.

2. *The age of the solid crust of the earth*

To calculate the age of the original radioactive substances, highly approximate data are deduced from the transmutation of these substances into the corresponding isotope of lead, for instance the transformation of the isotope of uranium 238 into RaG (an isotope of lead), of the uranium isotope 235 into actinium D, and of the isotope of thorium 232 into thorium D. The mass of helium which is formed thereby can also serve as a check. In this way the average age of the most ancient minerals is indicated at a maximum of five billion years.

3. *The age of meteorites*

The preceding method, when applied to meteorites to calculate their age, gives about the same figure of five billion years. This result takes on special importance because the meteorites are generally believed to be of interstellar origin and, except for terrestrial minerals, they are the only examples of celestial bodies which can be studied in scientific laboratories.

4. *The stability of the systems of double stars and star masses*

The oscillations of gravitation within these systems, like the wearing away of the tides, again restrict their stability within the limits of from five to ten billion years.

Although these figures are astonishing, nevertheless, even the simplest believer would not take them as unheard of and differing from those derived from the first words of Genesis, ‘In the beginning ...’, which signify the beginning of things in time. These words take on a concrete and almost mathematical expression, and new comfort is given to those who share with the Apostle an esteem for that Scripture, divinely inspired, which is always useful *ad docendum, ad arguendum, ad corripiendum, ad erudiendum* – to teach, to prove, to correct, to educate.⁷

⁷ 2 Tm 3:16.

E) *The state and nature of original matter*

With equal earnestness and freedom of investigation and verification, learned men, in addition to the question of the age of the cosmos, have applied their audacious talents to another question which we have already mentioned and which is certainly much more difficult, and that is the problem concerning the state and quality of primitive matter. According to the theories which are taken as a basis, the relative calculations differ considerably one from the other. Nevertheless, the scientists agree in holding that not only the mass but also the density, the pressure, and the temperature must have attained degrees of enormous intensity, as can be seen in the recent work of A. Unsöld, director of the Observatory in Kiel.⁸ Only under these conditions can one comprehend the formation of the heavy nuclei and their relative frequency in the periodical system of the elements.

On the other hand, the eager mind, in its search for truth, rightfully insists upon asking how matter came to be in a state so unlike that of our common experience of today, and what preceded it. One waits in vain for an answer from natural science, which honestly declares that this is an insoluble enigma. It is true that this is asking too much of natural science as such; but it is also true that the human spirit versed in philosophical speculation is able to penetrate the problem more profoundly.

It is undeniable that a mind illuminated and enriched by modern scientific knowledge, which calmly evaluates this problem, is led to break the circle of a matter preconceived as completely independent and autonomous – either because uncreated or self-created – and to acknowledge a Creative Spirit. With the same clear and critical gaze with which he examines and judges facts, he also catches sight of and recognises the work of the omnipotent Creator, Whose power, aroused by the mighty ‘fiat’ pronounced billions of years ago by the Creative Spirit, unfolded itself in the universe and, with a gesture of generous love, called into existence matter, fraught with energy. Indeed, it seems that the science of today, by going back in one leap millions of centuries, has succeeded in being a witness to that primordial *Fiat Lux*, when, out of nothing, there burst forth with matter a sea of light and radiation, while the particles of chemical elements split and reunited in millions of galaxies.

It is true that the facts verified up to now are not arguments of absolute proof of creation in time as are those which are drawn from metaphysics and revelation, in so far as they concern creation in its widest sense, and from revelation alone in so far as they concern creation in time. The facts pertinent to natural sciences, to which we have referred, still wait for further investigation

⁸ *Kernphysik und Kosmologie*, in the *Zeitschrift für Astrophysik*, 24, B (1948), pp. 278-305.

and confirmation, and theories founded upon them have need of new developments and proofs, in order to offer a secure basis to a line of reasoning which is, of itself, outside the sphere of the natural sciences.

Notwithstanding this, it is worth noting that modern exponents of the natural sciences consider the idea of the creation of the universe entirely reconcilable with their scientific conception, and indeed they are spontaneously brought to it by their researches, though only a few decades ago such a 'hypothesis' was rejected as absolutely irreconcilable with the present status of science. As late as 1911, the celebrated physicist Svante Arrhenius declared that 'the opinion that something can proceed from nothing is in contrast with the present status of science, according to which matter is immutable'.⁹ Similar to this is Plate's affirmation: 'Matter exists. Nothing proceeds from nothing: in consequence matter is eternal. We cannot admit the creation of matter'.¹⁰

How different and reflecting great vision is the language of a modern top grade scientist, Sir Edmund Whittaker, a Pontifical Academician, when he speaks of his researches concerning the age of the world: 'These different estimates converge to the conclusion that there was an epoch about 10^9 or 10^{10} years ago, on the further side of which the cosmos, if it existed at all, existed in some form totally unlike anything known to us: so that it represents the ultimate limit of science. We may perhaps without impropriety refer to it as the Creation. It supplies a concordant background to the view of the world which is suggested by the geological evidence, that every organism ever existent on the earth has had a beginning in time. If this result should be confirmed by later researches, it may well come to be regarded as the most momentous discovery of the age; for it represents a fundamental change in the scientific conception of the universe, such as was effected four centuries ago by the work of Copernicus'.¹¹

Conclusion

What, then, is the importance of modern science in the argument for the existence of God drawn from the mutability of the cosmos? By means of exact and detailed investigations into the macrocosm and the microcosm, it has widened and deepened to a considerable extent the empirical foundation upon which the argument is based and from which we conclude a self-existent Being (*Esse per essentiam*) immutable by nature. Further, it has

⁹ *Die Vorstellung vom Weltgebäude im Wandel der Zeiten* (1911), p. 362.

¹⁰ *Ultramontane Weltanschauung und Moderne Lebeskunde* (1907), p. 55.

¹¹ *Space and Spirit* (1946), pp. 118-119.

followed the course and the direction of cosmic developments, and just as it has envisioned the fatal termination, so it has indicated their beginning in time at a period about five billion years ago, confirming with the concreteness of physical proofs the contingency of the universe and the well-founded deduction that about that time the cosmos issued from the hand of the Creator.

Creation, therefore, in time, and therefore, a Creator; and consequently, God! This is the statement, even though not explicit or complete, that we demand of science, and that the present generation of man expects from it. It is a statement which rises from the mature and calm consideration of a single aspect of the universe, that is, of its mutability; but it is sufficient because all mankind, the apex and rational expression of the macrocosm and the microcosm, is made conscious of its sublime Creator and feels His presence in space and in time, and, falling to its knees before His sovereign Majesty, begins to call upon the name *Rerum Deus, tenax vigor – Immotus in te permanens – lucis diurnae tempora – successibus determinans*.¹²

The knowledge of God as unique Creator, a conviction shared by many modern scientists, is certainly the extreme limit which natural reason is capable of reaching; but it does not constitute the last frontier of truth. Science, which has encountered the Creator in its path, philosophy, and, much more, revelation, in harmonious collaboration because all three are instruments of truth, like rays of the same sun, contemplate the substance, reveal the outlines, and portray the lineaments of the same Creator. Revelation especially renders the presence almost immediate, full of life and love, which is what the simple believer and the scientist are aware of in the intimacy of their spirits when they repeat without hesitation the concise words of the ancient Creed of the Apostles: *Credo in Deum, Patrem omnipotentem, Creatorem caeli et terrae!*

Today, after so many centuries of civilisation (because they were centuries of religion), now the need is not to find God for the first time, but rather to recognise Him as a Father, to revere Him as Legislator, to fear Him as Judge; it is urgent for the salvation of all peoples that they adore the Son, the loving Redeemer of mankind and they bend the knee to the gentle urgings of the Spirit, fruitful Sanctifier of souls.

This conviction, which takes into account the deepest movements of science, is crowned by faith which, the more it is rooted in the consciousness of peoples, the more it can really lead to a fundamental progress for civilisation.

¹² *Hymn for None.*

It is a whole vision, of the present and of the future, of matter and of spirit, of time and of eternity, that, illuminating the mind, will save the men of today from a long and stormy night. And that faith, which makes us in this moment raise to Him Whom we have just called *Vigor, Immotus* and *Pater*, a fervent prayer for all His sons, who are given to us to look after: *Largire lum en vespere – quo vita nusquam decidat* – light for our life in time, light for eternal life.¹³

¹³ *Ibid.*

24 APRIL 1955

*'The Structure of the Matter of the Created World
as a Manifestation of the Wisdom and Goodness of God'
Address to the Plenary Session and to the Study Week on the Subject
'The Question of Oligoelements in Plant and Animal Life'*

The Pope observes that scientists are dedicated to the study of natural phenomena and that the 'created world is a manifestation of the wisdom and goodness of God'. For this reason, men and women of science have the mission to be the 'discoverers of the intentions of God'. He refers to the immense advances in science in modern times and regrets the historical separation of philosophy and science, calling for a productive union of the two, not least to achieve an 'all-embracing view of the visible world'.

As we bid you welcome in this house, whose doors have always been opened wide to those who cultivate the arts and sciences, we desire also to express to Your Excellencies, Members of our Academy, our lively satisfaction.

Your life, consecrated as is to the study of natural phenomena, enables you to observe every day more closely, and to interpret, the wonders which the Most High has inscribed on the reality of things. In very truth, the created world is a manifestation of the wisdom and goodness of God, for all things have received their existence from Him and reflect His grandeur. Each of them is, as it were, one of His words, and bears the mark of what we might call the fundamental alphabet, namely those natural and universal laws derived from yet higher laws and harmonies, which the labour of thought strives to discover in all their amplitude and their absolute character.

Created things are words of truth. In themselves, in their being, there is neither contradiction nor confusion. Rather, they always cohere one with the other. Sometimes they are difficult to understand because of their depth, but always, when clearly known, they are seen to be in conformity with the superior exigencies of reason. Nature opens up before you like a mysterious but astonishing book, which must be turned page by page and read in an orderly manner, with the aim in mind of progressing ceaselessly. In this manner, every forward step is a continuation of the preceding ones, corrects them, and climbs continually toward the light of a deeper understanding.

The mission confided to you, therefore, ranks among the most noble, for you should be, in a sense, the discoverers of the intentions of God. It pertains you to interpret the book of nature, to describe its contents, and to draw the consequences therefrom for the good of all.

First of all, you are the interpreters of the book of nature. It is, then, necessary that you fix your gaze on each line, and be ever most careful not

to pass over any detail. Set aside all personal bias, and accommodate yourselves with docility to every indication of truth which comes to light.

We are aware of the exceptional importance of the epoch through which science is passing at this time, an importance which not all succeed in appreciating. In fact, there exist, in regard to scientific problems, three different attitudes. Some, and they are the majority, are content to admire the extraordinary results obtained in the technical realm and, it would seem, believe that these results constitute the sole, or at least the principal, aim pursued by science.

Others, better informed, are capable of appreciating the method and efforts required by scientific research. They can thus follow and understand its remarkable advances, its successes and checks. They observe with interest the ceaseless perfecting of mathematical methods, of experimental procedure, of instrumentation. They follow passionately the working out of hypotheses, the establishment of conclusions, the intellectual labour of harmonising data, schematically modifying previous considerations, formulating new theories that will be subjected to verification. These multiple aspects are well understood by all those who, for various motives, interest themselves in the work of scientists.

As for the most essential problems of scientific knowledge, or those whose amplitude embraces its entire realm, the minds which perceive them are, it seems to us, relatively few in number, and we rejoice at the thought that you are among them. Has not science arrived at the point of demanding that our vision should penetrate readily the most profound realities and rise to a complete and harmonious view of these in their wholeness?

1. A little more than a century and a half ago, by starting from rational bases, the first hypotheses were formulated concerning the discontinuous structure of matter and the existence of very minute particles, which were considered the final constituents of all bodies. From that time until our day, molecules have been counted, weighed and analysed. Then the atom, at first considered indivisible, was split into its elements. It was examined and attacked in its innermost structure. The elementary electrical charge was determined, as well as the mass of the proton. The neutron, the mesons, the positron and many other elementary particles were identified and their characteristics determined. Means were found to guide these particles, to accelerate them, to shoot them into atomic nuclei. But it was especially by utilising neutrons that man succeeded in producing artificial radioactivity, nuclear fission, the transformation of one element into other elements, the production of enormous quantities of energy.

Theories and ingenious representations of the world have appeared; new mathematical methods and new geometries have been created. We can only mention here the special theory of relativity and the general theory of relativity, quanta, wave mechanics, quantum mechanics, recent ideas on the nature of nuclear forces, theories on the origin of cosmic rays, hypotheses concerning the source of stellar energy.

All this permits us to glimpse the depths into which science has moved, and one readily realises the problems of an intellectual nature which will arise. It should be taken into consideration, moreover, that, while the bold band of conquerors ever opens new breaches in the citadel of nature, the rest of the army is spread over numberless other fields of knowledge: and this is the point of view of extension, which must be added to that of depth. One would wish to be able, like the bold climber arriving at the summit of the mountain, to take in the entire spread of the panorama with a single glance.

If it were possible for us, we should like to show you the most advanced position in the various sectors of science, so that there might appear before your eyes a general view of the present situation.

See how astronomy, by means of instruments recently placed at its service, succeeds in unveiling entirely new mysteries in the heavens and, with the help of the physical sciences, has set out on the road which will perhaps lead it to elucidate the source of stellar energy. See how geology determines the absolute age of rocks by means of radioactivity and isotopic correlations: a beginning has even been made towards determining the age of the earth!

In mineralogy, crystalline structures are yielding up their secrets to powerful analyses using radiations of very short wave-length. Inorganic and organic chemistry is solving the complex problems of the structure of macromolecules: it is successfully building huge molecular chains and, by the resultant applications, is transforming whole sectors of industry. Radio technique has succeeded in producing electromagnetic waves which approach the limits of luminous radiation of greatest wave-length. The earth is delved into so that its hidden treasures may be discovered, the highest strata of the atmosphere are being explored, genetics is bringing to light, in certain particular cellular complexes, new aspects of the power of life.

Physiology and biology, starting from bases achieved by chemistry, physical chemistry and physics, daily encounter unsuspected marvels and daily interpret, explain, forecast new facts and bring them to realisation. The domain of the virus is giving way to the assault of the electronic microscope and of the electronic diffraction technique. The mass spectrograph, Geiger counters, radioactive isotopes, all such instruments facilitate the progress of science as it faces the greatest enigma of all visible creation: namely, the problem of life.

In synthesising all this knowledge it is philosophy which, with its broad concepts, states precisely the distinctive traits of vital factors, the necessary character of the underlying principle of unification, the internal source of action, of growth, of multiplication, the true unity of the living being. It shows, too, what matter, in some of its fundamental aspects, must be in order that there may be realised in the living being the characteristic properties which constitute it.

These are, without doubt, the domains that will give most work to the science of tomorrow.

2. But the feeling of elation engendered in one's soul by results like these is dampened by an impression of confusion and anguish existing among those who, with a sense of their responsibility, are following the unfolding of the facts. This anguish and confusion are to be understood in the most elevated sense, as sign of an aspiration toward an ever greater clearness in perspectives. For the triumphs of science are themselves at the origin of the two requirements to which we alluded above.

a) The first task is to penetrate the intimate structure of material beings and to consider the problems connected with the substantial foundation of their being and of their action. The question then arises: 'Can experimental science solve these problems by itself? Do they belong to its domain? Do they come within the field where its research methods can be applied?'. One must answer in the negative. The method of science is to take as its starting point sensations, which are external by their very nature. Through them, by the process of intelligence, it descends ever more deeply into the hidden recesses of things. But it must halt at a certain point, when questions arise which cannot be settled by means of sense observation.

When the scientist is interpreting experimental data and applying himself to explain phenomena that belong to material nature as such, he needs a light which proceeds in the inverse direction, from the absolute to the relative, from the necessary to the contingent; a light which is capable of revealing to him the truth which science is unable to attain by its own methods. This light is philosophy, namely, the science of general laws which apply to all being and therefore are applicable in the domain of the natural sciences, above and beyond the laws discerned empirically.

b) The second requirement springs from the very nature of the human soul, which seeks a coherent and unified view of truth. If one is satisfied with a juxtaposition of the various subjects of study and their ramifications, as in a kind of mosaic, one gets an anatomical composition of knowledge from which life seems to have departed. Man demands that a breath of

living unity enliven the knowledge acquired. It is in this way that science becomes fruitful and culture begets an organic doctrine.

This raises a second question: 'Can science with the means which are characteristic of it, effect this universal synthesis of thought? And in any case, since knowledge is split up into innumerable sectors, which one, out of so many sciences, is the one capable of realising this synthesis?'. Here again we believe that the nature of science will not allow it to accomplish so universal a synthesis.

This synthesis requires a solid and very deep foundation, from which it derives its unity and which serves as a basis for the most general truths. The various parts of the edifice thus unified must find in that foundation the elements that make up their essence. A superior force is required for this: unifying by its universality, clear in its depth, solid by its character of absoluteness, efficacious by its necessity. Once again that force is philosophy.

3. Unfortunately, for some time past, science and philosophy have been separated. It would be difficult to establish the causes and responsibilities for a fact so detrimental. Certainly the cause of the separation must not be sought in the nature of these two ways, each of which can lead to truth. Rather, it must be sought in historical contingencies and in persons who did not always possess the necessary goodwill and competence.

At one time men of science thought that natural philosophy was a useless weight, and they refused to allow themselves to be guided by it. On the other hand, philosophers ceased to follow the progress of science, and they halted in certain formal positions which they could have abandoned. But when, as we have shown, there arose the inevitable necessity for a serious work of interpretation, as also for the elaboration of a unifying synthesis, scientists fell under the influence of the philosophies which the circumstances of the time placed at their disposal. Many of them, perhaps, were not even clearly aware that their scientific investigations were being influenced by particular philosophical trends.

Thus, for example, mechanistic thought guided for a long time the scientific interpretations of the phenomena observed. Those who followed that philosophical trend believed that every natural phenomenon was reducible to an ensemble of physical, chemical and mechanical forces, in which change and action were solely the result of a different disposition of particles in space and of the forces or displacements, to which each of them was subject. It followed that, in theory, one could foresee with certainty any future effect whatsoever, provided one knew beforehand the geometrical and mechanical data. According to that doctrine, the world was merely an enormous machine, composed of an innumerable series of other machines joined together.

Further progress in experimental research showed, however, the inexactitude of those hypotheses. Mechanics, deduced from the facts of the macrocosm, cannot explain or interpret all the phenomena of the microcosm: other elements come into play which defy any explanation of a mechanistic nature.

Take, for example, the history of the theories of the structure of the atom. At the beginning they were based essentially on a mechanistic interpretation, which represented the atom as a minute planetary system, made up of electrons circling around the nucleus according to laws entirely analogous with those of astronomy. Quantum theory later imposed a complete revision of these concepts and produced interpretations which were ingenious, certainly, but also unquestionably strange. In effect, there was conceived a type of atom which, without eliminating the mechanistic aspect, made the quantum aspect more prominent.

The mode of behaviour of the corpuscles was thus explained in different ways: electrons which, although revolving about a nucleus, did not radiate energy when, according to the laws of electrodynamics, they should have been radiating it; orbits which could not change continuously, but only in jumps; the emission of energy which occurred only when the electron passed from one quantum state to another, producing photons of a definite frequency determined by the differences in energy levels.

These hypotheses, as points of departure, were later stated precisely after the birth of wave mechanics, which fitted them into a more general and coherent mathematical and intellectual framework from which the traditional mechanistic ideas have vanished.

Then, spontaneously, the question arises: 'How can it be that the macroscopic world, although composed of elements which all belong to the microscopic world, nevertheless obeys different laws?' Science answers, first of all, with the following observation: when the number of elements in question is very great (billions upon billions of particles), then the statistical laws deriving from the behaviour of these different elements taken in their entirety are considered to hold strictly in the world directly observable by us.

But if the statistical method is satisfactory for the purposes of science, it reveals also how false were certain philosophical hypotheses which were limited to external evidence perceptible to the senses and then extended arbitrarily to the entire cosmos.

Confirmation of this is found in the theories of modern nuclear physics. In reality, the forces which hold together the nuclei are different from those that are discovered when studying the macrocosm. To understand them it is also necessary to change the customary manner of conceiving the corpuscular particle, the wave, the exact value of energy and the rig-

orously precise localisation of a corpuscle, and, indeed, the foreseeable character of a future event.

The failure of the mechanistic theory has led thinkers to hypotheses entirely different – characterised rather by a kind of scientific idealism – wherein the consideration of the active subject performs the principle role. For example, quantum mechanics and its fundamental principle of indeterminism with the challenge to the principle of causality which it supposes, appear as scientific hypotheses influenced by currents of philosophical thought.

But because these hypotheses themselves do not satisfy the desire for complete clarity, many illustrious thinkers have been brought to scepticism when confronted with the problems of the philosophy of science. These claim that it is necessary to be satisfied with the simple verifying of facts and striving to have these included in formal presentations – synthetic and simple – in order to foresee the possible developments of a physical system from a given initial state.

This state of mind results in the abandonment of conceptual introspection and in the loss of all hope of producing grand universal syntheses. We do not, however, believe that such pessimism is justified. We rather think that the natural sciences, in permanent contact with a philosophy of critical realism, such as was always that of the *philosophia perennis* as exemplified by the most eminent of its representatives, can arrive at an all-embracing view of the visible world which would, to some extent, satisfy the quest and the ardent desire for truth.

But it is necessary to emphasise another point. If science has the duty to strive for coherence and to seek inspiration from sound philosophy, philosophy itself should never attempt to define truths which are drawn solely from observation and from the use of scientific methods. An infinite variety of entities and laws of matter is possible. Only observation or experiment, understood in their very broadest sense, can point out which among these the Creator, in fact, desired to make into reality.

Authorised interpreters of nature, may you also be the teachers who explain to their brothers the wonders which are unfolded in the universe, and which you, better than others, see assembled as in a single book. Indeed, the majority of men can scarcely devote themselves to the contemplation of nature. They deduce from the facts they perceive only superficial impressions. Become, you who interpret creation, teachers eager to reveal its beauty, its power and its perfection so that they may be enjoyed by others.

Teach others to behold, to understand and to love the created world so that the admiration of splendours so sublime may cause the knee to bend and invite the minds of men to adoration.

Never betray these aspirations, this trust. Woe to them who make use of falsely taught sciences to make men leave the right path! They are likened to stones maliciously placed in the path of the human race. They are the obstacles on which men stumble in their search for truth.

You have in your hands a powerful instrument with which to do good. Take into account the unutterable happiness that you procure for others when you disclose to them the mysteries of nature and bring them to understand its harmonious secrets. The hearts and the gaze of those who listen to you are, as it were, hanging on your every word, ready to chant a hymn of praise and thanksgiving.

20 MAY 1957

*Address to the Plenary Session and to the Study Week on the Subject
'The Problem of Stellar Populations'*

The Supreme Pontiff surveys the state of scientific research into the 'starry firmament', whose immensity and order speaks to humanity of the 'power and wisdom of its Author'. He stresses that such inquiry implies a search for higher truths and observes that advance in this area, as in others, must be linked to higher aspirations: 'since the moral universe transcends the physical world, every gain made by science is on a plane lower than that of man's personal destiny'. The scientist, therefore, must also turn to the 'acquisition of spiritual values, of justice and of charity'.

Like the other physical sciences, whose prodigious development we of the present day contemplate with admiration, astronomy is now passing through a period of extremely fruitful researches and discoveries. Thus we are particularly glad to welcome today, with the elect group of astronomers taking part in the conference convened at the Vatican Observatory, also the members of our Pontifical Academy of Sciences. In the midst of this assembly of distinguished scientists and tireless investigators of the wonders of creation, we feel an ardent desire to repeat the hymn that the Creator puts on the lips of all those who receive gratefully from Him the gift of life, of intelligence and of love: *Caeli enarrant gloriam Dei et opus manuum eius annuntiat firmamentum.*¹

In order to know better this starry firmament which speaks to you, by its immensity and its order, of the power and the wisdom of its Author, the conference convened under our auspices proposes to debate in free and friendly discussion questions of great interest, which are absorbing the attention of specialists, and also of all those who are interested in one way or another in our knowledge of the physical universe. When the Congress of the International Astronomical Union was held in Rome in 1952, we took the opportunity of congratulating its members on the marvellous conquests that their science had accomplished during recent years. We then retraced the salient steps which enabled astronomers to form a more precise idea of the galactic system and of the position that the Sun occupies within it; and then to determine the real nature of spiral nebulae, recognising in them other galaxies analogous to ours and containing thousands of millions of stars. Beyond the worlds already known, one could suspect the existence of others, which would soon reveal themselves with the aid of giant telescopes. At this very time, moreover, there

¹ Ps 18:2.

was published Baade's discovery that the hitherto accepted scale of the universe had to be multiplied by a factor of two or even more.

To the same astronomer we owe the first mention of the central theme of your present discussions, the existence of two types of stellar populations. Baade's paper, published in 1944, starts with the statement that recent photographs on red-sensitive plates, taken with the 100-inch telescope at Mount Wilson, for the first time resolved into stars the two companions of the Andromeda nebula and the central region of the Andromeda nebula itself. This was no chance discovery, it was the fruit of long and painstaking research. With giant modern telescopes it was possible to resolve the outer parts of the nebula and to photograph individual stars, but the central nucleus remained completely amorphous, even photographed with the most powerful instruments. Finally, skill and patience overcame the difficulty. On various grounds it seemed reasonable to suppose that the nucleus really contained individual stars, but that these stars were too faint to appear as such on the plates. It also seemed likely that the brightest stars in the nucleus would be red giant stars. Baade thought that it should be possible, by using red-sensitive plates, to pick up at least these red giants. By taking every precaution and using very long exposures (of up to nine hours) Baade reached the very limit of what was possible with the means then available and succeeded in photographing great numbers of stars in the nucleus of the Andromeda nebula and in its two companions.

Baade then showed that these newly discovered stars are cooler and less luminous than the blue giants in the spiral arms of the nebula and came to the conclusion that the stellar populations of the galaxies can be divided into two groups, one represented by the blue giants and the stars in galactic clusters (Type I), the other by the stars in the nucleus, those in globular clusters and short period Cepheid variables (Type II). The two types of stars differ not only in brightness and colour, but in age, location, chemical composition, and in the mode and rate of energy production.

In the same paper Baade points out that, as early as 1926, Oort had distinguished in our Galaxy two groups of stars, a group of stars moving with high velocity relative to the Sun, as contrasted with the stars moving more slowly. These two classes, which differ also in frequency of their spectral types and in galactic concentration, correspond to Baade's type II and type I respectively. Thus these discoveries of Baade and Oort supplement each other. They opened the way to a flood of theories and researches, with which you will deal in this conference.

A glance at the programme that you have prepared shows, even to one who is not a specialist in these matters, the complexity of the topics that bear on your problem and the many different lines of approach that are

needed for a thorough examination of the subject. You commence with a study of external galaxies and proceed later to a detailed discussion of our own Milky Way system. This is indeed the logical approach to a study of the question of stellar populations, and the line which advance in knowledge has in fact taken, for it has been extremely difficult to chart the details of our own Galaxy, owing to the fact that our own solar system is embedded in it. The first indications of your problem were found in external galaxies, although in the meantime a great deal has been learnt about our own Galaxy. The Dutch astronomers, for instance, have succeeded in tracing the spiral arms of the Galaxy by means of their observations of radio waves emitted by the hydrogen in the arms. Since the stars of our system are much less distant than those in external galaxies, the astronomer can learn a great deal more about them, by studying their brightness, their spectra, their motions and distribution in space.

Much of this knowledge could be acquired only with the aid of the most powerful means available. Thus the study of globular clusters, which has proved so fruitful in providing information about stars of population II, has been carried out with the 200-inch telescope at Mount Palomar. Nevertheless, much excellent work can be done with more modest instruments, notably in the study of variable stars, to which, we are happy to note, the Vatican Observatory is making a useful contribution. For the Cepheid variables, which constitute a precious source of information for the problem of stellar populations, one needs a more precise estimate of their distribution in the Galaxy, as well as more information about their spectra and their motions and about the mechanism which is responsible for their variability. As for the flare stars, those remarkable objects that flare up suddenly, remaining bright for a short time and then fading more slowly to their original brightness, no doubt new ones will be discovered and more will be learned about their behaviour and their distribution.

You will give much attention to problems connected with the evolution of the stars, the production of energy in their interior, the formation of atoms and the transmutations which they undergo. Here you need the aid of nuclear physicists and of experts in statistics, in order learn more about the nuclear changes in the intensely hot interior of a star, the different cycles that may succeed one another in the development of an individual star and the differences in this respect between the various types of stars. You will try to determine how the chemical composition affects the development of the different types and what changes it then undergoes, as well as what effects the interstellar medium, dust or gas, has on the stars which pass through it, what exchange of matter there is between medium and star, and what effect these processes have on both.

Of very great interest is the enormous difference in the ages that you now assign to various types of stars. Whereas you believe that stars of population II are about 5,000 million years old, about as old as the universe itself, the age of population I stars seems to be at most some tens of millions of years. It is understandable that the blue supergiants, which emit continuously such a vast quantity of energy in the form of heat and light, are so spendthrift of their store that they must burn themselves out comparatively quickly, whereas such ancient stars as our Sun husband their resources better, though even the Sun pours out what seems to us enormous quantities of energy. You may succeed in discovering stars more youthful still, or even perhaps in observing the very birth of a star.

The formation and evolution of the older stars of population II will also demand much of your attention, in spite of the interest naturally evoked by the spectacular transformations of their younger companions. Our Sun, in particular, cannot be neglected, for, apart from the direct influence it has on the earth and its inhabitants, it is so much nearer to us than any other star that we can learn far more about its secrets, and its study must ever remain an essential department of astronomy.

No one would think, on that account, of neglecting the external galaxies, the importance of which for astronomical research we have already emphasised. The Magellanic Clouds, in particular, have the advantage of being the two stellar systems nearest of all to our Galaxy, and information can be obtained from them that cannot be obtained from more distant systems. You have therefore invited to your conference the representative of a great observatory in the Southern hemisphere, who has devoted much of his labours to these systems.

The elliptical galaxies, which contain mainly stars of population II, bear some resemblance to globular clusters, but differ from them certainly in size and origin. The globular clusters themselves, when subjected to precise examination, show certain differences from one to another. Thus the Hertzsprung-Russell diagram in one cluster does not correspond precisely to that in another. It is even possible that the types of stellar population are not limited to two. It is now your task to debate among yourselves and to communicate on this point, as on the other topics which we have mentioned, the facts that you have gathered and the conclusions to which you have been led.

The tireless search for precise facts, the development of theories to explain the facts, the verification of theory by new observations, the modification of a theory when necessary, its replacement by another more perfect theory which fits better the data acquired, such is the incessant labour of the astronomer, a labour which appears titanic even to the uninitiated.

Whatever stage the astronomer has reached by his researches, he cannot dispense with a general picture of that universe, whose minutest details he is scrutinising. Even if awkward gaps in his knowledge cause some of his constructions to break down, he cannot lose the exciting conviction that by thought he is greater than the cosmos, and will sooner or later tear from it new secrets.

But even when he holds in his hands the keys which will open to him doors as yet closed, his task will still be far from finished; not only because the evolution of stellar worlds constantly renews the object of his interest, but also because the truth which will satisfy his urge is in reality on a higher plane than that of scientific research. The knowledge of the physical universe, from the infinitely small to the infinitely great, intoxicates the mind of man, by its tantalising, but alluring riddles; yet it does not free him from his unease. Like all other scientists, like the engineer at grips with modern applications of electronics or of nuclear energy, but also like the humblest of intellectual or manual workers, the astronomer seeks a truth which far surpasses that of mathematics, or of general laws of physics, or of material objects which he can measure, move, or control. What would the immensity of the cosmos, its splendour, its organisation be, without the intelligence which discovers itself in contemplating the cosmos and which sees in it as it were its own image? Is not what man reads in the stars a symbol of his own greatness, a symbol which invites him to mount higher, to seek elsewhere the meaning of his existence? Contemporary scientific thought is accustomed not to retreat before any problem, and that is legitimate so long as it remains within its own domain. But, since the moral universe transcends the physical world, every gain made by science is on a lower plane than that of man's personal destiny – the ultimate aim and purpose of his existence – and of the relations which unite him to God. Scientific truth becomes a decoy from the moment when it is considered adequate to explain everything, without being linked up with other truths and above all with subsistent truth, which is a living and freely creative Being. The labour of the scientist, however disinterested and courageous, loses its ultimate motive if he refuses to see, beyond purely intellectual ends, those proposed to him by conscience, the decisive choice between good and evil, the profound orientation of his life towards the acquisition of spiritual values, of justice and of charity; above all of that charity which is not merely philanthropy or a feeling of human solidarity, but which proceeds from a divine source, from the revelation of Jesus Christ.

Happy is he who can read in the stars the message which they contain, a message worthy of its author, and capable of rewarding the seeker for his tenacity and his ability, but inviting him also to recognise Him who gives

truth and life and who establishes His dwelling in the heart of those who adore and love Him. While expressing the sincere wish that your discussions will come up to your expectations and will bring you the lively satisfaction of having accomplished a most fruitful task, we beg the Author of all good to grant you His aid and protection, in pledge of which we give you with all our heart our Apostolic Blessing.

ADDRESSES
OF
HIS HOLINESS POPE BLESSED JOHN XXIII



His Holiness Blessed John XXIII meets the Members of the Pontifical Academy of Sciences, 5 October 1962



His Holiness Blessed John XXIII meets the Members of the Pontifical Academy of Sciences, 5 October 1962

BLESSED JOHN XXIII (1958-1963)

His Holiness John XXIII (28 Oct. 1958-3 June 1963) was the third of thirteen children in a family of peasant farmers. Angelo Giuseppe Roncalli was born on 25 November 1881 at Sotto il Monte, near Bergamo. After attending the village school and the two seminaries at Bergamo, he went on a scholarship to the S. Apollinare Institute, Rome, in 1901, graduating as Doctor of Theology in 1904. Secretary to Bishop Radini-Tedeschi of Bergamo 1905-14, he also lectured in Church history at the diocesan seminary. Conscripted in the First World War, he served first as a hospital orderly and later as a chaplain. In 1921 Benedict XV promoted him national director of the Congregation for the Propagation of the Faith. In his spare time he wrote monographs on diocesan history and St. Charles Borromeo (1538-84); and his researches in the Ambrosian Library, Milan, brought him into contact with Achille Ratti. It was Ratti who, as Pius XI, launched him on a diplomatic career, appointing him titular Archbishop of Areopolis and Apostolic Visitor (from 1931 Apostolic Delegate) to Bulgaria in March 1925 and Apostolic Delegate to Turkey and Greece in 1934. He much enjoyed the latter position, establishing friendly relations with members of the Turkish government and leaders of the Orthodox Churches. During the German occupation of Greece (1941-4) he worked to relieve distress and prevent the deportation of Jews. Appointed Nuncio to France on 22 December 1944, he dealt tactfully but firmly with the problem of the many bishops accused of collaborating with the Vichy regime; negotiated with the government over the financing of Church schools and the nomination of bishops; and arranged for German prisoners-of-war who were ordinands to follow courses in theology at Chartres. He also looked favourably on experiments with worker priests, and from 1952 was Permanent Observer for the Holy See at UNESCO. On 12 January 1953 he was named Cardinal, and on 15 January Patriarch of Venice, where he was noted for his pastoral zeal, informality, and firm resistance to communist manoeuvres. In 1958 he completed the fifth and last volume of his studies on St. Charles Borromeo. At the conclave of 25-28 October 1958 he was elected at the twelfth ballot; and was crowned on 4 November, the feast of his revered Charles Borromeo. Almost seventy-seven, many regarded his appointment as a caretaker one. It proved, however, a decisive turning-point.

At his coronation mass, John XXIII announced his desire to be above all things a good shepherd, and this was the hallmark of his pontificate. At his first consistory he abolished the rule, dating from Sixtus V, fixing 70 as the maximum number of Cardinals, and by 1962 he had increased the college to 87, making it larger and more international than ever before. On 25 January 1959 he proposed three major projects: a diocesan synod for Rome, an ecumenical council, and the revision of canon law. He held the synod, the first in Rome's history, in St. John Lateran from 24 to 31 January 1960; an overture to the Council, its aim was to reinvigorate church life in Rome itself. His outstanding achievement, however, was the Second Vatican Council, the calling of which he attributed to a sudden inspiration of the Holy Spirit. Its objective, he later explained, was to be a new Pentecost, a means of regeneration for the Church, bringing its teaching, discipline, and organisation 'up to date' (the term he used was 'aggiornamento'), and opening a way towards the reunion of the separated brethren of east and west. He set up preparatory commissions and secretariats on 5 June 1960 and opened the Council itself in St. Peter's on 11 October 1962. Official observers from eighteen non-Roman churches were present by invitation, and in his address he urged the Fathers to expound truth positively without relying on anathemas. Although he did not attend the deliberations himself, he intervened decisively on 21 November 1962 to rule that the conservative schema on revelation, which had been rejected by more than half but not the necessary two-thirds of the Fathers, should be redrafted by a mixed commission. On 8 December 1962 he closed the first session, adjourning the Council for nine months. Stricken with illness, he did not, however, live to see its resumption.

John XXIII set in motion his projected revision of canon law by creating a pontifical commission to deal with the question (28 Mar. 1962); he had earlier (22 Feb. 1959) established a new pontifical commission for cinema, radio, and television. His concern for the liturgy was shown in his approval of new rubrics for the breviary and the missal (25 July 1960), his insertion of the name of St. Joseph in the canon of the mass (13 Nov. 1962), and his permission for the use of the vernacular by certain Uniate Churches. His Encyclicals and other pronouncements were more pastoral than dogmatic in character. His major Encyclicals were *Ad Petri Cathedram* (29 June 1959), in which he pleaded that truth, unity, and peace should be promoted in the spirit of love, and greeted non-Catholics as 'separated brethren and sons'; *Mater et Magistra* (15 May 1961), which reinforced and brought up to date the social teaching of Leo XIII and Pius XI and called on richer nations to help the poorer ones; and *Pacem in Terris* (11 Apr. 1963), which, addressed to all mankind, set out the recognition of human rights and duties as the foundation of world peace, and, distinguishing

between Marxist ideology and the aspirations of Communist regimes, pressed for peaceful coexistence between the West and the Communist East. This last created a widespread impression, not least in the Soviet bloc, and led to his receiving Nikita Khrushchev's son-in-law in the spring of 1963. It also marked an important step in the inauguration by the Vatican of a more open eastern policy. During the Cuban missile crisis of 1962 John XXIII publicly urged both the USA and the USSR to exercise caution, winning the respect of N. Khrushchev as well as John F. Kennedy. Next year the International Balzan Foundation awarded him its Peace Prize.

As these initiatives suggest, John XXIII constantly wanted dialogue with the world, irrespective of creed. His concern for Christian unity was expressed in his establishment (5 June 1960) of the Secretariat for Christian Unity. Other significant gestures were his dispatch of personal envoys to Istanbul to greet Ecumenical Patriarch Athenagoras I (1948-72) on 27 June 1961, and his reception of Dr. Geoffrey Fisher, the Archbishop of Canterbury, on 20 December 1960 (the first Anglican Archbishop to be so received). He also exchanged greetings with Patriarch Alexis of Moscow. In November 1961, with his approval, five official Catholic observers attended the World Council of Churches in New Delhi. He removed words potentially offensive to Jews from the Good Friday liturgy, and on one occasion introduced himself to Jewish visitors with the words: 'I am Joseph, your brother'.

Warm-hearted and unaffectedly simple in spite of his erudition and command of many languages, attached to his humble origins and always retaining a keen sense of humour, John XXIII had a major impact on his office, in particular giving the episcopate a new awareness of its importance. Typically, at Christmas 1958 he revived the custom, which had lapsed in 1870, of visiting the Regina Coeli prison and one of the local hospitals. The death of this simple and holy man (after a prolonged and painful illness), which was relayed directly by television, deeply moved believers and men and women of good will. *The Times* of London commented that few pontificates had so captured the imagination of the world. On 3 September 2000 he was beatified by John Paul II.

John XXIII appointed 24 new members of the Pontifical Academy of Sciences, including such leading lights of the scientific world as: J. Chadwick, E.J. Conway, P.A.M. Dirac, R.A. Fisher, G. Giacomello, G.C. de Hevesy, C.N. Hinshelwood, S. Hörstadius, L. Leprince-Ringuet, and J.H. Oort. Four Cardinals were also made Honorary Members: A.M. Albareda, A.G. Cicognani, D. Tardini, and E. Tisserant. Reflecting his ecumenical spirit, John XXIII insisted on the importance of expanding the geographical representation of the membership of the Academy, significantly increasing the number of non-European members, for example: C. Chagas

(Brazil), J.C. Eccles (Australia), V.F. Hess (USA), A. Hurtado (Peru), S. Mizushima (Japan), C.V. Raman (India), M. Sandoval Vallarta (Mexico), and H. Yukawa (Japan). He also established the Pius XI Medal to be awarded to a young scientist who had distinguished himself or herself at an international level. John XXIII gave two papal addresses to the Academy, in the first of which (30 Oct. 1961) he stressed that it had the high task of participating in the educational mission of the Church: 'it is not because of a desire to remain true to the humanistic traditions inherited from the Renaissance that the Church welcomes you. It is because of the consciousness that in receiving you she is fulfilling part of her constant mission as mother and educator'. Always closely interested in the activities of the Pontifical Academy during his brief pontificate, John XXIII left it in a vigorous and 'up-dated' state, increasingly able to perform its task of being the 'Scientific Senate' of the Church at a time of increasing reflection and debate generated by the climate, deliberations and conclusions of his Second Vatican Council.

30 OCTOBER 1961

*Address to the Plenary Session and to the Study Week on the Subject
'Macromolecules of Biological Interest with Special Reference
to Nuclear Proteins'*

In a written message to the Academy, John XXIII emphasises how the presence of the scientists of the Academy bears witness to the 'complete agreement which has always existed between the Church and true science'. He observes that one mission of the Church is to be an educator and emphasises that she is the champion of the development of intellectual culture. Faith and reason are not in opposition to one another but help each other. The Church supports scientific advance because truth 'brings forth a broadening of the human person' and involves a 'glorification of the creative work of God'.

Gentlemen: we are happy to receive today for the first time the new President and members of your illustrious and learned assembly. This day, which is the anniversary of our election, happens also to be that of the episcopal consecration of Pius XI, the wise founder, or, to be more exact, the restorer of the academy which bears the title of Pontifical Academy. Our pleasure is all the greater as your ranks have recently been increased by other outstanding persons from many countries, who are recommended by their lofty merit and by the breadth of their scientific learning.

In response to our cordial invitation, you have been meeting for several days to hold a plenary session as well as a new study week on the structure of macromolecules, which are of biological interest.

Let us thank you sincerely for the eagerness with which, despite your manifold occupations, you answered this invitation, and express to you the pride felt by the Church in seeing such a select group of scientists meeting in the Vatican City to exchange information.

By the diversity of your origins and by the variety of your specialities, Gentlemen, you really constitute a reflection of the present-day world of learning and bear witness to the complete agreement which has always existed between the Church and true science.

As you know, it is not because of a desire to remain true to the humanistic traditions inherited from the Renaissance that the Church welcomes you. It is because of a consciousness that in receiving you she is fulfilling part of her constant mission as mother and educator. Wherever she has established herself, she has always created a noteworthy enthusiasm for the development of intellectual culture.

Such was, indeed, the noble purpose pursued by our predecessor, Pius XI when he founded, precisely a quarter of a century ago, the Pontifical Academy of Sciences. This purpose led him to include in the *Motu Proprio* of establishment the shining statement from the First Vatican Council on the relationships between faith and reason, which it pleases us to recall here: 'Not only can faith and reason never be in opposition to each other, but they render to each other reciprocal assistance'. And the same Pope concluded from that: 'It is our ardent and firm hope that by this institution which is both ours and theirs, the Pontifical Academicians may always contribute to the better progress of science. We are not asking anything else of them, for the service in favour of truth which we look for from them consists in this generous purpose and noble work'.¹

This expectation is also ours, you may be sure. You all know the importance which we attach personally to intellectual work and scientific investigation. It has always been close to our heart to use the leisure left to us by our diverse functions in pastoral and historical research. It was therefore with joy that we greeted at the time of its creation this Academy of yours.

In this perspective, we want to mention today the memory of its first President, Agostino Gemelli, who showed himself to be faithful to the admirable programme laid out by your founder. His life brought honour to the Church and to science. It is also pleasant for us to appreciate for its just value the happy choice made by your illustrious society in conferring the gold medal of Pius XI on Professor Robert Burns Woodward of Harvard University, whose scientific activity in the chemical field is full of success and of promise.

In fact, far from fearing the most daring discoveries of mankind, the Church believes, on the contrary, that any progress in the possession of truth brings forth a broadening of the human person and constitutes and advances toward the primary Truth as well as a glorification of the creative work of God.

Holy Scripture often reiterates these important thoughts, and without doubt, it often happens to you, Gentlemen, that, in the enthusiasm of research and discovery you allow the magnificent song recorded in the book of Daniel to sing within you: *Benedicite omnia opera Domini Domino* (All you works of the Lord, bless the Lord).² Following the three children of Israel, filled with admiration before the miracles of nature, how can we fail to call upon the angels, the stars and the elements, animals, plants,

¹ *In Multis Solaciis*, 28 Oct. 1936; *AAS* 28, p. 421.

² *Dn* 3:57.

minerals, the most saintly men and those most heard by God, to interpret our feelings of praise to the Creator?

With the assurance that you are working with all your energy in this undertaking of knowledge and praise, we are glad to invoke upon your work and yourselves, as a token of our paternal good will, an unstinted effusion of divine blessings.

5 OCTOBER 1962

*Address to the Plenary Session and to the Study Week on the Subject
'The Problem of Cosmic Radiation in Interplanetary Space'*

The Supreme Pontiff stresses that the Church welcomes science and looks with favour upon scientific research because it leads to a 'more complete knowledge of man and the universe, according to the command given by God to Adam'. He hopes that the tensions between scientific research and the demands of faith will become less marked and affirms that science helps humanity to understand more clearly the truth of the creation and is an expression of praise for the Creator. Referring to the imminent Second Vatican Council, he states that it, too, is dedicated to the search for truth.

Gentlemen,

It is our pleasant task today to receive the President and Members of the Pontifical Academy of Sciences, together with the scientists who have come from all over the world to take part in the study week on 'The Problem of Cosmic Radiation in Interplanetary Space'.

Last year, we conveyed to the Pontifical Academy our good wishes on the occasion of the twenty-fifth anniversary of its foundation by our predecessor, the great and learned Pius XI. This year, we have the joy of personally and gladly bidding you welcome to our house.

For in your persons, Gentlemen, permit me to say, it is science itself which the Church welcomes, that science which the scholars of the whole world, united in peaceful research, strive to advance by pooling the results of their labours.

On that account we are happy to be able to present to Professor Bengt Erik Andersson, the young and distinguished physiologist of the Royal Institute of Veterinary Medicine at Stockholm, the gold medal bearing the revered name of the founder of Our Pontifical Academy.

The Church gladly encourages the researches which are being carried out the world over, and which lead to more complete knowledge of man and the universe, according to the command given by God to Adam in the first pages of Genesis.¹ Thus we congratulate with all our heart this young scientist, who is an authority on the nervous mechanisms of hunger, thirst and body temperature, and we express our best wishes for the fruitfulness of his scientific career, in the service of humanity.

We must also point out, Gentlemen, with particular satisfaction, the timeliness of the subject chosen for your study week 'The Problem of Cosmic

¹ Cf. *Gn* 9:7.

Radiation in Interplanetary Space'. While it would be superfluous to emphasise its appropriateness, permit us at least to mention the close interest that the Church takes in those problems which are rightly engaging the attention of the men of our time, and which are the object of scientific investigation by leading specialists. You know how much we share the delight and satisfaction deriving from the brilliant results obtained by the scientists and technicians of our day, who have succeeded in taming nature in a way which, but lately, would have seemed impossible to the most fertile imagination.

We said recently: 'Oh! How we wish that these undertakings would signify a homage rendered to God, Creator and supreme Legislator. May these historic events, which will have their place in the annals of the scientific knowledge of the cosmos, likewise become the expression of a true and peaceful progress, contributing their share to the solid foundation of the brotherhood of man'.²

We have entered, thank God, upon an epoch when, let us hope, questions about opposition between the conquests of the human mind and the demands of faith will become less frequent. The First Vatican Council, in 1869-1870, stated clearly the relations between reason and faith. The exciting discoveries and achievements of the twentieth century, far from casting doubt on these solidly based truths, help the mind to a deeper appreciation of their value. The progress of science, while permitting us to understand better the extraordinary richness of creation, enriches the praise which the creature renders in thanksgiving to his Creator, who is the Redeemer of our souls. The heart of man, as also his intelligence, remains ever eager to reach the absolute and to surrender itself to it.

On the eve of the opening, now close at hand, of the Ecumenical Council, we cannot but call to your mind, Gentlemen, this great Assembly and the promises that it holds out, supported by the prayers of Catholics and by the expectation of the whole world. It presents to us the vision of a gathering, at once fraternal, pacific and spiritual, which should be devoted entirely to the praise of God and to the service of man, in his noblest aspirations to know the truth, to seek to attain it and to embrace it lovingly.

Such are the thoughts, Gentlemen, suggested to us by the presence of your illustrious and learned assembly. We are happy to have been able to meet you and to let you know the great interest that we take in your labours. With all our heart we invoke the abundance of divine graces on your study week, on yourselves and on your families, in token of which we impart to you a special Apostolic Benediction.

² *L'Osservatore Romano*, 24 August 1962.

ADDRESSES
OF
HIS HOLINESS POPE PAUL VI



His Holiness Paul VI meets the Members of the Pontifical Academy of Sciences, October 1963



His Holiness Paul VI meets the Academician Stephen Hawking, April 1975

PAUL VI (1963-1978)

His Holiness Paul VI (21 June 1963-6 Aug. 1978) was the son of a prosperous lawyer who was also a political writer and parliamentary deputy, and of a pious mother to whom he was devoted. Giovanni Battista Montini was born at Concesio, near Brescia, on 26 September 1897. Shy and of precarious health, but with an appetite for books, he attended the diocesan seminary from home, was ordained on 29 May 1920, and then pursued graduate studies in Rome. From 1922 he worked in the papal Secretariat of State, a brief spell (May-Nov. 1923) in the Warsaw nunciature being broken off for health reasons. Continuing in the Secretariat, he became deeply involved (1924-33) in the Catholic student movement, and from 1931 also taught diplomatic history at the papal academy for diplomats. On 8 July 1931 he was made a domestic prelate to the Holy See, and on 13 December 1937 assistant to Cardinal Eugenio Pacelli, then Secretary of State. When Pacelli became Pius XII in 1939, Montini continued to work closely with him, being assigned responsibility for internal Church affairs in 1944. Promoted Pro-Secretary of State in November 1952, on 1 November 1954 he was appointed Archbishop of Milan, a vast diocese beset with social problems. Aspiring to be 'the workers' archbishop' and accompanied by his now legendary ninety crates of books, he threw himself with immense energy into the task of restoring his war-battered diocese and establishing strong ties with the industrial workers and their families; for three weeks in November 1957 he carried out an intensive mission aimed at reaching every parish in the city. During such activities as a missionary and diocesan, he also found time for experiments in Christian unity, holding discussions, for instance, with a group of Anglicans in 1956. On 5 December 1958 John XXIII named him a Cardinal, and as that Pope's close adviser he played a noteworthy part in the preparations for Vatican Council II (1962-5). During these decades he travelled widely, visiting Hungary (1938), the USA (1951 and 1960), Dublin (1961), and Africa (1962). At the conclave of June 1963, attended by eighty Cardinals and the largest so far in history, he was elected as John XXIII's successor at the fifth ballot. He chose a name which suggested an outward-looking approach. Following in the footsteps of his predecessor, Paul VI immediately (22 June) promised to continue Vatican

Council II, interrupted by John XXIII's death; he also later revised canon law, promoted justice in civil, social, and international life, and worked for peace and the unity of Christendom (a theme that would become increasingly close to his heart).

Paul VI opened the second session of the Council on 29 September 1963, introducing important procedural reforms (e.g. the admission of laymen as auditors, the appointment of four moderators, and the relaxation of confidentiality), and closed it on 4 December 1963, promulgating the *Constitution on the Sacred Liturgy* and the *Decree on the Mass Media*. On 4-6 January 1964 he made an unprecedented pilgrimage by air to the Holy Land, meeting Ecumenical Patriarch Athenagoras I in Jerusalem. Having on 6 September announced the admission of women, religious and lay, as auditors to the Council, he opened the third session on 14 September 1964 and closed it on 21 November 1964, promulgating the *Constitution on the Church Lumen Gentium* (with a note attached explaining the collegiality of bishops, i.e. the doctrine that the bishops form a college which, acting in concert with and not independently of its head, the Pope, has supreme authority in the Church); the *Decree on Ecumenism Unitatis Redintegratio* (modifying several passages on his own authority); and the *Decree on the Eastern Catholic Churches Orientalium Ecclesiarum*; he also proclaimed the Blessed Virgin Mary 'Mother of the Church'. During the recess he flew (2-5 Dec. 1964) to Bombay for the International Eucharistic Congress. At the fourth and last session of the Council (14 Sept.-8 Dec. 1965), during which he flew to New York (4 Oct.) to plead for peace at the United Nations, he undertook to establish a permanent Synod of Bishops, with deliberative as well as consultative powers. Before mass on 17 December 1965 a joint declaration by himself and Patriarch Athenagoras I was read out deploring the mutual anathemas pronounced by representatives of the western and eastern Churches at Constantinople in 1054 and the schism which resulted. The following year, he solemnly confirmed all the decrees of the Council, and proclaimed an extraordinary Jubilee (1 Jan.-29 May 1966) for reflection and renewal in the light of the Council's teachings.

Paul VI then began implementing the Council's decisions with courage and an awareness of the difficulties involved. He set up several important post-conciliar commissions (e.g., for the revision of the breviary, the lectionary, the order of mass, sacred music, and canon law), and carried through the substitution of the vernacular in the liturgy with determination. He reorganised the Curia and the Vatican finances and confirmed the permanent Secretariats for the Promotion of Christian Unity, for Non-Christian Religions, and for Non-Believers. In pursuit of ecumenism, he held meetings with the Archbishop of Canterbury (Dr. Michael Ramsey) in Rome (24 Mar. 1966), and with Ecumenical Patriarch Athenagoras I in Istanbul

(25 July 1967) and Rome (26 Oct. 1967). In May 1967 he flew to the shrine of the Blessed Virgin Mary at Fatima, Portugal, to pray for peace. His public pronouncements included *Mysterium Fidei* (3 Sept. 1965), paving the way for liturgical reform and reasserting traditional Eucharistic doctrine; *Populorum Progressio* (26 Mar. 1967), a plea for social justice; *Sacerdotalis Caelibatus* (24 June 1967), insisting on the necessity for priestly celibacy; *Humanae Vitae* (25 July 1968), condemning artificial methods of birth control; and *Matrimonia Mixta* (31 Mar. 1970).

From 1967 to 1970 Paul VI carried out nine international journeys to the five continents of the world, both to stress the universality of the Church and to lend weight to his more general policy of internationalisation. The journeys of this 'pilgrim Pope' included those to Geneva to address the International Labour Organisation and the World Council of Churches, and to Uganda to honour its martyrs, in June and July 1969 respectively; to Sardinia to celebrate Our Lady of Bonaria in April 1970; and to the Far East (where he narrowly escaped assassination in Manila) in November-December 1970. On 25 October 1970 he canonised forty English and Welsh Roman Catholic martyrs of the sixteenth and seventeenth centuries; he also proclaimed St. Teresa of Avila (1515-82) and St. Catherine of Siena (1347-80) Doctors of the Church, the first women to be so denominated. In the same year he fixed the retirement age for priests and bishops (75), and decreed that Cardinals over 80 should not participate in Curial business. In furtherance of collegiality, he convened international episcopal synods in 1971 (on the priesthood), in 1974 (on evangelisation), and in 1977 (on catechesis). In April 1977 he and the Archbishop of Canterbury (Dr. Donald Coggan) issued a 'Common Declaration' which pledged united work towards reunion. One of his most important legacies to the Church, brought to completion in this closing phase, was his steady enlargement and internationalisation of the Sacred College. When he was elected it had some 80 members, but by 1976 he had raised the total to 138; moreover, by that latter date its Italian members were a small minority, and it contained many representatives from the third world.

Characteristically, Paul VI sought to make the papacy less formal and sold the tiara presented to him at his election for the benefit of the poor. In his last year he was profoundly disturbed by the kidnap and eventual murder (May 1978) of his lifelong friend Aldo Moro, the Christian Democrat statesman. Paul VI's last public appearance was to preside at his funeral in St. John Lateran, at which he declared: 'You have not answered our implorations for the safety of Aldo Moro, but You, O Lord, have not abandoned his immortal spirit'. A few months later Paul VI was stricken with arthritis, and after suffering a heart attack he died at Castel Gandolfo on 6

August 1978, bequeathing a famous spiritual testament which bore witness to his innermost feelings and sentiments. On 11 May 1993, in the diocese of Rome, the procedure was set in motion for his canonisation.

Paul VI appointed 56 new members of the Pontifical Academy of Sciences, amongst whom were such prominent figures as: D. Baltimore, A. Bohr, G. Colombo, C. de Duve, G. Herzberg, H.G. Khorana, J. Lejeune, L.F. Leloir, R. Levi-Montalcini, G.B. Marini-Bettòlo, R.L. Mössbauer, M.W. Nirenberg, S. Ochoa, D.J.K. O'Connell, G.E. Palade, G. Porter, M. Ryle, B. Segre, R.W. Sperry, and A. Szent-Györgyi. His pontificate also witnessed, for the first time, a member of the laity as President of the Academy: the Brazilian C. Chagas. In his official papal pronouncements in both written and oral form, Paul VI frequently stressed the importance of the two separate branches of knowledge of faith and reason, which he argued could work in harmonious tandem, and he also drew attention to the legitimacy of the pursuit of truth through reason. He also pointed to the obstacles created by the development of specialisation and warned against the dangers of not achieving an overall vision of reality.

Paul VI gave nine papal addresses to the Pontifical Academy of Sciences and on these and other occasions he strongly emphasised that the progress of science should have a strong moral and ethical dimension and work to the benefit of man in all his aspects. This formed a part of his general view, following on from Pius XI, that knowledge had an inherent and necessary 'charity'. Here we will recall those topics which in a special way served as guides and stimuli for the activities of the Academy. In 1966, at the reception of the Academicians and other scientists taking part in the study week on molecular forces, Paul VI reconfirmed the links that exist between man and science, and recalled that the Church recognises and values the importance of scientific research, just as she admires and encourages the intellectual and organisational efforts which are necessary to undertake such research. In Paul VI's opinion, a scientist, because of his moral qualities and his devotion to his work is 'an ascetic, and sometimes a hero' to whom the whole of humanity is indebted. But science alone is not sufficient because it is not an end in itself: 'science can only exist thanks to man, and it is by man's intervention that it must break out of the mere world of research in order to reach out to man and therefore to society and to history itself'. But after this acknowledgement he went on to address a question to scientists regarding the ethical norms which regulate the way science should be applied. He touched upon the ethical problems connected with the use of science in fields such as genetics, biology, atomic energy, emphasising the fact that a scientist cannot and must not avoid asking himself what the effects of his discoveries on the psycho-physiological nature of the human

personality might be. Paul VI expressed to scientists the beautiful concept of 'knowledge as charity', reminding those who hold the key to advanced culture that there are a countless number of people who are rarely aware of more than scattered fragments of the vast field of human knowledge. In 1972, at the audience granted to the Academicians and scientists who had attended the study week on fertilisers, Paul VI gave another important speech. Amongst other things, he referred to the point of contact between scientists and nature, underlining the risk of falling into a state of bewilderment in those cases where scientific results are not considered from a transcendent point of view. 'Human intelligence is a spark which belongs to the absolute light which has no shadows'. He went on to affirm: 'whatever progress we make, whatever synthesis we achieve reveal a little more to us of the plan which governs the universal order of existence and the efforts of humanity as a whole to make progress. We are searching for a new humanism which is capable of allowing modern man to find himself again, by voluntarily accepting the higher values of love, friendship, prayer and contemplation'. Nor did Paul VI limit himself to quoting the above sentence of *Populorum Progressio*. Taking his inspiration from the efforts of scientists to increase soil fertility, he stressed the importance of the problems of world hunger and the absolute necessity for social justice.

In his address of 23 October 1976, when welcoming those taking part in the study week on natural products and plant protection, he repeated his conviction that science should be placed at the service of man: 'Sciences tend to overcome those barriers which men themselves have set up ... science encourages the development of a mentality which seeks open, sincere and respectful dialogue with whoever is involved in working for man's common destiny', and emphasised that the research and activity of the Academy were an important instrument in promoting reciprocal understanding. Thus he declared: 'It can be clearly seen, then, what an instrument of mutual understanding and peace serious scientific research can represent, and what a contribution the Assembly which you constitute can make from this point of view to promoting a more united and peaceful life among the nations'. Quoting the words of the great Pontiff, Pius XI, Paul VI expressed the wish that the Academy would become an increasingly rich source of beneficial charity which Truth is. Reference should also be made to his observation, made during his address of 15 April 1975, that the Academy could and should render a signal service to mankind by promoting a greater knowledge of nature and an improvement in conditions of life.

13 OCTOBER 1963

*Address to the Plenary Session and to the Study Week on the Subject
'The Econometric Approach to Development Planning'*

In his first address to the Academy, Paul VI affirms that the Church wishes to 'maintain the most sincere relations with the contemporary scientific world'. He observes that religion is not in opposition to science but is itself 'the supreme science of life' and thus encourages the scientist to pursue his inquiries into truth, which 'exists'. The Pope also makes an appeal to those in authority 'that they may never abuse science'; he hopes that science will never become 'a peril, a nightmare, an instrument of destruction for human life'. He concludes by repeating John XXIII's call for the banning of nuclear weapons.

Gentlemen,

We do not propose to deliver a speech. Not that we should not have plenty to say to you; this meeting with the Pontifical Academy of Sciences in fact calls to mind many topics, questions, feelings which it would be worthwhile to express, but this is not the time. In these days, absorbed as they are by the Council and the problems to which it gives rise, we have no time to spare. This will be merely a brief greeting that we address to you, a greeting full of cordiality for the persons that we have the great honour of meeting, full of respect for this institution that we are happy to see here once again.

As you have just said, Mr. President, an esteem of long standing and a sincere friendship binds us to your Academy. We are glad to be able today to renew acquaintance with it and to greet you first of all, Mr. President, the worthy successor of the late lamented and unforgettable Padre Gemelli.

It is for us a joy to find the Academy, and all its members, dedicated to the faithful carrying out of its traditional activities. We take this opportunity to express to the veteran Academicians our devoted esteem and to bid a happy welcome to those whom we have not previously had the pleasure of greeting as members of this illustrious society.

We wish also to express our gratitude to those scientists who have accepted the invitation of our Academy and who have come to take part in this study week, bringing to it the valuable contribution of their learned research and honouring it with their presence.

To those who belong to the Pontifical Academy of Sciences, and to those who participate in its work or honour it with their friendly interest, we wish to reaffirm our high esteem for this institution, and the resolution

we have taken to grant it the support and honour which will ensure its stability and favour its development.

We have inherited a solemn responsibility from the Pope who founded your Academy, for whose members and promoters we cherish a profound esteem; we have a keen appreciation of the importance and the needs of modern science and a lively sense of the duty, the interest, and in a way the necessity, for the Catholic Church to maintain the most sincere relations with the contemporary scientific world. Finally we may say that we feel ourselves stimulated by the certainty that our religion not only does not pose any real objection to the study of natural truths, but that, without crossing the bounds of its proper sphere, or transgressing those of the domain of science properly so-called, it can promote scientific research, honour its results and help them to be better used for the good of humanity.

The religion which we have the happiness to profess is, in fact, the supreme science of life. It is thus the highest and most beneficent mentor in all those domains where life is manifested. It might seem to be absent when it not merely permits, but directs, the scientist to obey only the laws of truth. But looking more closely, it will be seen to be still beside him, to encourage him in his difficult task of exploration, assuring him that truth exists, that it is intelligible, splendid, divine; and also to remind him at every step that thought is an instrument for the conquest of truth and that it should be used with such respect for its own laws that one feels continually the transcendent responsibility that it imposes.

This will show you, Gentlemen, how seriously and with what favour we regard this institution, which we like to consider as representative of the scientific world, to which we send through you, its authoritative interpreters, our respectful greetings and encouragement.

A symbol of this greeting is the Pius XI Gold Medal which we have the pleasure of presenting to Professor Aage Bohr, a son of Denmark, a nation whose signal merits are appreciated by us, a scientist celebrated for his studies of nuclear structure and for the theoretical analysis of the motions of atomic nuclei. May the granting of this award be a token of respect and encouragement, both for the worthy person of this young professor as well as for the noble company, nowadays a whole army, of scientists devoted to the exploration of the marvels of the physical microcosm.

Coming from our priestly hands may this award constitute a warm invitation, an evangelical appeal, to all those in authority, that they may never abuse science, or rather its multiple practical applications – in particular those of nuclear science and its terrible possibilities – that they may never make it a peril, a nightmare, an instrument of destruction for human

life. Another of our wise predecessors, Pius XII, already in 1943 and again in 1948, addressing this same Academy, warned against the terrible and menacing possibility that atomic energy might become fatal for humanity. And, still more recently, Pope John XXIII, of happy memory, in his now famous Encyclical *Pacem in Terris*, expressed the wish that atomic weapons be banned.

We wish to make our own their fatherly appeal and to hope, with all good and wise men everywhere in the world, that this threat to the safety and peace of humanity may be averted.

In your peaceful assembly you are, thank God, far removed from these sombre prospects. You will be speaking of 'The Econometric Approach to Development Planning'. This is the subject of your study week, a subject which seeks to gather together the latest results of a new branch of science, econometry, and to present them to political economists in order to aid them in formulating those plans for a more stable security and for greater development which can contribute so much to the well-being and peace of nations.

We do not intend to enter upon this subject or to comment on it, but we are happy that such eminent men have come to address it before this Academy, and we thank them for this important contribution which they are making to the advance of science and to the reputation of this Academy. We are happy to congratulate you on the choice, the method of treatment and the aim of a subject as fruitful for scientific research as it is rich in practical applications. We are sure also that these econometric studies, integrated with the rest of our knowledge of human phenomena, including those in the field of economics, will truly prove of great utility in the ordered progress of human civilisation.

We give you a fatherly greeting and beg the divine protection for you and for your labours, bestowing on you all our Apostolic Blessing.

3 OCTOBER 1964

*Address to the Plenary Session and to the Study Week on the Subject
'Brain and Conscious Experience'*

After observing that consciousness is a reality connected to the spiritual activity of the soul, the Supreme Pontiff asserts that the 'Church does not fear the progress of science'. Indeed, every true scientist is her friend. He goes on to assert that whereas in the past the scientific world had generated opposition to religion, today the scientist is more open to religious values because he is aware that uncontrolled science can be a threat to man. The Pope concludes by saying that the Church is ready to offer scientists advice when questions are encountered which 'transcend the domain of science', namely those concerning the 'origin and ... destiny of man and of the world'.

Gentlemen,

Now that the study week organised by the Pontifical Academy of Sciences on the subject 'Brain and Conscious Experience' is about to conclude, we have desired to bring you personally our greetings and our thanks and to express anew the interest with which we follow the development and the progress of your scientific activities.

1. First of all we greet with pleasure the President and the members of the Academy here present, and we also welcome most cordially the scientists of various nations who have accepted the invitation to attend this session. Their very presence in this place calls for lively gratitude on our part, all the more when we consider the erudite communications which they have presented at this scientific meeting. Their many learned papers serve as an inspiration to the Pontifical Academy of Sciences, reflecting credit not only on the Holy See, but, we humbly dare to assert, for it is our conviction, on the world of science itself.

We have had before our eyes the series of researches already published in the official collection of the 'Commentarii' of the Pontifical Academy of Sciences, as well as the three volumes of 'Miscellanea Galileiana' which have been presented to us in your name. These many signs of the vitality of your Academy are a source of deep joy to us. The merit is yours, and with all our heart we congratulate you and thank you.

2. Our intention, as you will surmise, is not to comment on the subject which you have been discussing during these days with such competence and scientific rigour. May we be permitted simply to underline in a word its

importance, and to bring out its relationship – if one may use the term – with those domains in which the essential part of our own activity is exercised: we refer to the moral and religious sciences.

‘Brain and Conscious Experience’: seeing these words associated, it suffices to make clear that there you touch on that which is most specifically human in man, on that which approaches most nearly the mechanisms of his psychology, the problems of his soul. To be sure, when you speak of ‘consciousness’, you do not refer to the moral conscience: the very rigour of your methods ensures that you do not leave that strictly scientific domain which belongs to you. What you have in mind exclusively is the faculty of perceiving and of reacting to perception, that is to say the psycho-physiological concept which constitutes one of the accepted meanings of the word conscience.

But who does not see the close connection between the cerebral mechanisms, as they appear from the results of experimentation, and the higher processes which concern the strictly spiritual activity of the soul?

3. Your labours are valued by us, as you see, because of the domain in which they are pursued, because of their close affinities with that which is of supreme interest to a spiritual power such as ours – the domain of the moral and religious activities of man.

But, widening our field of view, we would like to profit by the occasion thus presented to us to reaffirm before you the Church’s attitude of esteem and confidence with regard to scientific thought in general.

The Church does not fear the progress of science. She undertakes willingly a dialogue with the created world and applauds the wonderful discoveries that scientists are making in that world. Every true scientist is for her a friend, and no branch of learning is shunned by her. The very variety of the subjects treated during the study weeks of the Pontifical Academy of Sciences is in itself a proof of this cultural ‘ecumenism’ of the Church, of her readiness to welcome every true and real progress in the domain of the sciences, of every science.

The Church follows this progress with close attention, as she does also the spiritual expressions which accompany the scientific effort. These expressions have varied according to time and place, and their evolution is for the Church an object of great interest.

The scientific world, which adopted in the past a position of autonomy and of self-confidence, from which flowed an attitude of distrust, if not of contempt, for spiritual and religious values, is today, on the contrary, impressed by the complexity of the problems of the world and of mankind, and feels a sort of insecurity and fear when faced with the possible evolu-

tion of a science left, without any control, to follow its own driving force. Thus the fine self-confidence of early days has for many given place to a salutary unease, so that the soul of the scientist today is more easily open to religious values, and glimpses, beyond the prodigious achievements of science in the material domain, the mysteries of the spiritual world and the gleams of the divine transcendence.

How can the Church not rejoice at this happy evolution? She is beside you in your labours, Gentlemen, you may be sure, and always ready to offer you the help of the lights of which she is the trustee, whenever your learned researches bring you to the threshold of those grave questions which transcend the domain of science and which from all time have presented themselves to the consciences of men: questions of the origin and of the destiny of man and of the world.

Receive from us, Gentlemen, these too brief thoughts, which are meant simply as a cordial affirmation of our esteem for your persons and your work, and of the profound interest with which the Church follows the evolution of scientific progress in the modern world. We wish complete success for the present session, and we invoke for you, and for the happy continuation of your learned activities, the most abundant divine favours.

23 APRIL 1966

*Address to the Plenary Session and to the Study Week
on the Subject 'Molecular Forces'*

The Pope observes that the Second Vatican Council's 'Pastoral Constitution on the Church in the Modern World' calls for a necessary synthesis of specialised knowledge. He emphasises that such specialisation can impede a spiritual perspective. Asserting that the Church 'rejoices at every true acquisition of the human spirit', the Pope makes clear that science should not only 'not injure morality or the profound welfare of the human being' but should also provide a service, 'what might be termed "the charity of knowledge"'. In such an endeavour, science cannot turn to science alone: Holy Scripture provides the 'decisive answers that science cannot give'.

Dear Gentlemen,

In welcoming you, Gentlemen, at the close of your study week on 'Molecular Forces', it is not our intention – as you may imagine – to venture into the scientific field which is yours. We prefer to speak to you of the Church's esteem for you, of the interest with which she follows your activities, the desire which animates her to do all in her power to encourage the happy development and constant progress of your researches within the Pontifical Academy of Sciences.

The eminent founder of this Academy, the great Pope Pius XI, as you are aware, was deeply interested in this activity. So also were his two successors, and it is unnecessary to remind you here of the masterly addresses by which, in the course of his long and glorious pontificate, our predecessor, Pius XII, desired to honour each of your sessions.

With the accession of Pope John XXIII, from whom we inherited the heavy burden of office, it may be said that quite a new element entered into relations between ecclesiastical authority and the scientific world.

It is no longer merely the visible head of the Church in isolated addresses, but the bishops of the whole world assembled in Council who have been obliged to express their opinion as to the Church's attitude in the modern world, more particularly in view of modern cultural developments and in regard to the object of those labours to which your lives are so nobly devoted, namely, scientific research.

The results of this vast 'examination of conscience' on the part of the Church in this field have been recorded in a document which, we believe, is worthy of your attention and with which many of you are no doubt already familiar, namely, the 'Pastoral Constitution on the Church in the Modern World'.

Contemplating in its second section a certain number of real problems with which the Church is faced in our day, this important document deals with the domain of culture. It hails the progress of culture, in the first place, and the advent of what may be called a 'new humanism'. But it points out immediately the complexity of the consequent problems, more particularly the one which seems to us to be of special interest to you: 'As special branches of knowledge continue to shoot out so rapidly', it states, 'how can the necessary synthesis of them be worked out, and how can men preserve the ability to contemplate and to wonder from which wisdom comes?'.¹

It can be said that this brief paragraph places perfectly face to face the point of view of the specialised scientist – your own – and that of the Church. You are concerned – and this does you honour – before all else about the progress of human knowledge, to ensure fresh acquisitions continually in each of its branches. There follows, by force of circumstances, this continued 'shooting out so rapidly' of which the conciliar document speaks. The Church herself is before all else solicitous for synthesis, for her mission is to safeguard the harmony and balance of the rational creature, to aid him to ascend to this higher 'wisdom' stemming from the divine revelation of which she is the depositary.

The Church is aware of the dangers involved in excessive specialisation and of the obstacles which the latter can place in the way of the soul's impulse towards what is spiritual.

In man's own interests, the Church desires at all costs to save that 'ability to contemplate and to wonder' to which a purely technical civilisation would be in danger of attaching little value. Above all does she fear, like a mother solicitous for the true good of her children, 'that man, confiding too much in modern discoveries, may even think that he is sufficient unto himself and no longer seek any higher realities'.² These are again the very words of the 'Constitution on the Church in the Modern World' and they introduce us into the heart of the debate between the Church and science. The Church asks: what exactly is the value of scientific research? Just how far does it go? Does it exhaust the whole of reality, or is it not rather a mere segment, the one pertaining to the truths that can be reached by scientific processes? And these truths themselves, so justifiably dear to the man of science, are they at least final, or are they not to be dethroned tomorrow by some new discovery? How many lessons do we receive on this point from the history of the sciences!

¹ N. 56, § 4.

² *Ibid.*, n. 57, § 5.

Besides, this study of the specialised researchers, however admirable and profound it may be, does it in the end supply the reason for the things it discovers? How many stars there are in the sky! Certainly, but how and why? How many marvels there are in the anatomy and physiology of the human body! Undoubtedly, but why does the human body exist? Why does man exist? Science is mute at this stage, and must be so, under pain of departing from its own domain. It stops on the threshold of the decisive questions: who are we? Whence have we come? Where are we going?

Do not think, Gentlemen, that in bringing up these questions we have even the slightest intention of calling in question the value of the scientific method. More than anyone else the Church rejoices at every true acquisition of the human spirit, in any field whatsoever. She recognises and keenly appreciates the importance of scientific discoveries. The effort of intelligence and organisation necessary to reach new results in this domain is, as far as she is concerned, the object of encouragement and admiration. For she does not see here merely the magnificent use of the intellect. She discovers also the exercise of high moral values which confer on the scientist the aspect and the merit of an ascetic, at times of a hero, to whom mankind must pay an ample tribute of praise and gratitude.

In her dialogue with the world of science, the Church does not limit herself to assigning to scientific research its exact place in the universe of knowledge, to stating precisely its limits and recognising its results. She has a further word to say to the man of science concerning his mission in the universe created by God.

It is only too evident that science does not suffice in itself, is unable of itself to be its own end. Science does not exist except through and for man; it must leave the circle of research and pour itself out on man, and hence on society and history as a whole.

Science is a queen in her own domain. Who would dream of denying it? But it is a servant in relation to man, who is king of creation. If it were to refuse to serve, if it no longer aimed at the good and the progress of humanity, it would become sterile, useless and, let us say so, harmful.

The consequences of this mission of service are incalculable, and here we ought to face – but the too brief moments at our disposal do not allow of this – the immense problem of the morality of the applications of science. Whether it is a question of genetics, of biology, of the employment of atomic energy, of many other fields which affect what is essential in man, the upright scientist cannot but question himself as to the bearing of his discoveries on this psycho-physiological complex which is, in a word, a human person. Is everything permissible? Can applied science dispense with a norm of morality, can it proceed unchecked ‘beyond good and evil’?

Who can fail to see the aberrations in which some could indulge in the name of science?

But the Church expects from science not merely that it may not injure morality or the profound welfare of the human being. She expects from it a positive service, what might be termed the 'charity of knowledge'. You, Gentlemen, are the ones who hold the keys of highest learning. We venture to assume towards you at this moment the office of advocate on behalf of the innumerable masses who receive only from a distance and rarely, a few drops, a few morsels of this vast human knowledge.

Allow us to ask you on their behalf to cultivate research, but in order that it may be of use to others, that the light of discovered truth may be spread abroad, that the human race may be enlightened by it, improved and perfected; so that the political economy of the nations may draw from it directives which will lead more surely to the true welfare of mankind. This is the immense panorama which is unfolded before the scientist when, coming forth from his laboratory to look around him, he perceives something of man's expectation; an expectation which stirs men's hearts and opens them up to hope and joy, although leaving room at times it must indeed be said, for a feeling of uneasiness and anxiety.

This uneasiness and anxiety will be dissipated on the day on which men will become aware and will feel that the scientist is animated by a sincere spirit of service towards humanity, that he desires nothing so much as to enlighten men, to assist them, to ensure their progress and happiness.

You will no doubt recall, Gentlemen, that 'message to men of thought and science' which was proclaimed on the closing day of the Council. Before dispersing, the imposing assembly turned to you to leave you with this urgent exhortation: 'Continue your search without tiring and without ever despairing of the truth ... Seek the light of tomorrow with the light of today until you reach the fullness of light'! And the Council Fathers added: 'We are the friends of your vocation as searchers, companions in your fatigue, admirers of your successes, and, if necessary, consolers in your discouragement and your failures'.

This latter phrase may have astonished you. Does not scientific research bring its own reward? Is the scientist not repaid for his trouble by the deep intellectual satisfactions attached to his work?

The Church nevertheless brings a higher wisdom, the source of incomparably greater joys. It may be said that your life as scientists is spent in reading from the great book of nature. We have another book, one which communicates to us the thoughts of God concerning the world, the inspired book, the holy book. This book gives us the decisive answers that science cannot give.

Allow us, Gentlemen, in concluding, to open before you a page of this book, the page in which the inspired author describes the rapture of his soul when he is given access to this wisdom, higher than all human knowledge, which you have heard the Council evoke just now.

‘I prayed and prudence was given me; to God I prayed and the spirit of wisdom came upon me. This I valued more than kingdom or throne; I thought nothing of my riches in comparison ... All my treasures of gold were a handful of dust beside it, my silver seemed but base clay in presence of it. I treasured wisdom more than health or beauty, preferred her to the light of day, for hers is a flame which never dies down. Together with her all blessings came to me ... The lessons she taught me are riches honestly won, shared without stint, openly proclaimed ... She is a treasure men will find incorruptible; those who acquire it win God’s friendship’.³

May this wisdom be the faithful companion of your arduous labours, Gentlemen. This is our wish and our hope, as we invoke from God upon yourselves, your families and your activities, most abundant blessings.

³ *Ws* 7:7-14.

27 APRIL 1968

*Address to the Plenary Session and to the Study Week on the Subject
'Organic Matter and Soil Fertility'*

Paul VI affirms that the Academy was founded to provide 'proof of the love and respect' the Church felt for the scientific world. He restates the commitment of the Church to scientific inquiry and affirms that it can contribute to the 'religious and Christian progress of mankind'. The Pope thus echoes the teaching of the Second Vatican Council and declares that a synthesis of the knowledge of science and of faith is possible. He goes on to say that science must 'tend towards the good of all mankind' and thus warns against the dangers of nuclear and bacteriological warfare. The true purpose of science is constructive. It should seek, for example, to conquer world hunger.

Dear Gentlemen,

In your persons, Gentlemen, we are happy to greet the organisation of distinguished savants, both those present here today and those absent, constituting our Pontifical Academy of Sciences, headed by its new and learned President, the Reverend Daniel O'Connell; and we are glad to have this opportunity of rendering public homage to your high standing in the scientific domain. The various contributions you render to the progress of science do you great honour, and that honour reflects upon the Holy See which assembled your organisation in the first place. We begin, therefore, by greeting you and by thanking you.

Different circumstances, among them the sad death of your President, Monsignor Georges Lemaître, have prevented your Academy from abounding in external manifestations in recent times. Certainly, no one will be tempted to interpret this merely apparent and accidental decrease of activity as a sign of lessened vitality in an institution which has, by now, acquired throughout the world the fame and celebrity it merits. For our part, we desire here and now to give solemn confirmation to the esteem and confidence we feel for you.

As you are aware, the idea which inspired the foundation of the Pontifical Academy of Sciences was that of giving, by means of the persons composing it and the activities it promotes, a proof of the love and respect which the Catholic Church nourishes for the contemporary scientific world. We wish now to renew our assurance to you, that this initial purpose is more alive than ever in the conscience and plans of the Apostolic See. Its duty will be to preserve the full vigour of the Academy. Its intention is to give witness, in this way, to the veneration the Catholic Church professes

for scientific research, the liberty she acknowledges in such research within its specific domain, the confidence with which she envisages its present and future achievements. In fact, if science, instead of being thought a sort of foreign body in the life of man, is properly inserted into his life, the Church believes that it can contribute to the progress, not only speculative and technical, but moral and even, without here having recourse to artificial processes, to the religious and Christian progress of mankind.

This should suffice to show that respectful attention with which the Church considers the mission of the scientist. In her eyes, you are the seekers and explorers of the mysterious realities of creation; in other words, those who fulfil in the highest degree the task which God entrusted to man when He created him: that of conquering the earth, of uncovering the secrets of nature. For nature is full of secrets, and it cannot be doubted that those who strive to discover them – and you know better than we do, what patient and painstaking research this entails! – are responding to the Creator's original purpose and clear will.

When we fix our attention upon your activity as scientists, it seems to us to develop from a twofold premise, which constitutes as it were the pedestal of that superior degree of human excellence to which you are raised by the exercise of your vocations as researchers.

First of all, there is the systematic and perfected use of your intelligence. If you are, in a way, more fully men than other men, it is in the first place because you have developed to a high degree the potentialities of what is noblest and likeliest to God in man: that is, thought, the ability to become all things – the *'fieri omnia'* described by classical philosophy – that unique and incomparable privilege of the human intellect, the thinking being's power to conquer reality, assimilate it into himself, to turn it into a truth which becomes his own possession even though by its universality it remains potentially the possession of all.

To this superior utilisation of the highest faculty of the human being, there is added in the scientist – and this is the second premise – his entry into the scientific tradition. He collects, assimilates, deepens and perfects all that is of value in the vast heritage of the study and reflection of those who preceded him; and he makes use of this patrimony of human knowledge amassed before him as a point of departure, to leap boldly forth towards new conquests, for the profit of his own generation and of those that follow.

Verily, then, men of science deserve honour and gratitude, and it is a heartfelt need, as well as a duty, for us to pay homage to your persons, Gentlemen, to such highly qualified representatives of modern culture and of its inspiring genius. We are well aware that, in doing so, we are faithfully inter-

preting the mind of the Church concerning you, a mind which she has often expressed in recent years, especially by the voice of our predecessor Pope Pius XII, a mind which she proclaimed again and proudly on the occasion of the recent Ecumenical Council. How could we let pass an occasion like this, without recalling that the conciliar assembly wanted to lend the full weight of its authority to the reaffirmation of the Church's positive attitude towards science?

Here is the aspect under which the Council envisages your calling as researchers: 'Whoever labours to penetrate the secrets of reality with a humble and steady mind is, even unawares, being led by the hand of God, Who holds all things in existence, and gives them their identity'. These words occur in the *Constitution on the Church in the Modern World*, which dedicates a whole chapter to the problem of culture. Analysing the development of culture, the Council document does not hesitate to note with satisfaction the positive acquisitions made by the present progress of science and of technology, and makes explicit mention of 'scientific study and strict fidelity towards truth in scientific research, the necessity of working together with others in technical groups, a sense of international solidarity, an ever clearer awareness of the responsibility of experts to aid men and even to protect them, the desire to make the conditions of life more favourable for all, especially for those who are deprived of the opportunity to exercise responsibility or who are culturally poor'.¹ The conciliar document, of course, warns Christians against the perils of a purely earthly humanism; but at the same time shows them how the faith they profess 'in no way decreases, but rather increases, the weight of their obligation to work with all men in constructing a more human world'.²

As you see, Gentlemen, we are here far from the frequently petty and almost always sterile disputes which once gave pleasure to certain minds, inclined as they were to consider the Church, and the advance of human knowledge, as two openly struggling adversaries.

This does not mean that the ancient and ever reviving question of the relationship between science and faith has lost all meaning and interest. If the time at our disposal were less limited, we should have liked to profit by an occasion like this to meditate the matter further with you. We should have liked to describe to you the new illumination which seems to shine on it today: that, namely, of a clearer distinction of the levels on which, separately, science and faith follow their proper methods, develop their knowl-

¹ *Gaudium et Spes*, nn. 36 and 57.

² *Ibid.*, n. 57.

edge; while the encompassing complexity of thought makes a happy synthesis of both orders of knowledge possible.

In that case, you would undoubtedly have demonstrated to us, as having experienced it directly, how scientific research, by absorbing as it can all the knowing capacity of the seeker, can seem to provide sufficient satisfaction and repletion for the intellectual and spiritual activity of man; how it can succeed in annulling, not only the knowledge, but even the desire of knowledge of God; to such a degree that finally atheism appears to some scientists to be a logical position, satisfying thought and justifying reality.

Then we, in turn, would be tempted to overthrow this fragile edifice of modern intellectual progress by affirming – and by calling again on your experience but on a deeper level – that science prepares for and presupposes an order of thought which transcends and justifies it, for science cannot explain everything; it can only explore what exists, what some Other, infinitely greater than science, has prodigally delivered over to the study of the sons of men. For if science is faithful in restricting research and certitudes within its proper sphere, that of the observable and measurable, so much the more will it progress in its investigations, and so much the more will it feel the need, as it were the intuition, of the immensity of that divine world which dominates it, and bestows upon it some reflection of itself.

We shall instead limit ourself to considering rather another aspect of the scientific world, to which your assembly so handsomely and laudably testifies, by asking: what use, what practical and useful employment should science, or rather men of science, and their brilliant pupils the technicians, make of the conquests of science? To this query only one reply is possible: everything must tend towards the good of all mankind.

It is certainly not necessary to remind you, Gentlemen, that the spectre of most terrible calamities, capable of overwhelming and razing to nothing the whole inhabited earth, rises in fact from the most advanced laboratories of modern physical science? Can we remain silent about such prospects? No matter how great is the responsibility of politicians in this regard, yet the full responsibility of men of science also remains. For this reason, we shall never cease to pray and implore, and you now provide us with a most propitious occasion to do. May necessary renunciations be made with courage! Let every measure be taken and every obligation assumed in order to prevent and avert the manufacture and use of nuclear arms, of bacteriological warfare, of every other means of deriving from scientific progress the diabolic power of inflicting upon entire nations, even those uninvolved in possible conflicts, the scourge of horrible devastation! May mankind return to its senses! May men find in themselves, in their leaders,

their teachers, the strength and the wisdom to forswear the evil use of destructive science! May they rather seek from science the secret of doing good to themselves!

This is what science is doing, indeed, to its own honour and for the advantage of all. You yourselves, Gentlemen, bear magnificent witness to this with the study week you are observing. Your subject, which is 'Organic Matter and Soil Fertility', is completely directed towards the good of men, nay rather, towards the integral and mutual development of mankind which we invoked, just a year ago, in our Encyclical Letter *Populorum Progressio*. To make the earth fruitful, producing bread for all its dwellers, to struggle against the sterility of desert wastes, to multiply agricultural products, to derive from man's labour easier and more abundant results, to make possible a victory over hunger which today still affects entire nations, to give hope and the means of subsistence to the ever increasing generations of men – such is your conquest, such your art, your mission, your crown!

We are proud of you, Gentlemen, and glad of your studies and your contributions to mankind's well-being. With all our heart do we express to you our praise and our good wishes. And, in the name of that God, so great and so mysterious, Whose works you explore; that God Who created the world and redeemed men; that God Whom in all humility but also in all truth we represent, we impart to you our Apostolic Blessing.

18 APRIL 1970

*Address to the Plenary Session and to the Study Week on the Subject
'Nuclei of Galaxies'*

The Supreme Pontiff, who cites Pius XI's idea that the Academy is a 'scientific Senate', declares that it can provide a 'solid basis upon which believers can reflect for a fruitful dialogue with scientific thought'. He also wonders whether other pontifical Academies should not be founded for other areas of knowledge. He goes on to say that reason 'is not and cannot be opposed to faith'; indeed, they help each other reciprocally. He also points out that the scientific study of the universe leads 'towards the invisible which is the source of the visible'. Such observation elevates man and gives meaning to his existence by drawing him closer to God. The flight of Apollo 13 had been a part of this process.

Excellencies and Gentlemen,

We thank you heartily for the delicate sentiments just expressed to us by Reverend Father O'Connell in the name of his illustrious colleagues. As you know, we are always happy to welcome the members of our Pontifical Academy of Sciences, in the presence of the diplomatic corps and distinguished personalities. We also experience a certain emotion to see such qualified representatives of the entire world gathered together, a veritable Senate of scholars, at the head of scientific research and of reflection which it stimulates in the human mind. Is not the subject of your work, devoted to the 'nuclei of galaxies', a striking sign of this?

1. Your plenary session marks an important moment in the life of the Academy, and we rejoice in this. For this institute remains highly significant: it can bring to our world appreciable help by the competency and universality of its testimony, and also provide a solid basis upon which believers can reflect for a fruitful dialogue with scientific thought. What roads have been travelled since the foundation of the Academy of the 'Lincei' in 1603, its revival by Pius IX, its enlargement under Leo XIII, and especially its reconstitution by the enlightened care of our great predecessor Pius XI, with the *Motu Proprio* of October 28, 1936, *In Multis Solaciis*, under the name of the Pontifical Academy of Sciences, comprised of seventy Pontifical Academicians 'a Senate of learned men, as it were, or a scientific Senate to promote the progress of the sciences', under the presidency of Father Agostino Gemelli of happy memory.¹

¹ Cf. AAS 28 (1936), pp. 423-424.

Illustrious scholars have never ceased to honour the Academy by their presence and their work, and we ourself, yesterday, had the joy of adding to this select Cenacle twelve new members who provide a better representation of the ensemble of teachers who cultivate the scientific disciplines with success throughout the world. Your studies of mathematical and experimental sciences, carried on with the liberty that is proper to culture, have certainly contributed to the progress of pure science, and prepared the progress of applied sciences. But should not such a development be extended to other domains today? While continuing your specialised researches whose importance does not cease to grow – experiences of the flights into space, the most recent of which we have followed these past days with anguish and, at the end, with thrilling joy and admiration – would it not be desirable and opportune to foster, in other Academies, other disciplines that are also essential to the human spirit, such as arts and letters, philosophy, law, history, economics, sociology, and the human sciences that characterise so profoundly the men of our times? This morning, we wish to entrust to you this thought upon which we have meditated for a long time and which, in our mind, is more than a dream: a real desire which it would please us to realise.

2. The very nature of your work prompts us to underline two principles of which you are already convinced, and to which your own experience (we could say: your personality) bears witness every day. The fact that reason, however advanced it may be, is not and cannot be opposed to faith: ‘Science which is the true knowledge of things is never contradictory to the truths of Christian faith’.²

Moreover, both faith and reason can be integrated in the unity of knowledge, while keeping their respective autonomy, as the first Vatican Council teaches: ‘Faith and reason ... are a mutual help to each other’.³

Understand us well. According to the pastoral Constitution *Gaudium et Spes* which ‘recalls the teaching of the first Vatican Council’, the Church ‘affirms the legitimate autonomy of human culture and especially of the sciences’, with ‘their own principles and their proper method, each in its own domain’.⁴ But these sciences which can so well ‘elevate the human family to a more sublime understanding of truth, goodness and beauty, and to the formation of judgments which embody universal values’,⁵ can also prepare

² *In Multis Solaciis*, AAS 28 (1936), p. 421.

³ H. Denzinger and A. Schönmetzer, *Enchiridion symbolorum, definitionum et declarationum de rebus fidei et morum*; 34th ed. (Freiburg im Breisgau, 1967), nn. 3019, 1799.

⁴ *Gaudium et Spes*, 59, § 3.

⁵ *Ibid.*, 57, § 3.

man to discover and accept the whole truth, provided these sciences do not incorrectly consider ‘the methods of investigation which these sciences can use as the supreme rule for discovering the whole truth’.⁶ It is the same God who has created the world with its laws which you scrutinise – ‘all things in heaven and on earth, everything visible and everything invisible’⁷ – and who reveals Himself to men and brings them salvation in Jesus Christ. The same human spirit is capable of scrutinising the secrets of creation and ‘of conquering the earth’,⁸ and at the same time, of discovering and accepting ‘under the impulse of grace’ the gift God makes of Himself to man, ‘The Word of God who, before He became flesh in order to save all things and to sum them up in Himself, “He was in the world” already as the true light that enlightens every man’.⁹ How could the Church not encourage the investigation, the discovery, and the conquest of this universe which, with its marvellous and admirable riches, leads us, from the infinitely small to the infinitely great, towards the invisible which is the source of the visible?¹⁰

3. But the subject you have just taken up, ‘the nuclei of galaxies’, deserves special attention. Our imagination becomes baffled and leaves us filled with amazement, as though overwhelmed, almost crushed by the immensity of the perspective unfolded, ‘the silence of infinite spaces’ so dear to Pascal. We follow with profound respect and great interest your patient work of observation, the coordination of experiments, and the formation of scientific hypotheses on the origin or evolution of astral worlds.

Does this mean that human thought exhausts all its possibilities at the level of these investigations?

In the background of these investigations, there is the problem of the very being of this cosmos, of this universe: the question of its existence. You remain, in fact, in scientific experimental observation, of a mathematical and cosmological order. But what prevents the mind, on philosophical grounds, from the possibility of ascending to the transcendent principle, to the Creator, ‘*causa subsistendi et ratio intelligendi et ordo vivendi*’?¹¹ Too often today, we doubt this power. ‘The more science, while perfecting its methods, subjugates the world to man, the more being, which in reaction

⁶ *Ibid.*, § 5.

⁷ *Col* 1:16.

⁸ *Gn* 1:28.

⁹ *Jn* 1:9-10; *Gaudium et Spes*, 57, § 4.

¹⁰ Cf. *Rom* 1:20.

¹¹ St. Augustine, *De Civ. Dei*, Bk. VIII, Ch. 4.

does not let itself be subjugated, evades him ... then comes the temptation to agnosticism'.¹² But we cannot maintain such an attitude. 'The intelligence absolutely cannot abdicate; it cannot renounce its formal law, which is to judge, that is, always affirm'.¹³ For the human mind, it is like 'an irrepressible need to possess, at every moment of its temporal experiment and in each state of its knowledge, an explanatory idea of the ensemble of things'.¹⁴

We often speak of the 'death of God'. But should we not rather speak of the death of man and of his thinking in its superior form? Without this recourse to God, the source of Being, man's thinking seems to become engulfed in the darkness and incomprehensibility of things, in the ignorance of a unity which presides over them, and of the finality of a mysterious order which is inseparable from them, leading to an absurdity which exists only in its own making. Perhaps you are better spared than others from what must be called a true sickness of the mind, you who scrutinise objectively the sciences of nature, of astrophysics, of physics.¹⁵ For the intelligence, by its very activity (if it does not remain in the external appearance of reality), rises to the level of its transcendental cause, the real Absolute, Who gives consistency not only to all creation but especially to the human spirit, without ever becoming identical with them. As has been happily said, the intelligence is 'necessarily a power of assimilation as well as a power of ascent ... It understands in all realities that by which realities are, that is, realities open towards the illumination of the act. And thus, it can be rightly said that the intelligence is the sense of the divine, the avid and skillful faculty of recognising the traces of God'.¹⁶

Here you have, it must be repeated, a natural development of thought, in its fundamental logic, and not an unjustified leap as claimed by an anti-metaphysical mentality improperly defined as scientific. True science, far from arresting the thrust of thought, constitutes a springboard which enables it to rise, in this very thrust, towards the One who generously provides it with food. For, 'the spirit itself is a road that travels ... We cannot get along without God'.¹⁷

¹² H. De Lubac, *Sur les chemins de Dieu* (Paris, Aubier, 1956), p. 84.

¹³ *Ibid.*

¹⁴ P.-H. Simon, *Questions aux savants* (Paris, Seuil, 1969), p. 41.

¹⁵ Cf. C. Tresmontant, *Comment se pose aujourd'hui le problème de l'existence de Dieu* (Paris, Seuil, 1966), p. 349.

¹⁶ Ch. de Moré-Pontgibaud, *Du fini à l'infini*. Introduction à l'étude de la connaissance de Dieu (Paris, Aubier, 1957), p. 65.

¹⁷ H. De Lubac, *op. cit.*, p. 78.

We are amazed, as we said before, in the presence of your studies on the nuclei of galaxies. The solar system already appeared so vast and so mysterious to our predecessors! But for all that, we are not disconcerted, knowing that 'God prefers rather to create beings in their seed in order to lead them subsequently to their blossoming'.¹⁸ Time and space, matter and form, can develop in a limitless way, indefinitely, as it were.

While listening to your teaching, we find assurance in our faith. And to our mind, to us who are in the school of faith, come the words of Holy Scripture: 'God created the heavens and the earth ... And God saw that it was good ... God saw all He had made, and indeed it was very good'.¹⁹ This joy God experienced in the presence of his creatures, why should we not have this same joy towards our Creator?

In our turn, we contemplate this mysterious beauty and goodness of creation. All these beings cry out to us, as they did to St. Augustine: we are not God, but it is God who made us. 'Ecce caelum et terra clamant quod facta sint'.²⁰ And Him we adore! The meeting with God is wrought before the quasi-limitless grandeur of his works (is it not a grace to be initiated in this grandeur?), in joy, in admiration, in prayer, in the adoration of the One who 'in bestowing thousands of graces ... hurried through these forests, and while beholding them ... left them clothed with his beauty'.²¹

At the conclusion of this contemplation of the supreme realities of the cosmos in their meeting with the supreme truths of the human mind, we cannot silence our emotions, our admiration, our satisfaction which are those of the entire world at a happy ending – yes, happy, very happy, even if the main aim of the adventurous flight of Apollo 13 was not achieved. All of you have certainly followed, with apprehension and then with joy, the unfolding of this extraordinary undertaking. And you will undoubtedly make it a point to congratulate warmly with us the valiant astronauts who have escaped the dangers of this grandiose flight, and to render homage to all those who, by their studies, their activity and their authority, have once again brought before the eyes of the world the limitless power of sciences and modern technology. You will also raise with us an ardent hymn of gratitude to God, Creator of the universe and Father of men, who, by these paths also, wishes to be sought after and found by man, adored and loved by Him.

¹⁸ Card. Ch. Journet, *L'Eglise du Verbe incarné*, t. 3, Essai de théologie de l'histoire du salut (Paris, Desclée de Brouwer, 1969), p. 114.

¹⁹ *Gn* 1:21-31.

²⁰ *Conf.*, Bk. XI, Ch. 4, 6; *PL* 32, 811. Cf. *In Ioannem tract.* 106, Ch. 17, n. 4; *PL* 35, 1910. Cf. *W's* 13:1 and 9.

²¹ St. John of the Cross, *Spiritual Canticle*, verse 5.

Such are the thoughts, Excellencies and dear Sirs, suggested to us by this very pleasant meeting. With all our heart, we encourage you to pursue your scholarly work, to pool it in an unselfish manner, beyond frontiers, and to help all your brothers answer the question which science or rather its applications will never cease to ask. You can and should do this, in the light of the faith you bear within you. This is our dearest wish. We accompany your intention with a generous Apostolic Blessing.

15 APRIL 1972

*Address to the Plenary Session and to the Study Week on the Subject
‘The Use of Fertilisers and its Effect in Increasing Yield
with Particular Attention to Quality and Economy’*

The Pope confirms the nobility of the scientific endeavour and praises the positive achievements of technical advance, which should conform to wisdom. The study of nature reveals the wisdom of its creator. It can also provide solutions to major problems, such as that of world hunger, a subject of great importance to the Church. Much improvement in this area has been achieved through the application of science to agriculture. In conclusion, Paul VI says that ‘what started out as a talk of science ends up as a talk on man, on his spiritual and moral value, the condition of real progress for the person as well as for society: this is the entire justification of the deep interest the Church takes in scientific work’.

Mr. President. Members of the Academy, My Lord Cardinals, Messieurs Ambassadors, and all of you who have kindly honoured us with your presence.

The noble words we have just heard have given us a brief but striking picture of the phases of the fruitful work of the Pontifical Academy of Sciences in the last years, and they would suffice in themselves to show the vitality of this institution. The awarding of the Pius XI Gold Medal to Professor György Némethy is also a sign of this vitality. It has become, as you know, a tradition to recognise in this way the merits of a scholar of international repute, in his specific field. Professor Némethy, a son of the noble Hungarian nation, has at present a chair at the Rockefeller University. He is, you know better than we do, a specialist in the physical chemistry of liquids and solutions, and we are happy to confer on him this mark of esteem and encouragement in the presence of such a highly qualified audience as yours.

A tribute to science

Your presence here, Gentlemen, like our own, is intended as a tribute to science; and the immensity of the horizons that this word itself conjures up before the mind’s eye, gives rise to almost infinite reflections.

When in 1936 our great Predecessor Pius XI set up the Pontifical Academy of Sciences, he indicated the aim he proposed for it as follows: ‘Our wish and our hope is that, through this Institute, the “Pontifical Academicians” will contribute more and more and better and better to the progress of sciences. We do not task anything else of them: this noble inten-

tion, this brilliant labour, such is the service we expect from men enamoured of truth'.¹

The disinterested search for truth, the tireless pursuit of the secrets of the universe are, in fact, among the highest values, the most enthralling ideals to which a man can devote his life, *'Intellectum valde ama'*, St. Augustine said; and last century the geologist Pierre Termier (1859-1930) dedicated a book which perhaps you know, to 'The joy of knowing'. The scholar's joys are familiar to you, Gentlemen: suddenly to find the solution to problems after long study; after prolonged efforts, often painful, sometimes unavailing, to penetrate further into the secrets of nature; on the basis of ever more specialised researches, to construct suddenly a magnificent synthesis – sometimes seen in a flash – which gathers in a luminous theory a series of partial truths, apparently heterogeneous, and exclaim: 'I have found it'; you have known these moments of exaltation.

Joy of the intelligence, rewarded for its works; aesthetic enjoyment, in the presence of a fine result; moral elevation, through the emphasis of effort: in all these ways the scholar rises above himself. And in this way, too, he serves mankind. As generation follows generation, new researches prolong previous discoveries; civilisations mature; progress expands. People have rightly spoken of the acceleration of history: true, it is due to the achievements of technology. But these achievements would not have been possible, or would have remained ambivalent, if the disinterested seeker had not first preceded, then accompanied the technician.

The real scholar goes even further. He knows that all civilisation presupposes wisdom. 'The future of the world stands in peril', Vatican II says, 'unless wiser men are forthcoming'. And it adds: 'Many nations, poorer in economic goods, are quite rich in wisdom and can offer noteworthy advantages to others'.²

This wisdom is not opposed to culture of the mind: they condition and complete each other. For science is not pride; it leads thereto only if deflected from its purpose. It is a lesson in humility: only by obeying nature is it possible to conquer it. Nature appears to us first of all as an obstacle to be overcome, darkness to be illuminated. It conflicts with our dreams and our fancies. But as we submit to its demands, we discover its laws. And we can gradually utilise them, discern means of putting them at the service of man. Thus the wise man accompanies the scholar; nature, at first hostile, but improved and transformed by work, becomes an ally and a friend.

¹ *In Multis Solaciis*, AAS 28 (1936), p. 424.

² *Gaudium et Spes*, n. 15, § 3.

The mystery of nature

This meeting of the scholar with nature sets him on a new path. One discovery leads to another, which in turn leads to yet another, but the spirit is never completely satisfied. Is it a case of indefinite progress towards an inaccessible goal? But this would be the abdication of intelligence! Nature, gradually dominated, reveals a mystery greater than itself. And here the scholar is invited to become a philosopher. Either at the beginning or at the end of the enigmas he meets with on his way and which he works to solve, he is led to recognise, or at least to divine, the presence of a Wisdom of another order, unlimited, transcending space and time, which explains the presence of these laws, at first unyielding, but then mastered and utilised.

The spark of light of human intelligence, unequally distributed but present in each of us, appears to the scholar as a participation in this absolute Light, where there is no darkness. Each step forward we take, each synthesis we make, reveals to us something of the plan that presides over the universal order of beings, over the forward effort of man and mankind. Here we are 'in search of a new humanism which will enable modern man to find himself anew by embracing the higher values of love and friendship, of prayer and contemplation'.³

So the task of the scholar is a hard one, if he claims to conquer nature by obeying it, to progress by dominating it. But that calls for other specific virtues, which are familiar to you: obdurate effort, in spite of apparent or temporary failure, patience in spite of the slowness of results, creative imagination in order to discover new ways, the passion for research with the determination to succeed. Then, as you have guessed, out of this alliance of deep reflection, of questioning about oneself, about mankind and the universe, which unites the scholar and the philosopher, there is born the wise man.

The study week of the Pontifical Academy of Sciences

At its advances, science has become more complex and specialised. Even a genius could not master it alone, not even in his own field. Any study whatsoever presupposes a series of problems, premises, a line of research and its own logic. All that may differ, not only according to previous individual discoveries or results, but depending on the angle of view chosen. Working on the same problem, isolated scholars may arrive at opposite conclusions. Collaboration, confrontation, call for personal and sufficiently prolonged contacts between them, if not with the hope of

³ *Populorum Progressio*, n. 20.

immediately solving the controversies, at least with the certainty of understanding divergences better and taking advantage of them. Thus the progress of science will become all the more rapid.

That is why you are here. Almost from its foundation, the Pontifical Academy of Sciences has organised study weeks, the first in 1940. It invited some eminent scholars, specialised in a clearly defined question, not too numerous in order that the dialogue would be really fruitful among them all, and that they could examine together all the facts relating to the problem. In spite of the circumstances – the world was then at war – the success measured up to the hopes. When peace was restored, the study weeks were multiplied, as we have just been reminded: yours is the twelfth.

‘The use of the fertilisers and their effect on the increase of crops, particularly with regard to quality and economy’: this is your subject. It was with keen interest that we read the summaries sent by each of you for the preparation of the work. Their technical aspect is not within our competence and belongs to you alone. But the subject dealt with involves such human interests that the Church, concerned as she is with the development of the whole man and of all men, anguished by the drama of hunger in the world, anxious about the gap which, far from closing, seems to be widening between industrial countries and countries considered as being still in a rural economy, the Church, we say, expects a great deal from your researches, to contribute to the solution of these problems.

The drama of hunger in the world

To make food resources proportionate to the growing population of the globe, to overcome malnutrition, and finally to enable less industrialised countries, the producers of agricultural goods, to enter world commerce in conditions that are not too inferior: all these ambitions are human in the first place, and aim at meeting in a more satisfactory way the requirements of social justice, either between sectors of production in regions of advanced industrial civilisation, or between the latter and populations that are mainly agrarian.

At least in the former unquestionable progress has been made, thanks to your work. The new rural generations are aware of the distance that still separates them from urban life, and the advantages that advanced technology offers the latter. If they do not benefit from them to the same extent, they receive the gleanings, and exploit them. Thanks to mechanisation, they have been able to cultivate wider areas. By using fertilisers, they have increased and sometimes doubled their yields. They have learned to have their soil analysed in order to know what it is best suited for. They aim at

specialisation. Though their numbers are small, they are able to provide for the feeding of denser and more demanding populations. Agriculture, once traditional and following a customary pattern, gradually becomes expert and technical. The peasant is replaced by the rural cultivator.

This being so, a deeply human task awaits you. You are and will to an increasing extent be the educators of this rural cultivator; he expects a great deal from your teachings. You will teach him to seek quality more than quantity, for it is a question of the food of mankind; to make a well balanced use of his fertilisers, in order not to exhaust his land by demanding from it more than it can give; not to contribute to the pollution of waters by an illegitimate use of uncontrolled pesticides. It is a highly moral problem. You will teach him that if the desire for a more just remuneration for his work and the aspiration for a more dignified human life are legitimate, he has also the noble mission of bringing men wholesome foodstuffs, not contaminated by unhealthy articles that serve only to hasten an abundant quantitative production.

But as you know, our concern goes first and foremost to the poorest, who, owing to their economic weakness, remain in a condition of inferiority in the field of international trade. That is why we rejoice to find in your programme identical concerns: the correct use of fertilisers in humid tropical and sub-tropical regions, the importance of soil fertility in tropical Latin America, the role of fertilisers in African agriculture. Here again you will be indispensable educators, the only ones perhaps, capable of awakening to new horizons a population too much attached to its routines.

The activity of FAO

A great deal has already been undertaken. For over twenty years, FAO has been studying these problems, not without difficulties, but not without results. Thanks to the use of more suitable fertilisers, to better seed selection, to less backward techniques, countries that seemed condemned to endemic famine have considerably improved the yield of their soil and increased their production. But there remains a great deal to be done. You will have to carry out, in the first place, a work of persuasion, by means of varied, but conclusive experimentation. For the peasant, even if uneducated, or even illiterate, believes in what he has seen. Your researches will teach him not to exhaust a soil that is already too poor, by exploiting it excessively or in too primitive a way, to balance the rotation of his crops in order to be less the victim of climatic uncertainties, to adapt the use of fertilisers to the conditions of the land and the climate. One thing is certain: too large a part of the earth is not rationally exploited. The first act of the

struggle against hunger consists in getting the soil to produce everything it can: this is part of your competence.

If you succeed in convincing not only the farmer stooped over his desolate land, but first of all those in charge of the national economy, a great step forward will have been taken. Having improved his conditions of material life, the Indian, African, South American peasant will at least be able to acquire more fully the goods of the spirit to which he aspires, a culture that is not copied from others but is specifically his, which will allow him, too, to rise above himself and become more of a man.

May your researches, sometimes obscure but efficient, lead to a common effort of all men of goodwill to use the immense resources of brain and brawn to fertilise the land.⁴ Is not that, after all, the conclusion of one of you: 'Technical means', Professor Baade writes, 'better plant food, the use of commercial fertilisers, we have known all that for a hundred and fifty years. But the utilisation of these technical means depends on progress in the field of human morality; and the real progress of peoples, which is determinant, consists in this'.⁵

The interest of the Church in scientific research

So, as you see, Gentlemen, what started out as a talk on science ends up as a talk on man, on his spiritual and moral value, the condition of real progress for the person as well as for society: this is the entire justification of the deep interest the Church takes in scientific work.

There remains for us, at the end of this talk, only to express to you once more our congratulations and best wishes. We do so wholeheartedly, invoking the abundance of divine blessing on the activities of your Academy and the happy continuation of your work, on yourselves, your families and all those who have kindly wished to emphasise the solemnity of this audience with their presence.

⁴ Cf. 'Address of 16 November 1970 to F.A.O.', in *AAS* 62 (1970), p. 837.

⁵ Prof. Dr. F. Baade, Kiel, Germany: programme of the study week on the use of fertilisers: 'A century of crop increase, thanks to the use of commercial fertilisers; looking back to the year 1900 and forward to the 2000', p. 135.

19 APRIL 1975

*Address to the Plenary Session and to the Study Week on the Subject
'Biological and Artificial Membranes and the Desalination of Water'*

Paul VI declares that the scientist and especially the Christian scientist should defend and steward the 'earthly future of mankind', and that such activity is, in relation to future generations, a 'form of charity' within the framework of 'ecology'. He also says that the scientific inquirer must realise that nature has secret possibilities which human intelligence should discover and make use of 'in order to reach the development which is in the Creator's plan'. God, who is the 'Author of nature and the human spirit', wants this initiative and this fact should encourage the scientific researcher in his endeavours.

Your Eminences, Excellencies,

At the end of your study week, we are happy to renew to you the expression of our deep esteem and our warm encouragement to bring to scientific progress the high quality contribution of which the Pontifical Academy of Sciences is capable.

If the Holy See rejoices at this contribution, and with you is proud of it, it is on account of the considerable service you can render mankind in a more thorough knowledge of nature and the improvement of living conditions. The Church is even more directly concerned when it is a question of fields in which science, ethics and faith are involved at one and the same time, sectors in which your testimony as believers together with your scientific competence is particularly appreciated.

During the year 1974, the activities of the Pontifical Academy of Sciences were continued, under the great drive of its President, to whom we wish to pay tribute. Work and meetings of experts, scientific publications, cultural events, speeches in connection with the Synod of Bishops, manifested brilliantly the vitality of your institution, which will soon celebrate its fortieth anniversary. We remember particularly the Commemoration of Guglielmo Marconi, an initiative of yours.

At present you have just studied the highly specialised problem of the biological and artificial membranes capable of bringing about the desalination of water. As you can imagine, we will not go into the technical question, or into the possibilities of its application, which would probably still be premature. But we know that it is a question of a kind of important metabolism, which it is in the interest of mankind to discern, since the shortage of reserves of fresh water threatens to hinder its development.

Let us just emphasise, in the more general field of scientific research, two attitudes which, it seems to us, should characterise the scientist, and especially the scientist who is a Christian. On the one hand, he must honestly consider the question of the earthly future of mankind and, as a responsible person, help to prepare it, preserve it, and eliminate risks; we think that this solidarity with future generations is a form of charity to which a great many men are sensitive today, in the framework of ecology. But at the same time, the scientist must be animated by the confidence that nature has in store secret possibilities which it is up to intelligence to discover and make use of, in order to reach the development which is in the Creator's plan. This hope in the Author of nature and of the human spirit, rightly understood, is capable of giving new and serene energy to the researcher who is a believer.

In this spirit, we encourage you to continue with your work and to carry out, according to the financial means, alas limited, of the Academy, the happy initiatives that do it credit.

We have the joy of presenting now the Pius XI Medal to Mr. Stephen William Hawking whose studies, among others, on 'Black Holes' have rightly won him an international reputation. All our congratulations, dear Professor, and our best wishes for all of you, Gentlemen, for your activities and those of the Academy. We add our Apostolic Blessing, as a token of our solicitude for your spiritual life.

23 OCTOBER 1976

*Address to the Plenary Session and to the Study Week on the Subject
'Natural Products and the Protection of Plants'*

The Supreme Pontiff affirms that the purpose of science is to 'serve man'. The ecological concerns of the study week form a part of that purpose and Paul VI observes that the stimulation of 'the progress of science for the service of man represents the institutional purpose' of the Academy. The composition of this body, with its representatives from many areas, bears witness to the universality of science, and in the context of this universality the Academy is able to 'promote a more united and peaceful life among nations'. The Pope also emphasises that the Church has always valued scientists – the 'seekers of truth' – and stresses that the Church appreciates the positive values of modern science, which 'are not unrelated to the work of salvation with which she is charged'.

Your Excellencies,

We are happy to receive you in special audience at the end of your study week, the central subject of which was of quite particular interest: 'natural substances and plant protection'. We greet you all very cordially and are anxious to assure you that we sincerely appreciate the valuable work you are carrying out, with dedication and a spirit of sacrifice, for the benefit of scientific progress. Our esteem is all the deeper in that your fundamental concern, as we know, is to serve man, and that is also the final aim of your research. You feel deeply within you the solidarity that binds you to mankind today and in the future, and that is why you adopt an attitude which is that of the ever serious scientist, the attitude of one who – as we had the opportunity to stress during our meeting last year – 'must honestly consider the question of the earthly future of mankind and, as a responsible person, contribute to prepare it, preserve it and eliminate risks'.¹

The subject chosen for the present study week reflects this concern in an evident way. With regard to the harmful agents which threaten plants, the fruits of which constitute directly or indirectly the main source of subsistence for the human being, protection is carried out today thanks above all to synthetic chemical products. But the latter are causing more and more serious concern, owing to their possible long-term toxic effects on man, and owing, too, to the changes they bring to the natural environment, with the consequent disturbances of the ecological balance. This is what prompts

¹ AAS 67 (1975), p. 268.

the scientist to intervene to study the possibility of using, for this work of protection, natural substances, which are already found in the environment and should not therefore cause ecological damage. This is precisely the subject of your study week.

We hope that this possibility of comparing and discussing the results of your researches in this field will have contributed effectively to furthering the progress of scientific knowledge of the means of defence put at man's disposal. May it also encourage the use of forms of protection which are not harmful to health! To stimulate the progress of science for the service of man represents the institutional purpose of this Pontifical Academy of Sciences.

We are happy to recall it on this occasion since we are celebrating this year the fortieth anniversary of its foundation by our predecessor Pius XI. The *Motu Proprio* which instituted this new organism defined its aims as follows: 'Our wish and our desire is that the *Academici Pontifici*, thanks to their and our Institute, will promote the progress of science more and more and better and better, and we ask nothing else of them, since it is this noble aim and this high task which constitute the service we expect of these men attached to truth'.²

These forty years of activity have not disappointed this expectation: through study weeks, working groups, scientific publications and the other initiatives of the past decades, the Pontifical Academy, we say so expressing your legitimate pride, has made a valuable contribution not only to the progress of scientific knowledge, but also to the cause of collaboration and understanding among men.

The very composition of the Academy, which gathers men of science regardless of nationality, religion or belief, effectively emphasises this universality of science, which is a primary element of meeting and understanding among peoples. Science tends by its very nature to go beyond the limits that men have given themselves by setting up frontiers between them. It seeks a truth which does not admit, as such, any political colouring. It engages in this research with rational methods which cannot but be the same for all scientists, whatever their origin may be. So it fosters a mentality which permits a trusting, sincere and respectful dialogue with all those involved in the common destiny of mankind. It can clearly be seen, then, what an instrument of mutual understanding and peace serious scientific research can represent, and what a contribution the Assembly which you constitute can make from this point of view to promoting a more united and peaceful life among the nations.

² Cf. *AAS* 28 (1936), p. 424.

The Church has always valued, and in a particularly forceful way at the conclusion of the Council, the seekers of truth that scientists are, whose paths are not alien to her own.³ Not only does she recognise the legitimate methodological autonomy of modern science,⁴ but she appreciates, in the change that the latter brings into the way of thinking and living, positive values which are not unrelated to the work of salvation with which she is charged. That is why the Church needs you, your demanding sense of research, and your love of truth.

We encourage you therefore to continue generously on your way as conscientious seekers, aiming at the conquest of new possibilities for human progress. Quoting once more some words of the great Pontiff Pius XI, we express the wish that 'this Academy will become an increasingly rich source of that beneficial charity which Truth is'.⁵ And we accompany this wish with our prayer, asking Almighty God, the Source of life and of the human spirit, to assist you in your research in the service of mankind and to bless you personally, as well as all those who are dear to you.

³ Cf. Paul VI, *Nuntii quibusdam hominum ordinibus dati*, 'Message to Men of Thought and Science', *AAS* 58 (1966), pp. 18-19.

⁴ Cf. *Gaudium et Spes*, n. 36.

⁵ Cf. Address to the meeting on 27 December 1925 at the Pontifical Academy of Sciences, 'Nuovi Lincei'.

22 OCTOBER 1977

*Address to the Plenary Session and to the Study Week on the Subject
'The Role of Non-Specific Immunity in the Prevention
and Treatment of Cancer'*

The Pope declares that true scientists – all those who 'work in a worthy way' – further scientific knowledge 'according to the Creator's invitation', and 'under the responsibility of conscience' prepare 'technical progress in harmony with man's vocation and complete good'. Thus, for example, the attempts to find cures for cancer, 'a terrible affliction', constitute a 'high service to humanity'.

Mr. President,
Ladies and Gentlemen,

We are very happy to receive your visit. And the reason is a double one: the presence of the Council of the Pontifical Academy of Sciences and that of eminent cancerologists.

We are always ready, in fact, to encourage the activity of our Academy, stimulated zealously by its President and its Council. The Holy See is anxious to honour in this way, in the persons of the members of this Pontifical Institution, and through them, all those who in a worthy way, shed lustre on science. For, by examining objectively the immense field of physical and biological realities, they contribute to ensuring the real progress of scientific knowledge, according to the Creator's invitation, and to preparing technical progress in harmony with man's vocation and complete good, and therefore under the responsibility of conscience.

But this morning our interest takes on a concrete form and grows, since with the specialists that we are happy to greet, you have just dedicated a week of studies to what is, rightly, the object of deep concern on the part of our contemporaries: the prevention and treatment of cancer.

You have concentrated your attention on non-specific immunity in this field. We ourselves attribute great importance to this work, for we share the anxiety of our brothers and Christ's ardent desire to see the sick relieved or cured of their infirmities. And it is a question of a terrible affliction, which strikes, still too often irremediably and in the midst of cruel sufferings, a large number of people, even at a comparatively young age, from every country. The disease is all the more powerful in that its mechanisms seem closely linked with the normal processes of cellular reproduction, in which they create grave anarchy.

In addition to surgical operations and radiological treatments which have already made great progress, at the risk, however, of acting on normal cells as well as on cells of cancerous tumours, you have wished to study the exploration of a new way, by utilising immunological and immunochemical means, to activate the defences of the organism or stop the proliferation of neoplastic cells. We thank you heartily for informing us of the results of your work. We hope that it will help to prepare the medical progress to which so many people aspire, physicians, patients and the relatives of patients. We congratulate you on this high service to humanity and we willingly implore on you and on the members of your families the blessings of God, the source of life and Saviour.

ADDRESSES
OF
HIS HOLINESS POPE JOHN PAUL II
TO THE PONTIFICAL ACADEMY OF SCIENCES



His Holiness John Paul II meets the Members of the Pontifical Academy of Sciences, Casina Pio IV, 24 September 1982



His Holiness John Paul II meets the Members of the Pontifical Academy of Sciences, Casina Pio IV, 24 September 1982



His Holiness John Paul II meets the Members of the Pontifical Academy of Sciences, Casina Pio IV, 30 October 1986



His Holiness John Paul II meets the Members of the Pontifical Academy of Sciences, 30 October 1986

JOHN PAUL II (1978-)

His Holiness John Paul II (16 Oct. 1978-) is the first Slav and the first non-Italian Pope since Hadrian VI. Karol Wojtyła was born on 18 May 1920 at Wadowice, an industrial town south-west of Krakow, Poland. His father was a retired army lieutenant, to whom he became especially close since his mother died when he was still a small boy. Joining the local primary school at seven, he went at eleven to the state high school, where he proved both an outstanding pupil and a fine sportsman, keen on football, swimming, and canoeing (he was later to take up skiing); he also loved poetry, and showed a particular flair for acting. In 1938 he moved with his father to Krakow where he entered the Jagiellonian University to study Polish language and literature; as a student he was prominent in amateur dramatics, and was admired for his poems. When the Germans occupied Poland in September 1939, the university was forcibly closed down, although an underground network of studies was maintained (as well as an underground theatrical club which he and a friend organised). Thus he continued to study incognito, and also to write poetry. In winter 1940 he was given a labourer's job in a limestone quarry at Zakrówek, outside Krakow, and in 1941 was transferred to the water-purification department of the Solway factory in Borek Falecki; these experiences were to inspire some of the more memorable of his later poems. In 1942, after his father's death and after recovering from two near-fatal accidents, he felt the call to the priesthood, began studying theology clandestinely and after the liberation of Poland by the Russian forces in January 1945 was able to rejoin the Jagiellonian University openly. Graduating with distinction in theology in August 1946, he was ordained priest by Cardinal Adam Sapieha, Archbishop of Krakow, on 1 November of the same year. In March 1946 his first collection of poems, *Song of the Hidden God*, was published. Sent by Cardinal Sapieha to the Pontifical University (the Angelicum) in Rome, he obtained his doctorate in June 1948 for a dissertation on the concept of faith in St. John of the Cross. After serving from 1948 to 1951 as a parish priest (at Niegowice, and then at St. Florian's, Krakow), he returned to the Jagiellonian to study philosophy (Martin Buber, Gabriel Marcel, and above all Max Scheler, on whom he published his thesis in 1960). During these

years (1952-8) he also lectured on social ethics at Krakow seminary, and in 1956 was appointed Professor of Ethics at Lublin University, becoming acknowledged as one of Poland's foremost ethical thinkers.

On 4 July 1958, while on a canoeing holiday with students, he was appointed titular Bishop of Ombi and auxiliary to the see of Krakow by Pius XII. On 30 December 1963 Paul VI named him Archbishop of Krakow, a role in which he revealed himself as a politically wise and forceful adversary of the repressive Communist government, and on 26 June 1967 made him a Cardinal. He had already published *Love and Responsibility* (1960), a pastoral treatise on the responsibilities of love, including the field of sexuality (1960), and at Vatican Council II (1962-65) he became a prominent figure internationally. A member of the Preparatory Commission, he attended all four sessions and made an influential contribution to the debate on religious freedom, contending that the Church should grant to others the liberty of thought, action, and speech that she claimed for herself. After the Council he was active in implementing its decisions, in Rome as well as in Poland, and attended four of the five general episcopal synods it established; at the 1971 synod he was elected a member of its steering committee. He was also a member of several of the Vatican congregations, or ministries. In the 1960s and 1970s he was becoming a familiar figure on the world stage, repeatedly visiting North America (e.g., attending the Eucharistic congress at Philadelphia in 1976), and travelling to the Middle East, Africa, South and East Asia, and Australia. In Poland he cooperated with his primate, Cardinal Stefan Wyszyński, in a struggle, which was broadly successful, to secure from the regime some kind of tolerable legal status for the Church. In 1976, at the invitation of Paul VI (who had read his *Love and Responsibility* (1960) and used it in drafting *Humanae Vitae*), he delivered the traditional course of Lenten addresses to the Pope and the papal household (published in English in 1976 as *Sign of Contradiction*). He was thus a well-known and widely respected personality when, at the conclave of October 1978, the Cardinals elected him Pope at the relatively youthful age of fifty-eight. Before being elected to the papacy, he had published, as Karol Wojtyła, a number of other works in the field of thought, poetry and theatre, including: *In Front of the Jeweller's Shop* (1960), *The Acting Person* (1969), *Sources of Renewal: The Implementation of the Second Vatican Council* (1972), *Brother of Our Lord* (1979), *Collected Poems* (1982), and *The Collected Plays and Writings on Theater* (transl. B. Taborski, 1987).

As with John Paul I, whose name he adopted, there was no coronation: the inauguration of his ministry as 'universal pastor of the Church' took place in St. Peter's Square on 21 October 1978 and his speech was famous for the phrase: 'do not be afraid'. Addressing the Cardinals on 17 October, the new

Pope pledged himself 'to promote, with prudent but encouraging action', the fulfilment of Vatican Council II. On 18 October he told the ambassadors that, as he saw it, his role was to be 'the witness of a universal love'; politically the Holy See sought nothing for itself but only that believers might be allowed true freedom of worship. His first Encyclical, *Redemptor Hominis* (Mar. 1979), set out his consistent teaching on human dignity and social justice, and also established the Christological character of his pontificate with his statement that Christ illuminates man for man. His second Encyclical, *Dives in Misericordia* (Dec. 1980), developed related themes, calling on men to show mercy to one another in an increasingly threatened world. On 13 May 1981, while being driven in a jeep in St. Peter's Square, he was shot and seriously wounded by a young Turk, Mehmet Ali Agça, underwent major surgery, and was convalescent until October 1981. He subsequently visited his would-be assassin in prison and extended his Christian forgiveness to him. In his third Encyclical, *Laborem Exercens* (Sept. 1981), which he revised while recovering, he commemorated the anniversary of Leo XIII's *Rerum Novarum* and called for a new economic order, neither capitalist nor Marxist but based on the rights of workers and the dignity of labour. Others followed: *Slavorum Apostoli* (June 1985), in commemoration of the eleventh centenary of the evangelising work of St. Cyril and St. Methodius, *Dominum et Vivificantem*, on the Holy Spirit in the life of the Church and the world (May 1986); *Redemptoris Mater* (Mar. 1987) on the Blessed Virgin Mary in the life of the pilgrim Church, in preparation for the Marian year; a work which continued his devotion to the Blessed Virgin Mary previously expressed in the motto adopted for his episcopal coat of arms: '*Totus tuus*'; *Sollicitudo Rei Socialis* (Dec. 1987), expressing concern for the social and international crisis (a work that greatly impressed Mikhail Gorbachev); *Redemptoris Missio* (Dec. 1990) on the permanent validity of the Church's missionary mandate; *Centesimus Annus* (May Day 1991), denouncing both Marxism, then moving towards eclipse, and consumerist capitalism; *Veritatis Splendor* (Oct. 1993), on certain fundamental questions of the Church's moral teaching and arguing that freedom of conscience cannot be absolute since certain things are inherently evil; *Evangelium Vitae* (Mar. 1995), on the value and inviolability of human life; and *Ut Unum Sint* (May 1995), on commitment to ecumenism. *Fides et Ratio* (15 Oct. 1998), perhaps his most important Encyclical, stressed the distinction between religious awareness and human rationality, but at the same time drew attention to their mutual 'circularity' and 'complementarity'. This interest in the role of philosophy and thought was a natural outcome of his academic and intellectual background which stressed the existence of two orders of knowledge which are distinct but not separate – faith and philosophical knowledge. In this Encyclical he also held up the

teaching of St. Thomas Aquinas as a leading pathway for the mission of achieving philosophy consonant with faith.

These thirteen Encyclicals were accompanied by forty-one Apostolic Letters dealing with a broad range of issues, such as: *Egregiae Virtutis* (1981), in which John Paul II proclaimed St. Cyril and St. Methodius, together with St. Benedict, the Patrons of Europe; *Caritatis Christi* (1982), addressed to the Church in China; *Salvifici Doloris* (Feb. 1984), on the Christian meaning of human suffering; *Redemptionis Anno* (Apr. 1984), on the City of Jerusalem, the sacred patrimony of all believers and the crossroads of peace for the peoples of the Middle East; *Les Grands Mystères* (May 1984), on the problem of the Lebanon; *Dilecti Amici* (Mar. 1985), to the youth of the world on the occasion of the United Nations' International Youth Year; *Euntes in Mundum Universum* (Jan. 1988), for the millennium of the baptism of Kievan Rus; *Mulieris Dignitatem* (Sept. 1988), on the dignity and vocation of women on the occasion of the Marian Year; *Ordinatio Sacerdotalis* (May 1994), to the bishops on reserving priestly ordination to men; *Tertio Millennio Adveniente* (Nov. 1994), one of the most important, which called for a new launching of the message of peace and the forgiveness for past errors to achieve a purification of memory, together with an end to the tradition of silence in relation to such errors: 'the Church feels it her duty to recognise the errors of her own members and to ask forgiveness of God and her brothers'; *Laetamur Magnopere* (Aug. 1997), for the approval and promulgation of the official Latin version of the *Catechism of the Catholic Church*; *Divini Amoris Scientia* (Oct. 1997), proclaiming St. Theresa of the Child Jesus a Doctor of the Universal Church; *Spes Aedificandi* (Oct. 1999), proclaiming St. Bridget of Sweden, St. Catherine of Siena and St. Teresa Benedicta of the Cross, Co-Patronesses of Europe; *Motu Proprio Misericordia Dei* on certain aspects of the celebration of the sacrament of penance (May 2002); and *Rosarium Virginis Mariae* on the Most Holy Rosary (Oct. 2002). In addition, John Paul II has engaged in the new and more personal form of communication of letters to specific groups in which he offers his participation in their human condition: to families (Feb. 1994), to children (Dec. 1994), to women (June 1995); it may be observed that in the same year Mary Ann Glendon was appointed by John Paul II as the first woman to head a Holy See delegation, in this case to address the fourth UN Conference on women, held in Beijing; to artists (Apr. 1999), and to the elderly (Oct. 1999). Reference should also be made to the two less 'official' books published by John Paul II during his pontificate: *Crossing the Threshold of Hope* (Oct. 1994) and *Gift and Mystery – on the Fiftieth Anniversary of My Priestly Ordination* (Nov. 1996).

Reaching out to a world in need of a new proclaiming of God and of Christ, another characteristic and highly successful method of the new evan-

gelisation promoted by John Paul II has been carefully organised apostolic journeys and pilgrimages by air – an initiative favoured by his command of many languages (including those of Central and Eastern Europe). His first was in January 1979 to open the Latin-American episcopal conference at Puebla, Mexico; his second, from 2 to 10 June 1979, was an epoch-making return to Poland. Since then each year of his pontificate has been highlighted by such journeys, which have emphasised the global mission of the papacy: to Ireland, the UN, and the United States of America (29 Sep.-8 Oct. 1979); Turkey on 28-30 November 1979, when he and the Ecumenical Patriarch attended each other's liturgies; Fatima, Portugal, in May 1982, to thank the Blessed Virgin Mary for deliverance from assassination; Britain (the first visit ever paid to it by a Pope), Rio de Janeiro, and Buenos Aires to call for peace in relation to the war between Argentina and Great Britain over the Falkland Islands/Malvinas; and Geneva (all in June 1982); Spain (Nov. 1982), for the closing of the fourth centenary of the death of St. Teresa of Avila; Lisbon, and Central America (Mar. 1983); Korea, Papua New Guinea, the Solomon Islands, and Thailand (May 1984); Switzerland (June 1984); Venezuela, Ecuador, Peru, and Trinidad and Tobago (Jan. 1985); Holland (May 1985); India (Jan. 1986); Colombia, and St. Lucia (July 1986); France (Oct. 1986); Bangladesh, Singapore, the Fiji Islands, New Zealand, Australia, and the Seychelles (Nov. 1986); Uruguay, Chile, and Argentina for the celebration in Buenos Aires of the Second World Youth Day (Apr. 1987); the U.S.A. and Canada (Sept. 1987); Uruguay, Bolivia, Paraguay, and Peru (May 1988); Austria (June 1988); Zimbabwe, Botswana, Lesotho, Mozambique, and Swaziland (Sept. 1988); Norway, Iceland, Finland, Denmark, and Sweden (June 1989); Santiago de Compostela (Spain) for the Fourth World Youth Day, and Asturias (Aug. 1989); Korea, Indonesia, and Mauritius (Oct. 1989); Cape Verde, Guinea Bissau, Mali, Burkina Faso, and Chad (Jan. 1990); Czechoslovakia (April 1990); Mexico, Curacao, and Malta (May 1990); Tanzania, Burundi, Rwanda, and Yamoussoukro (Sept. 1990); Portugal, Czestochowa in Poland for the Sixth World Youth Day, and Hungary (1991); Brazil (Oct. 1991); Senegal, Gambia, and Guinea (Feb. 1992); to Santo Domingo (Oct. 1992) for the fifth centenary of the evangelisation of Latin America; Albania (Apr. 1993) and Spain (June 1993); Jamaica, Merida, and Denver for the Eighth World Youth Day (Aug. 1993); Lithuania, Latvia and Estonia (Sept. 1993); Croatia (Sept. 1994); Manila (Jan. 1995) for the Tenth World Youth Day, Port Moresby (Papua New Guinea), Sydney (Australia) and Colombo (Sri Lanka); and Belgium (June 1995); Slovakia (June 1995); Yaoundé (Cameroon), Johannesburg/Pretoria (S. Africa), and Nairobi (Kenya) for the closing of the Special Assembly for Africa of the Synod of Bishops (Sept. 1995); Tunisia (April 1996); Hungary, and France (Sept. 1996); Sarajevo (Apr.

1997); Beirut for the closing of the Special Assembly for Lebanon of the Synod of Bishops (May 1997); Paris for the Twelfth World Youth Day (Aug. 1997); Cuba (Jan. 1998); Nigeria (Mar. 1998); Croatia (Oct. 1998); Romania (May 1999); Slovenia (Sept. 1999); New Delhi for the closing of the Special Assembly for Asia of the Synod of Bishops, and Georgia (Nov. 1999); Mount Sinai (Feb. 2000); the Holy Land (Mar. 2000); Fatima (May 2000); the Jubilee Pilgrimage in Greece, Syria and Malta in the footsteps of St. Paul the Apostle (May 2001); the Ukraine (June 2001); Kazakhstan, and Armenia to celebrate the anniversary of 1700 years of Christianity in that country (Sept. 2001); Azerbaijan and Bulgaria (May 2002); Canada and Guatemala (July 2002); and Mexico and Poland (Aug. 2002) where he attracted crowds that went into the millions. Such journeys have been accompanied by a very large number of visits to different parts of Italy (over 140 by late 2002). At the same time, John Paul II, from the beginning of his pontificate, has always devoted much attention to his local duties as Bishop of Rome, visiting 301 of the 334 parishes as well as institutions within the confines of the Eternal City.

In harmony with the ideas and aspirations which were to be expressed in the Encyclical *Ut Unum Sint*, John Paul II has been very active since the beginning of his pontificate in promoting the ecumenical spirit and developing closer ties with the other Christian Churches and the other religions of the world. Following a visit to Rome's main synagogue in April 1986, he attended the First World Day of Prayer for Peace on 27 October 1986, a meeting of world religious leaders in Assisi. This important event subsequently became an annual occasion for prayers for peace and religious understanding in harmony with the spirit of St. Francis. On 24 January 2002, after the terrorist attack of 11 September 2001, in response to an invitation by John Paul II, representatives of the religions of the world gathered in the name of peace in Assisi to affirm that true religion is in favour of 'justice and peace, forgiveness and life, love!' and against violence and terrorism. Since the first Assisi meeting, John Paul II has received a large number of religious leaders, encounters which have been followed by the issuing of joint statements: His Holiness Dimitrios, Ecumenical Patriarch of Constantinople (Dec. 1987); the Archbishop of Canterbury and Primate of the Anglican Communion, Dr. Robert Runcie (Sept. 1989); the Ecumenical Patriarch of Constantinople, Bartolomeo I (June 1995); the Archbishop of Canterbury and Primate of the Anglican Communion, Dr. George Leonard Carey (Dec. 1996); the Supreme Patriarch and Catholicos of all Armenians, His Holiness Karekin I (Dec. 1996); Aram I Keshishian, Catholicos of Cilicia of the Armenians (Jan. 1997); His Holiness Karekin II, Catholicos of all Armenians (Nov. 2000); and His Beatitude Teoctist, Patriarch of the Orthodox Church of Romania. In addition, on 31 October 1999 the Catholic Church and the

World Lutheran Federation signed a 'Joint Declaration on the Doctrine of the Justification' in Augsburg, Germany. In 2001 John Paul II visited a mosque in Syria during his pilgrimage in the footsteps of St. Paul.

During his twenty-five years as Pope, John Paul II has held eight consistories and appointed 201 Cardinals, including Cardinal Carlo Maria Martini (2 Feb. 1983), who later became a Member of the Pontifical Academy of Sciences.

John Paul II has also granted over 1000 audiences, and has received a large number of world leaders and Heads of State, including: H.M. Queen Elizabeth and Prince Philip (1980; 2000), Antonio R. Eanes (1980), Jimmy Carter (1980), Elio Toaff (1981; 1994), Yasser Arafat (1982; 1996; 1998; 2000; 2001), Sandro Pertini (1982; 1984), Ronald Reagan (1982; 1987), Shimon Peres (1985), Andrey Gromiko (1979; 1985), Francesco Cossiga (1985), Amin Gemayel (1986), Kurt Waldheim (1987), Wojciech Jaruzelski (1987), Raúl Alfonsín (1987), Corazon C. Aquino (1988), George Bush (1989, 2001), Patrick J. Hillery (1989), Mikhail S. Gorbachev (1989; 2002), Mario Soares (1990), Lech Walesa (1991), King Karl Gustaf XVI of Sweden and Queen Silvia (1991), Oscar L. Scalfaro (1992; 1998), Milan Kucan (1993), Giuliano Amato (1993), Carlos S. Menem (1993), Richard von Weizsacker (1994), Vaclav Havel (1994), Bill Clinton (1994), Yitzhak Rabin (1994), Thomas Klestil (1994), Jacques Chirac (1996), Romano Prodi (1996), Fidel Castro (1996), Benjamin Netanyahu (1997), Eduard Shevardnadze (1997), Madeleine Albright (1998), King Albert II and Queen Paola of the Belgians (1998), Nelson Mandela (1998), Ariel Sharon (1999), Carlo A. Ciampi (1999), Vladimir Putin (2000), George W. Bush (2001), and Silvio Berlusconi (2002).

Such activity has been accompanied by the establishment of new diplomatic relations with a number of States: the United States of America (Jan. 1984), Poland (July 1989), the Soviet Union (Mar. 1990), Albania (Sept. 1991), Croatia, Slovenia, and the Ukraine (Feb. 1992), Mexico (Sept. 1992); Israel (June 1994); Jordan (Mar. 1994); South Africa (Mar. 1994); and Libya (Mar. 1997). Furthermore, John Paul II has been forthright in his calls for peace at moments of major international crisis. Thus he played a major role in the signing of the treaty on borders between Argentina and Chile in 1984, and was firm in urging the achievement of peace at the time of the Falklands/Malvinas (May 1982), Gulf (Aug. 1990), and Afghanistan (Sept. 2001) wars. History must also record his notable contribution to the demise of the Communist empire in Central and Eastern Europe: the rapturous reaction of the people during his first visit to Poland in 1979 not only exposed the bankruptcy of Communist authority but also had a knock-on effect in other parts of the Soviet regime. Of great historical significance is also the fact that John Paul II was the first Pope to visit both the Polish Parliament (June 1999) and the Italian Parliament (Palazzo Montecitorio, Nov. 2002), where, surveying the history of the Italian people, he under-

lined their constant commitment towards peace, justice and solidarity. In October 2002, the Holy Father received the 'honorary citizenship' of the City of Rome. Thanking the Mayor, John Paul II said: 'The Bishop of Rome feels honoured to be able to repeat today, with particular significance, the Apostle Paul's words, *'Civis romanus sum'*' (cf. *At 22, 27*).

Aware of the holiness of the Catholic Church and of the need for her constant renewal, and eager to stress her spiritual universality, one of the other characteristics of the pontificate of John Paul II has been the large number of canonisations (457 by late Oct. 2002) and of beatifications (1282 by late Oct. 2002) of men and women from various parts of the world and different periods of history. Reference may be made here to the canonisation of: Fr. Maximilian Kolbe (Oct. 1982); St. Theresa of the Child Jesus and of the Holy Face, Doctor of the Church (Oct. 1997); Teresa Benedicta of the Cross, Edith Stein, martyr (Oct. 1998); Maria Faustyna Kowalska, virgin of the Sisters of the Blessed Virgin Mary of Mercy (Apr. 2000); Luis Batis Sáinz (May 2000); Padre Pio of Pietrelcina (June 2002); and Josémaría Escrivá de Balaguer, the founder of Opus Dei (Oct. 2002); and to the beatification of: Giuseppina Bakhita of Sudan (June 1991); Columba Marmion, Benedictine Abbot (Sept. 2000); Pope Pius IX and Pope John XXIII (Sept. 2000); and Luigi Beltrame Quattrocchi and Maria Corsini, widow of Luigi Beltrame Quattrocchi, the first time that a husband and wife were beatified (Oct. 2001).

Another significant aspect of the papacy of John Paul II, and an element which reflects his keenly-felt wish for direct communication and contact with people, has been the strong emphasis he has placed on meeting private individuals almost every day at holy masses in his private chapel in the Vatican. Equally, he has laid stress on the importance of working lunches and dinners in his private apartments. These new channels of communication have served in particular as an instrument to enable the Pope to enter into direct contact with individual Christians, reflecting thereby his vision of the human person and his centrality. This wish for direct communication (joined with a profound concern for the future) has been reflected in another significant theme of his pontificate: John Paul II has constantly sought close contact with, and devoted great attention to, young people, whom he has repeatedly held up as the hope of the Church and mankind. John Paul II has attended many of the United Nations' World Youth Days, and at the fifteenth such meeting, held in the Jubilee Year at the campus of Tor Vergata University in Rome, more than two million young people gathered to hear his address.

From the very outset of his papacy, John Paul II has demonstrated great interest in the whole question of the role of science in the modern world in general and the relationship between science and faith in particular. Developing the thought of his predecessors, the Pope has emphasised that sci-

ence should promote peace and justice and always be at the service of the human person. John Paul II has invariably had a great interest in the continuation and development of the Pontifical Academy of Sciences in line with the remarkable intuition of his venerated predecessor Pius XI who refounded it, but with an increased emphasis on looking at the human, moral and spiritual problems of our time. He has also laid stress on the need for science to safeguard the environment and contribute to the combating of poverty in developing countries. On 30 March 1979 he received in audience the members of the European Physical Society (researchers from twenty-eight countries from the West and the East of the continent) and laid emphasis on the fact that science must always respect the dignity of the human person. John Paul II's interest in the Pontifical Academy of Sciences has shown itself in so many ways and on so many different occasions, both public and private, that the task of summarising his teachings on the subject in an exhaustive way is virtually impossible. Here we will recall some of his addresses, all of which are of extremely high quality and interest, in which he encouraged the Academy and its activities. At his first meeting with the Academy on 10 November 1979, on the occasion of the commemoration of Albert Einstein, the Pope underlined the fundamental aim of science, namely the search for truth:

The search for truth is the task of basic science. The researcher who moves on this first aspect of sciences feels all the fascination of St. Augustine's words: 'Intellectum valde ama', 'he loves intelligence' and the function that is characteristic of it, to know truth. Pure science is a good which all people must be able to cultivate in full freedom from all forms of international slavery or intellectual colonialism ... Basic research must be free with regard to political and economic authorities, which must cooperate in its development, without hampering it in its creativity or harnessing it to serve their own purposes. Like any other truth, scientific truth is, in fact, answerable only to itself and to the supreme Truth, God, the creator of man and of all things.

The Pope went on to recall the harmony which exists between science and faith. 'The existence of this Pontifical Academy of Sciences, of which in its first establishment Galileo was a member, and which is now formed by scientists without any ethical or religious discrimination, is a visible and high demonstration among Peoples of the harmony which can exist between the truth of science and the truth of faith'.

Reflecting the ideas and hopes of his predecessors, John Paul II emphasised the role and the goals of the Academy once again at the time of this first address to the Academicians:

the Church of Rome united with all those in the world, attaches great importance to the function of the Pontifical Academy of Sciences ... The title 'Pontifical' attributed to this Academy signifies, as you know, the interest and support of the Church. These are manifested in very different forms, of course, from those of ancient patronage, but they are no less deep and effective. As the distinguished President of your Academy, the late Msgr. Lemaître, wrote: 'Does the Church need science? ... nothing human is alien to the Christian. How could the Church have failed to take an interest in the most noble of the strictly human occupations: the search for truth? ... Both ... the believing scientist and the non-believing scientist ... endeavour to decipher the palimpsest of nature, in which the traces of the various stages of the long evolution of the world are overlaid on one another and confused. The believer has perhaps the advantage of knowing that the enigma has a solution, that the underlying writing is, when all is said and done, the work of an intelligent being, therefore that the problem raised by nature has been raised in order to be solved, and that its difficulty is doubtless proportionate to the present or future capacity of mankind. This will not give him, perhaps, new resources in his investigation, but it will contribute to maintaining in him a healthy optimism without which a sustained effort cannot be kept up for long'.

The Pope also expressed his wish to re-examine the Galileo question:

To go beyond this stand taken by the Council, I hope that theologians, scholars and historians, animated by a spirit of sincere collaboration, will study the Galileo case more deeply and, in loyal recognition of wrongs from whatever side they come, will dispel the mistrust that still opposes, in many minds, a fruitful concord between science and faith, between the Church and the world. I give all my support to this task, which will be able to honour the truth of faith and of science and open the door to future collaboration ... For in this affair the agreements between religion and science were more numerous and above all more important than the incomprehensions which led to the bitter and painful conflict that continued in the course of the following centuries.

As is known, on 31 October 1992 John Paul II received in audience the Pontifical Academy of Sciences and the Academy presented to the Holy Father the conclusions reached by the 'Commission for the Study of the Ptolemaic-Copernican Controversy'.

One of the fields of interest of the Academy that the Pope has insisted on in particular is the theme of 'Science for Peace'. While addressing the Academicians who had gathered on 12 November 1983 for the plenary ses-

sion on science and peace, the Pope said: 'Science, which brings together researchers, technicians, workmen, which stimulates political and economic power, which transforms society at all levels and in all its forms, this same science today has a task which is both vital and urgent, that of collaborating to preserve and re-establish Peace'. After recalling the addresses of his predecessors, the Pope went on to say:

Unarmed prophets have been the object of derision in every age, especially on the part of shrewd politicians, the supporters of power. But today must not our civilisation recognise that humanity has need of them? Should not they alone be heard by the whole of the world's scientific community, so that the laboratories and factories of death may give place to laboratories of life? The scientist can exercise his freedom to choose the field of his own research. When, in a particular historical situation, it is all but inevitable that a certain form of scientific research will be used for purposes of aggression, he must make a choice that will enable him to work for the good of people, for the building up of peace. By refusing certain fields of research, inevitably destined, in the concrete historical circumstances, for deadly purposes, the scientists of the whole world ought to be united in a common readiness to disarm science and to form a providential force for peace.

Another point which John Paul II has mentioned repeatedly is the need for scientific research and scientific applications to respect moral questions. This means that scientists should exercise wisdom when making concrete use of their scientific discoveries. The worldwide scientific community, as represented by the various Academies of Sciences, could be an instrument for the construction of peace and development. This was what the Pope said on the occasion of the second centenary of the Italian Academy of Science known as the Forty:

It is the strictly scientific task of the Academies to advance the frontiers of science. But it is also their *social mission to respond to the questions and pleas of society*. It is their moral duty to carry out their activities at the service of humanity and of peace among peoples. Particularly during the last hundred years, science has been one of the major factors of the development of society and of man's future. But often, the ever more sophisticated and deadly technology that has stemmed from science has been used against man, to the point of creating fearsome stockpiles of both conventional and nuclear arms, and of biological and chemical weapons, capable of destroying a large part of humanity.

We hold that the Academies of Sciences, made up as they are of scientists of world fame and undoubted probity, as faithful disciples

and seekers after truth, and in view of their independence and freedom of judgement, can give a *valid response to the doubts that assail the modern world*. With their knowledge and conscientiousness, they can likewise direct technology toward the true good of humanity.

This duty of providing information and guidance for the public authorities and for public opinion proves that the Academies, while preserving their necessarily very selective structures, must not close themselves within the ivory tower of their private debates. They must be open to discussions, with the whole of humanity, on *the problems that assail people today* as they face the next millennium.

In this universal vision, John Paul II reminded the Academies and scientists in general of their obligations concerning the use of their scientific discoveries:

Today more than ever, science must *contribute with all its power to true human progress* and it must banish the impending threat of the criminal use of its discoveries; therefore it is necessary that the scientific community, aware that science constitutes an essential element of human development, must watch over the correct use of the fruits of its research in the service of humanity.¹

On 22 October 1996, this time in the form of a message on the occasion of the sixtieth anniversary of its refoundation, John Paul II once again chose the Pontifical Academy of Sciences as a qualified interlocutor to expound certain important reflections on the theory of evolution. Returning to and developing certain observations made by his predecessor Pius XII in the Encyclical *Humani Generis*, he now added that 'new knowledge leads the theory of evolution to be no longer considered as a mere hypothesis', thereby recognising 'that this theory has progressively imposed itself on the attention of researchers following a series of discoveries made in the various disciplines of knowledge', imposing itself also, therefore, on the attention of theologians and bible experts.

John Paul II has so far appointed 100 new members of the Academy, amongst whom are to be found such luminaries of the scientific world as: C.B. Anfinsen, W. Arber, G.S. Becker, P. Berg, S. Bergstrom, E. Berté, G. Blobel, N. Cabibbo, L.A. Caffarelli, L.L. Cavalli-Sforza, C. Cohen-Tannoudji, O.D. Creutzfeldt, A.C. Crombie, P.J. Crutzen, E. De Giorgi, M. Eigen, K. Fukui, S.W. Hawking, V.I. Keilis-Borok, J. Lederberg, N.M. Le Douarin, J.-M. Lehn, Y.I. Manin, M.J. Molina, J.E. Murray, S.P. Novikov, R. Noyori, M.F. Perutz, J.C. Polanyi, V. Prelog, M.J. Rees, C. Rubbia, A. Salam, K. Siegbahn, C.H. Townes, C.N. Yang, H.A. Zewail, and A.

¹ *Memorie di Scienze Fisiche e Naturali*, Rend. Accademia Nazionale delle Scienze detta dei XL, V, 7, (11) 33-36 (1985).

Zichichi. He has also recently revived an important tradition of the Academy in making Cardinals of eminent learning members of the Academy: in this case, Cardinal C.M. Martini and Cardinal J. Ratzinger. The importance he attaches to the Academy has also been expressed in the detailed and extensive restoration work carried out to its Renaissance buildings.

In a letter sent to Padre George Coyne, the Director of the Vatican Observatory and a member of the Council of the Academy, a document which is certainly one of the most profound there is on the subject of the dialogue between science and faith, John Paul II observed that science has acted to purify faith and that faith has acted to generate scientific research, a truth demonstrated by the fact that Galilean modern science was born in a Christian climate marked by the increasing assimilation of the message of freedom placed in the heart of man. Thus, in the same letter, referring to the wider context of universities, the Pope declared that:

The Church and academic institutions, because they represent two institutions which are very different but very important, are mutually involved in the domain of human civilisation and world culture. We carry forward, before God, enormous responsibilities towards the human condition because historically we have had and we continue to have a determining influence in the development of ideas and values and the course of human actions.

For this to come about, the Pope stressed the importance of there being experts and places especially dedicated to such a dialogue: 'the Church for a long time has recognised the importance of this by founding the Pontifical Academy of Sciences, in which scientists of world renown regularly meet each other to discuss their research and to communicate to the wider community the directions research is taking. But much more is required'. And in this 'more' John Paul II saw the need, in their irreplaceable dialogue, for scientific institutions and the Catholic Church not to think in a reductive way about the settling of ancient conflicts. He also stressed the important need for mutual help in the investigation of truth and for a shared development of responsibility towards the good of the peoples of the world and the future of mankind. And it was with this approach, marked by a new readiness to engage in service, that the President of the Academy, Professor Cabibbo (already serving his third term), in his address to John Paul II on the occasion of the Jubilee plenary session of 2000 on the subject of 'science and the future of mankind', spoke about the 'renewed commitment' of the Pontifical Academy of Sciences, in conjunction with the Holy See, to the good of the whole Church, of the scientific community, and of those men and women who inquire and believe. It can rightly be affirmed that, during the intense twenty-five years of his pontificate, John Paul II, with his documents and his praxis, has opened up a new horizon of light between faith and science.

30 MARCH 1979

Address to the Members of the European Physical Society

The Pope refers to his previous personal contacts with physicists and hopes that such contacts will continue in the future. Proceeding to reflect on the relationship between science and faith, he stresses that research forms an act of respect to God the Creator. Modern science, which brings with it both benefits and dangers, should be guided by 'moral norms' in its approach to man and nature; it should be 'humanising' in its impact. If scientific research is carried out in the proper way, and Scripture is read correctly, 'there can be no opposition between faith and science'. The two branches of knowledge can have a positive relationship: 'Faith does not offer resources to scientific research as such, but it encourages the scientist to pursue his research knowing that he meets, in nature, the presence of the Creator'.

I would like first of all to express my gratitude to you, Professor, for this initiative to pay me a visit today. I cannot express how grateful I am for this initiative and for this presence of yours. For me it is a continuation of my previous experiences, when I was still in Poland, in Krakow, when it was a usual thing for me to meet scientists, and especially physicists, for different talks. So this day, and our meeting, are for me a first promise that this way of acting, these meetings, will have a future, that they do not belong just to my past but will have a future on another plane. I am also so grateful for what you said, and I think that all that you said was rather the essential talk of our meeting. What I can say now will be rather some allusion, some reference.

Actually, having the fortune to meet you today, I thought that I was not prepared. I would like to be better prepared, but I said to myself: well, let us go as things are, we must take a step, the first stage, as we are, and then, perhaps, we will prepare together with future meetings. But I must say that the things you expressed are really essential for the content of this meeting of ours because they are the fundamental problems: the problems of the very nature of science, and then the problems of the relationships of science and faith, religion. These are problems which are not just, let us say, internal problems of science, but problems of him who is the subject and who is the bearer, the author, of science, and who creates with science an environment of his own for himself: a cosmos of his own, a human cosmos for the problems of man. And so all the other things that you expressed are essential; but I am particularly happy that you should say that the effort that science is making will, perhaps, be a happier one than the effort made by others, such as, for example, politicians. They have not succeeded in recon-

stituting the unity of Europe, of our continent, while, on the contrary, scientists, you, are convinced that you will be able to obtain it. Then I am with the scientists; I am with you.

Contacts with the scientific world

Allow me, Professor, to make a change of language now. I want now to speak in French because it will perhaps be easier for all the participants to translate my sentiments and then also some ideas.

Ladies and gentlemen, I am happy to greet in you a group of eminent scientists, members of the European Physical Society, presided over by Professor Antonino Zichichi. The meeting this morning gives me particular pleasure. In fact, if my personal formation has been rather, and still remains, humanistic (I must say that I know very little about your subject), geared, afterwards, to philosophical, theological, and moral questions, your concerns, however, are not alien to me. It was even a little strange, but I was always given a good reception by physicists, by the people, by the professors, who represent your profession, your specialisation; and, though knowing so little of your problems, your science, I felt rather at home with them. It was possible to understand one another, and so we did so. In Krakow I always sought, and found very fruitful, contacts with the scientific world and particularly with specialists in physical sciences. This tells you the value this moment has for me, conjuring up so many other meetings, in particular, perhaps, the one with the 'Rome Club' – the results of the work of this Club are well known in our country, in Poland – even if the circumstances do not make it possible to give it that aspect of personal exchange which I appreciated so much. But we will try to give, perhaps, more of this aspect of personal exchange to our meetings in the future.

Important problems

The problems you have set forth yourselves in the course of this international meeting are of great importance and are very topical, for they may constitute a point of reference for the development of modern physics. You have, in fact, dealt in your work with very topical scientific problems which range from very high energies for study of sub-nuclear phenomena to nuclear fusion, from astrophysical radio-interferometers to the light of synchrotrons. Excuse me if I utter these words and if I am unable to give a personal significance to all these expressions, to this terminology. But it is also, I think, our situation when we live in this highly specialised world; we lose the facility of speaking all possible languages, not just languages in the

linguistic sense, but also languages in the scientific sense. Thanks to knowledge of the classical languages (Greek, Latin), we understand a little of what these words mean, but the real significance, the correspondence with the reality determined by this terminology, must certainly be brought by you. Your society, furthermore, which comprises several thousand physicists belonging to twenty-eight European nations, is also an appeal to the cultural unity of the whole community of European countries.

Work of researchers

I do not intend to make a profound speech today but just some remarks on the problem, always new and relevant, of the mutual position of scientific knowledge and faith. You are in the first place researchers; I must say that this is a word particularly dear to me. Researchers! It is opportune to point out this characteristic of your activity and to encourage the rightful freedom of your research in its own object and method, according to 'the legitimate autonomy of culture and especially of the sciences', recalled by the Second Vatican Council.¹ I must say that this paragraph of *Gaudium et Spes* is really important for me. *Science in itself is good since it is knowledge of the world, which is good, created and regarded by the Creator with satisfaction*, as the book of Genesis says: 'And God saw everything that he had made, and behold, it was very good'.² I am very attached to the first chapter of Genesis. Original sin has not completely spoilt this original goodness. Human knowledge of the world is a way of participating in the Creator's knowledge. It is, therefore, a first degree of man's resemblance to God, an act of respect towards Him, for everything that we discover pays tribute to basic truth.

Humanising man

The scientist discovers the still unknown energies of the universe and puts them in man's service. Through his work, he must, therefore, cause man and nature to grow at the same time. He must humanise man more, while respecting and perfecting nature. The universe has a harmony in all its parts and every ecological imbalance leads to harm for man. So the scientist will not treat nature as a slave but, taking inspiration, perhaps, from the *Canticle of the Creatures* by St. Francis of Assisi, he will consider it rather as a sister called to cooperate with him to open new ways for the progress of humanity.

¹ *Gaudium et Spes*, n. 50.

² *Gn* 1:31.

This way cannot be traversed, however, without the help of technique, of technology, which make scientific research efficient. Allow me to refer to my recent Encyclical *Redemptor Hominis*, where I recalled the necessity of a moral rule and ethics which enable man to take advantage of the practical applications of scientific research, where I spoke of the fundamental question of the deep disquiet of modern man. 'Does this progress, which has man for its author and promoter, make human life on earth 'more human' in every aspect of that life? Does it make it more 'worthy of man?'.³

There is no doubt that from many points of view technical progress, born of scientific discoveries, helps man to solve very serious problems, such as food, energy, the struggle against certain diseases more than ever widespread in the third world countries. There are also these great European projects, with which your international seminar dealt, which cannot be solved without scientific and technical research. But it is also true that man, today, is the victim of great fear, as if he were threatened by what he produces, by the results of his work and the use made of it. In order to prevent science and technique from becoming slaves to the will for power of tyrannical forces, political as well as economic, and in order positively to ordain science and technique to the advantage of man, what is necessary, as is usually said, is a supplement of soul, a new breath of spirit, faithfulness to the moral norms that regulate man's life.

Abiding by moral norms

It is incumbent on scientists of the different disciplines, and particularly on you, physicists, who have discovered immense energies, to use all your prestige in order that scientific implications abide by moral norms in view of the protection and development of human life.

A scientific community such as yours, comprising scholars of all European countries and of all religious convictions, can cooperate in an extraordinary way in the cause of peace. As you have just said, science, in fact, transcends political frontiers and calls, especially today, for collaboration of a worldwide character. It offers specialists an ideal place for meetings and friendly exchanges which contribute to the service of peace.

In an increasingly higher conception of science, in which knowledge is put in the service of mankind in an ethical perspective, you will allow me to present to your reflection a new degree of spiritual ascesis.

There is a link between faith and science, as you were able to affirm, too. The Magisterium of the Church has always said so and one of the founders of modern science, Galileo, wrote that 'Holy Scripture and Nature

³ Cf. n. 15.

both proceed from the divine Word: one, as being dictated by the Holy Spirit, and the other, as the very faithful executor of God's orders'; so he wrote in his letter to B. Castelli in 1613.⁴

If scientific research proceeds according to absolutely rigorous methods and remains faithful to its own object, and if the Scripture is read according to the wise directives of the Church, given in the conciliar Constitution *Dei Verbum*, which are, let us say, the most recent directives – previously there were other similar ones – there can be no opposition between faith and science. In cases in which history stresses such an opposition, the latter always derives from erroneous positions which the Council has openly rejected, deploring 'certain attitudes (not unknown among Christians) deriving from a short-sighted view of the rightful autonomy of science: they have occasioned conflict and controversy and have misled many into opposing faith and science'.⁵

When scientists advance humbly in their search for the secrets of nature, God's hand leads them towards the summits – of the mind, as was noted by my Predecessor, Pope Pius XI, in the *Motu Proprio* which set up the Pontifical Academy of Sciences; the scientists called to be members of it 'did not hesitate to declare, rightly, that science, in whatever branch it may be, opens and consolidates the way leading to Christian faith'.

Faith encourages

Faith does not offer resources to scientific research as such, but it encourages the scientist to pursue his research knowing that he meets, in nature, the presence of the Creator. Some of you are walking along this way. All of you are concentrating your intellectual forces on your specialty, discovering every day, with the joy of knowledge, the indefinite possibilities that fundamental research opens for man, and the formidable questions that it sets him at the same time, sometimes even for his future.

I would like us to be able to continue this conversation in the future, finding the opportunity and methods of an indirect exchange – my occupations, like yours, do not leave any other possibility – which will enable me to get to know your concerns better and what you would like to hear from the Pope. I think that these few observations are, in a way, preliminary ones. I hope, ladies and gentlemen, that the blessing of the Almighty will descend on your work and on your persons, and will give you the comfort of contributing to the real progress of humanity, to physical and spiritual health, and to solidarity and peace among peoples. Thank you.

⁴ *Opere*, vol. V (Florence, G. Barbèra, 1968), p. 282.

⁵ *Gaudium et Spes*, n. 36.

10 NOVEMBER 1979

Address to the Plenary Session (Commemoration of Albert Einstein)

John Paul II pays tribute to the memory of Einstein and declares that the 'search for truth is the task of basic science', asserting that this must be carried out in freedom. The applications of science provide great benefits to humanity but must be 'united with conscience'. The Pope then calls for a study of the Galileo case after expressing regret at how the great scientist had been treated by the Church; he also observes that Galileo had believed that 'the two truths, of faith and science, can never contradict each other'. John Paul II stresses that the Academy is made up of believing and non-believing scientists and repeats that the universal Church 'attaches great importance to the function of the Pontifical Academy of Sciences'.

Venerable Brothers, Your Excellencies, Ladies and Gentlemen,

1. I thank you heartily, Mr. President, for the warm and fervent words you addressed to me at the beginning of your address. And I rejoice also with Your Excellency, as with Mr. Dirac and Mr. Weisskopf, both illustrious members of the Pontifical Academy of Sciences, in this solemn commemoration of the centenary of the birth of Albert Einstein.

The Apostolic See also wishes to pay to Albert Einstein the tribute due to him for the eminent contribution he made to the progress of science, that is, to knowledge of the truth present in the mystery of the universe.

I feel in full solidarity with my predecessor Pius XI and with those who succeeded him in Peter's See, in calling upon members of the Pontifical Academy of Sciences, and all scientists with them, to bring about 'the progress of sciences more and more nobly and intensely without asking anything else of them; and that because the mission of serving truth, with which we charge them, consists in this excellent intention and in this noble labour'.¹

2. The search for truth is the task of basic science. The researcher who moves on this first aspect of sciences feels all the fascination of St. Augustine's words: 'Intellectum valde ama',² 'he loves intelligence' and the function that is characteristic of it, to know truth. Pure science is a good which all people must be able to cultivate in full freedom from all forms of international slavery or intellectual colonialism.

¹ Pius XI, *In Multis Solaciis*, 28 Oct. 1936: AAS 28 (1936), p. 424.

² *Epist.* 120, 3, 13; *PL* 33, 459.

Basic research must be free with regard to political and economic authorities, which must cooperate in its development, without hampering it in its creativity or harnessing it to serve their own purposes. Like any other truth, scientific truth is, in fact, answerable only to itself and to the supreme Truth, God, the creator of man and of all things.

3. In its other aspect, science turns to practical applications, which find their full development in the various technologies. In the phase of its concrete achievements, science is necessary to mankind to satisfy the rightful requirements of life, and to overcome the different ills that threaten it. There is no doubt that applied science has rendered and will continue to render immense services to man, provided it is inspired by love, regulated by wisdom, and accompanied by the courage that defends it against the undue interference of all tyrannical powers. Applied science must be united with conscience, so that, in the trinomial, science-technology-conscience, it is the cause of man's real good that is served.

4. Unfortunately, as I had occasion to say in my Encyclical *Redemptor Hominis*, 'The man of today seems ever to be under threat from what he produces ... This seems to make up the main chapter of the drama of present-day human existence'.³ Man must emerge victorious from this drama which threatens to degenerate into a tragedy, and he must find again his true kingship over the world and his full dominion over the things he produces. At the present time, as I wrote in the same Encyclical, 'The essential meaning of this "kingship" and "dominion" of man over the visible world, which the Creator himself gave man for his task, consists in the priority of ethics over technology, in the primacy of the person over things, and the superiority of spirit over matter'.⁴

This threefold superiority is maintained to the extent to which the sense of the transcendence of man over the world and of God over man, is preserved. Exercising her mission of guardian and advocate of both transcendences, the Church considers she is helping science to keep its ideal purity in the aspect of basic research, and to carry out its service of man in the aspect of its practical applications.

5. The Church willingly recognises, moreover, that she has benefited from science. What the Council said about certain aspects of modern culture must be attributed to it, among others: 'As regards religion there is a

³ John Paul II, *Redemptor Hominis*, n. 15.

⁴ *Ibid.*, 16.

completely new atmosphere that conditions its practice. People are taking a hard look at all magical world-views and prevailing superstitions and demanding a more personal and active commitment to faith, so that not a few have achieved a lively sense of the divine'.⁵

The collaboration between religion and modern science is to the advantage of both, without violating their respective autonomy in any way. Just as religion demands religious freedom, so science rightly claims freedom of research. The Second Vatican Council, after reaffirming, with the First Vatican Council, the rightful freedom of the arts and of human disciplines in the field of their own principles and their own method, solemnly recognises 'the legitimate autonomy of culture and especially of the sciences'.⁶ On the occasion of this solemn commemoration of Einstein, I would like to confirm again the declarations of the Council on the autonomy of science in its function of research on the truth inscribed in creation by the finger of God. The Church, filled with admiration for the genius of the great scientist in whom the imprint of the creative Spirit is revealed, without intervening in any way with a judgment which it does not fall upon her to pass on the doctrine concerning the great systems of the universe, proposes the latter, however, to the reflection of theologians to discover the harmony existing between scientific truth and revealed truth.

6. Mr. President! You said, very rightly, in your address that Galileo and Einstein characterised an era. The greatness of Galileo is known to everyone, like that of Einstein; but unlike the latter, whom we are honouring today before the College of Cardinals in the apostolic palace, the former had to suffer a great deal – we cannot conceal the fact – at the hands of men and organisms of the Church. The Vatican Council recognised and deplored certain unwarranted interventions: 'We cannot but deplore' – it is written in number 36 of the conciliar Constitution *Gaudium et Spes* – 'certain attitudes (not unknown among Christians) deriving from a shortsighted view of the rightful autonomy of science: they have occasioned conflict and controversy and have misled many into thinking that faith and science are opposed'. The reference to Galileo is clearly expressed in the note to this text, which cites the volume *Vita e opere di Galileo Galilei* by Msgr. Pio Paschini, published by the Pontifical Academy of Sciences.

To go beyond this stand taken by the Council, I hope that theologians, scholars and historians, animated by a spirit of sincere collaboration, will study the Galileo case more deeply and, in loyal recognition of wrongs from

⁵ *Gaudium et Spes*, n. 7.

⁶ *Ibid.*, n. 59.

whatever side they come, will dispel the mistrust that still opposes, in many minds, a fruitful concord between science and faith, between the Church and the world. I give all my support to this task, which will be able to honour the truth of faith and of science and open the door to future collaboration.

7. Allow me, Gentlemen, to submit to your attention and your reflection some points that seem to me important to set again in its true light the Galileo affair. For in this affair the agreements between religion and science were more numerous and above all more important than the incomprehensions which led to the bitter and painful conflict that continued in the course of the following centuries.

He who is rightly called the founder of modern physics, declared explicitly that the two truths, of faith and of science, can never contradict each other, 'Holy Scripture and nature proceeding equally from the divine Word, the former dictated, as it were, by the Holy Spirit, the latter as a very faithful executor of God's orders', as he wrote in his letter to Father Benedetto Castelli on 21 December 1613.⁷ The Second Vatican Council does not express itself otherwise: it even takes up again similar expressions when it teaches: 'Methodical research in all branches of knowledge, provided it is carried out in a truly scientific manner and does not override moral laws, can never conflict with the faith, because the things of the world and the things of faith derive from the same God'.⁸

Galileo feels in his scientific research the presence of the Creator, who stimulates him, inspires and helps his intuitions, acting in the deepest recesses of his spirit. In connection with the invention of the telescope, he writes at the beginning of *Sidereus Nuncius*, recalling some of his astronomical discoveries: '*Quae omnia ope Perspicilli a me excogitati divina prius illuminante gratia, paucis abhinc diebus reperta, atque observata fuerunt*'.⁹ 'All that has been discovered and observed in the last few days thanks to the 'telescope' that I have invented, after having been enlightened by divine grace'.

Galileo's confession of divine illumination in the mind of the scientist finds an echo in the text already quoted of the conciliar constitution on the Church in the modern world: 'The humble and persevering investigator of the secrets of nature is being led, as it were, by the hand of God in spite of himself'.¹⁰

⁷ *Opere*, vol. V (Florence, G. Barbèra 1968), pp. 282-285.

⁸ *Gaudium et Spes*, n. 36.

⁹ Galilei, *Sidereus Nuncius*, Venetiis, apud Thomam Baglionum, MDCX, fol. 4.

¹⁰ *Gaudium et Spes*, n. 36.

The humility which the conciliar text stresses is a virtue of the spirit necessary for scientific research as well as for adherence to faith. Humility creates a climate favourable to the dialogue between the believer and the scientist; it calls for the illumination of God, already known or still unknown but loved in both cases by him who humbly seeks the truth.

8. Galileo formulated important norms of an epistemological character, which are indispensable to reconcile Holy Scripture and science. In his letter to the grand-duchess mother of Tuscany, Christine of Lorraine, he reaffirms the truth of the Scriptures: 'Holy Scripture can never lie, provided, however, that its real meaning is understood. The latter – I do not think it can be denied – is often hidden and very different from what the mere sense of the words seems to indicate'.¹¹ Galileo introduces the principle of an interpretation of the sacred books which goes beyond the literal meaning but is in conformity with the intention and the type of exposition characteristic of them. It is necessary, as he affirms, that 'the wise men who expound it should show its real meaning'.

The ecclesiastical Magisterium admits the plurality of the rules for the interpretation of Holy Scripture. It teaches expressly in fact, with Pius XII's Encyclical *Divino Afflante Spiritu*, the presence of different literary styles in the sacred books and therefore the necessity of interpretations in conformity with the character of each of them.

The various agreements that I have mentioned do not in themselves solve all the problems of the Galileo affair, but they contribute to creating a starting point favourable to their honourable solution, a state of mind propitious to the honest and loyal solution of old oppositions.

The existence of this Pontifical Academy of Sciences, with which Galileo was associated in a certain way through the old institution which preceded the present one, to which eminent scientists belong today, is a visible sign which manifests, without any form of racial or religious discrimination, the deep harmony that can exist between the truths of science and the truths of faith.

9. In addition to the foundation of your Pontifical Academy by Pius XI, my predecessor John XXIII wished the Church to continue to promote scientific progress and to reward it by establishing the Pius XI Gold Medal. In conformity with the choice made by the Council of the Academy, I am happy to confer this high distinction on a young researcher, Dr. Antonio Paes de Carvalho, whose basic research works have made an important contribution to the progress of science and the good of mankind.

¹¹ *Opere, op. cit.*, vol. V, p. 315.

10. Mr. President and Members of the Academy, before the Lord Cardinals present here, the Diplomatic Corps accredited to the Holy See, the illustrious scientists and all the personalities attending this academic session, I would like to declare that the universal Church, the Church of Rome united with all those in the world, attaches great importance to the function of the Pontifical Academy of Sciences.

The title 'Pontifical' attributed to this Academy signifies, as you know, the interest and support of the Church. These are manifested in very different forms, of course, from those of ancient patronage, but they are no less deep and effective. As the distinguished President of your Academy, the late Msgr. Lemaître, wrote: 'Does the Church need science? Certainly not, the cross and the gospel are sufficient for her. But nothing human is alien to the Christian. How could the Church have failed to take an interest in the most noble of the strictly human occupations: the search for truth?'.¹²

In this Academy which is yours and mine, believing and non-believing scientists collaborate, concurring in the search for scientific truth and in respect for the beliefs of others. Allow me to quote here again an enlightening passage by Msgr. Lemaître: 'Both of them, (the believing scientist and the non-believing scientist) endeavour to decipher the palimpsest of nature, in which the traces of the various stages of the long evolution of the world are overlaid on one another and confused. The believer has perhaps the advantage of knowing that the enigma has a solution, that the underlying writing is, when all is said and done, the work of an intelligent being, therefore that the problem raised by nature has been raised in order to be solved, and that its difficulty is doubtless proportionate to the present or future capacity of mankind. That will not give him, perhaps, new resources in his investigation, but it will contribute to maintaining in him a healthy optimism without which a sustained effort cannot be kept up for long'.¹³

I wish you all this healthy optimism of which Msgr. Lemaître speaks, an optimism which draws its mysterious but real origin from God, in whom you have put your faith, or from the unknown God to whom the truth, which is the object of your enlightened researches, is directed.

May the science that you profess, Members of the Academy and scientists, in the field of pure research as in that of applied research, help mankind, with the support of religion and in agreement with it, to find again the way to hope and to reach the ultimate aim of peace and faith!

¹² O. Godart and M. Heller, *Les relations entre la science et la foi chez Georges Lemaître*, Pontificia Academia Scientiarum, *Commentarii*, vol. III, 21, p. 7.

¹³ *Ibid.*, p. 11.

14 NOVEMBER 1980

*Address to the Study Week on the Subject
'Mankind and Energy: Needs – Resources – Hopes'*

In discussing the question of energy, the Supreme Pontiff declares that mankind 'must look for new methods in order to use the resources of energy that Divine Providence has put at the disposal of man'. He points out that energy policy must 'promote ecological safeguards' and inhibit harm to man. The Pope also warns against the economic and moral dangers of consumer civilisation and of inequalities in relation to world resources. In its approach to energy, which is a universal good, humanity should strive to work to the benefit of all men and 'respect nature': this is a 'duty of justice and charity'.

Your Excellencies, Ladies and Gentlemen,

You know the value I attach to the research work of members of our Pontifical Academy of Sciences. This tells you how happy I am to meet you here, before the end of your work which honours the Holy See, to express to you myself my esteem and encouragement.

The study week which has brought you together deals with one of the most serious questions that humanity must cope with today. And precisely your analysis of the scientific data on energy is geared to concern with the fate of mankind: 'Energy and Humanity'. I congratulate you, I, who, at the tribune of UNESCO, last June 2, stressed the necessity of preventing the progress of disinterested scientific knowledge from ignoring the responsibilities of consciences.¹

Allow me now to recall before you, in a very simple way, free of technicalities, these data which are, of course, very familiar to you; I do so only for the purpose of manifesting to you my interest in your discussions and of sharing some ethical concerns with you.

In the course of his history, man has developed the forms of energy that he needed, passing from the discovery of fire to ever richer forms of energy, and arriving finally at nuclear energy, which is staggering from so many points of view. At the same time, the progress of industrialisation has given rise, especially in recent times, to ever increasing consumption, to such an extent that some natural resources are becoming exhausted. Our civilisation – above all its scientists and technicians – must look for new methods in order to use the sources of energy that Divine Providence has

¹ Cf. John Paul II, *Allocutio ad UNESCO*, 20-22, 2 June 1980, *Insegnamenti di Giovanni Paolo II*, III, 1 (1980), p. 165 ff.

put at the disposal of man. It is necessary, furthermore, that governments themselves should pursue a unified energy policy, so that the energy produced in one region can be used in other regions.

It certainly seems that the sun, the first source of energy and the richest one for our planet, should be studied more attentively by researchers; it must become one of their main concerns. While it is true that direct use of solar energy is still far away, this prospect must not reduce the efforts of researchers or the support of governments. Moreover, results have already been achieved and are being used to advantage in different parts of the world. Furthermore, other forms of energy, such as wind, marine or geothermal energy, have already been used, even if to a limited extent as yet, and depending on geographical conditions.

I have learned that use of biomass has drawn your attention and that you have dwelt on the necessity of developing studies concerning photosynthesis.

Wood takes its place among the oldest sources of energy. In the developing countries, it will undoubtedly remain for a long time the main source of energy. But it is necessary that use of this traditional and important form of energy should not give rise to deforestation and the destruction of forests, which creates serious ecological imbalances. It would be necessary, therefore, to plan active reforestation, to be carried out by botanists, ecologists and pedologists, and its implementation should be the object of attentive care on the part of planners and politicians.

As regards other forms of energy, such as waterfalls, coal, oil and nuclear energy, their choice is based, of course, on various factors depending on natural and human resources, population growth, ways of development, and the economy. I am sure that you will have considered in your discussions the rules that are necessary to eliminate the dangers that threaten, from far and near, those who are exposed to possible harm due to the use of certain sources of energy, and also always to promote ecological safeguards, the protection of fauna and flora, to avoid the destruction of natural beauty which fills the heart with admiration and poetry.

I myself have seen the harm done to the beauty of nature by industrial installations which could have been placed elsewhere or planned differently. Above all, I have had personal experience of the sufferings of coal miners, whose lungs are impregnated with the dust that poisons the mine tunnels. I hope and trust that, in the name of human rights and for the improvement of the quality of life, new and effective measures have already been adopted for the utilisation of conventional sources of energy, and that in this way we will no longer have to see jeopardised not only the natural environment, but also workers and populations.

Finally it is opportune to reflect on the economic and moral dangers due to what is called the consumer civilisation of today and its structures. As I wrote in my Encyclical *Redemptor Hominis*: 'Everyone is familiar with the picture of the consumer civilisation, which consists in a certain surplus of goods necessary for man and for entire societies – and we are dealing precisely with the rich highly developed societies – while the remaining societies, at least broad sectors of them, are suffering from hunger, with many people dying each day of starvation and malnutrition ...

So widespread is the phenomenon that it brings into question the financial, monetary, production and commercial mechanisms that, resting on various political pressures, support the world economy. These are proving incapable either of remedying the unjust social situations inherited from the past, or of dealing with the urgent challenges and ethical demands of the present. By submitting man to tensions created by himself, squandering at an accelerated pace material and energy resources, and compromising the geophysical environment, these structures unceasingly make the areas of misery spread, accompanied by anguish, frustration and bitterness'.²

The frustrations to which man is subject today due to excessive consumption on the one hand, and the energy crisis on the other, can be solved only if it is recognised that energy, whatever its form or origin, must contribute to the good of man. Energy and the problems that it raises must not serve the selfish interests of particular groups which are trying to increase their sphere of economic and political influence, far less must it divide peoples, make some nations dependent on others, and increase the risks of war or of a nuclear holocaust.

Energy is a universal good that Divine Providence has put in the service of man, of all men, to whatever part of the world they may belong, and we must think also of the men of the future, for the Creator entrusted the earth and the multiplication of its inhabitants to man's responsibility.

I think it can be considered a duty of justice and charity to make a resolute and persevering effort to husband energy resources and respect nature, so that not only humanity as a whole today may benefit, but also the generations to come. We are bound in solidarity to the generations to come. And I hope that Christians, moved particularly by gratitude to God, by the conviction that life and the world have a meaning, by unlimited hope and charity, will be the first to appreciate this duty and draw the necessary conclusions.

I thank you, Ladies and Gentlemen, for having responded in such large numbers to the appeal that the Pontifical Academy of Sciences had made to

² John Paul II, *Redemptor Hominis*, n. 16.

you in view of your high competence, and I express my best wishes that your work may serve the good of the whole of humanity. I pray to God to assist you in this noble task, at the moment when I am setting out for Germany to commemorate St. Albert the Great, whose scientific work was considerable for his time, as well as his philosophical and theological reflection. I also pray to the Lord to bless you personally and your families.

3 OCTOBER 1981

Address to the Plenary Session and to the Study Week on the Subject 'Cosmology and Fundamental Physics' with Members of Two Working Groups who had Discussed 'Perspectives of Immunisation in Parasitic Diseases' and 'Statement on the Consequences of the Use of Nuclear Weapons'

The Pope affirms that the Church 'esteems pure science'. He declares that the Bible discusses the origins of the universe not in the form of a scientific treatise but to bring out the relationship between man and God. Holy Scripture 'does not wish to teach how heaven was made but how one goes to heaven'. John Paul II goes on to say that all forms of scientific research and its application must respect 'the norms of morality' and the dignity of the human person. He adds that science must continue to combat illness and makes an appeal for the banishment of nuclear weapons and the upholding of the 'human right to justice and peace'.

Mr. President,
Members of the Academy,
Ladies and Gentlemen,

1. The programme of work which your President has presented, and with which I was already acquainted before this meeting, demonstrates the great vitality of your Academy, its interest in the most acute problems of modern science and its interest in the service of humanity. On the occasion of a previous solemn session I already had the opportunity to tell you how highly the Church esteems pure science: it is 'a good, worthy of being loved, for it is knowledge and therefore perfection of man in his intelligence ... It must be honoured for its own sake, as an integral part of culture'.¹

Before speaking of the questions which you have already discussed during these days and those which you now propose to study, permit me to express my warm thanks to your illustrious President, Professor Carlos Chagas, for the congratulations which he kindly expressed in the name of your whole Assembly for my having regained my physical strength, thanks to the merciful Providence of God and the skill of the doctors who have cared for me. And I am pleased to avail myself of the occasion to express my particular gratitude to the Members of the Academy who from all parts of the world have sent me their good wishes and assured me of their prayers.

¹ *Address to the Pontifical Academy of Sciences, 10 November 1979.*

2. During this study week, you are dealing with the subject of 'Cosmology and Fundamental Physics', with the participation of scholars from the whole world, from as far away as North and South America and Europe and China. This subject is linked to themes already dealt with by the Pontifical Academy of Sciences in the course of its prestigious history. Here I wish to speak of the session on microseisms, stellar clusters, cosmic radiation and galactic nuclei, sessions which have taken place under the presidency of Father Gemelli, Monsignor Lemaître and also Father O'Connell, to whom I address my most fervent good wishes and whom I pray the Lord to assist in his infirmity.

Cosmogony and cosmology have always aroused great interest among peoples and religions. The Bible itself speaks to us of the origin of the universe and its make-up, not in order to provide us with a scientific treatise, but in order to state the correct relationships of man with God and with the universe. Sacred Scripture wishes simply to declare that the world was created by God, and in order to teach this truth it expresses itself in the terms of the cosmology in use at the time of the writer. The Sacred Book likewise wishes to tell men that the world was not created as the seat of the gods, as was taught by other cosmogonies and cosmologies, but was rather created for the service of man and the glory of God. Any other teaching about the origin and make-up of the universe is alien to the intentions of the Bible, which does not wish to teach how heaven was made but how one goes to heaven.

Any scientific hypothesis on the origin of the world, such as the hypothesis of a primitive atom from which derived the whole of the physical universe, leaves open the problem concerning the universe's beginning. Science cannot of itself solve this question: there is needed that human knowledge that rises above physics and astrophysics and which is called metaphysics; there is needed above all the knowledge that comes from God's revelation. Thirty years ago, on 22 November 1951, my predecessor Pope Pius XII, speaking about the problem of the origin of the universe at the study week on the subject of microseisms organised by the Pontifical Academy of Sciences, expressed himself as follows: 'In vain would one expect a reply from the sciences of nature, which on the contrary frankly declare that they find themselves faced by an insoluble enigma. It is equally certain that the human mind versed in philosophical meditation penetrates the problem more deeply. One cannot deny that a mind which is enlightened and enriched by modern scientific knowledge and which calmly considers this problem is led to break the circle of matter which is totally independent and autonomous – as being either uncreated or having created itself – and to rise to a creating Mind. With the same clear and critical gaze with which it examines and judges the

facts, it discerns and recognises there the work of creative Omnipotence, whose strength raised up by the powerful *fiat* uttered billions of years ago by the creating Mind, has spread through the universe, calling into existence, in a gesture of generous love, matter teeming with energy’.

3. Members of the Academy, I am very pleased with the subject that you have chosen for your plenary session beginning on this very day: ‘The Impact of Molecular Biology on Society’. I realise the advantages that result – and can still result – from the study and applications of molecular biology, supplemented by other disciplines such as genetics and its technological application in agriculture and industry, and also, as is envisaged, for the treatment of various illnesses, some of a hereditary character.

I have firm confidence in the world scientific community, and in a very special way in the Pontifical Academy of Sciences, and I am certain that thanks to them biological progress and research, as also all other forms of scientific research and its technological application, will be carried out in full respect for the norms of morality, safeguarding human dignity, freedom and equality. It is necessary that science should always be accompanied and controlled by the wisdom that belongs to the permanent spiritual heritage of humanity and that takes its inspiration from the design of God implanted in creation before being subsequently proclaimed by his Word.

Reflection that is inspired by science and by the wisdom of the world scientific community must enlighten humanity regarding the consequences – good and bad – of scientific research, and especially of that research which concerns man, so that, on the one hand, there will be no fixation on anti-cultural positions that retard the progress of humanity, and on the other hand that there will be no attack on man’s most precious possession: the dignity of his person, destined to true progress in the unity of his physical, intellectual and spiritual well-being.

4. There is another subject which, during these days, has occupied the thoughts of some of you, eminent scholars from different parts of the world who have been brought together by the Pontifical Academy of Sciences: the question of parasitic diseases, diseases which strike the poorest countries of the world and are a serious obstacle to the development of man in the harmonious framework of his physical, economic and spiritual well-being. The efforts to eliminate, as far as possible, the serious harm caused by parasitic diseases to a considerable part of humanity are inseparable from the efforts which should be made for the socio-economic development of those same peoples. Human beings normally need a basic minimum of health and material goods in order to be able to live in a manner worthy of their

human and divine vocation. It is for this reason that Jesus turned with infinite love to the sick and infirm, and that he miraculously cured some of the diseases with which you have been concerned in these past days. May the Lord inspire and assist the work of the scientists and doctors who dedicate their research and profession to the study and treatment of human infirmities, especially those which are the most grave and humiliating.

5. In addition to the question of parasitic diseases, the Academy has been studying the question of a scourge of catastrophic dimensions and gravity that could attack the health of humanity if a nuclear conflict were to break out. Over and above the death of a considerable part of the world's population, a nuclear conflict could have incalculable effects on the health of the present and future generations.

The multi-disciplinary study which you are preparing to undertake cannot fail to be for the Heads of State a reminder of their tremendous responsibilities, and arouse in all humanity an ever more intense desire which comes from the most profound depths of the human heart, and also from the message of Christ who came to bring peace to people of good will.

By virtue of my universal mission, I wish to make myself once more the spokesman of the human right to justice and peace, and of the will of God who wishes all people to be saved. And I renew the appeal that I made at Hiroshima on February 25 of this year: 'Let us pledge ourselves to peace through justice; let us now take a solemn decision, that war will never be tolerated or sought as a means of resolving differences; let us promise our fellow human beings that we will work untiringly for disarmament and the banishing of all nuclear weapons; let us replace violence and hate with confidence and caring'.

6. Among the efforts to be made in order to secure the peace of humanity, there is the effort to ensure for all peoples the energy needed for their peaceful development. The Academy concerned itself with this problem during its study week last year. I am happy to be able to award today the Pius XI Gold Medal to a scientist who has contributed in an outstanding way, by his research in the field of photo-chemistry, to the utilisation of solar energy: Professor Jean-Marie Lehn of the Collège de France and the University of Strasbourg, and I express to him my most cordial congratulations.

To all of you, I offer my sincere compliments on the work which you are doing in scientific research. I pray that Almighty God will bless you, your families, your loved ones, your collaborators, and the whole of humanity, for whom in diverse yet converging ways you and I are carrying out the mission which has been entrusted to us by God.

23 OCTOBER 1982

*Address to the Study Week on the Subject
'Modern Biological Experimentation'*

John Paul II emphasises that science must be guided by wisdom and that 'science and wisdom' are 'at the service of man'. He condemns 'experimental manipulations of the human embryo' because the human being cannot 'be exploited for any purpose whatsoever'. Animals may be experimented on but they 'must be treated as creatures of God' and not abused by man. The benefits of scientific advance should be made available to developing countries through fruitful and disinterested exchange. This applies in particular to the question of food supplies because 'one of the greatest challenges that humanity must face', together with the danger of a nuclear holocaust, is 'the hunger of the poor of this world'.

Mr. President, Ladies and Gentlemen,

1. I desire to express to you my deep gratitude for your visit and to present my best wishes for your activities, of which Professor Chagas has spoken. Permit me, first of all, to offer my felicitations to the President of the Pontifical Academy of Sciences for the intense work performed in various areas of science and for the initiatives undertaken for the well-being of all humanity, such as the recent appeal against nuclear war, endorsed by approximately forty Presidents of Academies throughout the world and by other scientists who gathered on 23-24 September last in the Casina Pio IV, the headquarters of our own Academy.

2. The work which you have accomplished during these days, besides having a *high scientific value*, is also of *great interest for religion*. My predecessor Paul VI, in his address to the United Nations Organisation on 4 October 1965, spoke from the viewpoint of being an 'expert in humanity'. This expertise is indeed linked with the Church's own wisdom, but it likewise comes from culture, of which the natural sciences are an ever more important expression.

In my talk to UNESCO on 2 June 1980, I mentioned, and now I wish to repeat it to you scientists, that there exists 'an organic and constitutive link between culture and religion'. I must also confirm before this illustrious assembly what I said in my address of 3 October 1981 to the Pontifical Academy of Sciences, on the occasion of the annual study week: 'I have firm confidence in the world scientific community, and in a very particular way in the Pontifical Academy of Sciences, being certain that, thanks to

them, biological progress and research, as also all other scientific research and its technological application will be accomplished in full respect for the norms of morality, safeguarding the dignity of people and their freedom and equality'. And I added: 'It is necessary that science should always be accompanied and guided by the wisdom that belongs to the permanent spiritual heritage of humanity, and which is inspired by the design of God inscribed in creation before being subsequently proclaimed by His Word'.

3. Science and wisdom, which in their truest and most varied expressions constitute a most precious heritage of humanity, are *at the service of man*. The Church is called, in her essential vocation, to foster the progress of man, since, as I wrote in my first Encyclical: '... man is the primary route that the Church must travel in fulfilling her mission: *he is the primary and fundamental way for the Church*, the way traced out by Christ Himself'.¹ Man is also for you the ultimate term of scientific research, the whole man, spirit and body, even if the immediate object of the sciences that you profess is the body with all its organs and tissues. The human body is not independent of the spirit, just as the spirit is not independent of the body, because of the deep unity and mutual connection that exist between one and the other.

The substantial unity between spirit and body, and indirectly with the cosmos, is so essential that every human activity, even the most spiritual one, is in some way permeated and coloured by the bodily condition; at the same time the body must in turn be directed and guided to its final end by the spirit. There is no doubt that the spiritual activities of the human person proceed from the personal centre of the individual, who is predisposed by the body to which the spirit is substantially united. Hence the great importance, for the life of the spirit, of the sciences that promote the knowledge of corporeal reality and activity.

4. Consequently, I have no reason to be apprehensive for those *experiments in biology* that are performed by scientists who, like you, have a profound respect for the human person, since I am sure that they will contribute to the *integral well-being of man*. On the other hand, I condemn, in the most explicit and formal way, experimental manipulations of the human embryo, since the human being, from conception to death, cannot be exploited for any purpose whatsoever. Indeed, as the Second Vatican Council teaches, man is 'the only creature on earth God willed for itself'.²

¹ John Paul II, *Redemptor Hominis*, n. 14.

² *Gaudium et Spes*, n. 24.

Worthy of esteem is the initiative of those scientists who have expressed their disapproval of experiments that violate human freedom, and I praise those who have endeavoured to establish, with full respect for man's dignity and freedom, guidelines and limits for experiments concerning man.

The experimentation that you have been discussing is directed to a greater knowledge of the most intimate mechanism of life, by means of artificial models, such as the cultivation of tissues, and experimentation on some species of animals genetically selected. Moreover, you have indicated some experiments to be accomplished on animal embryos, which will permit you to know better how cellular differences are determined.

It must be emphasised that new techniques, such as the cultivation of cells and tissues, have had a notable development which permits very important progress in biological sciences, and they are also complementary to experimentation done on animals. It is certain that animals are at the service of man and can hence be the object of experimentation. Nevertheless, they must be treated as creatures of God which are destined to serve man's good, but not to be abused by him. Hence the diminution of experimentation on animals, which has progressively been made ever less necessary, corresponds to the plan and well-being of all creation.

5. I have learned with satisfaction that among the subjects discussed during your study week you have focused attention on *in vitro* experiments which have yielded *results for the cure of diseases related to chromosome defects*.

It is also to be hoped, with reference to your activities, that the new technique of modification of the genetic code, in particular cases of genetic or chromosomal diseases, will be a motive of hope for the great number of people affected by those maladies.

It can also be thought that, through the transfer of genes, certain specific diseases can be cured, such as sickle-cell anaemia, which in many countries affects individuals of the same ethnic origin. It should likewise be recalled that some hereditary diseases can be avoided through progress in biological experimentation.

The research of modern biology gives hope that the transfer and mutations of genes can ameliorate the condition of those who are affected by chromosomal diseases; in this way the smallest and weakest of human beings can be cured during their intrauterine life or in the period immediately after birth.

6. Finally, I wish to recall, along with the few cases which I have cited that benefit from biological experimentation, the important advantages that

come from *the increase of food products* and from the formation of new edible plant species for the benefit of all, especially people most in need.

In terminating these reflections of mine, which show how much I approve and support your worthy researches, I reaffirm that they must all be subject to moral principles and values, which respect and realise in its fulness the dignity of man. I express the hope that the scientists of those countries which have developed the most advanced modern techniques will take into sufficient account the problems of developing nations and that, beyond every economic or political opportunism which reproduces the schemes of an old colonialism in a new scientific and technical edition, there can be had a fruitful and disinterested exchange. This exchange must be that of culture in general and of science in particular, among scientists of nations of different degrees of development, and may there thus be formed, in every country, a nucleus of scholars of high scientific value.

I ask God, who is the merciful Father of all, but especially of the most abandoned and of those who have neither the means nor the power to defend themselves, to direct the application of scientific research to the production of new food supplies, since one of the greatest challenges that humanity must face, together with the danger of a nuclear holocaust, is the hunger of the poor of this world.

For this intention and for the overall genuine progress of man, created in the image and likeness of God, I invoke on you and on your scientific activities abundant divine blessings.

12 NOVEMBER 1983

Address to the Plenary Session on the Subject 'Science in the Service of Peace', and to the Study Week on 'Chemical Events in the Atmosphere and their Impact on the Environment' and to a Working Group on 'Specificity in Biological Interactions'

The Supreme Pontiff observes that the Church supports the scientific quest for truth and hopes that scientists will be 'assisted by the sense of the divine'. He takes Newton as an example, a scientist who 'saw in the Universe the presence of God'. Knowledge should be used for the benefit of mankind and the Pope asks from Men of Science 'the love of knowledge that builds peace'. Peace is born of justice and scientists should thus strive to promote justice in the world through a diffusion of the benefits of science. In this context 'every form of scientific and technological colonialism must cease'. Science must not serve 'war, tyranny and terror' but be based upon 'truth, freedom, justice and love' in order to benefit humanity and especially humanity in need.

1. In this prestigious Assembly of Scientists, honoured by our presence, Cardinals and brother Bishops, and by the Diplomatic Corps accredited to the Holy See, as well as numerous representatives and leaders of the world of culture, I wish to extend heartfelt greetings and an expression of my highest consideration to the distinguished members of the Pontifical Academy of Sciences as they prepare to address in their Plenary Session the subject: 'Science in the Service of Peace'.

With the same cordial sentiments I greet the distinguished scientists who have come from every part of the world for a week of study on the subject: 'Chemical Events in the Atmosphere and their Impact on the Environment', and, in a working session, another equally important subject: 'Specificity in Biological Interactions'.

In a few days' time another working group will meet to deal with 'Modern Biology applied to Agriculture'.

I congratulate you, Mr. President, Professor Carlos Chagas, for the wisdom and dedication with which you have contributed new and important developments to the life of the Academy. I congratulate you for the planning and promotion of this present series of meetings of personages who devote their energies to the search for truth at the service of humanity.

2. All knowledge takes its nobility and dignity from the truth that it expresses. Only in the unbiased pursuit of truth do culture and especially science preserve their freedom and are able to defend it from any attempt at manipulation by ideologies or powers.

‘The truth will set you free’: these words from the Gospel enjoy perennial validity and illumine with divine light the endeavours of the scientist who refuses to subordinate his commitment and his research to anything but the truth.

Truth is the goal of the whole universe: *finis totius Universi est veritas*, as one of the greatest thinkers of all time, Thomas Aquinas, wrote.¹ The truth of all beings, their forms and their laws are hidden in the bosom of the Universe, which yearns for its truth to be discovered by the human intellect. You, Men of Science, who welcome the world into your minds, work upon it in your laboratories, and investigate its most secret byways in your dedicated efforts, what are you seeking if not the truth?

Have courage and the boldness of reason that untiringly seeks the truth and you will find in the Church and in this Apostolic See your most convinced allies. Of course, the conquests of science are at times provisional, subject to review and rethinking, and they will never succeed in expressing the whole truth hidden in the Universe. The sense of mystery is part of your intellectual heritage and reminds you that what you do not know is much vaster than what you do know. In the search for truth, the boldness of reasons is linked with the humility of its own limits, the joy of knowing goes hand-in-hand with wonder at the unknown.

Furthermore, the sense of mystery also envelops those truths which science cannot discover, but which question the mind of the scientist in the innermost part of his being, where he experiences an irresistible longing and yearning for the divine. The goal of the Universe is not only to reveal the truths it holds within itself, but to manifest the First Truth which gave the worlds its origin and form.

3. Whatever the paths of your scientific research, may you always be assisted by the sense of the divine. How can one fail to mention here Isaac Newton? He in no way thought, as Auguste Comte was to claim later, that science must rise on the ruins of religion and metaphysics; but he saw in the Universe the presence of God, a presence not immanent but transcending nature.

In the *Scholium Generale* added to the second edition of his *Philosophiae Naturalis Principia Mathematica*, Newton wrote: ‘This most elegant order of the sun, planets and comets could not have been born without the design and power of an intelligent and powerful being. He rules all things, not as the soul of the world, but as Lord of the Universe ... From blind metaphysical necessity that is absolutely identical always and everywhere, no

¹ *Contra Gentiles*, Bk. I, Ch. 1.

variety in things can be born. The whole truth of things, including places and times, could only have arisen from the ideas and the will of a necessarily existing being'.²

The message addressed by the Second Vatican Council to the 'men and women of thought and science' agrees with Newton in his conviction that scientific thought and religious thought are inseparable: 'Never perhaps, thank God, has there been so clear a possibility as today of a deep understanding between real science and real faith, both in the service of the one truth. Do not lose the occasion of this important encounter: have confidence in faith, this great friend of intelligence'.

Gentlemen, the scientific truth which ennobles your intellect and lifts your research to the level of contemplation of the world and of its Creator, must be transmitted to the whole of humanity for the integral development of each human being and of all nations, for the service of peace, which is the object of your reflections and projects.

4. There are different ways for men and women of culture to live the precious value of knowledge. Bernard of Clairvaux, one of the strongest personalities in history, who came down from the loftiest peaks of mysticism to share divine and human truth with the ecclesial and civil society of his time, as a true master of love and knowledge, described the different types of men and women of culture always found in history. According to Saint Bernard there are five motives that lead human beings to study: 'There are people who only wish to know for the sake of knowing: this is base curiosity. Others wish to know in order that they themselves may be known: this is shameful vanity, and such people cannot escape the mockery of the satirical poet who said about their likes: "For you, knowing is nothing unless someone else knows that you know". Then there are those who acquire knowledge in order to re-sell it, and for example to make money or gain honours from it: their motive is distasteful. But some wish to know in order to edify: this is charity. Others in order to be edified: this is wisdom. Only those who belong to these last two categories do not misuse knowledge, since they only seek to understand in order to do good'.³

The words of Saint Bernard the mystic indicate a profound grasp of what motivates those who engage in culture, and they are more than ever relevant in order to remind both the teachers of thought as well as their disciples of the true purpose of knowledge. In my address of 15 November

² Cf. L. Geymonat, *Storia del pensiero filosofico e scientifico* (Milan, Garzanti, 1970), vol. II, p. 646.

³ St. Bernardus, *Sermo XXXVI in Cantica*, PL, CLXXXIII, 968.

1980 in Cologne to the scholars and students of the German Universities I pointed out that “all areas of our culture are impregnated by a science that proceeds in a mostly functional way”. And I warned that “a purely functional science, deprived of values and alienated from truth, can be completely enslaved by one or other ideology”.

I gladly recall here what an illustrious and now deceased member of the Pontifical Academy of Sciences had to say some forty years ago in a conference to young university students at Lausanne: ‘One has come to replace the search for truth by the search for what is useful. The young people who previously turned to the masters of thought in order to enlighten their minds, began to ask them for the secrets of nature from which would spring material goods in such abundance. Of the various fields of knowledge, one little by little came to value not those that seek the highest reaches of thought but those that seem more fertile in practical applications’.⁴

Saint Bernard of Clairvaux raised knowledge to the level of love, to the level of charity and understanding: *Sunt qui scire volunt ut aedificent et charitas est.*

5. Members of the Academy, Men of Science, at this very grave moment of history, I ask from you the love of knowledge that builds peace.

Peace is a gift of God offered to people of good will. I speak now to all men and women of good will, whatever faith they belong to, and especially to you who are listening to me now.

The science which brings together those engaged in research, technicians and workers, which mobilises political and economic powers, which transforms society at all levels and in all its institutions, has a task today which is proving more urgent and indispensable than ever, namely the task of cooperating in preserving and building up peace.

From the depths of centuries past there rises the voice of an unarmed prophet, Isaiah: ‘They shall beat their swords into ploughshares and their spears into pruning hooks’.⁵

In recent times, at a moment when war was imminent, there rose with biblical force the prophetic voice of an unarmed Pope, Pius XI, who quoted the Psalm: *Dissipa gentes quae bella volunt.*⁶

Unarmed prophets have been the object of derision in every age, especially on the part of shrewd politicians, the supporters of power. But today

⁴ G. Colonnetti, *Pensieri e fatti dall'esilio. Conferenza del 12 giugno 1944* (Accademia Nazionale dei Lincei, Rome, 1973), p. 31.

⁵ *Is* 2:4.

⁶ *Ps* 67:31.

must not our civilisation recognise that humanity has need of them? Should not they alone be heard by the whole of the world's scientific community, so that the laboratories and factories of death may give place to laboratories of life? The scientist can exercise his freedom to choose the field of his own research. When, in a particular historical situation, it is all but inevitable that a certain form of scientific research will be used for purposes of aggression, he must make a choice that will enable him to work for the good of people, for the building up of peace. By refusing certain fields of research, inevitably destined, in the concrete historical circumstances, for deadly purposes, the scientists of the whole world ought to be united in a common readiness to disarm science and to form a providential force for peace.

Faced with this great patient in danger of death which is humanity as a whole, scientists, in collaboration with all the other members of the world of culture and with the social institutions, must carry out a work of salvation analogous to that of the doctor who has sworn to use all his powers to heal the sick.

6. Peace is born not only from the elimination of theatres of war. Even if all these latter were eliminated others would inevitably appear, if injustice and oppression continue to govern the world. Peace is born of justice: *Opus iustitiae pax*.⁷ Now science, which seeks the truth and is free from all ideologies, can and must promote justice in the world; while not remaining a slave of the economically privileged peoples, it can and must spread everywhere, in order to ensure, through appropriate technical means, that all peoples and all individuals are given their due. The modern world awaits the liberation of science that is a result of the liberation of the mind. Gentlemen, be united in the defence of your liberties in order to build up peace in justice throughout the world.

This is a relentless work that will never cease, for because of sin, both individual and social, sources of injustice continually arise in the world. With an acute sense of history, the Second Vatican Council warned us of this: 'The common good of people is in its basic sense determined by the eternal law. Still the concrete demands of this common good are constantly changing as time goes on. Hence peace is never attained once and for all, but must be built up ceaselessly'.⁸

Pax perpetuo aedificanda: peace has to be ceaselessly built up. Peace is a continuous effort which, in so far as it is up to you, is entrusted to your research, to the technical applications that you must direct, through your authority, to the promotion of justice, with that freedom, that freedom of

⁷ Is 32:17.

⁸ *Gaudium et Spes*, n. 78.

thought which enables you to make other choices when efforts are made to do you violence, in order to exploit your research and discoveries against justice and peace.

7. More than any other, the scientific community is a community of peace, for your rigorous search for the truth in the field of nature is independent of ideologies and therefore of the conflicts that result from them. Your activity demands sincere collaboration, and the frank communication of the results of your research.

The scientific community, a community of peace, must be extended to all nations, through the foundation everywhere of institutes for research and sound technological application. It is not enough that political colonialism has ceased; every form of scientific and technological colonialism must cease as well. I cannot fail to note with satisfaction that the Pontifical Academy of Sciences includes an ever greater number of scientists from all the nations of the world, with no racial or religious discrimination. This is a form of cultural ecumenism which the Church, as the promoter of true religious ecumenism, cannot but regard with a sense of lively satisfaction.

8. From the scientific community, especially when it extends to all the regions of the world, there have come discoveries which have helped the development of humanity in every field: diseases and epidemics have been conquered, new food resources have been found, communications between people have been intensified, the peoples of all the continents have come closer together, natural disasters have been foreseen and overcome. Who can list the benefits brought by science? And cannot one say that these benefits would have been much more important if the techniques resulting from science had not been manipulated by evil powers? Who can deny that science and its applications can be placed at the service of man and of a greater justice?

It is an irreplaceable task of the scientific community to ensure, as is your intention, Mr. President of the Pontifical Academy of Sciences, that the discoveries of science are not placed at the service of war, tyranny and terror.

The intention to direct science to the promotion of justice and peace demands a great love for humanity. Every human virtue is a form of love. This is the case, in particular, of justice, which is love of neighbour, of individuals, and of peoples. Only the person who loves wants justice for the other person. The person who does not love seeks only to obtain justice for himself.

9. Truth, freedom, justice and love: such, Gentlemen, must be the cornerstones of the generous choice of a science that builds up peace. These four values, the cornerstones of science and of the life of civilised society, must be at the basis of that universal call of scientists, of the world of cul-

ture, of the citizens of the world, which the Pontifical Academy of Sciences, with my full and convinced approval, desires to address to the world for the reconciliation of peoples, for the success of the only war that must be fought: the war against hunger, disease and the death of millions of human beings whose quality and dignity of life could be helped and promoted with seven per cent of the amount spent each year for the incessant and threatening rearmament of the richest nations.

Permit me at this point to recall with you, in the name of science and in the name of your personal moral authority, the need for a universal conversion to the true goods of man. Peace cannot be invoked, as it is too often, in order to guarantee ethical permissiveness and consumerism. The universal call for peace must be marked by profound reflection on the destiny of man, on the meaning and quality of life. When conversion to truth, freedom, justice and love does not become a necessity widely recognised and put into practice everywhere, social peace is unstable, because it lacks its deepest root, which is found in the heart of man.

10. It is from God that peace comes for those who are in communion with Him and also for those who, even though they have not found Him, are seeking Him with a sincere heart, in a spirit which, far from stifling the sense of the divine, seeks to liberate it within itself. Mr. President, Members of the Academy, and distinguished scientists, I renew the expression of my confidence in you, and as I bring this speech to a close I would like to make my own the words which my predecessor Paul VI addressed in 1966 to the Pontifical Academy of Sciences: 'More than anyone else the Church rejoices in every true conquest of the human spirit in whatever field it may be. She recognises and values highly the importance of scientific discoveries ... she sees in them not only a magnificent use of the intelligence, but she discovers in them also the exercise of high moral virtues, which confer on the scientist the character and the merit of an ascetic, sometimes of a hero, to whom humanity must repay a generous tribute of praise and gratitude'.⁹

Gentlemen, as men of thought and science, as pilgrims of the truth, as explorers in the different branches of science and knowledge, about man and the universe, who submit yourselves to the labour of observing, thinking, searching, so that man may be ever more man and may find in nature the proper environment for his development: I ask you to work for justice, love and peace, and to believe that today more than ever the Catholic Church is your ally, this Church which loves true science and right thinking, this Church which prays for you and which in my person, respecting your beliefs, invokes upon each one of you the blessing of God.

⁹ Address to the Pontifical Academy of Sciences on 23 April 1966: *Scripta Varia*, 31, p. XLV.

1 JUNE 1984

*Address to the Working Group on the Subject
'Immunology, Epidemiology and Social Aspects of Leprosy'*

The Pope praises the efforts of science to eradicate leprosy. In this and in other fields scientists require the assistance of the Spirit and the benefit of high moral virtues in order to 'exercise the charity of knowledge'. Science when directed towards peace can 'lessen the world's ills, improve the human condition, and help to raise the quality of life', especially the quality of life of those who are the humblest and most neglected.

Mr. President, Ladies and Gentlemen,

1. Today's meeting is a source of deep interest for me, as the subject which you are studying during these days recalls to my heart, no less than to yours, the terrible sufferings of a large number of our brothers and sisters, those who are afflicted by the dreaded disease of leprosy, and especially those in whom it has caused irreversible loss of limbs. *My interest* is matched by my *sincere admiration* for the careful and untiring researches which you conduct for the purpose of fighting this illness and saving many human lives.

At this moment my thoughts go to the various meetings which Jesus had with lepers. I wish to quote from just one, as told by Saint Mark in the first chapter of his Gospel. The sacred text reads: 'And a leper came to Him beseeching Him, and kneeling said to Him: 'If you will, you can make me clean'. At this request Jesus 'stretched out his hand and touched him, and said to him: "I will; be clean". And immediately the leprosy left him, and he was made clean'.¹

By touching the leper's sores with his hand, *Jesus knocked down the barrier* separating the untouchables from the human community, and by this miraculous cure he opened a path of hope that religion and science have to follow. Neither for the one nor for the other can any person henceforth be called unclean, but every individual will have to be respected and helped to regain the good health worthy of the human person.

2. The sense of universal brotherhood proclaimed by the Gospel evoked from followers of every faith a *generous eagerness to assist sufferers from leprosy*, and leper colonies and hospitals were set up in every part of the world. In every place there was a widespread movement to provide vol-

¹ Mk 1:40-42.

untary aid, an 'unexpected gift of private mercy' on the part of those who, 'strong in courage ... moved by pity, took upon themselves and virtuously maintained the care to which they were not called by their duties', as happened during the plague in Milan described by Alessandro Manzoni in his famous novel *I Promessi Sposi*.²

Among the apostles of the lepers who appeared among the Christian missionaries, both Catholic and Protestant, I cannot fail to mention Father Damien de Veuster of the Picpus Fathers, who has been honoured throughout the world as the most generous example of Christian charity towards lepers. Together with him I wish also to mention among the lay apostles Marcello Candia, who made a total gift of himself and his resources to the sufferers from this disease.

However, the care given by generous volunteers, and the institutions subsequently set up by governments, could not have been effective on the health-care level had not science offered and provided means and methods of diagnosis and therapy.

3. As in every other field, so in the sphere of the treatment of the widely differing forms of disease, feelings of brotherhood and *scientific research* link hand in order to rescue humanity from its needs and afflictions. The help of charitable volunteers and the scientist's work both call for powerful spiritual energies. Scientific research is not only a magnificent use of the mind; in the words of my predecessor Paul VI, in a speech to the Pontifical Academy of Sciences, it also demands 'the exercise of lofty moral virtues, which confer upon the scientist the aspect and merit of an ascetic, sometimes of a hero, to whom humanity must pay a great tribute of praise and gratitude'.³

Eminent moral virtues and *the assistance of the Spirit* are needed by the scientist who not only devotes himself to research but who also wishes to exercise the charity of knowledge. When reason, tired and perhaps disillusioned in the efforts of study, seems to give in to the temptation of abandoning its undertaking, the Spirit comes to the aid of those who wish heroically to persist in the efforts they are making for love of neighbour, and at the highest point of the mind He lights a spark that brings a sudden intuition of the truth, whence research resumes its path and reaches the longed-for discovery.

² Ch. 32.

³ Address to the Pontifical Academy of Sciences on 23 April 1966: *Scripta Varia*, 31, p. XLV.

4. Ladies and Gentlemen, you are following the path traced out by Gerhard Hansen, who through the perseverance of reason and the spark of the Spirit discovered the cause of leprosy: *Mycobacterium leprae*. Through your enlightened scientific work, in harmonious collaboration with wise doctors and generous volunteers, and through the farsightedness of governmental and private institutions, leprosy has diminished in many parts of the world. But there are still *millions of our brothers and sisters* who suffer its terrible consequences. For the sake of these people efforts must be everywhere increased to ensure that those who are still condemned to a sort of social death *can rediscover life*, improve its quality, and find in society a place corresponding to their human dignity, for like all other people they are made in the image and likeness of God. There is no reason at all why those who have been cured should not be fully reintegrated into society.

Mr. President, in your address you have rightly stated that science when directed towards peaceful purposes can lessen the world's ills, improve the human condition, and help to raise the quality of life, especially of those who are the humblest and the most neglected among human beings.

5. *I therefore call upon governments, international institutions and philanthropical associations* to make increasing contributions to the work being done by research scientists, doctors and volunteers in order to free leprosy patients from their sickness and from their humiliating and tragic rejection by society.

Mr. President, you mentioned my apostolic pilgrimage to Brazil and in particular my visit, accompanied by yourself, to the leprosarium at Marituba. There and also, more recently, in Korea I had the opportunity to express my solidarity personally with those who suffer and to assure them of the *love and concern of the universal Church*.

Ladies and Gentlemen, continue your research and your therapy, and be assured that the Church fully supports your works, for like you she has received Christ's command, written in the Gospel, to 'heal the lepers', and she knows that lepers who have been cured are a sign of the Kingdom of God.⁴ Help to build up the Kingdom of God, which is also the kingdom of humanity. Be dispensers of justice and love to all those who, in the most desolate corners of the world, are waiting to receive *a message of hope* from today's society.

May God bless you and your dear ones in the service of His people.

⁴ Cf. *Mt* 10:8; 11:5.

2 OCTOBER 1984

*Address to the Study Week on the Subject
'The Impact of Space Exploration on Mankind'*

John Paul II points out that Galileo, Kepler and Newton all 'searched the heavens with the spirit of believers'. He rejoices in the advances in man's knowledge about the nature of the universe but poses the question: 'to whom does space belong?' Space belongs to humanity as a whole and must never be used 'for the exclusive benefit of one nation or social group'. Thus satellites should be used to conquer illiteracy, promote international dialogue, and support and defend the world's ecology. At the same time space technology must not be used by rich countries to 'impose their own culture on poorer nations'. A technology is required that will 'free the poor peoples and relieve oppressed nature, that will promote projects and agreements'.

Dear Friends,

1. I am very grateful to the Pontifical Academy of Sciences and to its President, Professor Carlos Chagas, for having arranged this interesting study week on the subject of 'The Impact of Space Exploration on Mankind' being held in the Casina of Pius IV.

For me it is a source of great satisfaction to meet you, the members of the Pontifical Academy and scientists from all over the world. The present assembly gives me an opportunity to express my admiration at the exceptional developments which have taken place in space technology. At the same time it enables me to expound the guidelines of a moral, social and spiritual order which belong to the mission entrusted to the Successor of Peter by Christ.

2. Centuries have passed since Galileo's telescope penetrated the heavens and gave mankind a new vision of the universe. In his brief but fundamental work entitled *Sidereus Nuncius*, published in Venice in 1610, he spoke of the discoveries made by means of his telescope, but he added, being both a scientist and a believer, that he had made them *divina prius illuminante gratia*, preceded by the enlightenment of divine grace.

Other great scientists such as Kepler and Newton likewise searched the heavens with the spirit of believers. Poets and philosophers such as Pascal contemplated with awe the mysterious silence of outer space.

3. Today, your gaze is directed at the heavens not only in order to study and contemplate the stars created by God, as was done by the great figures

I have just mentioned, but in order to speak of the space probes, space stations and satellites made by man. I am with you in your work, for I regard the presence in space of man and of his machines with the same admiration as that of Paul VI at the time of the Apollo 13 under-taking when he invited those taking part in the study week on 'The Nuclei of the Galaxies' to "pay homage to those who, by their study, action and authority have once more shown the world the unlimited powers of the sciences and of modern technology. With us also you will raise an ardent hymn of gratitude to God, the Creator of the universe and Father of humanity, who in these ways also wishes to be sought and found by man, adored and loved by him'.

4. Today, years after those first events, we can see the immense path covered by man's intelligence in knowing the universe, and we rejoice in this by reason of our very faith, for the perfection of man is the glory of God. The researches of sciences on the nature of our universe have progressed and will progress still more, with the use of highly sophisticated systems such as those perfected by the late member of the Pontifical Academy, Professor Giuseppe Colombo. Instruments are capable of going into space and avoiding the disturbances connected with the earth's surface and the lower layers of the atmosphere. Space probes, a new challenge by man to the distances of space and a symbol of his ever restless desire for knowledge, are coming ever closer to the heavenly bodies, in order to reveal their inmost secrets. Permanent space stations will in their turn be centres of observation making possible experiments never before attempted and the study of new techniques. All these new space instruments have been achieved thanks to the great progress of fundamental scientific research in mathematics, physics and chemistry, and through the development of the telecommunications techniques discovered by a great member of the Academy, Guglielmo Marconi.

5. These various modes of man's presence in space lead us to ask a question: to whom does space belong? While space was something merely observed and studied by the human eye, though with the aid of powerful astronomical instruments, this question was not yet asked. But now that space is visited by man and his machines, the question is unavoidable: to whom does space belong? I do not hesitate to answer that space belongs to the whole of humanity, that it is something for the benefit of all. Just as the earth is for the benefit of all, and private property must be distributed in such a way that every human being is given a proper share in the goods of the earth, in the same way the occupation of space by satellites and other instruments must be regulated by just agreements and international pacts

that will enable the whole human family to enjoy and use it. Just as earthly goods are not merely for private use but must also be employed for the good of neighbour, so space must never be for the exclusive benefit of one nation or social group. The questions of the proper use of space must be studied by jurists and given a correct solution by governments.

The presence of man in space with his satellites and other instruments also involves other matters of a cultural, moral and political nature which I would like to bring to your attention.

6. One of the biggest tasks that can be carried out by the use of satellites is the elimination of illiteracy. About one billion people are still illiterate. Again, satellites can be used for a wider spreading of culture in all the countries of the world, not only in those where illiteracy has already been eliminated but also in those where many can still not yet read or write, for culture can be spread with the use of pictures alone. I hope that the scientific and technological progress which you are now discussing will cooperate in the spreading of a culture that will truly promote the all-round development of man.

But the transmission of culture must not be identified with the imposition of the cultures of the technologically advanced countries on those still developing. Peoples with ancient cultures, though sometimes still partly illiterate but endowed with an oral and symbolic tradition capable of passing on and preserving their own cultures, must not fall victim to a cultural or ideological colonialism that will destroy those traditions. The rich countries must not attempt, through the use of the instruments at their disposal and in particular modern space technology, to impose their own culture on poorer nations.

7. Satellites will carry out a beneficial task when instead of imposing the culture of the rich countries they favour a dialogue between cultures, which means a dialogue between the nations, essential for the peace of the world. Nations have cultural frontiers that are more deeply rooted than geographical and political ones: it must be possible to cross these latter, for every human being is a citizen of the world, a member of the human family. These barriers must not however be altered in a violent way. Similarly, cultural frontiers must not impede a fruitful dialogue between cultures, nor must they be violated by forms of cultural or ideological dictatorship. Modern space technology must not be used by any form of cultural imperialism, to the detriment of the authentic culture of human beings in the legitimate differences that have developed in the history of the individual peoples.

8. Modern space technology properly understood also provides observations useful for the cultivation of the earth, far beyond anything that can be done by any system working on the earth's surface. Through the use of satellites it is possible to obtain exact data regarding the condition of tracts of land, the flow of water and weather conditions. These data can be used for the purpose of improving agriculture, checking the state of woodlands and forests, evaluating the condition of individual zones or of the whole earth, thus making it possible to draw up particular or global programmes in order to meet concrete situations.

This so-called 'remote sensing' is of fundamental importance in the fight against hunger, provided that the economic and political powers that possess these special means of observing the world situation help the poorer countries to draw up programmes of economic development and help them in a practical way to carry out these programmes.

9. With your knowledge and practice of modern space technology, you are well aware of how it would be possible to work out adequate programmes for helping the world to overcome the imbalance of agricultural practices, the advance of deserts, ecological disasters caused by human rapacity against the earth, in the waters and in the atmosphere, with the ever more alarming destruction of animal and plant life, and with grave and mortal illnesses affecting human life itself.

Order and justice must be re-established, harmony between man and nature must be restored. We must strive for a technology that will free the poor peoples and relieve oppressed nature, that will promote projects and agreements. Space technology can make a highly effective contribution to this cause.

10. Ladies and Gentlemen, true peace is born from the heart of those who are open to the gift of God, that God who at the coming of Christ promised peace to people of good will. In your scientific researches and technological inventions I invite you to seek the God of peace, the Invisible One who is the source of everything that is visible. I exhort you to seek Him by listening to the silence of space. Heaven and earth proclaim that they are only creatures, and they urge you to rise into the supreme heaven of transcendence, in order to open your minds and hearts to the love that moves the sun and the other stars. Thus you will be the creators not only of ever more perfect instruments but also of that civilisation which is the only one desired by God and by men and women of good will: the civilisation of truth and love, so necessary to guarantee peace between the nations of the world.

21 OCTOBER 1985

Address to two Working Groups on the Subject: 'The Artificial Prolongation of Life and the Determination of the Exact Moment of Death', and 'The Interaction of Parasitic Diseases and Nutrition'

The Supreme Pontiff likens men and women of science who are dedicated to helping those afflicted by sickness and malnutrition to the Good Samaritan. Scientists and physicians must place 'their skill and energy at the service of life' and thus must never engage in euthanasia. People should be allowed to die with dignity. Malnutrition is a major problem in the world and the 'economically most advanced' countries should help poor populations.

Ladies and Gentlemen,

1. I extend a most cordial welcome to all of you. And I rejoice with the Pontifical Academy of Sciences and its illustrious President, Professor Carlos Chagas, for having succeeded in bringing together two groups of such distinguished scientists to reflect on the subject: 'The Artificial Prolongation of Life and the Determination of the Exact Moment of Death', and 'The Interaction of Parasitic Diseases and Nutrition'.

In the specialised areas encompassed by these subjects, the men and women of science and medicine give yet another proof of their desire to work for the good of humanity. The Church is joined with you in this task, for she too seeks to be *the servant of humanity*. As I said in my first Encyclical, *Redemptor Hominis*: 'The Church cannot abandon man, for his 'destiny', that is to say, his election, calling, birth and death, salvation or perdition, is so closely and unbreakably linked with Christ'.¹

2. Your presence reminds me of the Gospel parable of the Good Samaritan, the one who cared for an unnamed person who had been stripped of everything by robbers and left wounded at the side of the road. *The figure of that Good Samaritan I see reflected in each one of you*, who by means of science and medicine offer your care to nameless sufferers, both among peoples in full development and among the hosts of those individuals afflicted by diseases caused by malnutrition.

For the Christian, life and death, health and sickness, are given fresh meaning by the words of Saint Paul: 'None of us lives for himself, and none

¹ John Paul II, *Redemptor Hominis*, n. 14.

of us dies for himself. If we live, we live for the Lord, and if we die, we die for the Lord; so then, whether we live or whether we die, we are the Lord's'.²

These words offer great meaning and hope to us who believe in Christ; non-Christians, too, whom the Church esteems and with whom she wishes to collaborate, understand that within the mystery of life and death there are values which transcend all earthly treasures.

3. When we approach the subject which you have dealt with in your first Group, 'The Artificial Prolongation of Life and the Determination of the Exact Moment of Death', we do so with two fundamental convictions, namely: Life is a treasure; Death is a natural event.

Since *life is indeed a treasure*, it is appropriate that scientists promote research which can enhance and prolong human life and that physicians be well informed of the most advanced scientific means available to them in the field of medicine.

Scientists and physicians are called to place their skill and energy at the service of life. They can never, for any reason or in any case, suppress it. For all who have a keen sense of the supreme value of the human person, believers and non-believers alike, euthanasia is a crime in which one must in no way cooperate or even consent to. *Scientists and physicians must not regard themselves at the lords of life, but as its skilled and generous servants.* Only God who created the human person with an immortal soul and saved the human body with the gift of the Resurrection is the Lord of life.

4. It is the task of doctors and medical workers to give the sick the treatment which will help to cure them and which will aid them to bear their sufferings with dignity. Even when the sick are incurable they are never untreatable: whatever their condition, appropriate care should be provided for them.

Among the useful and licit forms of treatment is *the use of pain-killers*. Although some people may be able to accept suffering without alleviation, for the majority pain diminishes their moral strength. Nevertheless, when considering the use of these, it is necessary to observe the teaching contained in the Declaration issued on 4 June 1980 by the Congregation for the Doctrine of the Faith: 'Painkillers that cause unconsciousness need special consideration. For a person not only has to be able to satisfy his or her moral duties and family obligations; he or she also has to prepare himself or herself with full consciousness for meeting Christ'.

² *Rm* 14:7-8.

5. The physician is not the lord of life, but neither is he the conqueror of death. *Death is an inevitable fact of human life, and the use of means for avoiding it must take into account the human condition.* With regard to the use of ordinary and extraordinary means the Church expressed herself in the following terms in the Declaration which I have just mentioned: 'If there are no other sufficient remedies, it is permitted, with the patient's consent, to have recourse to the means provided by the most advanced medical techniques, even if these means are still at the experimental stage and are not without a certain risk ... It is also permitted, with the patient's consent, to interrupt these means, where the results fall short of expectations. But for such a decision to be made, account will have to be taken of the reasonable wishes of the patient and the patient's family, as also of the advice of the doctors who are specially competent in the matter ... It is also permissible to make do with the normal means that medicine can offer. Therefore one cannot impose on anyone the obligation to have recourse to a technique which is already in use but which carries a risk or is burdensome ... When inevitable death is imminent in spite of the means used, it is permitted in conscience to take the decision to refuse forms of treatment that would only secure a precarious and burdensome prolongation of life, so long as the normal care due to the sick person in similar cases is not interrupted'.

6. We are grateful to you, Ladies and Gentlemen, for having studied in detail the *scientific problems connected with attempting to define the moment of death*. A knowledge of these problems is essential for deciding with a sincere moral conscience the choice of ordinary or extraordinary forms of treatment, and for dealing with the important moral and legal aspects of transplants. It also helps us in the further consideration of whether the home or the hospital is the more suitable place for treatment of the sick and especially of the incurable.

The right to receive good treatment and the right to be able to die with dignity demand human and material resources, at home and in hospital, which ensure the comfort and dignity of the sick. Those who are sick and above all the dying must not lack the affection of their families, the care of doctors and nurses and the support of their friends.

Over and above all human comforts, no one can fail to see the enormous help given to the dying and their families by *faith in God and by hope in eternal life*. I would therefore ask hospitals, doctors and above all relatives, especially in the present climate of secularisation, to make it easy for the sick to come to God, since in their illness they experience new questions and anxieties which only in God can find an answer.

7. In many areas of the world the matter which you have begun to study in your second working group has immense importance, namely *the question of malnutrition*. Here the problem is not merely that of a scarcity of food but also the quality of food, whether it is suitable or not for the healthy development of the whole person. Malnutrition gives rise to diseases which hinder the development of the body and likewise impede the growth and maturity of intellect and will.

The research which has been completed so far and which you are now examining in greater detail in this colloquium aims at identifying and treating the diseases associated with malnutrition. At the same time, it points to the need to adapt and improve methods of cultivation, methods which are capable of producing food with all the elements that can ensure proper human subsistence and the full physical and mental development of the person.

It is my fervent hope and prayer that your deliberations will encourage the governments and peoples of the economically more advanced countries to help the populations more severely affected by malnutrition.

8. Ladies and Gentlemen, the Catholic Church, which in the coming World Synod of Bishops will celebrate the twentieth anniversary of the Second Vatican Council, reconfirms the words which the Council Fathers addressed to the men and women of thought and science: 'Our paths could not fail to cross. Your road is ours. Your paths are never foreign to ours. We are the friends of your vocation as searchers, companions in your labours, admirers of your successes, and, if necessary, consolders in your discouragement and your failures'.

It is with these sentiments that I invoke the blessings of God, the Lord of life, upon the Pontifical Academy of Sciences, upon all the members of the two present working groups and upon your families.

20 JUNE 1986

*Address to the Study Week on the Subject
'Remote Sensing and Its Impact on Developing Countries'*

John Paul II praises the advantages of the technique of 'remote sensing' and calls for the application of modern technology to achieve a 'more just form of worldwide co-existence'. The resources of science could be employed to 'feed the whole human family' but the political will is often lacking. The resources of space should be utilised to unify 'the human family in justice and peace'. His Holiness concludes by affirming that national and international economic powers should serve everyone but especially those whose lives are 'particularly threatened and who need assistance to secure their very survival and the means of living in a way consonant with human dignity'.

Mr. President,
Ladies and Gentlemen,

It is a pleasure to receive today those taking part in the study week organised by the Pontifical Academy of Sciences on the subject of 'Remote Sensing and Its Impact on Developing Countries'.

An ever deeper knowledge of the earth, and in particular of its poorest zones, is the purpose for which the Pontifical Academy and its distinguished President have brought you together in order to study this subject.

1. The new technique of remote sensing makes it possible to survey anything from a few square metres to huge expanses of the earth's surface. Certain areas, the home of hundreds of thousands of people, are being affected by the *terrible phenomenon of desertification*, with consequent famine and disease. The causes of this phenomenon vary from unsuitable methods of farming to climatic factors such as cyclones and other atmospheric disturbances.

Surveys carried out *with the aid of satellites* linked to a network of ground tracking stations can provide a detailed and exact picture of crops, including their increase or deterioration, and can offer the chance of using *technical means of combating the encroaching desert*, which imperils the livelihood of a high percentage of the world's population.

With the help of remote sensing, it is possible to give useful advice for many schemes. These latter include the improvement of soil condition, forecasting and increasing the development of crop harvesting both in quantity and quality, the introduction of new crops, the prevention of the destruction of forested areas needed for ecological balance, and the taking of measures to meet possible atmospheric conditions, both harmful and beneficial.

By means of remote sensing it is likewise possible to detect the presence of concealed sources of energy, both renewable and non-renewable, as also the presence of food resources on the sea-bed and in rivers and lakes, together with the mineral wealth lying in the subsoil.

2. Your meeting has highlighted the possibility of aiding all peoples, with the help of advanced technological methods, to attain a *more just form of worldwide co-existence, so that the earth's resources, which are the patrimony of all, may be fairly distributed and shared*. This is in accordance with the will of the Creator who made man and woman in His own likeness and said to them, '... have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth... I have given you every plant yielding seed which is upon the face of all the earth, and every tree with seed in its fruit; you shall have them for food'.¹

The resources of science make it possible to feed the whole human family, with the remedying of past and present mistakes and shortcomings. Nevertheless, one cannot help noting that there is still a lack of firm determination in political circles to make proper use of the technological means which you have been examining during these days of study and of service to human welfare. We know that *progress must not be the exclusive privilege of the favoured few*. We should not forget the words of Pope Paul VI who said that development is the new name of peace.

3. It is a source of satisfaction that the conclusions of your previous study week, held in October of the year before last, on the subject of 'The Impact of Space Exploration on Mankind', have been adopted by the United Nations Organisation and sent to all member States. This is indeed a sign of profound respect for the relevance and importance of the work being done by the Pontifical Academy.

It is my hope that by means of joint agreements and commitments all governments will promote the *peaceful uses of space resources for the sake of the unification of the human family in justice and peace*. I take this opportunity to express once more my conviction that national and international economic powers should serve all peoples and every individual, but with special preference for those whose lives are particularly threatened and who need assistance to secure their very survival and the means of living in a manner consonant with human dignity.

May the Lord of heaven and earth look kindly upon you and grant to you and your families the abundance of His blessings.

¹ *Gn* 1:28-29.

26 SEPTEMBER 1986

*Address to the Study Week on the Subject
'Persistent Meteo-Oceanographic Anomalies and Teleconnections'*

The Pope declares that science does not only have the task of studying natural phenomena but should also 'make a decisive intellectual and ethical effort to foresee the development and consequences of those phenomena'. Scientists should inquire into the universe and thereby enter into communion with God. Powerful natural forces should be dominated 'so that they may be placed at the service of all'. The resources of the world must not be corrupted or squandered. A 'harmonious environmental balance' is needed which will 'favour human security and dignity'.

Mr. President,
Ladies and Gentlemen,

1. The present study week on 'Persistent Meteo-Oceanographic Anomalies and Teleconnections' offers a fresh proof of the intention of the Pontifical Academy of Sciences to be of service to humanity, especially by its interest in the main scientific problems of the day. The subject of your Symposium is in fact one of the most urgent at the present time.

I extend a most cordial greeting to the eminent specialists in the fundamental oceanographic and atmospheric problems that you are dealing with. I am pleased to see that you come from many different parts of the world: from North and South America, Europe and Asia. This is yet another demonstration of the harmonious collaboration that exists between scientists and which is of such benefit to world peace.

2. Science does not merely have to study natural phenomena in themselves. It also has to *make a decisive intellectual and ethical effort to foresee the development and consequences of those phenomena*, in order to safeguard and enhance the welfare of humanity. This is the aim that you have set yourselves. You have been studying phenomena such as El Niño, the monsoons and their worldwide effects, the causes of the climatic disturbances in the eastern zones of the Pacific Ocean, as well as the prolonged drought in the Sahel.

The studies which you have carried out in the institutes which you represent individually and which you have been dealing with in the tranquil surroundings of the Casina di Pio IV, the seat of the Pontifical Academy of Sciences, will enable you to provide those who are threatened by these and other negative phenomena with timely weather forecasts, thus

making it possible to take the necessary steps to avoid the most serious effects of approaching natural disasters. In various parts of the world it is now possible, as a result of dedicated efforts, to set up systems for recording climatic phenomena and to gather facts on a worldwide scale which affect the entire globe.

3. Through your work you are carrying out the Biblical command to subdue the earth, to control the catastrophes that harm the human family, and to make the earth obedient to our service. Science encourages legitimate human curiosity to know the universe and to admire and contemplate its beauty and goodness. In this way we enter into communion with God Himself, who looked upon what He had created and saw that it was very good.¹ But *we are also called by God to control the movements of violence and death that occur in nature*, subject as it is to inevitable adjustments of its balance. We are called to discover new sources of energy, to replace those that are non-renewable or that prove to be insufficient. Unfortunately it sometimes happens that, in order to satisfy his unlimited craving for material well-being, man corrupts and squanders the world's resources, with effects that are especially harmful to those least able to defend themselves, who possess the fewest technical skills, and who inhabit the least hospitable territories.

You, on the other hand, are engaged in the genuine task of the scientist: you are studying in order to contemplate and understand, to control and make fruitful. In the course of your studies, you cannot fail to *admire the powerful forces of nature*. But at the same time you see that these forces can pose dangers and threats to humanity, and *you teach how to dominate them, so that they may be placed at the service of all*.

4. Ladies and Gentlemen, I am particularly grateful to the Pontifical Academy of Sciences and to its President for bringing you together. I invoke upon you the blessings of God, the Provident Creator, for the studies that you are engaged in to secure a harmonious environmental balance which will favour human security and dignity, and which will especially benefit those who are unprepared and defenceless in the face of natural catastrophes.

¹ Cf. *Gn* 1:31.

23 OCTOBER 1986

*Address to the Working Group on the Subject
'Molecular Mechanisms of Carcinogenic and Anti-tumor Activity'*

The Supreme Pontiff welcomes the Academy's constant commitment to combating cancer and observes that although the scientists present at the meeting come from the developed countries, the benefits of their work are 'intended for all the world'.

Mr. President,
Ladies and Gentlemen,

For the third time in its history, the Pontifical Academy of Sciences directs its attention towards cancer, an illness that destroys the organism of a great number of human beings and is terrifying in the diversity of its forms.

In 1948 a study week was devoted to 'The Biological Problems of Cancer'. In 1977 another study week researched 'The Role of Non-specific Immunity in the Prevention and Treatment of Cancer'. At the present meeting you have chosen the subject 'Molecular Mechanisms of Carcinogenic Anti-tumor Activity'.

The working group gathered this week in the Pontifical Academy of Sciences is composed of renowned scientists from around the world, who have devoted their activity to investigate, at the most fundamental level, the origins of cancer, the means to cure it and, if possible, the ways to prevent it.

You come from the most developed countries, which have the material means of conducting research at such a fundamental level and on such a large scale. The benefits of your work are, however, intended for all the world.

The particular feature of this working group is to combine, in the same exploration and discussion, the mechanism of action of carcinogenic and anti-tumor agents, those which cause the terrible disease and those which help to cure it. The discussions thus bear on the suffering of man, but also on his efforts to find a remedy for it.

Another striking feature of this working group is that it tries to go into the very fundamentals of the problem by investigating the molecular mechanisms of the events which are responsible for the action of the carcinogenic and anti-tumor agents.

I wish to express my gratitude to the Pontifical Academy for having chosen such an important and urgent subject. I also thank the eminent scientists who have worked vigorously during these days. May your research achieve the results necessary to defeat this terrible scourge which is cancer!

God bless you and your families.

28 OCTOBER 1986

*Address on the Occasion of the Fiftieth Anniversary
of the Pontifical Academy of Sciences*

John Paul II refers to the history of the Academy and recalls that Pius XI wanted it to be the 'scientific Senate' of the Church. He adds that there is 'no contradiction between science and religion' although science needs to be in harmony with wisdom and ethics. The Pope then declares that a 'new type of dialogue has now begun between the Church and the world of science'. He surveys the past and refers to the Galileo case. In its pursuit of truth, science must serve culture and man; fragmentation should be avoided, and scientists, thinkers and theologians must combine in a common effort. Science should work for peace and ecological balance. The Pope concludes by praising the Academy, which 'bears witness to the harmony between the Church and men of science'.

Your Eminences,
Mr. Director-General of UNESCO,
Mr. Minister of Scientific Research of Italy,
Your Excellencies,
Ladies and Gentlemen,

It is with great joy that I celebrate with you the fiftieth anniversary of the act by which Pope Pius XI renewed the Pontifical Academy of the 'New Lincei' and made it the Pontifical Academy of Sciences with the Motu Proprio *In Multis Solaciis* of 28 October 1936.

1. The word 'Lincoo' belongs to your history and to your very being, dear Academicians, because you draw your origin and your fundamental inspiration from the group of young scientists who were gathered by Prince Federico Cesi and gave birth in the year 1603 to the Academy of the 'Lincei'; Galileo Galilei became a member in the year 1611 and thereafter signed all his works with the title 'Lincoo'.

The bonds between the Church and the Academy became particularly intense under Pius IX, who entrusted to it tasks of scientific research in the service of the Papal States, and the relationship became even deeper under his successors, especially under Pius XI, who conferred on it the title and the function of *Scientific Senate* of the Church, made up of seventy members whom the Sovereign Pontiff asked to 'promote ever more and ever better the progresses of the sciences', adding: 'We do not ask anything more of them, for this noble goal and this sublime task constitute the service that we expect from men closely bound to the truth'.

My venerated predecessors Pius XII, John XXIII and Paul VI encouraged the Pontifical Academy, fully convinced of the indispensable role of science in the service of created truth, and ultimately in the service of the First Truth, who is God, following the path from the finite to the infinite – a path that is printed on the human spirit. The Sovereign Pontiffs were actively supported in this by the succession of Presidents, from Father Agostino Gemelli, Monsignor Georges Lemaître, and Father Daniel O’Connell to Professor Carlos Chagas, whom I thank warmly for the important work which he has carried out. Thanks to these Presidents, thanks also to the collaboration of all the members of the Chancellery, this Academy has acquired a celebrated prestige and a scientific role on a very high level, awakening elsewhere participation in important work of many representatives of the world scientific community.

2. In the course of the fifty years of your history, Ladies and Gentlemen, you have very properly given primacy to *pure* science, claiming for it its legitimate autonomy. When I addressed you in my first discourse in this very place, on 10 November 1979, I proclaimed the dignity and the high value of science, with regard to its theoretical side: ‘Fundamental research must be free in its relationship to political and economic power, which must cooperate in its development, without placing obstacles in its path ... Like every other truth, scientific truth is obliged to give account of itself only to itself and to the supreme truth that is God, the creator of man and of everything’.

In addition to pure science, you have dedicated yourselves to the study of its consequences for *applied sciences*, which – as I said in that same discourse – ‘has rendered and will render immense services to man, provided that it is inspired by love, guided by wisdom, and accompanied by the courage that defends it against the undue interference of all tyrannic powers’. Your Academy has been actively involved in the applied sciences as these relate to the needs of humanity as a whole, always in awareness of the requirements of the moral law.

3. The existence and the activity of this Academy, which was founded by the Holy See and is in constant liaison with it, illustrate above all the fact that there is *no contradiction between science and religion*. The Church esteems science, and even recognises a certain connaturality with those who dedicate their endeavours to science, as with all who seek to open up the human family to the noblest values of the true, the good and the beautiful, to the understanding of the things that have universal value.¹ The Pontifical

¹ Cf. *Gaudium et Spes*, n. 57, § 3.

Academy, for its part, shows clearly that *science*, likewise, needs to be in harmony with wisdom and with ethics, in order to satisfy the deepest requirements of man's spirit and heart, so that his dignity may be safeguarded.

A new type of dialogue has now begun between the Church and the world of science. In my address to men of science and students at Cologne, on 15 November 1980, I went so far as to say: 'The Church takes up the defense of reason and of science, recognising that science has the capacity to attain to the truth ... defending the freedom of science which gives it its dignity as a human and personal good ...'. If divergences can appear between the Church and science, 'the reason for this must be sought in the finitude of our reason, which is limited in its extent and thus exposed to error'.

4. We have the good fortune to experience today the close of a history in which the harmony between scientific culture and Christianity was not always easy.² At the beginning of this address, I recalled the institution which prefigured the Academy around the year 1600. But one must consider above all the manner in which the question of the relationship between theology and the natural sciences was posed on the threshold of the modern period.

Isaac Newton synthesised and brought to completion the discoveries of Kepler, Copernicus, Galileo and Descartes; he was the witness and the decisive agent of *the scientific revolution* of the seventeenth century. It was then that modern science broke through the traditional boundaries which had been determined hitherto by a geocentric view of the universe and by a conception of the elements of nature that was more qualitative than quantitative. These great *scholars* who were experts in an experimental study of the universe, with ever increasing precision and specialisation, did no less remain in an attitude that sought the global meaning of nature; their speculation as *thinkers* about the cosmos bears witness to this. Their bold researches helped to define better *the boundaries between the different orders of knowledge*. They were not always accepted on this point, and the Church herself took a long time to become reconciled to their points of view.

The experience of *Galileo* is a typical illustration of this. Although it was a painful experience indeed, it rendered an invaluable service to the world of science and to the Church, leading us to understand better the relationship between the revealed Truth and the truths that are discovered empirically. Galileo himself did not accept a genuine contradiction between science and faith: both come from the same Source and are to be brought into relationship with the first Truth.

² Cf. *Gaudium et Spes*, n. 62.

Christians have been led to read the Bible afresh, without seeking in it a scientific cosmological system. And scientists themselves have been invited to remain open to the absoluteness of God and to an awareness of creation. In itself, no field is barred to scientific investigation, provided that this respects the human being; it is, rather, the methodologies employed that bring the scientists to make certain abstractions and delimitations.

5. One could mention other very vivid tensions that belong – let us hope – to a vanished past. *In the last century*, in the name of the new sciences and the new philosophies, positivism blamed the traditional positions of the Church, accusing her of being opposed to science and to research. Leo XIII took up the challenge and showed that the Church joyfully welcomes whatever permits man to explore nature better and to improve the human condition. At the same time, he gave a vigorous impulse to the renewal of the ecclesiastical sciences.

In our days, *the distinction* and the complementarity of the orders of knowledge – the order of faith and the order of reason – were expressed with decisive clarity in the teaching of the *Second Vatican Council*: ‘The Church affirms the legitimate autonomy of culture, and particularly that of the sciences’.³ ‘It is by virtue of creation itself that all things are established in accordance with their own substance, truth and excellence, with their ordering and their specific laws’.⁴ One must recognise the particular methods of each of the sciences. ‘This is why methodical research, in all the fields of knowledge, will never be truly opposed to faith, if it is carried out in a truly scientific manner and follows the norms of morality: worldly realities and the realities of faith find their origin in the same God’.⁵ But it would be false to understand this autonomy of earthly realities to mean that they did not depend on God, and that man could dispose of them without reference to the Creator.

The principles are clear and ought from now onwards to remove every attitude of fear or of defiance, but this does not mean that every difficulty is resolved: new researches and discoveries of the sciences pose *new questions* which will all be new demands for theologians in the way that they present the truths of the faith while always safeguarding the sense and the meaning of these truths.⁶ But scientists themselves for their part go on to make a criticism of their methods and objectives.

³ *Gaudium et Spes*, n. 59, § 3.

⁴ *Ibid.*, n. 36, § 2.

⁵ *Ibid.*

⁶ Cf. *Ibid.*, n. 62, § 2.

Today, far from shutting herself up in an apologetic or defensive perspective, the Church rather makes herself the advocate of science, of reason, and of the freedom of research, to legitimise authentic science. Your Academy can bear witness to this. And I speak here, beyond your own persons, to the scientific community of the whole world.

6. It is indeed important to situate scientific endeavour *within the general context of culture*. Man can never neglect to ask himself the question of the profound meaning of culture and of science for the human person.⁷

Man lives a truly human life thanks to culture, that is, by cultivating the goods and the values of nature, affirming and developing the manifold capacities of his spirit and his body. A principal aspect of culture is the submission of the universe by means of knowledge.⁸ The widening and deepening of scientific knowledge constitute therefore an undeniable progress for man, because this brings him closer to a precise knowledge of the truth.

This free search for truth for its own sake is one of the noblest prerogatives of man. Science goes astray if it ceases to pursue its ultimate end, which is the service of culture and hence of man; it experiences crisis when it is reduced to a purely utilitarian model; it is corrupted when it becomes a technical instrument of domination or manipulation for economic or political goals. There is then what one can call a crisis of the legitimation of science, and it is therefore urgent to defend authentic science that is open to the question of the meaning of man and to the search for the whole truth, a *free science that is dependent only on the truth*. From the point of view of the Church, it would be impossible to separate science and culture.

In the same way, the Church considers man to be not only the object of culture, but its subject, and she encourages the work of science: she appreciates not only the scientists' use of intelligence, but their professional and moral merit, their intellectual honesty, their objectivity, their search for what is true, their self-discipline, their cooperation in teams, their commitment to serve man, their respect in the presence of the mysteries of the universe. These are human values that display the spiritual vocation of man.

7. Besides this, the man of science is called in a new way to *openness*. With all respect for the methodological requirements of abstraction and specialised analysis, one may never neglect the unified orientation of knowledge. Modern conditions have brought to light *a risk of fragmentation* and the risk of limiting oneself to the immediate object of the research. Science cannot neglect the fundamental questions concerning its role and its goal; it

⁷ Cf. *Ibid.*, n. 61, § 4.

⁸ Cf. *Ibid.*, n. 53.

cannot close itself to *the universal*, nor to the knowledge of things as a whole, nor to *the Absolute*, even if it is unable by itself to answer the question of meaning.

It seems to me today that the scientific community, after a necessary period of extreme specialisation on the level of experimentation, is in the process of recovering interest in things as a whole, *the question of the meaning of the universe*, the marvellous mystery of nature and of the human being. Many scientists venture into this field; they may perhaps do so timidly, because of a certain agnosticism or through fear of going beyond what their own research permits them to say. But the fact that a certain number are more sensitive to the values of the spirit and of morality brings a new dimension to their disciplines. Does not the scientist remain a man, open to all human questions, to everything that is to serve man, to the search for the Truth in all its depth?

It may perhaps be difficult to ask all the specialists today to become philosophers, but the needs of contemporary culture spur you on strongly to contribute your indispensable participation in the *interdisciplinary researches in which scientists, thinkers and theologians must collaborate*. Philosophical and theological studies of man and nature need your contribution, so that our common knowledge of the inanimate world, of the living universe, and of the human being may advance.

8. If we go on from the progress of pure knowledge to consider the manifold technological applications of the researches and discoveries of science, we may say that the world scientific community has considerable moral responsibilities, of which it is more vividly aware.

When I spoke to this Academy in 1983, I emphasised how the collaboration of the scientists of the entire world had permitted discoveries that were greatly beneficial to the progress of all humanity. This is obvious.

But how could one fail to speak clearly about the dangers too, which humanity incurs if it uses thoughtlessly the power that comes to it from science? And although this goes beyond the competence of the researcher, he cannot remain indifferent: more and more, people turn to the community of scientists for an answer to the questions of collective ethics. As I said on 3 November 1982 to the university teachers at Madrid: 'Men and women of science and culture, your *moral power* is considerable. Together, and thanks to your prestige, you can see to it that the scientific sector serves first of all man's culture, and is never employed for his destruction'.

One thinks spontaneously of the dangers of *nuclear energy*. When atomic power was unleashed, the researchers who did so had their own share in the origin of a moral crisis that is without parallel in history, as I

emphasised at Hiroshima. At Unesco, I insisted on the fact that the future of man and of the world would remain radically threatened, despite the intentions of men of science, if one were to use their discoveries for destructive purposes. I appealed also in a solemn manner from that distinguished seat of culture to scientists to help humanity by uniting conscience and science, by making the primacy of ethics respected, and by being vigilant so that science should serve life and man.⁹

The maintenance of *peace* among peoples is absolutely fundamental, and we hope that the witness of many religious leaders, praying yesterday at Assisi for peace, will contribute in its own way to establish this peace, which is also a gift of God.

The harmonious relationship between man and nature is a fundamental element of civilisation, and it is easy to grasp all the contribution that science can bring in this field of *ecology*, in the form of defence against violent alterations of the environment and of growth in the quality of life through the humanisation of nature.

But how could one fail to think above all of the field of *genetics*, which is so immense nowadays? The temptation to manipulate man radically here, determining the conditions of his procreation, with the risk of damaging human life even in the state of the embryo or the foetus, and of damaging the integrity and equilibrium of the human being, poses such grave questions that some scientists themselves are asking themselves whether they should continue their experiments.

To sum up: scientists are asked to remain conscious of all the demands of ethics, which ensure the transcendent dignity of the human being. The decisive question is how can science *serve man*? How can it respect and ensure the objective fundamental rights of the person?

9. *The specific contribution of the Pontifical Academy of Sciences* is the objectivity of the data that are gathered scientifically by scientists who are outstanding, in the highly specialised fields that are theirs, for the rigour of their analysis of the facts, for the depth of their scientific insights, for their disinterested service of the truth, and for the importance which they give to moral values also. Politicians will be able to profit from these objective analyses and syntheses – for example, to measure the risks of using certain sources of energy or certain weapons, or the ecological consequences of certain undertakings. Sociologists and economists can likewise profit here; as can practitioners of medicine and surgery, in order to evaluate the meaning and the effects of their experimentations and operations; moralists, who

⁹ Cf. John Paul II, *Discourse to Unesco* (2 June 1980), pp. 20-22.

need to know the laws of nature with precision; philosophers, who research into the meaning of existence and transcendent truth; theologians, who are especially interested in the relationship between faith and science. Your scientific contribution is therefore of first importance for all these fields, even if it is directly neither political nor theological; it constitutes an indispensable basis for the work of those who bear responsibility, and for the specialists whom I have just mentioned. For its part, the Holy See has received the much appreciated service of the scientific competence of this Academy on various occasions, for questions that touched directly natural and evangelical morality, and it continues to count on you.

As a Body established at the Holy See, the Pontifical Academy of Sciences bears witness to the harmony between the Church and men of science, to their reciprocal support; and it is an appeal to the values of the conscience in the world of science.

10. One must *wish* that your work should be better known in the Church and in the world. It seems opportune that your intellectual research, your studies and your publications should continue to give even greater help to *the work at the Holy See* and of the Church *in universities and in the field of culture*, for example in liaison with the Congregation for Catholic Education, the Pontifical Council for Culture, the International Theological Commission, with the other Academies and with the universities. Is there not a need to explore some common projects, in which the link between science and culture would be manifested? The Academy, which unites various disciplines, has also an *interdisciplinary vocation* to realise this 'cultural ecumenism' of which I have already spoken.

At the beginning of my pontificate, I had thought of an Academy of human sciences and culture. After consultations, I opted for a Pontifical Council for Culture. This indicates to you my concern to promote and defend man's culture, which is the basis of his dignity. I am convinced that the Pontifical Academy of Sciences shares efficaciously in this objective, and I encourage you warmly to emphasise more and more the cultural aspect of your labours; the intrinsic value of these is in itself a precious contribution to the progress of knowledge.

11. Your Eminences, Your Excellencies, Ladies and Gentlemen: in this half-century the Pontifical Academy of Sciences has carried out a task of historic importance, for it has situated the objective fruits of scientific research in the perspective of truth, of freedom, of morality, of the service of humanity and of peace, of the ascent to the first Truth, which alone can answer the fundamental questions about the reason for existence and about

the meaning of human life and of the world. I thank the President and each one of its members who have given their collaboration with great competence and with a meritorious dedication.

For my part, I have invariably had a great interest in the continuation and development of this Academy, in the line of the remarkable intuition of my venerated predecessor Pius XI who founded it, but with an increased insistence on looking at the human, moral and spiritual problems of our time. In this Jubilee Year, I express my heartfelt wishes for its future: for the value of its work; for the enrichment which its members, so diverse in their origin and in their personal convictions, can bring to each other, and can bring together to humanity; for the unequalled service which the Academy can render to those who bear a heavy responsibility in the world community or in the Church, and especially at the Holy See, offering valuable data for their reflections and decisions, and shedding light on the object of their moral responsibility. And above all, may this senate of scientists – who have been called to membership in the Pontifical Academy and who have loyally accepted this honour and this responsibility – bring more and more to the world the testimony to the esteem in which the Church holds science that is worthy of the name, and to the trust which she has in those who dedicate themselves competently and honestly to science, and to the invitation which she offers them of dialogue and of cooperation that goes across all boundaries, and to the responsibility which she recognises they have for the good of humanity!

I am touched to see that many Academies of Sciences in the whole world have accepted the invitation addressed to them to come and associate themselves with this jubilee celebration. I greet their delegations and thank them warmly. I express my best wishes to these Academies also, that they may encourage their members to promote the progress of scientific knowledge in all liberty, in openness to the fundamental truth about man and about the cosmos, in order that their mutual relationships may be fruitful and that together they may, as it were, form a significant body within the world community, which uses the prestige of its moral authority to see that science always remains, in all its applications, at the service of man, at the service of his life, of his culture, and of his moral and spiritual elevation.

I am very happy to be able to pay homage to all the men of science present here, before the Cardinals and the Diplomatic Corps, and I invoke on you, as also on your families and those who collaborate with you, the Blessings of the Lord 'in whom we live and move and have our being'.¹⁰

¹⁰ *Ac* 17:28.

6 NOVEMBER 1987

*Address to the Study Week on the Subject
'A Modern Approach to the Protection of the Environment'*

The Pope declares that science 'must be directed solely to the good of humanity' and adds that science and technology must be governed by moral and ethical principles. He refers to the dangers to nature and to ecological balance caused by man's activities and calls for a worldwide effort to remove and remedy these dangers. In the use of genetic therapy 'extreme care must be taken to avoid endangering the physical integrity and the life of each individual'.

Dear Friends,

1. It is a distinct pleasure for me to welcome those taking part in the study week arranged by the Pontifical Academy of Sciences on the subject of 'A Modern Approach to the Protection of the Environment'. This topic merits most careful attention and is truly one of tremendous importance at the present moment in the history and development of our modern world.

Science is a human work and must be directed solely to the good of humanity. Technology, as the transfer of science to practical applications, must seek the good of humanity and never work against it. Therefore science and technology must be governed by ethical and moral principles.

Theory aimed only at profit has produced in the last century a technology that has not always respected the environment, that has led to situations causing great concern by reason of the irreversible damage done, both locally and worldwide.

Similarly, inadequate farming systems in many countries and the need for energy have continued to create very serious inroads on forest resources. The adverse effects on the environment can be corrected in the causes that produce them only by teaching people a new and respectful attitude towards the environment, an attitude that ensures the rational use of the natural resources which have to be preserved and passed on for the use of future generations.

2. Plans for the rational use of resources must include a harmonisation between nature and human settlements. This will be done through education and through planning which is gradual but which takes into account the enormous problem of poverty.

In 1983 the Academy of Sciences carried out a specific study of the damage done to the environment by the increase of carbon dioxide and by the

reduction of the ozone layer. In developing countries – which are generally characterised by a hostile climate and adverse weather conditions – there is the acute problem of the destruction of the forests in the wet tropics and of desertification in the dry tropics, problems that threaten the feeding of the population. The findings of science must be put to use in order to ensure a high productivity of land in such a way that the local population can secure food and sustenance without destroying nature.

In the industrialised countries there is the worrying problem of waste products in gaseous, liquid, solid or radioactive form. Imprudent practices have caused very serious damage to nature. Uncontrolled discharges have resulted in acid rain, trace substances in the environment and the contamination of the seas, as for example the Mediterranean.

3. Many people have contributed to the effort to protect the environment, but the skill and good will of individual experts and scientists are not capable of solving the complex problem. Profound worldwide economic and moral changes must be dealt with at the level of groups of communities and governments, which must include interregional and international exchanges and agreements. Fundamental to this action is educating people about the environment and creating an attitude of understanding, respect, and genuine goodwill.

4. I wish to thank all those present here who have contributed their scientific knowledge and their enthusiasm. I likewise thank the representatives of international bodies such as the European Economic Community and the United Nations Environment Programme, whose headquarters in Nairobi I visited in 1985.

I also wish to thank the experts who last week concluded an important working meeting, developing reports and scientific discussions on ‘Aspects of the Uses of Genetic Engineering’: the production of drugs and vaccines, and the improvement of the nutritional situation especially on behalf of the developing countries. The prospects of genetic therapy for treating diseases are likewise hopeful and deserve the commitment of science and the skill of those carrying out research. But in genetic therapy extreme care must be taken to avoid endangering the physical integrity and the life of each individual. About all, any attempt to alter, or danger of altering, the inviolable genetic identity of the human person must be stopped.

Finally, I send in advance my greetings and welcome to the scientists who will next week begin discussions on an important subject of modern astrophysics: ‘Large Scale Motions in the Universe’. Twenty scientists will seek to increase our understanding of the degree of homogeneity in the uni-

verse on a broad scale, the distribution and nature of 'hidden mass', the question of whether the universe will continue to expand or is destined to fall into another 'singularity'.

May your efforts, individually in your particular fields of competence and as a body associated with the activities of the Pontifical Academy of Sciences, be crowned with every success, as you labour for the good of all humanity!

1 JUNE 1988

TO THE REVEREND GEORGE V. COYNE, S.J.
DIRECTOR OF THE VATICAN OBSERVATORY

John Paul II comments on the long and ancient history of both the Church and the academic community. Fragmentation in the world is matched by fragmentation within learning. At the same time, however, there is a move towards greater openness, and this is also true as regards the relationship between the Church and the scientific community: 'we have begun to talk to one another on deeper levels than before'. The Pope envisages a 'dynamic interchange' between the two and declares: 'science can purify religion from error and superstition; religion can purify science from idolatry and false absolutes'; and this at a time when 'crisis is upon us both'.

'Grace to you and peace from God our Father and the Lord Jesus Christ'.¹

As you prepare to publish the papers presented at the study week held at Castelgandolfo on 21-26 September 1987, I take the occasion to express my gratitude to you and through you to all who contributed to that important initiative. I am confident that the publication of these papers will ensure that the fruits of that endeavour will be further enriched.

The three hundredth anniversary of the publication of Newton's *Philosophiæ Naturalis principia Mathematica* provided an appropriate occasion for the Holy See to sponsor a study week that investigated the multiple relationships among theology, philosophy and the natural sciences. The man so honoured, Sir Isaac Newton, had himself devoted much of his life to these same issues, and his reflections upon them can be found throughout his major works, his unfinished manuscripts and his vast correspondence. The publication of your own papers from this study week, taking up again some of the same questions which this great genius explored, affords me the opportunity to thank you for the efforts you devoted to a subject of such paramount importance. The theme of your conference, 'Our Knowledge of God and Nature: Physics, Philosophy and Theology', is assuredly a crucial one for the contemporary world. Because of its importance, I should like to address some issues which the interactions among natural science, philosophy, and theology present to the Church and to human society in general.

The Church and the Academy engage one another as two very different but major institutions within human civilisation and world culture. We bear

¹ *Ep* 1:2.

before God enormous responsibilities for the human condition because historically we have had and continue to have a major influence on the development of ideas and values and on the course of human action. We both have histories stretching back over thousands of years: the learned, academic community dating back to the origins of culture, to the city and the library and the school, and the Church with her historical roots in ancient Israel. We have come into contact often during these centuries, sometimes in mutual support, at other times in those needless conflicts which have marred both our histories. In your conference we met again, and it was altogether fitting that as we approach the close of this millennium we initiated a series of reflections together upon the world as we touch it and as it shapes and challenges our actions.

So much of our world seems to be in fragments, in disjointed pieces. So much of human life is passed in isolation or in hostility. The division between rich nations and poor nations continues to grow; the contrast between northern and southern regions of our planet becomes ever more marked and intolerable. The antagonism between races and religions splits countries into warring camps; historical animosities show no signs of abating. Even within the academic community, the separation between truth and values persists, and the isolation of their several cultures – scientific, humanistic and religious – makes common discourse difficult if not at times impossible.

But at the same time we see in large sectors of the human community a growing critical openness towards people of different cultures and backgrounds, different competences and viewpoints. More and more frequently, people are seeking intellectual coherence and collaboration, and are discovering values and experiences they have in common even within their diversities. This openness, this dynamic interchange, is a notable feature of the international scientific communities themselves, and is based on common interests, common goals and a common enterprise, along with a deep awareness that the insights and attainments of one are often important for the progress of the other. In a similar but more subtle way this has occurred and is continuing to occur among more diverse groups – among the communities that make up the Church, and even between the scientific community and the Church herself. This drive is essentially a movement towards the kind of unity which resists homogenisation and relishes diversity. Such community is determined by a common meaning and by a shared understanding that evokes a sense of mutual involvement. Two groups which may seem initially to have nothing in common can begin to enter into community with one another by discovering a common goal, and this in turn can lead to broader areas of shared understanding and concern.

As never before in her history, the Church has entered into the movement for the union of all Christians, fostering common study, prayer, and discussions that 'all may be one'.² She has attempted to rid herself of every vestige of anti-semitism and to emphasise her origins in and her religious debt to Judaism. In reflection and prayer, she has reached out to the great world religions, recognising the values we all hold in common and our universal and utter dependence upon God.

Within the Church herself, there is a growing sense of 'world-church', so much in evidence at the last Ecumenical Council in which bishops native to every continent – no longer predominantly of European or even Western origin – assumed for the first time their common responsibility for the entire Church. The documents from that Council and of the Magisterium have reflected this new world-consciousness both in their content and in their attempt to address all people of good will. During this century, we have witnessed a dynamic tendency to reconciliation and unity that has taken many forms within the Church.

Nor should such a development be surprising. The Christian community in moving so emphatically in this direction is realising in greater intensity the activity of Christ within her: 'For God was in Christ, reconciling the world to himself'.³ We ourselves are called to be a continuation of this reconciliation of human beings, one with another and all with God. Our very nature as Church entails this commitment to unity.

Turning to the relationship between religion and science, there has been a definite, though still fragile and provisional, movement towards a new and more nuanced interchange. We have begun to talk to one another on deeper levels than before, and with greater openness towards one another's perspectives. We have begun to search together for a more thorough understanding of one another's disciplines, with their competences and their limitations, and especially for areas of common ground. In doing so we have uncovered important questions which concern both of us, and which are vital to the larger human community we both serve. It is crucial that this common search based on critical openness and interchange should not only continue but also grow and deepen in its quality and scope.

For the impact each has, and will continue to have, on the course of civilisation and on the world itself, cannot be overestimated, and there is so much that each can offer the other. There is, of course, the vision of the unity of all things and all peoples in Christ, who is active and present with

² *Jn* 17:20.

³ *2 Co* 5:19.

us in our daily lives – in our struggles, our sufferings, our joys and in our searchings – and who is the focus of the Church's life and witness. This vision carries with it into the larger community a deep reverence for all that is, a hope and assurance that the fragile goodness, beauty and life we see in the universe is moving towards a completion and fulfilment which will not be overwhelmed by the forces of dissolution and death. This vision also provides a strong support for the values which are emerging both from our knowledge and appreciation of creation and of ourselves as the products, knowers and stewards of creation.

The scientific disciplines too, as is obvious, are endowing us with an understanding and appreciation of our universe as a whole and of the incredibly rich variety of intricately related processes and structures which constitute its animate and inanimate components. This knowledge has given us a more thorough understanding of ourselves and of our humble yet unique role within creation. Through technology it also has given us the capacity to travel, to communicate, to build, to cure, and to probe in ways which would have been almost unimaginable to our ancestors. Such knowledge and power, as we have discovered, can be used greatly to enhance and improve our lives or they can be exploited to diminish and destroy human life and the environment even on a global scale.

The unity we perceive in creation on the basis of our faith in Jesus Christ as Lord of the universe, and the correlative unity for which we strive in our human communities, seems to be reflected and even reinforced in what contemporary science is revealing to us. As we behold the incredible development of scientific research we detect an underlying movement towards the discovery of levels of law and process which unify created reality and which at the same time have given rise to the vast diversity of structures and organisms which constitute the physical and biological, and even the psychological and sociological, worlds.

Contemporary physics furnishes a striking example. The quest for the unification of all four fundamental physical forces – gravitation, electromagnetism, the strong and weak nuclear interactions – has met with increasing success. This unification may well combine discoveries from the sub-atomic and the cosmological domains and shed light both on the origin of the universe and, eventually, on the origin of the laws and constants which govern its evolution. Physicists possess a detailed though incomplete and provisional knowledge of elementary particles and of the fundamental forces through which they interact at low and intermediate energies. They now have an acceptable theory unifying the electro-magnetic and weak nuclear forces, along with much less adequate but still promising grand unified field theories which attempt to incorporate the strong nuclear interac-

tion as well. Further in the line of this same development, there are already several detailed suggestions for the final stage, superunification, that is, the unification of all four fundamental forces, including gravity. Is it not important for us to note that in a world of such detailed specialisation as contemporary physics there exists this drive towards convergence?

In the life sciences, too, something similar has happened. Molecular biologists have probed the structure of living material, its functions and its processes of replication. They have discovered that the same underlying constituents serve in the make-up of all living organisms on earth and constitute both the genes and the proteins which these genes code. This is another impressive manifestation of the unity of nature.

By encouraging openness between the Church and the scientific communities, we are not envisioning a disciplinary unity between theology and science like that which exists within a given scientific field or within theology proper. As dialogue and common searching continue, there will be growth towards mutual understanding and a gradual uncovering of common concerns which will provide the basis for further research and discussion. Exactly what form that will take must be left to the future. What is important, as we have already stressed, is that the dialogue should continue and grow in depth and scope. In the process we must overcome every regressive tendency to a unilateral reductionism, to fear, and to self-imposed isolation. What is critically important is that each discipline should continue to enrich, nourish and challenge the other to be more fully what it can be and to contribute to our vision of who we are and who we are becoming.

We might ask whether or not we are ready for this crucial endeavour. Is the community of world religions, including the Church, ready to enter into a more thorough-going dialogue with the scientific community, a dialogue in which the integrity of both religion and science is supported and the advance of each is fostered? Is the scientific community now prepared to open itself to Christianity, and indeed to all the great world religions, working with us all to build a culture that is more humane and in that way more divine? Do we dare to risk the honesty and the courage that this task demands? We must ask ourselves whether both science and religion will contribute to the integration of human culture or to its fragmentation. It is a single choice and it confronts us all.

For a simple neutrality is no longer acceptable. If they are to grow and mature, peoples cannot continue to live in separate compartments, pursuing totally divergent interests from which they evaluate and judge their world. A divided community fosters a fragmented vision of the world; a community of interchange encourages its members to expand their partial perspectives and form a new unified vision.

Yet the unity that we seek, as we have already stressed, is not identity. The Church does not propose that science should become religion or religion science. On the contrary, unity always presupposes the diversity and the integrity of its elements. Each of these members should become not less itself but more itself in a dynamic interchange, for a unity in which one of the elements is reduced to the other is destructive, false in its promises of harmony, and ruinous of the integrity of its components. We are asked to become one. We are not asked to become each other.

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. Each should possess its own principles, its pattern of procedures, its diversities of interpretation and its own conclusions. Christianity possesses the source of its justification within itself and does not expect science to constitute its primary apologetic. Science must bear witness to its own worth. 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.

But why is critical openness and mutual interchange a value for both of us? Unity involves the drive of the human mind towards understanding and the desire of the human spirit for love. When human beings seek to understand the multiplicities that surround them, when they seek to make sense of experience, they do so by bringing many factors into a common vision. Understanding is achieved when many data are unified by a common structure. The one illuminates the many; it makes sense of the whole. Simple multiplicity is chaos; an insight, a single model, can give that chaos structure and draw it into intelligibility. We move towards unity as we move towards meaning in our lives. Unity is also the consequence of love. If love is genuine, it moves not towards the assimilation of the other but towards union with the other. Human community begins in desire when that union has not been achieved, and it is completed in joy when those who have been apart are now united.

In the Church's earliest documents, the realisation of community, in the radical sense of that word, was seen as the promise and goal of the Gospel: 'That which we have seen and heard we proclaim also to you, so that you may have fellowship with us; and our fellowship is with the Father and with his Son Jesus Christ. And we are writing this that our joy may be complete'.⁴

⁴ 1 Jn 1:3-3.

Later the Church reached out to the sciences and to the arts, founding great universities and building monuments of surpassing beauty so that all things might be recapitulated in Christ.⁵

What, then, does the Church encourage in this relational unity between science and religion? First and foremost that they should come to understand one another. For too long a time they have been at arm's length. Theology has been defined as an effort of faith to achieve understanding, as *fides quaerens intellectum*. As such, it must be in vital interchange today with science just as it always has been with philosophy and other forms of learning. Theology will have to call on the findings of science to one degree or another as it pursues its primary concern for the human person, the reaches of freedom, the possibilities of Christian community, the nature of belief and the intelligibility of nature and history. The vitality and significance of theology for humanity will in a profound way be reflected in its ability to incorporate these findings.

Now this is a point of delicate importance, and it has to be carefully qualified. Theology is not to incorporate indifferently each new philosophical or scientific theory. As these findings become part of the intellectual culture of the time, however, theologians must understand them and test their value in bringing out from Christian belief some of the possibilities which have not yet been realised. The hylomorphism of Aristotelian natural philosophy, for example, was adopted by the medieval theologians to help them explore the nature of 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. Theologians might well ask, with respect to contemporary science, philosophy and the other areas of human knowing, if they have accomplished this extraordinarily difficult process as well as did these medieval masters.

If the cosmologies of the ancient Near Eastern world could be purified and assimilated into the first chapters of Genesis, might contemporary cosmology have something to offer to our reflections upon creation? Does an evolutionary perspective bring any light to bear upon theological anthropology, the meaning of the human person as the *imago Dei*, the problem of Christology – and even upon the development of doctrine itself? What, if any, are the eschatological implications of contemporary cosmology, especially in light of the vast future of our universe? Can theological method

⁵ Cf. *Ep* 1:10.

fruitfully appropriate insights from scientific methodology and the philosophy of science?

Questions of this kind can be suggested in abundance. Pursuing them further would require the sort of intense dialogue with contemporary science that has, on the whole, been lacking among those engaged in theological research and teaching. It would entail that some theologians, at least, should be sufficiently well-versed in the sciences to make authentic and creative use of the resources that the best-established theories may offer them. Such an expertise would prevent them from making uncritical and overhasty use for apologetic purposes of such recent theories as that of the 'Big Bang' in cosmology. Yet it would equally keep them from discounting altogether the potential relevance of such theories to the deepening of understanding in traditional areas of theological inquiry.

In this process of mutual learning, those members of the Church who are themselves either active scientists or, in some special cases, both scientists and theologians could serve as a key resource. They can also provide a much-needed ministry to others struggling to integrate the worlds of science and religion in their own intellectual and spiritual lives, as well as to those who face difficult moral decisions in matters of technological research and application. Such bridging ministries must be nurtured and encouraged. The Church long ago recognised the importance of such links by establishing the Pontifical Academy of Sciences, in which some of the world's leading scientists meet together regularly to discuss their researches and to convey to the larger community where the directions of discovery are tending. But much more is needed.

The matter is urgent. Contemporary developments in science challenge theology far more deeply than did the introduction of Aristotle into Western Europe in the thirteenth century. Yet these developments also offer to theology a potentially important resource. Just as Aristotelian philosophy, through the ministry of such great scholars as St. Thomas Aquinas, ultimately came to shape some of the most profound expressions of theological doctrine, so can we not hope that the sciences of today, along with all forms of human knowing, may invigorate and inform those parts of the theological enterprise that bear on the relation of nature, humanity and God?

Can science also benefit from this interchange? It would seem that it should. For science develops best when its concepts and conclusions are integrated into the broader human culture and its concerns for ultimate meaning and value. Scientists cannot, therefore, hold themselves entirely aloof from the sorts of issues dealt with by philosophers and theologians. By devoting to these issues something of the energy and care they give to their research in science, they can help others realise more fully the human

potentialities of their discoveries. They can also come to appreciate for themselves that these discoveries cannot be a genuine substitute for knowledge of the truly ultimate. Science can purify religion from error and superstition; religion can purify science from idolatry and false absolutes. Each can draw the other into a wider world, a world in which both can flourish.

For the truth of the matter is that the Church and the scientific community will inevitably interact; their options do not include isolation. Christians will inevitably assimilate the prevailing ideas about the world, and today these are deeply shaped by science. The only question is whether they will do this critically or unreflectively, with depth and nuance or with a shallowness that debases the Gospel and leaves us ashamed before history. Scientists, like all human beings, will make decisions upon what ultimately gives meaning and value to their lives and to their work. This they will do well or poorly, with the reflective depth that theological wisdom can help them attain, or with an unconsidered absolutising of their results beyond their reasonable and proper limits.

Both the Church and the scientific community are faced with such inescapable alternatives. We shall make our choices much better if we live in a collaborative interaction in which we are called continually to be more. Only a dynamic relationship between theology and science can reveal those limits which support the integrity of either discipline, so that theology does not profess a pseudo-science and science does not become an unconscious theology. Our knowledge of each other can lead us to be more authentically ourselves. No one can read the history of the past century and not realise that crisis is upon us both. The uses of science have on more than one occasion proven massively destructive, and the reflections on religion have too often been sterile. We need each other to be what we must be, what we are called to be.

And so on this occasion of the Newton Tricentennial, the Church speaking through my ministry calls upon herself and the scientific community to intensify their constructive relations of interchange through unity. You are called to learn from one another, to renew the context in which science is done and to nourish the inculturation which vital theology demands. Each of you has everything to gain from such an interaction, and the human community which we both serve has a right to demand it from us.

Upon all who participated in the study week sponsored by the Holy See and upon all who will read and study the papers herein published I invoke wisdom and peace in our Lord Jesus Christ and cordially impart my Apostolic Blessing.

31 OCTOBER 1988

*Address to the Plenary Session and to the Study Week on the Subjects
'Agriculture and the Quality of Life', and
'The Principles of Design and Operation of the Brain'*

The Supreme Pontiff refers to the grave problem of hunger and malnutrition in the world and adds that the question of development requires 'above all a political will and action of an ethical and cultural nature'. He goes on to say that in the study of the human brain scientists should work together with theologians and philosophers to study the 'relationship between the spirit and the cerebral apparatus'. The Church encourages scientific research but science is not exhaustive in the study of reality: there remains the 'world of the mind, of moral and spiritual values'. There must therefore be a 'patient reintegration of knowledge'. The Pope also calls on the Academy to engage in research projects with other institutions of the Holy See.

Mr. President,
Eminent Cardinals,
Excellencies,

1. I am happy to meet the Members of the Pontifical Academy of Sciences on the occasion of the plenary session which dealt with the subject of the responsibility of science. The importance of this meeting is underlined by the presence of the Cardinals and of the Heads of the Diplomatic Missions accredited to the Holy See. I thank them for their interest in the work of the Academy.

This plenary meeting takes place following a study week in the course of which two groups of experts from all over the world discussed, on the one hand, 'agriculture and the quality of life', and on the other, 'the structure and function of the brain'.

On the question of agriculture, the experts were able to carry out a wide assessment where the scientific and technical aspects of the problem are finally catching up with the ethical aspects. On the one hand, scientific research has made possible a considerable increase of the world's food production. On a global scale, agricultural production today would be sufficient to satisfy the needs of the whole of humanity. This observation raises by contrast the dramatic problem of hunger and malnutrition in the world. Certainly, one must take into account the physical and material obstacles, such as the great difference in levels of fertility in the different regions. But the very unequal distribution of food resources has not yet given rise to an overall policy, nor to sufficiently effective projects to ensure that agricul-

tural production benefits all peoples and all individuals. Once more, we must observe that the problem of development requires above all a political will and action of an ethical and cultural nature, as I said in the Encyclical *Sollicitudo Rei Socialis*. The key to all human development is to be found in a generous effort of solidarity among all groups and all men and women of good will. With good reason did you stress that the necessary interventions with regard to this grave question should respect individuals and their own traditions, that is to say, they should go beyond the strictly economic and technical levels and take into consideration the principles of social justice and of the authentic development of the human person.

2. A second group of scholars evaluated the studies on the human brain and its marvellous functions. The results of research provide a better understanding today of the organic structures and processes which underlie the cognitive and affective operations of the human being. But beyond all empirical observation, there appears the mystery of the spirit, which cannot be reduced to the biological supports which come into play in the behaviour of the intelligent being open to transcendence. Confronted with what is now known about the brain, the believer cannot forget the words of the Book of Genesis: 'The Lord God formed man of dust from the ground, and breathed into his nostrils the breath of life'.¹ In anthropological terms, the ancient narrative of creation brings out very well the intimate bond that exists between the physical organ and the spirit in man. Thus it was opportune that scientists compare the results of their experimental studies with the reflections of philosophers and theologians on the relationship between the spirit and the cerebral apparatus. Niels Stensen, in his 'Discourse on the Anatomy of the Brain', had already said of the brain that it was 'the most beautiful masterpiece of nature'.

3. You desired to take part in the recent celebration of the beatification of Niels Stensen, that great scientist who sought, in his whole life and work, to reconcile the different orders of knowledge which constitute the grandeur of the human being. Your Academy, together with Denmark, desired that the memory of this event should endure and be commemorated by a plaque placed in its own offices. I must express my deep gratitude to the Danish nation and to the Academy for this gesture.

4. Today, having very much in mind the itinerary followed by Niels Stensen throughout his life, I would like to note here some elements which

¹ Gn 2:7.

contribute to deepening the meaning, the value and the responsibility of science. This scientist explored the marvels of nature, particularly in the domains of anatomy, physiology and geology. While pursuing his studies of the natural phenomena, he never lost sight of that which transcends nature itself, and, while directing his attention to the infinitely minute and to measurable data, he always remained open to the grandeurs that surpass all measure.

For him, the synthesis of knowledge combines the data obtained thanks to experiments on nature and the values which, while inaccessible to experimentation perceptible to the senses, nevertheless form part of reality. Stensen was profoundly attracted by the beauty of the physical universe, but even more so by spiritual values and the nobility of human behaviour. He studied with care the certitudes of the mathematical order, but he was just as much drawn by other certitudes of the historical, moral and spiritual orders.

5. Experimental science arouses a legitimate admiration, and the Church willingly encourages the research of scientists who help us to understand the enigmas of the physical and biological universe. Yet experimental science does not exhaust the whole knowledge of reality. Beyond the visible and sensible, there exists another dimension of reality, attested to by our most profound experience: this is the world of the mind, of moral and spiritual values. Above all, there is the order of charity, which binds us to each other and to God whose name is Love and Truth.

Even with the frailty of his condition as creature, man still maintains the imprint of the original divine unity in which all perfections are united without confusion. In the visible world, these perfections appear dispersed and diminished, but they no less effectively recall, particularly in man, the image of the true unity of the Creator. This image is that of the Truth itself.

Such are the characteristics of the overall synthesis which establishes the unity of knowledge and which inspires, by way of consequence, a unity and consistency of behaviour. It is a question here of a unity constantly to be built, according to the dynamic characteristics of life.

6. My predecessor, Pope Pius XI, in one of the first speeches which he addressed to the Pontifical Academy of Sciences after its reconstitution, developed at length the theme of truth. He said that it is important to conceive and to affirm the truth, but that it is still more important to recall that 'he who *does* what is true comes to the light'.² This is the fundamental rule of thought and of action which transforms every work into a visible reflection of the truth. It was this ideal that inspired Pius XI when, in 1936, he

² Jn 3:21.

named the first seventy members of the restored Academy, inviting them to take part in it in view of the importance of their original scientific studies and their high moral quality, without any ethnic or religious discrimination. This is still expressed in your statutes and it is in the same spirit that I invite you to pursue your work and your research.

7. The Pope still today asks your Academy to contribute to 'doing the truth', that is to say, to seek the unity of knowledge in international scientific solidarity, in human solidarity, in openness to all values, for the good of humanity.

Undoubtedly, as scholars, you must rigorously apply the rules proper to each of your disciplines so as to arrive at conclusions that will be valid and verifiable by every other specialist in your fields. Yet, while respecting the necessity for methodological abstraction and the autonomy of each discipline, you are invited to examine the results of your research in the light of the other sciences. Every scholar is called on today to participate in a patient reintegration of human knowledge. Nothing less than the future of man and of culture is at stake.

Your Academy, which is international, presents a peculiar characteristic: on the one hand, it has the duty of working in close connection with the international scientific community and, on the other hand, it is called to collaborate with the departments of the Church so as to supply them with elements useful in the fields of their competences.

It is in this spirit that I would like to renew to the illustrious Members of the Academy the request I made during the audience for the fiftieth anniversary, urging them to promote concrete proposals which would favour interdisciplinary collaboration at all levels. While continuing your specialised programmes, it would also be useful that you develop joint research projects, in close consultation with other cultural, scientific and university organisms of the Holy See. The Church needs your research to deepen her knowledge of man and of the universe. She likewise counts on your studies to confront the grave technical, cultural and spiritual problems which concern the future of human society. I thank you in advance for your indispensable contribution to our common effort to understand in greater depth the enigma of man and of his destiny, in the order of creation and in the order of salvation.

8. Before concluding, I would like very specially to greet Professor Carlos Chagas who, at the end of sixteen years of presidency, is now relinquishing the responsibilities which he has discharged with such distinction, generosity and selflessness. I must pay him a very special tribute by noting

the considerable work accomplished under his leadership. Thanks to him, the Academy has seen an important development in the number of its members and in the diversity of the countries from which they come: one could speak now of universal representation. Under his impulse, the Academy has become a centre of continual activity, making contact with other Academies and with scholars of numerous countries, taking up important subjects in the realm of the historical sciences, for example, the studies on Galileo and Albert Einstein; in the domain of the fundamental sciences, such as research on cosmology, astronomy, the microsciences, the structure of matter, the origin of life, biological processes; or again in the field of the sciences applied to the problems of the modern world, notably in matters pertaining to peace and disarmament. One could say that the important concerns of today's world have not escaped its attention. Today, the Holy See thanks Professor Chagas for the vitality he has communicated to the Academy, for the radiance he has given to it, for his highly appreciated activity which has made it possible for the Church to become much more present to the world of science. And I am personally grateful to him for being willing to continue to place his outstanding talents at the service of the Church.

I have asked Professor Giovanni Battista Marini-Bettòlo to succeed Professor Chagas. He has collaborated actively in the work of the Academy for over twenty years; in his new responsibilities, I wish him a fruitful period of work. I am confident that, with the help of the members of the Academy, he will continue the work undertaken by his predecessors.

While renewing the expression of my esteem for the work of the Academy and of my gratitude for the service it renders to the Holy See, I invoke upon you the Blessing of God.

27 OCTOBER 1989

*Address to the Study Week on the Subject
'Science for Development in a Solidarity Framework'*

John Paul II refers to imbalances in the world at the level of development and calls for renewed effort in this sphere. He observes that in this area: 'solidarity is a grave moral obligation, for nations as well as for individuals'. Scientific study can find the practical means by which to implement such solidarity. His Holiness makes a special reference to the problem of international debt which weighs so heavily on developing countries and calls for an equitable solution.

Your Excellency,
Mr. President,
Distinguished Members of the Academy,

1. It gives me great pleasure to greet all of you who have participated in the study week organised by the Pontifical Academy of Sciences on the subject 'Science for Development in a Solidarity Framework'. The topic which you have addressed is indeed complex, and will certainly require the sort of further study which only eminent scientists like yourselves can provide. Nonetheless, the topic is one of vital importance for the solution of one of the most urgent problems facing today's world: that of a development which can take place within a framework of genuine solidarity among peoples and States.

2. The Church has always had a special concern for the full development of peoples, as is evident from the impressive body of her social doctrine. This is particularly true in our own day, when this issue has taken on such immense proportions. Indeed, throughout its long history, mankind has never known an era of prosperity even vaguely comparable to that which the world in this second half of the twentieth century has come to enjoy. And yet, this prosperity, on closer analysis, has proved to be distorted and unbalanced. It is a prosperity which benefits but a small proportion of mankind, while leaving the majority of the world's inhabitants in a state of underdevelopment.

Development has thus given rise to very serious problems which the Church could hardly fail to address. These problems are not only of the political and economic order; they likewise involve the moral order. In effect, what is at stake is man himself. And the Church's primary duty is to make her voice heard in every problem where man comes into play – in his

dignity as a human person; in his right to free association in view of a better and more humane growth; in his right to freedom.

3. In essence, the Church has chosen to intervene in the problem of development for two reasons. First, she desires *to proclaim God's plan for mankind* as that plan emerges from Christian Revelation, which has its culmination and definitive expression in the teaching of Jesus. But the Church also desires to offer a 'reading' of the problem of development *in the light of the Gospel and the natural moral law* which she has the duty both to safeguard and to apply to changing historical situations. In doing this, she hopes to make evident the distortions and injustices which do harm to human persons, to indicate their causes, and to point out those principles and courses of action necessary for a balanced and just development. This, in fact, is precisely what Pope Paul VI attempted to do in 1967 with his great Encyclical *Populorum Progressio*. In the twenty years that have passed since that important document was issued, great changes have taken place in the world. In some areas, signs are present which allow some hope of resolving the problem of development. Yet, in other areas, the lack of progress towards development has reached truly catastrophic proportions. For this reason, I considered it my duty to take up the teaching of Pope Paul VI and to develop it further in my Encyclical *Sollicitudo Rei Socialis* of 30 December 1987. I am very pleased that this study week echoes an important theme of that Encyclical.

In the Encyclical, I noted that the conditions of developing countries 'have become notably worse'¹ because of 'a too narrow idea of development, that is a mainly economic one'.² The developed countries bear responsibility for this, for they 'have not always, at least in due measure, felt the duty to help' countries that are cut off from the world of prosperity.³ I felt it necessary to 'denounce the existence of economic, financial and social mechanisms which, although they are manipulated by people, often function almost mechanically, thus accentuating the situation of wealth for some and poverty for the rest'.⁴ Moving beyond merely political or economic readings of the situation – as important and as valuable as these may be – and making a theological reading of those mechanisms or processes, I went on to speak of certain 'structures of sin'. Two factors in particular have contributed to creating, fostering and reinforcing these 'structures', thus making them even more capable of conditioning human conduct: an exclu-

¹ John Paul II, *Sollicitudo Rei Socialis*, n. 16.

² *Ibid.*, n. 15.

³ *Ibid.*, n. 16.

⁴ *Ibid.*

sive desire for profit and the thirst for power which aims at imposing one's own will upon others. 'Obviously, not only individuals fall victim to this double attitude of sin; nations and blocs can do so too. And this favours even more the introduction of the 'structures of sin' of which I have spoken. To diagnose the evil in this way is to identify precisely, on the level of human conduct, the path to be followed in order to overcome it'.⁵

4. What, then, is the path to be followed?

It is the Church's task to awaken consciences and invite them to face the fact that today, like Lazarus at the door of the rich man, millions of people are in dire need while a great part of the world's resources are employed in areas which have little or nothing to contribute to the improvement of life on this planet. The Church has forcefully affirmed that solidarity is a grave moral obligation, for nations as well as for individuals.

The virtue of solidarity finds its deepest roots in Christian faith, which teaches that God is our Father and that all men and women are brothers and sisters. From this belief flows Christian ethics, an ethics which excludes every form of selfishness and arrogance and seeks to unite persons freely in pursuit of the common good. Christian ethics gives rise to the conviction that it is unjust to squander resources which might be necessary for the lives of others. Today a new awareness of this moral imperative is needed, given the present conditions of such large portions of the human race.

Solidarity also leads to the collaboration of all social groups, which are thus called to look beyond the horizons of their own self-interest making solidarity a 'culture' to be fostered in the formation of the young and made evident in new patterns of behaviour. Indeed, only a widespread 'culture of solidarity' will permit that exchange of goals and energies which seems so necessary if a truly humane level of life upon this earth is to be reached.

5. Practically speaking, what must be done if the principle of solidarity among individuals and peoples is to take more widespread root? The Church, for her part, cannot offer technical solutions to the problem of underdevelopment as such, since she has neither the mission nor the ability to state those contingent ways and means by which human problems of the political and economic order can and should be resolved. At this point, the role of the sciences comes into play.

It is here that we find the real significance of this study week and of other similar undertakings aimed at developing the directions charted by the Encyclical. Their object is to analyse and study more intensively –

⁵ *Ibid.*, n. 37.

making use of an interdisciplinary and scientifically tested approach – the cultural, economic and political causes of underdevelopment; to identify with a rigorous and precise analysis the processes that perpetuate underdevelopment; and to suggest models of development which can be considered workable in present historical circumstances. Such analysis seeks to indicate the ways and proper times to intervene, the conditions, means and tools necessary for passing from underdevelopment to a balanced development, that is, a ‘development in a solidarity framework’.

6. Among the many problems which must be taken into consideration, there is one in particular which I would like to bring to your attention. It is the problem of international debt, a debt which weighs heavily, at times with devastating consequences, upon many developing countries. It is not a problem which can be seen in isolation from others; rather the debt problem is intimately connected with a host of other issues, such as those of overseas investment, the equitable working of major international institutions, the price of raw materials, and so forth. I would only observe that this problem, in recent years, has become a symbol of already existing imbalances and injustices whose burden is often borne by the poorest segments of the population, and it points to an apparent inability to reverse a baneful process which seems at times to take on a life of its own.

The Holy See has already had occasion to address this problem on an official level.⁶ And yet the Church continues to hear pleas of her pastors in those countries which labour most under this enormous burden, a burden which seems without reprieve and which gravely compromises the very possibility of a free and positive development.

I have underlined the importance of this issue because, once it is dealt with equitably, competently and in a spirit of authentic solidarity, it has the potential to become a genuine symbol and model of creative and effective resolve in the face of the other complex and pressing issues of international development.

The solutions to these problems are neither simple nor close at hand; yet, once they are discerned with wisdom and courage, they foster hope for a world where solidarity would no longer be merely a word, but an urgent task and a conviction which bears fruit in action. The virtue of solidarity, practised at a deep and authentic level, will demand of all parties both a willingness to be involved and a deep respect for others. Only in this way

⁶ Cf. Pontifical Commission ‘Iustitia et Pax’: *At the Service of the Human Community: an Ethical Approach to the International Debt Question*, 27 December 1986.

will the great potential resources of the developing countries *be transformed* into a concrete reality that has much to offer to the entire world.

Distinguished Members of the Academy and eminent Professors: I have only wished to point out some of the more pressing issues and ideas which you have been discussing during this study week. In expressing my hopes that your labours have been fruitful, I invoke upon all of you abundant divine blessings.

14 DECEMBER 1989

*Address to the Working Group on
'The Determination of Brain Death and its Relationship to Human Death'*

The Supreme Pontiff declares that the Church's action gains support from scientific discovery. Human life and dignity must be defended at all points and thus researchers must at times refuse certain paths of inquiry which damage the human person. In referring to the scientific question of the moment of death, he says that death, when seen through the eyes of faith, becomes an entry into a new life. Finally he states that: 'scientific research and moral reflection must proceed side by side in a spirit of mutual help'.

Distinguished Friends,

1. It is always a pleasure for me to meet the men and women of science and culture who come together under the auspices of the Pontifical Academy of Sciences for an exchange of ideas and experiences on subjects of the highest interest for the advancement of knowledge and the development of peoples. Today I am happy to greet you at the close of this gathering during which you have considered the serious problems connected with defining the moment of death, a topic which the Academy decided to take up as part of a research project begun at a study week in 1985. It is also a source of satisfaction that this present meeting has been arranged in cooperation with the Congregation for the Doctrine of the Faith. This in itself indicates the importance which the Holy See attaches to the subject under discussion.

In order to be as fruitful as possible, the Church's action in and on behalf of the world derives much benefit from an ever increasing and more profound knowledge of man, of the situations in which he finds himself, of the questions he asks himself. While it is not the Church's specific role to advance knowledge of a strictly scientific nature, she cannot ignore or neglect issues which are closely related to her mission of bringing the Gospel message to the thought and culture of our times.¹

This is particularly so when it is a question of defining the rules which should regulate human conduct. Human action affects concrete and temporal reality. Therefore the values which should inspire human conduct must reckon with that reality, with its possibilities and its limits. If the Church is to fulfil her role as the guide of consciences and not disappoint those who seek light in her, she must be well informed about this reality, which provides immense scope for positive new scientific and technical dis-

¹ Cf. *Gaudium et Spes*, nn. 1-3.

coveries and achievements, while also involving advances which are sometimes disturbing and not infrequently perplex the human conscience.

2. This is especially the case when the reality in question is human life itself in relation to its beginning and temporal end. Life, in its spiritual and somatic unity, commands our respect.² Neither individuals nor society are permitted to endanger life, whatever the benefits that might possibly accrue as a result.

The value of life springs from what is spiritual in man. The body too receives from the spiritual principle – which inhabits it and makes it what it is³ – a supreme dignity, a kind of reflection of the Absolute. The body is that of a person, a being which is open to superior values, a being capable of fulfilment in the knowledge and love of God.⁴

When we consider that every individual is a living expression of unity and that the human body is not just an instrument or item of property, but shares in the individual's value as a human being, then it follows that the body cannot under any circumstances be treated as something to be disposed of at will.⁵

3. One cannot make the body a mere object of experimentation with no other norms than those of scientific research and technical capacity. However interesting or even useful certain kinds of experimentation may appear, however technologically possible they may now be, anyone with a true understanding of values and human dignity will immediately recognise that even an apparently promising avenue of experimentation must be abandoned if it involves the degradation of man or the deliberate termination of his earthly existence. In the long run, apparent benefits of this kind would be of an illusory nature.⁶ Thus, some form of renunciation on the part of scientists and researchers is called for. It may seem unreasonable to admit that a feasible and promising experiment should be hindered by moral imperatives, especially when it is almost certain that other people, who feel less bound by ethical restraints, will in any case carry out the same research. But is this not the case with all moral imperatives? And are not those who remain faithful to such imperatives often considered as naive and treated as such?

² Cf. *Ibid.*, nn. 14, 27.

³ Council of Vienna, *Constitutio 'Fidei Catholicae'*, Denzinger-Schoenmetzer, *Enchiridion Symbolorum*, n. 902.

⁴ Cf. *Gaudium et Spes*, nn. 12, 15.

⁵ Cf. *Ibid.*, n. 14.

⁶ Cf. *Ibid.*, nn. 27, 51.

Here the difficulty is even greater because a prohibition made in the name of respect for life seems to conflict with other important values: not only the value of scientific knowledge, but also values connected with the concrete good of humanity, such as the improvement of living conditions, health, the relief or healing of illness and suffering, etc. This is the very problem you are considering. How does one reconcile respect for life – which forbids any action likely to cause or hasten death – with the potential good that results for humanity if the organs of a dead person are removed for transplanting to a sick person who needs them, keeping in mind that the success of such an intervention depends on the speed with which the organs are removed from the donor after his or her death?

4. At what moment does that which we call death take place? That is the crux of the matter. In essence, exactly what is death?

As you know, and as your discussions have confirmed, it is not easy to reach a definition of death which can be understood and accepted by all. Death can mean decomposition, disintegration, a separation.⁷ It occurs when the spiritual principle which ensures the unity of the individual can no longer exercise its functions in and upon the organism, whose elements, left to themselves, disintegrate.

This destruction does not of course affect the entire human being. Christian faith – and it is not alone here – affirms the continuation of man's spiritual principle beyond death. However, this state of 'beyond' – for those who do not have faith – is without a clear face or form, and everyone feels anguish when confronted by a separation which so brutally contradicts our will to live, our wish to exist. Unlike animals, man knows that he must die and he perceives this as an affront to this dignity. Although in the flesh he is mortal, he also realises that he ought not to die, because he carries within himself an openness, an aspiration towards the eternal.

Why does death exist? What is its meaning? Christian faith affirms that there is a mysterious link between death and moral disorder or sin. Yet at the same time, faith imbues death with a positive meaning because it has the resurrection as its horizon. It shows us the Word of God who takes on our mortal condition and offers his life in sacrifice for us sinners on the Cross. Death is neither a simple physical consequence nor a mere punishment. It becomes the gift of self for the sake of love. In the Risen Christ we see death definitively conquered: 'death has no more dominion over him'.⁸ The Chris-

⁷ Cf. John Paul II, *Salvifici Doloris*, n. 15; *Gaudium et Spes*, n. 18.

⁸ *Rm* 6:9.

tian also confidently looks forwards to regaining his own personal totality, transfigured and definitively possessed in Christ.⁹

Such is death seen through the eyes of faith. It is not so much an end of living as an entry into a new life, a life without end. If we freely accept the love which God offers us, we will have a new birth in joy and in light, a new *dies natalis*.

This hope does not however prevent death from being a painful separation, at least as it is experienced at the ordinary level of awareness. The moment of this separation is not directly discernible, and the problem is to identify its signs. How many questions emerge here, and how complex they are! Your reports and your discussions have emphasised this fact, and have provided valuable elements for a solution.

5. The problem of the moment of death has serious implications at the practical level, and this aspect is also of great interest to the Church. In practice, there seems to arise a tragic dilemma. On the one hand, there is the urgent need to find replacement organs for sick people who would otherwise die or at least would not recover. In other words, it is conceivable that in order to escape certain and imminent death a patient may need to receive an organ which could be provided by another patient, who may be lying next to him in hospital, but about whose death there still remains some doubt. Consequently, in the process there arises the danger of terminating a human life, of definitively disrupting the psychosomatic unity of a person. More precisely, there is a real possibility that the life whose continuation is made unsustainable by the removal of a vital organ may be that of a living person, whereas the respect due to human life absolutely prohibits the direct and positive sacrifice of that life, even though it may be for the benefit of another human being who might be felt to be entitled to preference.

Even the application of very certain principles is not always easy, for the confrontation with opposite demands clouds our imperfect vision and therefore our perception of the absolute values which depend neither on our vision nor on our emotions.

6. In such conditions two tasks need to be addressed.

Scientists, analysts and scholars must pursue their research and studies in order to determine as precisely as possible the exact moment and the indisputable sign of death. For, once such a determination has been arrived at, then the apparent conflict, between the duty to respect the life of one person and the duty to effect a cure or even save the life of another, disap-

⁹ Cf. 1 Co 15:22.

pears. One would be able to know at what moment it would be perfectly permissible to do what had been definitely forbidden previously, namely, the removal of an organ for transplanting, with the best chances of a successful outcome!

Moralists, philosophers and theologians must find appropriate solutions to new problems and to new aspects of age-old problems in the light of new data. They must examine situations which were previously inconceivable and which have therefore never before been assessed. In other words, they must exercise what the moral tradition defines as the virtue of prudence, which presupposes moral rectitude and faithfulness to the Good. This virtue makes it possible to assess all the factors and values involved according to their respective importance. It guards against facile solutions or solutions which, in resolving a difficult case, surreptitiously introduce false principles. Thus the acquisition of new data can stimulate and refine moral reflection, just as, by contrast, moral demands which seem perhaps to scientists to restrict their freedom may be and indeed often are an incentive to further fruitful research.

Scientific research and moral reflection must proceed side by side in a spirit of mutual help. We must never lose sight of the supreme dignity of the human person whose well-being research and reflection are called to serve, and in whom the believer recognises nothing less than the image of God himself.¹⁰

Distinguished friends, may the Spirit of Truth assist you in your difficult but necessary and most valuable research. I thank you for your cooperation with the Pontifical Academy of Sciences, which seeks to foster interdisciplinary dialogue and a wide exchange of information in fields of human endeavour which involve moral choices and responsibilities of the utmost importance for the well-being of the human family. May God bless you abundantly!

¹⁰ Cf. *Gn* 1:28-29; *Gaudium et Spes*, n. 12.

18 MAY 1990

*Address to the Study Week on the Subject 'Man and his Environment.
Tropical Forests and the Conservation of Species'*

The Pope deplores the depletion of the 'earth's tropical biodiversity' and the tropical forests, and stresses that this threatens many forms of life and the quality of human life. The unjustified search for profit is one factor; the fight against poverty another; the consequences of third world debt yet another. Population pressure is often cited as a further factor, yet not all demographic expansion is 'incompatible with orderly development'. His Holiness emphasises that the 'Church untiringly upholds the freedom of couples to decide about children according to the moral law and their religious belief'. Man is a steward of nature and his stewardship must conform to divine will; thus 'ecological commitment' forms a part of man's 'responsibilities within God's designs'.

Ladies and Gentlemen,

1. It is with special pleasure that I welcome the distinguished men and women of science who have been taking part in the study week organised by the Pontifical Academy of Sciences in conjunction with the Royal Swedish Academy of Sciences on the subject of 'Tropical Forests and the Conservation of Species'. The topic you have been studying is of immense importance. It is to the undeniable credit of scientists that the value of the biodiversity of tropical ecosystems is coming to be more and more understood and appreciated. However, the extent of the depletion of the earth's tropical biodiversity is indeed a very serious problem: it threatens countless other forms of life. Even the quality of human life, because of its dependence on the dynamic interaction of other species, is being impoverished.

2. Tropical forests deserve our attention, study and protection. As well as making an essential contribution to the regulation of the earth's climatic conditions, they possess one of the richest varieties of the earth's species, the beauty of which merits our profound aesthetic appreciation. Moreover, some plants and microorganisms of these forests are capable of synthesising unlimited numbers of complex substances of great potential to the production of medicines and antibiotics. Other plants possess value as sources of food or as a means of genetically improving strains of edible plants.

Unfortunately, the rate at which these forests are being destroyed or altered is depleting their biodiversity so quickly that many species may never be catalogued or studied for their possible value to human beings. Is

it possible, then, that the indiscriminate destruction of tropical forests is going to prevent future generations from benefiting from the riches of these ecosystems in Asia, Africa and Latin America? Should a concept of development in which profit is predominant continue to disrupt the lives of the native populations which inhabit these forests? Should a lack of foresight continue to harm the dynamic processes of the earth, civilisation and human life itself?

3. If an unjustified search for profit is sometimes responsible for the deforestation of tropical ecosystems and the loss of their biodiversity, it is also true that a desperate fight against poverty threatens to deplete these important resources of the planet. Thus, while certain forms of industrial development have induced some countries to deplete dramatically the size of their tropical forests, foreign debt has forced other countries to administer unwisely their hardwood resources in the hope of reducing that debt. And likewise, the attempt to create lands for farming, pasture or grazing is sometimes an unfortunate proof of how inappropriate means can be used for good or even necessary aims. In this case the solution of an urgent problem can create another equally serious one.

Population pressure is very often cited as a major cause of the destruction of tropical forests. Here though, it is essential to state that demographic expansion is not simply a matter of statistics; it is a cultural and profoundly moral issue. Indeed, not 'all demographic expansion is incompatible with orderly development'.¹ Besides condemning the pressures, including economic ones, to which people are subjected, especially in the poorer countries, in order to force them to submit to population control programmes, the Church untiringly upholds the freedom of couples to decide about children according to the moral law and their religious belief.²

4. Every kind of life should be respected, fostered and indeed loved, as the creation of the Lord God, who created everything 'good'.³ But it is precisely the special value of human life that counsels, in fact compels us, to examine carefully the way we use the other created species. There is no doubt that man is entitled to make use of the rest of creation: the Creator himself gave to mankind, as well as to the animals, 'all plants and seeds and fruit trees' in order to sustain their lives in this world.⁴ This gift, however,

¹ John Paul II, *Sollicitudo Rei Socialis*, n. 25.

² Cf. *Ibid.*; also *Familiaris Consortio*, n. 30.

³ Cf. *Gn* 1:31.

⁴ Cf. *Ibid.* 1:29-30.

together with the command to 'dominate the earth',⁵ is subject to two limits set by God the Creator.

The first one is man himself. He must not make use of nature against his own good, the good of his fellow human beings and the good of future generations. That is why there is a moral dimension to the concept and practice of development which must in every case be respected.

The second limit is created beings themselves; or rather, the will of God as expressed in their nature. Man is not allowed to do what he wishes and how he wishes with the creatures around him. On the contrary, he is supposed to 'keep' and 'cultivate' them, as taught in the Biblical narrative of creation.⁶ The very fact that God 'gave' mankind the plants to eat and the garden 'to keep' implies that God's will is to be respected when dealing with his creatures. They are 'entrusted' to us, not simply put at our disposal. We are stewards, not absolute masters. For this reason, the use of created beings implies moral obligations.⁷ Ecological commitment is not only a question of concern for natural beings and the atmosphere around them. It is a question of morality, and therefore of man's responsibilities within God's designs. In this context, man's ultimate well-being may be summed up as 'peace with God the Creator, peace with all of creation'.⁸

5. Today, the work of scientists such as yourselves is becoming more and more important. An intense programme of information and education is needed. In particular, your study and research can contribute to fostering an enlightened moral commitment, more urgent now than ever. I trust that the conclusions of your seminar, together with your personal work and responsible commitment as men and women of science, will help very much towards the attainment of such an aim. In this way, the present ecological crisis, especially grave in the case of the tropical forests, will become an occasion for a renewed consciousness of man's true place in this world and of his relationship to the environment. The created universe has been given to mankind not for selfish measures but for the glory of God, which consists, as Saint Irenaeus said many centuries ago, in 'the living man'.⁹

I encourage you and invoke upon you Almighty God's abundant blessings.

⁵ Cf. *Ibid.*, 1:26.

⁶ Cf. *Ibid.*, 2:15.

⁷ Cf. John Paul II, *Sollicitudo Rei Socialis*, n. 34, and the 1990 *World Day of Peace Message*, n. 6 ff.

⁸ John Paul II, 1990 *World Day of Peace Message*.

⁹ St. Irenaeus, *Adversus Haereses* IV, 20, 7.

29 OCTOBER 1990

*Address to the Plenary Session and to the Study Week on the Subject
'Science in the Context of Human Culture I'*

John Paul II refers to Pius XI's idea that the Academy was 'the Holy See's scientific senate' and lays stress on the 'fruitfulness of a trusting dialogue between the Church and science'. He adds that scientific advance has contributed to the common cultural heritage of mankind and maintains that the defence of reason is a priority requirement for every culture: 'scholars will find no better ally than the Church in this struggle'. Science now has a central role to play in aiding contemporary culture and in making the 'earth more habitable, more fertile, and more fraternal'. The active forces of science and religion should combine to help contemporaries meet the challenges of 'integral development'.

Mr. President,
Your Eminences,
Distinguished Members,

1. With great joy I welcome you today, the Pontifical Academy of Sciences, gathered in plenary session to study the topic of 'science in the context of human culture'. I have the pleasure of welcoming twelve new members to this Academy, so dear to the Sovereign Pontiffs, which my predecessor Pius XI once called 'the Holy See's scientific senate'. In bidding you each a personal welcome, I cordially congratulate you and thank you in advance for the valuable collaboration that you will offer the Academy and your contribution to its importance.

As you well know, Pius XI truly refounded the Pontifical Academy of Sciences in 1936, giving it noteworthy encouragement; successive Popes constantly desired to encourage it. My own sentiments echo their deep convictions about the decisive role which culture and science are called to play in our day and on the fruitfulness of a trusting dialogue between the Church and science. It is my great desire that the Academy may continue to develop according to its own nature and the demands of today's culture, which greatly shows humanity's desire for fraternity and a greater practice of solidarity.

The subject of your current session, 'science in the context of human culture', confirms your intention to combine scientific precision with interdisciplinary research, in order to improve still more the services which the Academy offers. This goal corresponds to the hopes of the Second Vatican Council which paid very special attention to science, research and all the

dimensions of culture. Let us recall that the Council adopted an illuminating viewpoint on culture, as is witnessed to by the Pastoral Constitution *Gaudium et Spes*.¹ This perspective has proven very useful for analysing your topic. Indeed, the anthropological dimensions of culture which the Council shed greater light on directly concern your research.

2. Culture involves the growth of the human person through the development of his or her talents and intellectual, moral and spiritual capacity. Who can fail to see science's great contribution to the growth of intellectual learning? Not only scholars but all our contemporaries have been raised in the light of science's wonderful progress. It has greatly affected the minds and mentalities of our contemporaries. Of course, besides the mathematical, physical and natural sciences and their technological application, we must acknowledge the considerable contribution of the human sciences, as well as that of moral and religious sciences. All these disciplines together progressively form our common cultural heritage. We must acknowledge with great admiration that the progress of science does not come about without hard work and a thorough application, which are the fruit of an asceticism and honesty which do honour to a true scholar. Every researcher methodically concentrates on that portion of reality which he or she studies according to his or her field of specialisation. In your separate disciplines and precise research, your work as acknowledged specialists contributes greatly to the enrichment of modern culture by the thoroughness of your analyses as well as by your attempts at synthesis. In looking over the list of the Academy's members I note with satisfaction that almost all the scientific disciplines are honourably represented there. For the first time specialists in epistemology are added to your number. We hope that their contribution may enrich even more the epistemological studies which your statutes propose as one of the Academy's goals.²

3. In practice epistemological research is becoming more and more a necessary part of scientific culture. Fundamental questions are raised about the *how* and *why* of scientific knowledge. Even though the disciplines are becoming more and more specialised, at the same time they call into question the meaning of the knowledge which they gather, and the connection between scientific knowledge and the almost unlimited capacity of the human intellect. At first scientific culture grows most of all by the accumulation of many scattered studies. Little by little a mosaic of knowledge in a

¹ N. 53.

² Cf. art. 2.

given field is created. This mosaic needs to be interpreted and analysed in a way that responds to the new demands of rational legitimacy made by each discipline. Is it not a sign of a science's maturity when it questions itself and its relationship to the more general order of knowledge?

Please allow me to repeat that the Church highly values your specialised research, which includes epistemological reflection on the meaning of science. Your studies bear witness to the efforts of human reason to explore reality more fully and to discover the truth in all its dimensions. This is a necessary and urgent service. Scholars themselves must show the validity of scientific research and its ethical and social legitimacy in the face of the anti-scientific and irrational currents which threaten our present culture. Defending reason is a priority demand of every culture. Scholars will find no better ally than the Church in this struggle.

Indeed, for the Church nothing is more fundamental than knowing the truth and proclaiming it. Culture's future depends on it. This is what I recently reminded the Catholic universities of in the Apostolic Constitution *Ex Corde Ecclesiae* (1990): 'The present age is in urgent need of this kind of disinterested service, namely of *proclaiming the meaning of truth*, that fundamental value without which freedom, justice and human dignity are extinguished'.³ This is the Church's first mission, because she is the servant of Him who proclaimed Himself the Way, the Truth and the Life. The Church constantly makes herself the advocate of mankind which is capable of accepting truth in its entirety. Thus she encourages research which explores all orders of truth, convinced that they all converge to the glory of the one Creator, Himself the supreme Truth and Light of all people, those of yesterday, today and tomorrow.

4. This leads us to another aspect of culture which Vatican II considered: our contemporaries see culture as a social and historical reality. The scientific world as a whole is keenly aware that it must place itself critically at the centre of the changes in contemporary cultures; henceforth, the people of our day are going to be strongly challenging the representatives of science about their responsibilities concerning the need for peace, development of all peoples, and the safeguarding of human life and the environment. This new awareness by the general public of the scholars' responsibility is a characteristic of modern culture. It is a clear sign for the Pontifical Academy of Sciences.

To my satisfaction I can see that you have already clearly aimed your work in that direction. Without neglecting in any way your own disciplines,

³ N. 4.

you have recently organised several projects which highlight the mutual relationship between science and our contemporary culture. You have methodically studied complex scientific and ethical problems such as development, peace, the consequences of nuclear war, the environment, nutrition, bioethics, the quality of life, health, the meaning of death, the relationship between science and the modern world, and the responsibility of science. You have courageously undertaken studies on the scientific experiences of the past, particularly on the case of Galileo, a problem which I asked you to examine in all its aspects without any reservations. All of this research presupposes a very great understanding of the problem under study, the empirical, historical and epistemological aspects of which often have a philosophical and theological dimension. In doing so, you are responding to one of the objectives expressed in your statutes,⁴ when they call for the study of the scientific and technological problems involved in human development and a deeper study of moral, social and spiritual questions, thanks to your own contribution.

As I encouraged you at the time of the celebration of your fiftieth anniversary, you have been able to broaden the scope of your research by joining together with other bodies of the Holy See, such as the Curia departments, universities and cultural institutions. I encourage you to continue this fruitful collaboration.

5. With all my heart, I encourage the Pontifical Academy of Sciences to develop its activity in the two directions already mapped out, that is the pursuit of quality specialised studies and the interdisciplinary opening of research. These two ways should lead the Academy to a constant re-examination of its own activity, keeping in mind the profound changes affecting today's world. In particular I once again draw your attention to the urgent problems of the integral development of the person and fraternal solidarity among peoples.

Everyone believes that humanity has reached a new turning point. Thanks to science and modern technology instant communication to all parts of the world has allowed the community of peoples to know one another better and has aroused everywhere a great desire for freedom and dignity. Men and women of science will have a leading role to play in the joint effort demanded of our generations to make the earth more habitable, more fertile and more fraternal. The job to be done can seem utopian and engender a certain fatalism. We must strongly react against this error and

⁴ Art. 3.

temptation. Rather, the time has come to create a new bond between all people and groups of good will.

We must combine the active forces of science and religion in order to prepare our contemporaries to meet the great challenge of integral development, which demands skill and qualities which are both intellectual and technical, moral as well as spiritual. Your contribution, men and women of science, is indispensable and urgent. I invite you to examine this problem with all your talent and energy. The Pontifical Academy of Sciences could thus, I am sure, give exemplary witness to the entire scientific community.

6. What is ultimately at stake is the profound meaning of your vocation as scholars in today's culture. Of what use is your science? How does it contribute to human development, to culture understood in its highest sense? In asking this question, I am not ignoring the indispensable value of basic research. Before modern science, which evokes so much admiration but which also arouses so many fears, the Church wonders with you about the questions involving the future of culture and of mankind itself and invites the best spirits to reply. I say to you what I recently said to the Catholic universities: 'What is at stake is the *very meaning of scientific and technological research*, of social life and of culture, but, on an even more profound level, what is at stake is *the very meaning of the human person*'.⁵

Therefore, Ladies and Gentlemen, it seems to me that the topic which you are dealing with this year, 'science in the context of human culture', is a judicious and promising one. It is not only an appropriate choice, but a project which should continue to be methodically explored. You also plan to collaborate further with the Pontifical Council for Culture, and I heartily encourage you.

7. At the beginning of my pontificate I stated that the Church's dialogue with culture has a decisive role for the future of humanity. More than once I repeated this with conviction and I appealed to all the Church's institutions to see to it that their activity in regard to culture may always be more enlightened, lively and fruitful.

I know that the Pontifical Academy of Sciences constantly re-evaluates its mission in the light of its constitutive nature and specific intent. Your efforts and work in this regard have my full support. You are looking at how your methods and objectives can be revised so that the Academy can better respond to the needs and aspirations of today's culture, as well as to the Holy See's wishes. May this revision be done in conjunction with a sim-

⁵ John Paul II, *Ex Corde Ecclesiae*, n. 7.

ilar renewal which should also be undertaken by all the Pontifical Academies in a spirit of scientific precision and interdisciplinary collaboration.

After fifty years of distinguished service given to the scientific community and the Holy See, the Pontifical Academy of Sciences can look to the future with a renewed determination to respond to the cultural challenges of a new era.

This is the wish which I express for the Academy and each of you, once again telling you of my gratitude and invoking upon you the blessing of Almighty God, who is Truth and Love.

4 OCTOBER 1991

*Address to the Symposium on
'Science in the Context of Human Culture II'*

The Pope stresses that since the beginning of his pontificate he has sought 'to encourage reflection on culture and all its components'. He welcomes the collaboration of men and women of culture, science and faith. The Pope then warns against the dangers of the fragmentation of knowledge and calls for culture and science to act together. Scientific progress, especially in the sphere of genetics, must be guided by sound ethics so that 'science and culture may deserve to be called "human"'. He observes that scientists are increasingly adopting an ontological approach and adds that they are now called to act against the dangers of a wrong use of the earth's resources and to work for 'genuinely human progress'. After referring to the 'lived faith of so many scientists who are believers', the Pope affirms that co-operation between religion and science will contribute to a 'decisive renewal of culture'.

Your Eminence,
Mr. President,
Your Excellencies, Ladies and Gentlemen,

1. I am happy to welcome you at the end of your study days in the Vatican City, organised under the auspices of the Pontifical Academy of Sciences and the Pontifical Council for Culture. Your symposium on 'science in the context of human culture' appropriately follows the one which took place here in October of 1990. Your carefully chosen subject is timely; it will be useful to pursue the questions it raises.

2. You are well aware of *the interest which the Church and the Holy See have in the progress of science and its relationship to culture*. Since the beginning of my pontificate, I have been anxious to encourage reflection on culture and all its components. Human destiny depends on this. The earth-shaking events which are undermining society and threatening peace convince us of this.

Your symposium marks a step in the necessary, but difficult, collaboration of science, culture and religion. In spite of mutual prejudices, both old and new, which have been able to keep them distant from each other, your labours attest to our common will to work for the good of man. So I am particularly delighted with this programme, which brings together men and women of culture, science and faith. I express my gratitude to all of you

who have been willing to participate in this reflection. I hope that this kind of collaboration can take place again in the future. I especially thank the Pontifical Academy of Sciences and the Pontifical Council for Culture, who made it possible for this meeting to run so smoothly. These two institutions of the Holy See will certainly be called upon, each according to its own competence, to play an increasing role in the dialogue you have begun. I am certain that they will fulfil this mission generously.

3. *The fragmentation of knowledge*, caused by specialisation in each science and by dividing up their technical applications, often makes it impossible to see the human being in his ontological unity and to understand the harmonious complexity of his faculties. In fact, there is a real risk of seeing science and culture growing apart, even to the point of disregarding each other. But both of them are at the integral service of the human person. The Church has profound respect for men and women of science and culture, for they have been given a specific and undeniable responsibility with regard to the human race and its future, especially on the eve of the Third Millennium, in the midst of a world undergoing profound change, in which human destiny is more than ever in their own hands.

4. *Culture*, in the full sense of the term, is a concept which embraces everything of which man is at once the centre, the subject and the object. It includes all his capabilities, both as an individual and as one who lives in society. It humanises persons, manners and institutions. *Science*, for its part, instead of being in competition with culture, is actually a fundamental and now indispensable element of all culture which is ordered to the good of the whole person and every person. In the most diverse fields, scientific and technical progress aims to guarantee the human person a better life so that he can completely and more readily fulfil his specific vocation.

5. *Men and women of science*, you are asking yourselves: 'What is the profound meaning of our vocation, as research workers, in today's culture?'. To answer this question, which many of our contemporaries are asking as well, we must turn to man as a cultural being, to the person as the subject who cannot be reduced to the level of all other creatures.

We are witnessing an extraordinary scientific and technological development. The limits of knowledge seem to be endlessly receding. But, at the same time, we shudder with fear when we see the uses to which it is put. The agitated history of our century confronts us with our respective responsibilities. Today we are more aware, than in the past, of the ambivalence of science. Man can use it for his betterment, but also for his destruction.

Science has so many implications that it calls for an increased awareness on the part of conscience.

Men and women of science, you feel in the depths of your being that the human person cannot, without denying himself, avoid asking the most decisive questions, which science rightly excludes from its field, because these questions belong to another sphere of knowledge.

Scientific progress, particularly in the field of genetics, keeps conscience on the alert and stimulates ethical reflection. This progress cannot be limited to technical aspects which one could consider morally neutral, because it directly concerns the human person in regard to his most valuable possession: his very structure as a person. Even if their value judgements diverge and their political doctrines are extremely different, a number of political authorities have established national ethics committees in many countries. Beyond the divergent viewpoints which these institutions can inspire, the sole fact of their recent establishment clearly shows that those responsible for civil society perceive, along with the tragic loss of consensus on fundamental moral convictions, the complexity and the seriousness of the interests at stake. It is your responsibility to use your expertise to assist this necessary development of moral awareness. Promoting the ethical dimension of scientific and technical progress means helping it to become genuinely human, in order to build a society which is on a human scale. Not only do ethical concerns not prejudice in any way the scientific rigour of researchers and their work, but in addition they give them a hitherto unsuspected human importance. In the absence of this kind of ethical reflection, all humanity and even the earth itself would be in danger. Men and women of science, men and women of culture, the world needs you, your witness and your personal commitment, so that ethics may enlighten science and technology, so that the primacy of the person over things and that of the spirit over matter may be respected, and so that science and culture may deserve to be called 'human'.

6. The evolution of thought and the march of history show, often by means of crises and conflicts, *an unstoppable movement towards unity*. People are becoming aware that they can no longer live alone and that isolation leads to certain decline. Cultures are opening up to what is universal and are mutually enriching each other. Presumptuous philosophies and ideologies, such as scientism, positivism and materialism, which wanted to be exclusive and claimed to explain everything at the cost of reductionism, have now been overcome. Reality has been discovered in its immensity and complexity, and now produces an attitude of humility in research workers. The experimental method allows one to grasp only certain partial aspects of

reality, whereas philosophy, art and religion grasp it in a more or less global way in their specific approaches.¹

During recent decades, a significant change of attitude has led many scientists to be concerned not only with the effectiveness of their work, but with its meaning as well. They are rediscovering an ontological approach, which for a long time had been rejected for methodological reasons that were legitimate in themselves. It is now clear that *human nature is at stake* in scientific applications. Man could not remain unconcerned about universality and transcendence with impunity. Redefining different approaches to reality, without excluding any, will help man to understand himself better. He longs for the harmonious development of all his faculties. He could not manage without culture, ethical values or religion. In an increasing way, science contributes to this harmony, to the extent that its ultimate purpose and ways of acting are ordered to the human person's benefit. With its new possibilities, science enriches culture, broadens the area of personal and collective responsibility, and contributes to the progress of humanity.

7. Men and women of science, *our contemporaries are turning more and more to you*. They expect from you and your research *an increased protection of the human person and nature*, the transformation of their living conditions, the improvement of society, the establishment and preservation of peace. Stricken by accidents and mistakes in judgement which assume the dimension of ecological catastrophes, they are more aware of the dangers resulting from the irrational use of nature, which has been put at their disposal by their Creator. They see that the exploitation of the earth's resources has consequences for culture and human beings. As one example, think of the crisis of the Amazon aborigines, who are threatened with extinction, as extensive deforestation compromises their fragile ecological and cultural balance. Reasonable and decent planning in the use of the planet's natural resources will greatly contribute to preserving nature, the human person and his culture.

Your role has the same primary importance *in regard to culture*: your competencies allow you to expel the irrational, to denounce aberrant traditional behaviour and to encourage a genuinely human progress. I recently wrote in the Encyclical *Centesimus Annus*: 'From this open search for truth, which is renewed in every generation, the culture of a nation derives its character'.² Every day we experience *the influence of scientific and techno-*

¹ Cf. 'Address at the European Centre for Nuclear Research' (15 June 1982), nn. 4-5.

² N. 50.

logical culture on our contemporaries, to the point of profoundly changing their way of living, viz., their tastes, the focus of their interests, and their personal and collective behaviour. Therefore, see that scientific and technological progress is truly at the service of man and that it does not turn him into its servant, incapable of providing for himself, should it fail. May your discoveries assist the human person in fully developing his talents of creativity, intelligence, self-mastery, knowledge of the world and solidarity. Be open to building a new and truly human world!

8. When they follow their own, respective methods, *religion and science are constitutive elements of culture*. On the eve of the Third Christian Millennium, instead of being opposed, they are marked by a complementarity which is illustrated by the lived faith of so many scientists who are believers. Recent decades have witnessed the beginning of a new dialogue between scientists and religion. This dialogue has frequently permitted the clarification of misunderstood positions resulting from confusion between the methods and areas of research that are proper to religion and to science. Today, astrophysicists study the origins of the universe and theologians and exegetes study the creation of the universe as God's gift to man, in a happy complementarity, without suspicion or competition. In the face of anti-scientific movements and irrational impulses, which appear as the anguished cries of individuals whose lives have lost all meaning and whom technology is overwhelming, the Church defends the dignity and necessity of scientific and philosophical research, to discover the still hidden secrets of the universe and to shed light on the nature of the human being. Scientists and believers can form a great spiritual family and construct a culture which is genuinely searching for the Truth. Without a doubt, after a separation, even an opposition, between science and religion, the joining of different types of knowledge and wisdom, which is so necessary today, will produce a decisive renewal of culture. Religion and science will have to answer to God and humanity for how they have tried to integrate human culture, thus avoiding the risk of a fragmentation which would mean its destruction.

9. Your Eminence, Mr. President, dear friends, the future of humanity 'is in the hands of those who are capable of providing the generations to come with reasons for life and optimism'.³ At the end of this conversation, which I would like to prolong with each of you, I strongly encourage you to continue your efforts to achieve a harmonious cooperation between science, culture and faith, for the good of all human beings. On the eve of the Third

³ *Gaudium et Spes*, n. 31.

Millennium, during this period of so many upheavals, the human family turns to you, men and women of culture and science, to help them to improve their conditions of life and to make clear their reasons for living. On this path, you will always find a committed and impartial partner in the Church.

I am happy to have had this opportunity to express my esteem, and I invoke upon you, your families and your co-workers blessings of the Lord, the Creator of nature and the inspiration of culture, of which He is the beginning and the end.

22 NOVEMBER 1991

*Address to the Study Week on the Subject
'Resources and Population'*

The Pope observes that the 'relationship between the accelerated increase in world population and the availability of natural resources' is of great concern to contemporary society. He then observes that 'human society is first and foremost a society of persons, whose inalienable rights must always be respected'. The Pope calls for educational advance, an improvement in the condition of women, greater moral responsibility, the defence of the environment, and a 'redistribution of economic resources'. But he stresses, in particular, the importance of solidarity, upon which 'the solution to the questions with which you are dealing depends'. Overall reform must be based upon 'personal renewal', which is a task first of all for the family, which in turn must adhere to a 'balanced attitude towards procreation'.

Ladies and Gentlemen,

1. I extend to each of you a cordial welcome. I greet you and I thank you for having accepted the invitation of the Pontifical Academy of Sciences to take part in a scientific discussion on a problem which is of great concern to society today: *the relationship between the accelerated increase in world population and the availability of natural resources.*

The close connection between the world's resources and its inhabitants must be evaluated, as you have opportunely done, by also taking into account the present imbalances in demographic distribution, in movements of migrants, in the allocation and consumption of resources.

The increase both of population and of available resources varies from place to place, to such an extent that different parts of the world are presently experiencing, and can be expected to experience, unequal trends.

The data emerging from your research and discussions will therefore prove important and very useful in enabling the Holy See to formulate and clarify – in accordance with its proper mission and responsibilities – appropriate guidelines and suggestions. The Academy's independence and scientific competence enable it to provide a valuable service to the Church. The Church in turn can then make use of the Academy's analysis of reliable data in order to develop – in the field of her own competence and autonomy – a carefully considered judgment of a religious and ethical nature.

2. Although the starting-point of your research is the current world situation, you have rightly chosen to look at the past as well. You have high-

lighted the causes which have produced the earth's present situation and led to the notable growth of the world population in recent decades. You have then looked to the future, in order to make certain projections based on the connection between the dynamics of demography and the dynamics of available resources, particularly with regard to their impact on the environment.

It is a well-known fact that the availability of resources is obstructed by various social, economic and political factors, to the extent that some people fear that the point will even be reached when it will be impossible to feed all the world's people. It is important, however, not to be guided by fear; instead, what is needed is a careful evaluation of the various aspects of the problem.

3. An analysis of the different situations points to a growing diversification with regard not only to basic natural resources, but more specifically to those resources capable of actually being used by man, through the application of his intelligence, enterprise and labour. Science and its relative applications have made new resources available and hold out the promise of alternative forms of energy. But centres of scientific research are not evenly spread, and the propagation of skills and technologies is conditioned, and at times slowed down, by various factors which make the practice of international solidarity difficult. Yet, such solidarity is the fundamental premise for full and balanced development.

What we are speaking of, then, is a problem of social organisation and hence also a political problem. Various aspects of life in society are involved here, from family rights to the regulation of land ownership, from social welfare to the organisation of labour, from public order to ways of establishing a consensus in society.

Human society is first and foremost a society of persons, whose inalienable rights must always be respected. No political authority, whether national or international, can ever propose, much less impose, a policy that is contrary to the good of persons and of families.¹

4. There is a widespread opinion that population control is the easiest method of solving the underlying problem, given that a worldwide reorganisation of the processes of production and a redistribution of resources would require an enormous amount of time and would immediately give rise to economic complications.

¹ Cf. *Gaudium et Spes*, nn. 25-26; *Dignitatis Humanae*, n. 3.

The Church is aware of the complexity of the problem. It is one that must be faced without delay; but account must also be taken of the differing regional situations, some of which are the complete opposite of others: some countries show a massive population increase, while others are heading towards a dwindling, ageing population. And often it is precisely the latter countries, with their high level of consumption, which are most responsible for the pollution of the environment.

The urgency of the situation must not lead into error in proposing ways of intervening. To apply methods which are not in accord with the true nature of man actually ends up by causing tragic harm. For this reason, the Church, as an 'expert in humanity',² upholds the principle of responsible parenthood and considers it her chief duty to draw urgent attention to the morality of the methods employed. These must always respect the person and the person's inalienable rights.

5. The increase or the forced decrease of population is partly the result of deficiencies in social institutions. Damage to the environment and the increasing scarcity of natural resources are often the result of human errors. Despite the fact that the world produces enough food for everyone, hundreds of millions of people are suffering from hunger while elsewhere enormous quantities of food go to waste.

In view of these many different mistaken human attitudes, it is necessary to address first of all the people who are responsible for them.

6. Population growth has to be faced not only by the exercise of a responsible parenthood which respects divine law, but also by economic means which have a profound effect on social institutions. Particularly in the developing countries, where young people represent a high percentage of the population, it is necessary to eliminate the grave shortage of adequate structures for ensuring education, the spread of culture and professional training. The condition of women must also be improved as an integral part of the modernisation of society.

Thanks to advances in medicine which have reduced infant mortality and increased the average life expectancy, and thanks also to the development of technology, there has been a real change in living conditions. These new conditions must be met not only with scientific reasoning, but more importantly with recourse to all available intellectual and spiritual energies. People need to rediscover the moral significance of respecting limits; they

² Cf. Paul VI.

must grow and mature in the sense of responsibility with regard to every aspect of life.³

By not taking steps in this direction, the human family could well fall victim to a devastating tyranny which would infringe upon a fundamental aspect of what it means to be human, namely giving life to new human beings and leading them to maturity.

It is the responsibility of the public authorities, within the limits of their legitimate competence, to issue directives which reconcile the containment of births and respect for the free and personal assumption of responsibility by individuals.⁴ A political programme which respects the nature of the human person can influence demographic developments, but it should be accompanied by a redistribution of economic resources among the citizens. Otherwise such provisions can risk placing the heaviest burden on the poorest and weakest sectors of society, thus adding injustice to injustice.

Man, 'the only creature on earth whom God willed for its own sake',⁵ is the subject of primordial rights and duties, which are antecedent to those deriving from social and political life.⁶ The human person is 'the origin, the subject and the purpose of all social institutions',⁷ and for this reason authorities must keep in mind the limits of their own competence. For her part, the Church invites the human family to plan its future, impelled not just by material concerns but also and especially by respect for the order which God has placed within creation.

7. We all have precise duties towards future generations: this is an essential dimension of the problem, and it impels us to base our proposals on solid prospects regarding population growth and the availability of resources.

The conservation of resources presupposes peaceful co-existence, since – as is generally recognised – wars are among the worst causes of environmental damage. Peaceful co-existence in its turn presupposes solidarity, which is the result of a developed moral sense. The basic virtues of social life constitute a favourable climate for world solidarity, about which I wrote in my Encyclical Letter, *Sollicitudo Rei Socialis*.⁸ It is mainly upon solidarity that the solution to the questions with which you are dealing depends.

³ Cf. *Mater et Magistra*, n. 195; *Humanae Vitae*, passim; *Gaudium et Spes*, nn. 51-52.

⁴ Cf. *Gaudium et Spes*, n. 87; *Populorum Progressio*, n. 47.

⁵ *Gaudium et Spes*, n. 24.

⁶ Cf. *Pacem in Terris*, nn. 5, 35.

⁷ *Gaudium et Spes*, n. 25.

⁸ Cf. nn. 39-40.

8. Within this context a strong common commitment to institutional reform is needed, a commitment which aims at raising the level of intellectual and personal maturity by means of a satisfactory educational system. It will also aim at strengthening enterprise and the creation of jobs through adequate investments. The destruction of the environment caused by industry and industrial products must be reduced in accordance with precise plans and undertakings, also at the international level. A radical effort to change the current state of affairs is now required.

This reform must be based on personal renewal.⁹ There must be action within the sphere of education and still more in the field of the all-round authentic personal development of individuals. This will be done by educating people in awareness of the values that are proper to human beings, in order to bring about a society in which they take an active part and which offers better living conditions for the whole of humanity. This is certainly not an easy undertaking. It is a task first of all for the family, the basic unit of society. The family draws moral strength from parents' sense of responsibility, about which the Council speaks,¹⁰ and which includes a balanced attitude towards procreation, an attitude which seeks to build a more united and caring society.

9. The appeal to each individual's sense of responsibility is an urgent one. So is the appeal for solidarity on the part of everyone.

The dynamics of population growth, the complexity of uncovering and distributing resources, and their mutual connections and consequences for the environment constitute a long-term and demanding challenge. It is only through a new and more austere manner of living, one which springs from respect for the dignity of the person, that humanity will be able to meet this challenge adequately.¹¹

In short, a renewed way of life is needed, one which will spread by way of an authentic humanism and will therefore be capable of dissuading public authorities from proposing and legalising solutions which are contrary to the true and lasting common good. It is a manner of living which, by reflecting the real interests of the individual, will help to bring about a world in which love for others is accepted as the general and normative rule.

Ladies and Gentlemen, I thank you very much for the scientific contribution which during these days you have made to a better understanding of such pressing issues. With these sentiments, I invoke divine protection upon each of you and once more offer you a cordial greeting.

⁹ Cf. *Gaudium et Spes*, n. 24.

¹⁰ *Ibid.*, n. 51.

¹¹ Cf. *Dignitatis Humanae*, n. 3.

31 OCTOBER 1992

Address to the Plenary Session on 'The Emergence of Complexity in Mathematics, Physics, Chemistry and Biology'

The Supreme Pontiff declares that contemporary culture, during this age of specialisation, requires a 'constant effort to synthesise knowledge and to integrate learning'. Otherwise the world runs the risk of having a 'shattered culture': 'a true culture cannot be conceived of without humanism and wisdom'. The Pope then dwells in detail on the Galileo case and observes that theologians should keep themselves regularly informed about scientific advances. He states clearly that the myth of the Galileo case had encouraged the erroneous idea that science and the Christian faith were in opposition but declares that this 'sad misunderstanding now belongs to the past'. Human advance takes place both through an individual drawing closer to God and through the development of culture, scientific research and technology.

Your Eminences,
Your Excellencies,
Ladies and Gentlemen,

1. The conclusion of the plenary session of the Pontifical Academy of Sciences gives me the pleasant opportunity to meet its illustrious members, in the presence of my principal collaborators and the Heads of the Diplomatic Missions accredited to the Holy See. To all of you I offer a warm welcome.

My thoughts go at this moment to Professor Marini-Bettòlo, who is prevented by illness from being among us, and, assuring him of my prayers, I express fervent good wishes for his restoration to health.

I would also like to greet the members taking their seats for the first time in this Academy; I thank them for having brought to your work the contribution of their lofty qualifications.

In addition, it is a pleasure for me to note the presence of Professor Adi Shamir, of the Weizmann Institute of Science at Rehovot, Israel, holder of the Pius XI Gold Medal, awarded by the Academy, and to offer him my cordial congratulations.

Two subjects in particular occupy our attention today. They have just been ably presented to us, and I would like to express my gratitude to Cardinal Paul Poupard and Fr. George V. Coyne for having done so.

2. In the first place, I wish to congratulate the Pontifical Academy of Sciences for having chosen to deal, in its plenary session, with a problem of great importance and great relevance today: the problem of 'the emergence of complexity in mathematics, physics, chemistry and biology'.

The emergence of the subject of complexity probably marks in the history of the natural sciences a stage as important as the stage which bears relation to the name of Galileo, when a univocal model of order seemed to be obvious. Complexity indicates precisely that, in order to account for the rich variety of reality, we must have recourse to a number of different models.

This realisation poses a question which concerns scientists, philosophers and theologians: how are we to reconcile the explanation of the world – beginning with the level of elementary entities and phenomena – with the recognition of the fact that ‘the whole is more than the sum of its parts’?

In his effort to establish a rigorous description and formalisation of the data or experience, the scientist is led to have recourse to *metascientific concepts*, the use of which is, as it were, demanded by the logic of his procedure. It is useful to state exactly the nature of these concepts in order to avoid proceeding to undue extrapolations which link strictly scientific discoveries to a vision of the world, or to ideological or philosophical affirmations, which are in no way corollaries of it. Here one sees the importance of philosophy which considers phenomena just as much as their interpretation.

3. Let us think, for example, of the working out of new theories at the scientific level in order to take account of *the emergence of living beings*. In a correct method, one could not interpret them immediately and in the exclusive framework of science. In particular, when it is a question of the living being which is man, and of his brain, it cannot be said that these theories of themselves constitute an affirmation or a denial of the spiritual soul, or that they provide a proof of the doctrine of creation, or that, on the contrary, they render it useless.

A further work of interpretation is needed. *This is precisely the object of philosophy*, which is the study of the global meaning of the data of experience, and therefore also of the phenomena gathered and analysed by the sciences.

Contemporary culture demands *a constant effort to synthesise knowledge and to integrate learning*. Of course, the successes which we see are due to the specialisation of research. But unless this is balanced by a reflection concerned with articulating the various branches of knowledge, there is a great risk that we shall have a ‘shattered culture’, which would in fact be the negation of true culture. A true culture cannot be conceived of without humanism and wisdom.

4. I was moved by similar concerns on 10 November 1979, at the time of the first centenary of the birth of Albert Einstein, when I expressed the hope before this same Academy that ‘theologians, scholars, and historians,

animated by a spirit of sincere collaboration, will study the *Galileo case* more deeply and, in frank recognition of wrongs from whatever side they come, dispel the mistrust that still opposes, in many minds, a fruitful concord between science and faith'.¹ A Study Commission was constituted for this purpose on 3 July 1981. The very year when we are celebrating the 350th anniversary of Galileo's death, the Commission is presenting today, at the conclusion of its work, a number of publications which I value highly. I would like to express my sincere gratitude to Cardinal Poupard, who was entrusted with coordinating the Commission's research in its concluding phase. To all the experts who in any way took part in the proceedings of the four groups that guided this multidisciplinary study, I express my profound satisfaction and my deep gratitude. The work that has been carried out for more than ten years responds to a guideline suggested by the Second Vatican Council and enables us to shed more light on several important aspects of the question. In the future, it will be impossible to ignore the Commission's conclusions.

One might perhaps be surprised that, at the end of the Academy's study week on the subject of the emergence of complexity in the various sciences, I am returning to the Galileo case. Has not this case long been shelved and have not the errors committed been recognised?

That is certainly true. However, *the underlying problems of this case concern both the nature of science and the message of faith*. It is therefore not to be excluded that one day we shall find ourselves in a similar situation, one which will require both sides to have an informed awareness of the field and of the limits of their own competencies. The approach provided by the theme of complexity could provide an illustration of this.

5. *A twofold question* is at the heart of the debate of which Galileo was the centre.

The first is of the epistemological order and concerns *biblical hermeneutics*. In this regard, two points must again be raised. In the first place, like most of his adversaries, Galileo made no distinction between the scientific approach to natural phenomena and a reflection on nature, of the philosophical order, which that approach generally calls for. That is why he rejected the suggestion made to him to present the Copernican system as a hypothesis, inasmuch as it had not been confirmed by irrefutable proof. Such, therefore, was *an exigency of the experimental method* of which he was the inspired founder.

¹ AAS 71 (1979), pp. 1464-1465.

Secondly, the geocentric representation of the world was commonly admitted in the culture of the time as fully agreeing with the teaching of the Bible, of which certain expressions, taken literally, seemed to affirm geocentrism. The problem posed by theologians of that age was, therefore, that of the compatibility between heliocentrism and Scripture.

Thus the new science, with its methods and the freedom of research which they implied, obliged theologians to examine their own criteria of scriptural interpretation. Most of them did not know how to do so.

Paradoxically, Galileo, a sincere believer, showed himself to be more perceptive in this regard than the theologians who opposed him. 'If Scripture cannot err', he wrote to Benedetto Castelli, 'certain of its interpreters and commentators can and do so in many ways'.² We also know of his letter to Christine de Lorraine (1615) which is like a short treatise on biblical hermeneutics.³

6. From this we can now draw our first conclusion. The birth of a new way of approaching the study of natural phenomena demands *a clarification on the part of all disciplines of knowledge*. It obliges them to define more clearly their own field, their approach, their methods, as well as the precise import of their conclusions. In other words, this new way requires each discipline to become more rigorously aware of its own nature.

The upset caused by the Copernican system thus demanded epistemological reflection on the biblical sciences, an effort which later would produce abundant fruit in modern exegetical works and which found sanction and a new stimulus in the Dogmatic Constitution *Dei Verbum* of the Second Vatican Council.

7. The crisis that I have just recalled is not the only factor to have had repercussions on biblical interpretation. Here we are concerned with *the second aspect of the problem, its pastoral dimension*.

By virtue of her own mission, the Church has the duty to be attentive to the pastoral consequences of her teaching. Before all else, let it be clear that this teaching must correspond to the truth. But it is a question of knowing how to judge a new scientific datum when it seems to contradict the truths of faith. The pastoral judgement which the Copernican theory required was difficult to make, in so far as geocentrism seemed to be a part of scriptural

² Letter of 21 November 1613, in *Edizione Nazionale delle Opere di Galileo Galilei*, dir. A. Favaro, edition of 1968, vol. V, p. 282.

³ Letter to Christine de Lorraine, 1615, in *Edizione Nazionale delle Opere di Galileo Galilei*, dir. A. Favaro, edition of 1968, vol. V, pp. 307-348.

teaching itself. It would have been necessary all at once to overcome habits of thought and to devise a way of teaching capable of enlightening the people of God. Let us say, in a general way, that the pastor ought to show a genuine boldness, avoiding the double trap of a hesitant attitude and of hasty judgement, both of which can cause considerable harm.

8. *Another crisis*, similar to the one we are speaking of, can be mentioned here. In the last century and at the beginning of our own, advances in the historical sciences made it possible to acquire *a new understanding of the Bible and of the biblical world*. The rationalist context in which these data were most often presented seemed to make them dangerous to the Christian faith. Certain people, in their concern to defend the faith, thought it necessary to reject firmly-based historical conclusions. That was a hasty and unhappy decision. The work of a pioneer like Fr. Lagrange was able to make the necessary discernment on the basis of dependable criteria.

It is necessary to repeat here what I said above. It is a duty for theologians to keep themselves regularly informed of scientific advances in order to examine, if such be necessary, whether or not there are reasons for taking them into account in their reflection or for introducing changes in their teaching.

9. If contemporary culture is marked by a tendency to scientism, the cultural horizon of Galileo's age was uniform and carried the imprint of a particular philosophical formation. This unitary character of culture, which in itself is positive and desirable even in our own day, was one of the reasons for Galileo's condemnation. The majority of theologians did not recognise *the formal distinction between Sacred Scripture and its interpretation*, and this led them unduly to transpose into the realm of the doctrine of the faith a question which in fact pertained to scientific investigation.

In fact, as Cardinal Poupard has recalled, Robert Bellarmine, who had seen what was truly at stake in the debate, personally felt that, in the face of possible scientific proofs that the earth orbited round the sun, one should 'interpret with great circumspection' every biblical passage which seems to affirm that the earth is immobile and 'say that we do not understand, rather than affirm that what has been demonstrated is false'.⁴ Before Bellarmine, this same wisdom and same respect for the divine Word guided St. Augustine when he wrote: 'If it happens that the authority of Sacred Scripture is set in opposition to clear and certain reasoning, this must mean

⁴ Letter to Fr. A. Foscarini, 12 April 1615, cf. *Edizione Nazionale delle Opere di Galileo Galilei*, dir. A. Favaro, vol. XII, p. 172.

that the person who *interprets Scripture* does not understand it correctly. It is not the meaning of Scripture which is opposed to the truth, but the meaning which he has wanted to give to it. That which is opposed to Scripture is not what is in Scripture but what he has placed there himself, believing that this is what Scripture meant'.⁵ A century ago, Pope Leo XIII echoed this advice in his Encyclical *Providentissimus Deus*: 'Truth cannot contradict truth, and we may be sure that some mistake has been made either in the interpretation of the sacred words, or in the polemical discussion itself'.⁶

Cardinal Poupard has also reminded us that the sentence of 1633 was not irreformable, and that the debate, which had not ceased to evolve thereafter, was closed in 1820 with the *imprimatur* given to the work of Canon Settele.⁷

10. From the beginning of the Age of Enlightenment down to our own day, *the Galileo case* has been a sort of 'myth', in which the image fabricated out of the events was quite far removed from reality. In this perspective, the Galileo case was the symbol of the Church's supposed rejection of scientific progress, or of 'dogmatic' obscurantism opposed to the free search for truth. This myth has played a considerable cultural role. It has helped to anchor a number of scientists of good faith in the idea that there was an incompatibility between the spirit of science and its rules of research on the one hand and the Christian faith on the other. *A tragic mutual incomprehension* has been interpreted as the reflection of a fundamental opposition between science and faith. The clarifications furnished by recent historical studies enable us to state that this sad misunderstanding now belongs to the past.

11. From the Galileo affair we can learn a *lesson which remains valid* in relation to similar situations which occur today and which may occur in the future.

In Galileo's time, to depict the world as lacking an absolute physical reference point was, so to speak, inconceivable. And since the cosmos, as it was then known, was contained within the solar system alone, this reference point could only be situated in the earth or in the sun. Today, after Einstein and within the perspective of contemporary cosmology, neither of these two

⁵ St. Augustine, *Epist.* 143, 7; *PL* 33, 588.

⁶ *Leonis XIII Pont. Max. Acta*, vol. XIII (1894), p. 361.

⁷ Cf. Pontificia Academia Scientiarum, *Copernico, Galilei e la Chiesa. Fine della controversia (1820). Gli Atti del Sant'Uffizio*, edited by W. Brandmüller, E.J. Greipl and Leo Olschki (Florence, 1992).

reference points has the importance they once had. This observation, it goes without saying, is not directed against the validity of Galileo's position in the debate; it is only meant to show that often, beyond two partial and contrasting perceptions, *there exists a wider perception which includes them and goes beyond both of them.*

12. Another lesson which we can draw is that *the different branches of knowledge call for different methods.* Thanks to his intuition as a brilliant physicist and by relying on different arguments, Galileo, who practically invented the experimental method, understood why only the sun could function as the centre of the world, as it was then known, that is to say, as a planetary system. The error of the theologians of the time, when they maintained the centrality of the earth, was to think that our understanding of the physical world's structure was, in some way, imposed by the literal sense of Sacred Scripture. Let us recall the celebrated saying attributed to Baronius: '*Spiritui Sancto mentem fuisse nos docere quomodo ad coelum eatur, non quomodo coelum gradiatur*'. In fact, the Bible does not concern itself with the details of the physical world, the understanding of which is the competence of human experience and reasoning. There exist two realms of knowledge, one which has its source in Revelation and one which reason can discover by its own power. To the latter belong especially the experimental sciences and philosophy. The distinction between the two realms of knowledge ought not to be understood as opposition. The two realms are not altogether foreign to each other; they have points of contact. The methodologies proper to each make it possible to bring out different aspects of reality.

13. Your Academy conducts its work with this outlook. Its principal task is to promote the advancement of knowledge, with respect for the legitimate freedom of science⁸ which the Apostolic See expressly acknowledges in the statutes of your institution.

What is important in a scientific or philosophic theory is above all that it should be true or, at least, seriously and solidly grounded. And *the purpose of your Academy* is precisely *to discern and to make known*, in the present state of science and within its proper limits, *what can be regarded as an acquired truth* or at least as enjoying such a degree of probability that it would be imprudent and unreasonable to reject it. In this way unnecessary conflicts can be avoided.

The seriousness of scientific knowledge will thus be the best contribution that the Academy can make to the exact formulation and solution of the

⁸ Cf. *Gaudium et Spes*, n. 36, § 2.

serious problems to which the Church, by virtue of her specific mission, is obliged to pay close attention – problems no longer related merely to astronomy, physics and mathematics, but also to relatively new disciplines such as *biology* and *biogenetics*. Many recent scientific discoveries and their possible applications *affect man more directly than ever before*, his thought and action, to the point of seeming to threaten the very basis of what is human.

14. Humanity has before it *two modes of development*. The first involves culture, scientific research and technology, that is to say *whatever falls within the horizontal aspect of man* and creation, which is growing at an impressive rate. In order that this progress should not remain completely external to man, it presupposes a simultaneous raising of conscience, as well as its actuation. The second mode of development involves what is deepest in the human being, when, transcending the world and transcending himself, man turns to the One who is the Creator of all. It is only this *vertical direction* which can give full meaning to man's being and action, because it situates him in relation to his origin and his end. In this twofold direction, horizontal and vertical, man realises himself fully as a spiritual being and as *homo sapiens*. But we see that development is not uniform and linear, and that progress is not always well ordered. This reveals the disorder which affects the human condition. The scientist who is conscious of this twofold development and takes it into account contributes to the restoration of harmony.

Those who engage in scientific and technological research admit, as the premise of its progress, that the world is not a chaos but a 'cosmos'; that is to say, that there exist order and natural laws which can be grasped and examined, and which, for this reason, have a certain affinity with the spirit. Einstein used to say: 'What is eternally incomprehensible in the world is that it is comprehensible'.⁹ This intelligibility, attested to by the marvellous discoveries of science and technology, leads us, in the last analysis, to that transcendent and primordial Thought imprinted on all things.

Ladies and Gentlemen, in concluding these remarks, I express my best wishes that your research and reflection will help to give our contemporaries useful directions for building a harmonious society in a world more respectful of what is human. I thank you for the service you render to the Holy See, and I ask God to fill you with his gifts.

⁹ In *The Journal of the Franklin Institute*, vol. 221, n. 3, March 1936.

31 OCTOBER 1992

*His Eminence Cardinal Paul Poupard, President of the Pontifical Council
for Culture, Addressed the Holy Father in the Name of the Pontifical
Commission on the Galileo Case,
Giving a Summary of the Conclusions Reached*

Most Holy Father,

Nearly thirteen years have now passed since you received the Pontifical Academy of Sciences, in this same *Sala Regia*, for the first centenary of the birth of Albert Einstein, and again directed the attention of the world of culture and of science to another scholar, Galileo Galilei.¹

1. *You expressed the hope that interdisciplinary research would be undertaken to explore the difficult relations of Galileo with the Church.* You also established, on 3 July 1981, a Pontifical Commission for the study of the Ptolemaic-Copernican controversy of the 16th and 17th centuries, to which the Galileo case belongs² and you had entrusted to Cardinal Garrone responsibility for coordinating the research. You have asked me to give an account of their results.

That Commission was made up of four working groups, with the following chairmen: Cardinal Carlo M. Martini for the exegetical section; myself for the cultural section; Prof. Carlos Chagas and Fr. George V. Coyne for the scientific and epistemological section; Msgr. Michele Maccarrone for historical and juridical questions; Fr. Enrico di Rovasenda served as secretary.

Calm and objective reflection undertaken

The aim of these groups was to reply to the expectations of the world of science and culture regarding the Galileo question, to rethink this whole question, with complete fidelity to established historical facts and in conformity with the teachings and the culture of the times, and to recognise honestly, in the spirit of the Second Vatican Council, the right and the wrongs, regardless of their source. It was not a question of conducting a

¹ Address of Pope John Paul II to the Pontifical Academy of Sciences, 10 November 1979, in *AAS* 81 (1979), pp. 1464-1465.

² Cf. *Edizione Nazionale delle Opere di Galileo Galilei*, edited by Antonio Favaro (Florence, Giunti Barbèra, 1890-1909); reprinted, 1929-1939. 20 vols. Cf. Mons. Pio Paschini, *Vita e Opere di Galileo Galilei*, 2 vols., Libreria Editrice Vaticana (1964), cited in *Gaudium et Spes*, Part I, Ch. 3, n. 36, 'Rightful Autonomy of Earthly Affairs', note 7.

retrial but of undertaking a calm and objective reflection, taking into account the historical and cultural context. The investigation was broad, exhaustive and carried out in all the areas involved. And the series of studies, theses and publications of the Commission have also stimulated numerous studies in various spheres.

2. *The Commission addressed three questions: What happened? How did it happen? Why did it happen? The answers to these three questions, answers based upon a critical investigation of the texts, throw light on a number of important points.*

The critical edition of the documents, and in particular of items from the Vatican Secret Archives, enables one to consult easily and with all the desirable guarantees the complete record of the two trials and especially the detailed account of the interrogations to which Galileo was subjected.³ The publication of Cardinal Bellarmine's declaration to Galileo, together with that of other documents, clarifies the intellectual horizon of that key person of the whole affair.⁴ The editing and publication of a series of studies have cast light on the cultural, philosophical and theological context of the 17th century.⁵ They have also led to a clearer understanding of the positions taken by Galileo with respect to the decrees of the Council of Trent⁶ and to the exegetical orientations of his time,⁷ and this has made possible a careful appraisal of the immense literature dedicated to Galileo, from the Enlightenment down to our own day.⁸

³ *I Documenti del Processo di Galileo Galilei*, edited by Fr. Sergio M. Pagano, Pontificiae Academiae Scientiarum, *Scripta Varia*, 53 (Vatican City, 1984). Cf. M. d'Addio, *Considerazioni sui processi a Galileo*, Quaderni della Rivista della Chiesa in Italia n. 8 (Rome, Herder Editrice e Libreria, 1985).

⁴ *The Louvain Lectures (Lectiones Lovanienses) of Bellarmine and the Autograph Copy of his 1616 Declaration to Galileo*, Ugo Baldini and Fr. George V. Coyne, ed., Texts, Commentary and Notes, Studi Galileiani, vol. I, n. 2, Specola Vaticana (1984).

⁵ *Galileo Galilei, 350 ans d'histoire, 1633-1983*, under the direction of Cardinal Paul Poupard, Coll. *Cultures et Dialogue* n. 1 (Paris, Desclée International, 1983); *Galileo Galilei, 350 anni di storia (1633-1983)*, Studi e Ricerche, Coll. *Culture e Dialogo* n. 1 (Casale Monferrato, AL, Piemme, 1984); *Galileo Galilei: Toward a Resolution of 350 Years of Debate, 1633-1983* (Pittsburgh, PA, Duquesne University Press, 1986). *Sprawa Galileusza, Wybór i redakcja* J. Zycinski, Znak (Kraków, 1991).

⁶ O. Pedersen *Galileo and the Council of Trent*, Studi Galileiani, vol. I, n. 1, Specola Vaticana (1983).

⁷ R. Fabris, *Galileo Galilei e gli orientamenti esegetici del suo tempo*, Pontificiae Academiae Scientiarum, *Scripta Varia*, 62 (Vatican City, 1986).

⁸ *The Galileo Galilei Affair. A Meeting of Faith and Science. Proceedings of the Cracow Conference 1984*, G. Coyne, M. Heller, J. Zycinski eds., Vatican Observatory Publications, vol. I, n. 3 (1985). J. Zycinski, *The Idea of Unification in Galileo's Epistemology*, *Ibid.*, vol. I, n. 4 (1988); R.S.

Cardinal Bellarmine asked the two real questions

Cardinal Robert Bellarmine, in a letter of 12 April 1615 to the Carmelite Foscarini, had already stated the two real questions raised by Copernicus' system: is Copernican astronomy *true*, in the sense that it is *supported by real and verifiable proofs*, or does it rest only on conjectures or probabilities? Are the Copernican theses *compatible* with the statements of Sacred Scripture? According to Robert Bellarmine, as long as there was no proof that the earth orbited round the sun, it was necessary to interpret with great circumspection the biblical passages declaring the earth to be immobile. If the orbiting of the earth were ever demonstrated to be certain, then theologians, according to him, would have *to review their interpretations* of the biblical passages apparently opposed to the new Copernican theories, so as to avoid asserting the error of opinions which had been proved to be true: 'I say that if it were really demonstrated that the sun is at the centre of the world and the earth is in the third heaven, and that it is not the sun which revolves round the earth, but the earth round the sun, then it would be necessary to proceed with great circumspection in the explanation of Scriptural texts which seem contrary to this assertion and to say that we do not understand them, rather than to say that what is demonstrated is false'.⁹

3. *In fact, Galileo had not succeeded in proving irrefutably* the double motion of the earth – its annual orbit round the sun and its daily rotation on the polar axis – when he was convinced that he had found proof of it in the ocean tides, the true origin of which only Newton would later demonstrate. Galileo proposed tentative proof in the existence of the trade winds, but at that time no one had the knowledge necessary for drawing therefrom the necessary clarifications.

More than 150 years still had to pass before the optical and mechanical proofs for the motion of the earth were discovered. For their part, Galileo's adversaries, neither before nor after him, have discovered anything which could constitute a convincing refutation of Copernican astronomy. The facts were unavoidably clear, and they soon showed the relative character of

Westfall, *Essays on the Trial of Galileo, Ibid.*, vol. I, n. 5 (1989); W. Brandmüller, *Galilei und die Kirche oder Das Recht auf Irrtum*, Pustet (Regensburg, 1982); *Galileo y la Iglesia*, Rialp (Madrid, 1987); *Galilei e la Chiesa ossia il diritto ad errare*, Libreria Editrice Vaticana (Vatican City, 1992).

⁹ Letter of Cardinal Bellarmine to the Carmelite Fr. Foscarini, 12 April 1615: '... Dico che quando ci fusse vera dimostrazione che il sole stia nel centro del mondo e la terra nel 3° cielo, e che il sole non circonda la terra, ma la terra circonda il sole, allhora bisogneria andar con molta considerazione in esplicare le Scritture che paiono contrarie, e più tosto dire che non l'intendiamo, che dire che sia falso quello che si dimostra', *Opere di Galileo Galilei*, op. cit., vol. XII, p. 172.

the sentence passed in 1633. This sentence was not irreformable. In 1741, in the face of the optical proof of the fact that the earth revolves round the sun, Benedict XIV had the Holy Office grant an imprimatur to the first edition of the *Complete Works of Galileo*.

All involved in trial had good faith

4. *This implicit reform of the 1633 sentence became explicit* in the decree of the Sacred Congregation of the Index which removed from the 1757 edition of the *Catalogue of Forbidden Books* works favouring the heliocentric theory. Despite this decree, however, there were many who remained hesitant about admitting the new interpretation. In 1820, Canon Settele, Professor at the University of Rome *La Sapienza*, was preparing to publish his *Elements of Optics and Astronomy*. He came up against the refusal of Father Anfossi, Master of the Sacred Palace, to grant the *imprimatur*. This incident gave the impression that the 1633 sentence had indeed remained unreformed because it was unreformable. The unjustly censured author lodged an appeal with Pope Pius VII, from whom in 1822 he received a favourable decision. A decisive fact was this: Father Olivieri, former Master General of the Order of Preachers and Commissary of the Holy Office, drew up a report favouring the granting of the *imprimatur* to works presenting Copernican astronomy as a *thesis*, and no longer as a mere hypothesis.¹⁰

This papal decision was to receive its practical application in 1846, with the publication of a new and updated Index.¹¹

5. *In conclusion, a rereading of the archival documents* shows once more that all those involved in the trial, without exception, have a right to the benefit of good faith, in the absence of extra-procedural documents showing the contrary. The philosophical and theological qualifications wrongly granted to the then new theories about the centrality of the sun and the movement of the earth were the result of a transitional situation in the field of astronomical knowledge, and of an exegetical confusion regarding cosmology. Certain theologians, Galileo's contemporaries, being heirs of a unitary concept of the world universally accepted until the dawn of the 17th century, failed to grasp the profound, non-literal meaning of the Scriptures when they describe the physical structure of the created universe. This led them unduly to transpose a question of factual observation into the realm of faith.

¹⁰ P. Maurizio Benedetto Olivieri, O.P., *Di Copernico e di Galileo*, scritto postumo (Bologna, 1872).

¹¹ Cf. Pont. Acad. Scientiarum, *Copernico, Galilei e la Chiesa. Fine della controversia* (1820). *Gli Atti del Sant'Uffizio*, edited by W. Brandmüller, E.J. Greipl and Leo Olschki (Florence, 1992).

It is in that historical and cultural framework, far removed from our own times, that Galileo's judges, incapable of dissociating faith from an age-old cosmology, believed, quite wrongly, that the adoption of the Copernican revolution, in fact not yet definitively proven, was such as to undermine Catholic tradition, and that it was their duty to forbid its being taught. This subjective error of judgement, so clear to us today, led them to a disciplinary measure from which Galileo 'had much to suffer'. These mistakes must be frankly recognised, as you, Holy Father, have requested.

These are the results of the interdisciplinary enquiry which you asked the Commission to undertake. All its members, through myself, thank you for the honour and trust which you have shown to them in leaving them the fullest latitude to explore, research and publish, in the complete freedom which scientific studies demand.

May Your Holiness deign to accept the Commission's fervent and filial homage.

22 OCTOBER 1993

*Address to the Working Group on the Subject
'Chemical Hazards in Developing Countries'*

John Paul II stresses the harmful effects of chemical pollution especially in developing countries. Peoples and nations must be moved by solidarity in their relations with each other. Thus developing countries have a high moral duty 'to assist the developing countries in their efforts to solve their chemical pollution and health hazard problems'. The international community should act to defend and promote the environment at a time when the balance of ecosystems is of great importance for the future of 'human survival and well-being'. This constitutes part of the Christian's duty to respect the work of God.

Distinguished Men and Women of Science,
Ladies and Gentlemen,

1. It gives me great pleasure to meet you, participants in the workshop on 'Chemical Hazards in Developing Countries' organised by the Pontifical Academy of Sciences in conjunction with the Royal Swedish Academy of Sciences, and with the support of the Swedish Wenner-Gren Foundation. The very enunciation of the subject of your meeting highlights the importance and timeliness of your reflections. Who cannot but be deeply concerned by the prospect of the already existing and ever expanding danger from pollution and other side effects of the production and use of chemicals? Indeed, your discussions, reflecting the highest levels of scientific competence, will be of great relevance to the growing public concern about the environment. I am confident that the publication of your studies and proposals will be of interest to the appropriate agencies and to governments, both in industrialised and in developing countries.

2. In most industrialised countries, attention is paid to the risks to human beings and to the environment from man-made chemicals. In some countries regulations are in place. But in developing countries, where most chemical hazards have their origin in the import of chemical substances and technologies, a lack of expertise and of necessary infrastructures often renders efficient control difficult or impossible. Very few countries, in fact, have a specific legislation regulating the handling and use of toxic chemicals. Other problems in developing countries concern the introduction of highly polluting industries, not subject to the more rigorous control that is applied in developed countries. It is a serious abuse and an offence against

human solidarity when industrial enterprises in the richer countries profit from the economic and legislative weakness of poorer countries to locate production plants or accumulate waste which will have a degrading effect on the environment and on people's health.

The answer, certainly, is not to deny developing countries the imports and technologies they need, especially when these have to do with food production and the setting up of basic industries: 'Peoples or nations too have a right to their full development'.¹ In fact, development, which ensures the conditions required for the exercise of fundamental rights, belongs to the domain of universal human rights. It is a direct consequence of the universal destination of the goods of creation.

3. Although primarily scientific and technical, your workshop is not without great interest also for the Church: not in the sense that the Church has any particular scientific competence in the field, but in the sense that what is in question cannot be divorced from the ethical and moral character of the development which has given rise to this problem.

A fundamental principle of the Church's approach to development is expressed succinctly in the words of my predecessor Pope Paul VI: 'Development cannot be limited to mere economic growth. In order to be authentic, it must be complete: integral, that is, it has to promote the good of every person and of the whole person'.² This does not mean that the Christian holds a negative view of the greater availability of material goods and the spreading of those industries which produce them. It means – as I have written elsewhere – that 'development cannot consist only in the use, dominion over and indiscriminate possession of created things and the products of human industry, but rather in subordinating the possession, dominion and the use to man's divine likeness and to his vocation to immortality'.³

Man's spiritual nature and his transcendent vocation imply a fundamental solidarity between people, whereby we are all responsible for each other. Respect for the natural environment and the correct and moderated use of the resources of creation are a part of each individual's moral obligations towards others. This truth applies also to relations between peoples and nations. In this context the technical dimension of the subject of your discussions is inseparable from its moral aspects. It would be difficult to

¹ *Sollicitudo Rei Socialis*, n. 32.

² *Populorum Progressio*, n. 14.

³ *Sollicitudo Rei Socialis*, n. 29.

overstate the weight of the moral duty incumbent on developing countries to assist the developing countries in their efforts to solve their chemical pollution and health hazard problems.

4. The international community, for its part, should continue to promote global agreements regarding the production, trade and handling of hazardous substances. In the 1990 World Day of Peace Message I wrote that, 'the concepts of an ordered universe and a common heritage both point to the necessity of a more internationally coordinated approach to the management of the earth's goods'.⁴ Specifically in relation to the environment, I noted that 'the right to a safe environment is ever more insistently presented today as a right that must be included in an updated Charter of Human Rights'.⁵ The 1992 United Nations Environmental Conference in Rio de Janeiro took steps in this regard, and in Chapter 19 of Agenda 21 several actions, which are especially relevant to developing regions, are recommended. The Holy See gladly agrees with the proposal in Agenda 21 that recommends the setting up of an International Forum on Chemical Safety, with the purpose of giving developing countries assistance to increase their competence and capacity in this field.

5. The human family is at a cross-roads in its relationship to the natural environment. Not only is it necessary to increase efforts to educate in a keen awareness of solidarity and interdependence among the world's peoples. It is also necessary to insist on the interdependence of the various ecosystems and on the importance of the balance of these systems for human survival and well-being. Mere utilitarian considerations or an aesthetic approach to nature cannot be a sufficient basis for a genuine education in ecology. We must all learn to approach the environmental question with solid ethical convictions involving responsibility, self-control, justice and fraternal love.

For believers, this outlook springs directly from their relationship to God the Creator of all that exists. For Christians, respect for God's handiwork is reinforced by their certain hope of the restoration of all things in Jesus Christ, in whom 'all the fullness of God was pleased to dwell, and through him to reconcile to himself all things, whether on earth or in heaven, making peace by the blood of his cross'.⁶

⁴ N. 9.

⁵ John Paul II, *1990 World Day of Peace Message*, n. 9.

⁶ *Col* 1:19-20.

6. Ladies and Gentlemen, I wish to encourage you in your commitment. I pray that your workshop will be successful in suggesting guidelines for controlling the problem of chemical pollution and consequent health hazards in developing countries, and that it will offer valid recommendations for the protection of the environment, the food chain and human health in different parts of the world.

Upon all of you I invoke abundant divine blessings.

20 NOVEMBER 1993

*Address to the Working Group on the Subject
'The Legal and Ethical Aspects of the Human Genome Project'*

The Pope declares that research into the human genome must involve 'respect for the life and integrity of the subject'. Science cannot answer all truths; moral criteria for attaining what is good must be sought in the dignity of the human person. Application of knowledge in this field could 'represent a formidable threat to the human being'. The human embryo can never be used as a 'pure object of analysis or experimentation' and should be 'recognised as a legal subject by the laws of nations lest humanity be endangered'. In conclusion, John Paul II renews his appeal to the scientific community 'that the meaning of man and moral values remain the basis for decisions in the field of research'.

Your Excellencies,
Reverend Fathers,
Ladies and Gentlemen,

1. Your working sessions on the subject 'the legal and ethical aspects of the human genome project' are taking place at a particularly opportune moment. Recent news of experimentation in human genetics has overwhelmed the scientific community and many of our contemporaries. In the face of rapid scientific progress, ethical and legal reflection on such serious issues seems urgent as this century draws to a close.

2. I must first acknowledge *the numerous efforts of scientists, researchers and doctors who are dedicated to deciphering the human genome* and to analysing the results to gain greater knowledge of molecular biology and the genetic causes of many diseases. One cannot but encourage these studies, as long as they lead to new horizons in genetic treatment and therapy with respect for the life and integrity of the subject, and seek the individual protection or cure of patients, born or unborn, who are affected by what prove most frequently to be lethal pathologies. One must not, however, overlook the fact that these discoveries risk being used for the selection of embryos, eliminating those affected by genetic diseases or which are carriers of pathological genetic traits.

The constant improvement of our knowledge of the living being is in itself good because the search for the truth is inherent in man's primordial vocation and is the first praise addressed to the Creator 'who shapes each

man's beginning as he brings about the origin of everything'.¹ *Human reason*, endowed with innumerable powers and varying activities, combines *scientific reason and ethical reason*. It is capable of perfecting experimental procedures to learn more about creation, and at the same time reminds us of the obligations of the moral law at the service of human dignity. The desire to acquire knowledge, therefore, cannot be science's sole motive and justification, as we are sometimes tempted to think, at the risk of endangering the aim of the medical process: to seek, in an inseparable way, the good of the individual and of all humanity.

Because it enables us to discover the infinitely great and the infinitely small, and achieves impressive results, *science is seductive and fascinating*. But we should remember that even though it may be able to explain biological functions and the interaction of molecules, *alone it cannot express the ultimate truth and offer the happiness* that man seeks to attain, nor dictate moral criteria for attaining the good. Indeed, the latter are not established on the basis of what is technically possible; they are not deduced from the findings of experimental sciences but must be 'sought in the dignity proper to the human person'.²

3. *The project that consists in deciphering the sequences of the human genome and in studying their macro-molecular structure in order to determine each individual's genetic map*, makes certain knowledge available to doctors and biologists. Some of the applications of this knowledge could reach beyond the medical field, and represent *a formidable threat to the human being*. It is enough to recall the many forms of eugenics or discrimination connected with the possible uses of prognostic medicine. In the light of recent research, the responsibility of the entire human community is called upon to ensure the respect due to the human person. According to their capacities, spiritual families, moralists, philosophers, lawyers and political authorities will exercise their vigilance to ensure that every scientific process respects the integrity of the human person, 'an ever urgent need'.³

4. It is therefore important to *take stock of the moral problems* that have bearing not on knowledge itself, but on *the means of acquiring knowledge as well as on its possible or predictable applications*. Indeed, we know that today we are able to acquire knowledge of the human genome without

¹ 2 M 7:23.

² Cf. *Veritatis Splendor*, n. 50.

³ *Ibid.*, n. 13.

the slightest injury to the subject. Thus the first moral criterion to guide all research is respect for the human being on whom the research is being carried out. But certain discoveries, which appear to be technical achievements or scientific feats, could be at the root of a certain tension for the scientific spirit itself: on the one hand they cause admiration at the ingenuity displayed, and on the other, the frequently justifiable fear that the human person's dignity might be seriously harmed or jeopardised. This tension is all to the credit of those who reflect on the values that guide their choices as regards research, for they indicate the ethical sense that is naturally present in all consciences.

5. It is not the Church's task to establish the scientific and technical criteria of medical research, but it is up to the Church, *in the name of her mission and her centuries-old tradition, to recall the limits within which any process is beneficial to man*, for freedom must always be ordered to the good. In Christ, the Church contemplates the perfect Man, the model *par excellence* of all men and the way to eternal life; she wishes to offer lines of thought, to enlighten her brothers and sisters in humanity and to propose to them the moral values necessary for action, which may also serve as indispensable reference points for researchers led to take decisions in which the dignity of man is involved. In fact, Revelation alone leads to man's integral knowledge, which philosophic wisdom and scientific disciplines can apprehend in a gradual and marvellous way, but which is always uncertain and incomplete.

6. *Each human being must be considered and 'respected as a person from the very moment of his conception'*,⁴ consisting of a body and a spiritual soul and possessing an intrinsic value;⁵ for the Church this is the guiding principle for the development of research. The human person is not defined according to his present or future activity nor obliged to become what is glimpsed of him in the genome, but according to the essential qualities of his being, the capacities connected with his very nature. From the moment of fertilisation, a new being cannot be reduced to its genetic inheritance, which are its biological basis and which hold the promise of life for the subject. As Tertullian says: 'he who must become a man is already a man'.⁶ In the scientific realm as in all areas, the right moral decision requires an integral view of man, in other words a conception going beyond the visible and

⁴ Congregation for the Doctrine of the Faith, *Donum Vitae* nn. 2, 8.

⁵ Cf. *Jr* 1:5.

⁶ *Apologeticum*, Bk. IX, Ch. 8.

the tangible, which recognises transcendent value and takes into account what establishes him as a spiritual being.

Consequently, *to use an embryo as a pure object of analysis or experimentation is to attack the dignity of the person and the human race*. Indeed, no one has the right to determine the threshold of humanity for an individual being, which would amount to claiming for himself an inordinate power over his fellow man.

7. Therefore at no moment in its development can the *embryo be the subject of tests that are not beneficial, or of experimentation* that would inevitably lead to its destruction or mutilation or irreversibly damage it, for man's nature itself would be mocked and wounded. The genetic inheritance is the treasure that belongs or could belong to a unique being who has the right to life and integral human growth. Thoughtless manipulations of gametes or embryos, which consist in transforming the specific sequences of the genome that bear the traits proper to the species and the individual, make humanity run the serious risk of genetic mutations that will necessarily alter the spiritual and physical integrity not only of the human beings on which these alterations are made but even more on individuals in future generations.

If it is not ordered to his good, *experimentation on man*, which first seems an achievement in the area of knowledge, risks leading to the degradation of the authentic dignity and value of what is human. In fact, the *moral criteria for research is always man in his physical and spiritual being*. The ethical sense implies not being willing to engage in research that would offend his human dignity or hamper his overall growth. This is not however to condemn researchers to ignorance; they are invited to redouble their ingenuity. With a keen sense of what a man is, they will be able to find new paths of knowledge and carry out the invaluable service, expected from them by the human community.

The use of prognostic medicine, which accompanies the sequencing of the human genome, also raises other delicate problems. In particular, there is the issue of informed consent by the adult subject on whom the genetic research is performed, as well as that of respect for confidentiality regarding the possible discovery of factors that could affect the person and his descendants. Nor should one any longer neglect the delicate issue of communicating to individuals data proving the existence, in latent form, of genetic pathologies that justify prognoses harmful to the subject's health.

8. *The Church wishes to remind legislators of their responsibility for the protection and promotion of persons*, since projects for human genome

analysis are rich in promise but also imply innumerable risks. The embryo should be recognised as a legal subject by the laws of nations lest humanity be endangered. By protecting the embryo, society is protecting every man who recognises in this tiny, defenceless being what he was at the beginning of his existence. More than any other, this earliest human frailty requires the concern of *a society that prides itself on guaranteeing respect for its weakest members*. In this way it is responding to the basic requirements of justice and solidarity that unite the human family.

9. At the end of our meeting, I would like to *renew my appeal to the scientific community that the meaning of man and moral values remain the basis for decisions in the field of research*. I hope that the reflections made by your working party may offer reference points to researchers as well as to those drafting codes of professional ethics and legal documents. My gratitude goes to those who have cooperated in different ways in these study days. I thank those who have contributed during the enriching exchanges. I thank you sincerely for your participation in this research group, which I hope will bear abundant fruit and I pray to the Almighty to help you in your efforts of moral reflection as well as in your research.

28 OCTOBER 1994

*Address to the Plenary Session on the Subject
'Human Genome; Alternative Energy Sources for Developing Countries;
the Fundamental Principles of Mathematics;
and Artificial Intelligence'*

The Supreme Pontiff observes that 'science alone cannot claim to account for the transcendent origin and ultimate purpose of human existence'. Investigation into the human genome is legitimate but this whole area must be guided by certain basic moral norms: man is more than his mere genetic inheritance; the results of such research should not be patented; knowledge in this area should not be used to destroy embryos or marginalise those affected by a genetic disease; and an individual has a right to his biological privacy. In this field, legislation must protect 'the human person and his genetic inheritance'. In discussing energy resources, the Pope affirms that 'solidarity and sharing are indispensable in creating a fair relationship between producer and consumer countries'.

Your Excellencies,
Monsignors,
Ladies and Gentlemen,

1. It is a great joy for me to meet you at the annual plenary session of the Pontifical Academy of Sciences. I extend to each of you my respectful and cordial greetings and assure you once again of my interest in and esteem for your work in the Academy.

At the beginning of our meeting, I would like first of all to honour the memory of the seven illustrious members of your assembly who died last year. I pray that the Lord may grant them their eternal reward. I hope that their contributions to the Academy's work will continue to be reference points and an invitation to pursue tirelessly your research in service to truth and to our brothers and sisters, for truth is the basis of human dignity.¹

2. Your plenary session is the occasion when you announce the appointment of the new Academicians who are called to take part in the life of the Academy because of their abilities and widely recognised achievements. I am pleased to acknowledge their appointment, which stresses the international dimension of your assembly and its openness to new scientific disciplines. It enables you to be more in touch with the constant progress of science and technology in all the continents, since the questions that our society is facing increasingly need to be illuminated by the

¹ Cf. *Veritatis Splendor*, n. 63.

sciences, which are one of the prized resources of our constantly evolving and changing world.

However, at the same time, one should not lose sight of the fact that science alone cannot claim to account for the transcendent origin and ultimate purpose of human existence; every researcher is asked to take into consideration the metaphysical and moral questions that become even more pressing when the certitude obtained by science is seen in relation to the whole truth about man.

3. On the agenda for this session, as at your previous meetings, you have given an important place to the question of the human genome, a critical issue for the future of individuals and humanity. I appreciate the fact that, in addressing this question, you are making every effort to offer an analysis to our contemporaries that combines, without contradiction, scientific findings and the integral truth about what man objectively is.

The gradual discovery of the genetic map and the increasingly detailed knowledge of genome sequencing, research that will take several more years, are an advance in scientific knowledge which first of all causes justifiable wonder, particularly with regard to the reconstruction of the DNA chain, the chemical basis of genes and chromosomes. It now seems an accepted fact that for all living species including man, DNA is the vehicle for hereditary characteristics and their transmission to successive generations. The multiple consequences for man, which cannot be totally discerned yet, hold great promise. In fact, in the not-too-distant future, we can reasonably foresee that the whole genome sequencing will open new paths of research for therapeutic purposes. Thus the sick, to whom it was impossible to give proper treatment due to frequently fatal hereditary pathologies, will be able to benefit from the treatment needed to improve their condition and possibly to cure them. By acting on the subject's unhealthy genes, it will also be possible to prevent the recurrence of genetic diseases and their transmission.

Genome research will enable man to understand himself to an unprecedented degree. In particular, it will be possible to perceive genetic influences more clearly and to distinguish them from those stemming from the natural and cultural surroundings and those associated with the individual's own experience. In addition, by shedding light on the web of influences within which man exercises his freedom, we will arrive at a clearer understanding of this mysterious reality.

Some, perhaps, will be tempted to seek a purely scientific explanation of human freedom and to consider this sufficient. Such an explanation would negate what it seeks to explain and would clash with the personal

and irrefutable evidence that our inner self cannot be reduced to the influences to which it may be subject, but that it ultimately remains the sole author of our decisions.

Scientific progress such as that involving the genome is a credit to human reason, for man is called to be lord of creation, and it honours the Creator, source of all life, who entrusted the human race with stewardship over the world. Discoveries of the complexity of the molecular structure can invite members of the scientific community, and more broadly, all our contemporaries, to wonder about the First Cause, about the One who is the origin of all existence and who has secretly fashioned each one of us.²

4. As regards interventions in the human genome sequencing, it would be appropriate to recall certain basic moral norms. All interference in the genome should be done in a way that absolutely respects the specific nature of the human species, the transcendental vocation of every being and his incomparable dignity. The genome represents the biological identity of each subject; furthermore, it expresses a part of the human condition of the being desired by God for his own sake through the mission entrusted to his parents.

The ability to establish the genetic map should not lead to reducing the subject to his genetic inheritance and to the alterations that can be made to it. In his mystery, man goes beyond the sum of his biological characteristics. He is a fundamental unit, in which the biological cannot be separated from the spiritual, family and social dimensions without incurring the serious risk of suppressing the person's very nature and making him a mere object of analysis. By his nature and uniqueness, the human person is the norm for all scientific research. 'He is and he ought to be the beginning, the subject and the object ...' of all research.³

On this subject, we rejoice that numerous researchers have refused to allow discoveries made about the genome to be patented. Since the human body is not an object that can be disposed of at will, the results of research should be made available to the whole scientific community and cannot be the property of a small group.

Ethical reflection should also focus on the use of a person's medical data, especially information contained in the genome that could be exploited by society to the detriment of individuals, for example, by destroying embryos with chromosome abnormalities or by marginalising those affected by one or other genetic disease; nor can a person's biological

² Cf. *Ps* 139:15; *Pr* 24:12.

³ Second Vatican Council, *Gaudium et Spes*, n. 25.

privacy be violated or investigated without his explicit consent, nor divulged for uses which would not be of a strictly medical nature or for the therapeutic benefit of the person concerned. Independently of the biological, cultural, social or religious differences that distinguish human beings, each individual has a natural right to be what he is and to have sole responsibility for his genetic inheritance.

5. Nevertheless, we must not allow ourselves to be beguiled by the myth of progress, as though the possibility of conducting research or of applying a technique would immediately qualify them as morally good.

The moral goodness of all progress is measured by its genuine benefit to man, considered in relation to his twofold corporeal and spiritual dimension; as a result, justice is done to what man is; if the good were not linked to man, who must be its beneficiary, it might be feared that humanity were heading for its own destruction. The scientific community is ceaselessly called to keep the factors in order, situating scientific aspects within the framework of an integral humanism; in this way it will take into account the metaphysical, ethical, social and juridical questions that conscience faces and which the principles of reason can clarify.

I am pleased that in the programme for your present session you are concerned, as scientists, to put your knowledge at the service of moral truth, reflecting on the ethical implications and legal arrangements which should be proposed to governments and scientific teams. It is to be hoped that your authoritative voice may contribute to formulating an international consensus in so sensitive an area, a consensus based on the objective truth about man learned from right reason. On this basis, we must hope that the institutions concerned will encourage thorough reflection, so that each country may equip itself with regulations that will protect the human person and his genetic inheritance, while promoting basic research and research applied to the health of individuals.

6. It is not because of a specific scientific competence that the Magisterium is concerned with the areas which are the subject of your research. The very existence of the Academy is proof that the Church respects the autonomy of scientific disciplines. Furthermore, 'far from considering the conquests of man's genius and courage as opposed to God's power ... Christians ought to be convinced that the achievements of the human race are a sign of God's greatness and the fulfilment of his mysterious plan'.⁴ The

⁴ *Ibid.*, n. 34.

Church intervenes only by virtue of her Gospel mission: she has the duty to bring the light of Revelation to human reason, to defend man and to watch over 'his dignity as a person who is endowed with a spiritual soul and with moral responsibility and who is called to beatific communion with God'.⁵

Since the human being is the issue, the problems go beyond the area of science, which cannot take into account the transcendence of the subject nor lay down moral norms deriving from the subject's central place and primordial dignity in the universe. In this spirit, the work of ethics committees is to be encouraged in order to help science evaluate the moral aspects of research and to establish ethical conditions.

7. The topics you are discussing include that of alternative energy sources, for developing countries, which is a subject of great importance for humanity's future and is being considered at a time when demographic issues are the subject of serious debate. To foster the world's economic vitality, it is important to take stock of realistic solutions to replace current resources, which risk one day being depleted. The present generation more than any other has the responsibility and the duty not to uselessly squander its energy resources. Decisions in this area should also keep future generations in mind. Our planet's energy resources are riches that should enable all peoples to develop and to possess the material means for a dignified life, by avoiding the creation of economic and ecological imbalances. These resources must not be exploited by a small number of countries to the detriment of others. Goods on the surface of our planet are unequally distributed. Solidarity and sharing are indispensable for creating a fair relationship between producer and consumer countries.

8. Together with the notion of 'mathematical certainty', research undertaken on 'basic mathematical principles' has led to reconsidering the epistemological methods mathematicians employ in order to respect the demands of their science such as clarity, consistency, intellectual integrity and trust in man's rational capacities. This reflection has created the key concept of 'artificial intelligence'. However it should be remembered that machines are but an instrument at man's service. Their 'intelligence' is limited for they do not possess reason in the full sense of the term, the reason that enables man to think like a creature, to comprehend the good, the true and the beautiful, to direct his life and to proceed towards his end by voluntary action.

⁵ Congregation for the Doctrine of the Faith, *Donum Vitae*, n. 1.

On this topic you have recalled the importance of studying the correlation between the human brain and the electronic systems in the field of neuroscience, so that machines may compensate for a certain number of human deficiencies and improve the quality of life for the handicapped. It is the greatness of science to be especially at the service of our brothers and sisters who are most in need of aid in order to lead a life that corresponds to their nature and their incomparable dignity.

9. As we approach the sixtieth anniversary of the refoundation of this illustrious institution by Pius XI, it can be asserted that it fulfils the functions which were assigned to the scientists: appointed on the basis of their competence, without ethnic or religious discrimination, they are called to act freely. With concern for greater effectiveness, you have revised your internal regulations in order to fulfil more satisfactorily the role expressed in your statutes: participation in scientific progress and a further development of the nature of scientific knowledge.

At the end of our meeting, I would like to thank you for your contributions to the Holy See on new and important issues that call for deeper knowledge. In the tremendous progress of the contemporary world, it is the whole community's task to be particularly careful to promote an integral humanism. At stake is the very meaning of man. I entrust to the Most High your efforts and your research, which are always open to the demands of this humanism.

18 NOVEMBER 1994

Address to the Working Group on the Subject 'Scientific Bases of the Natural Regulation of Fertility and Associated Problems'

John Paul II declares that research has demonstrated that 'natural methods of regulating fertility, of family planning, are trustworthy and effective'. Such methods help couples 'to embrace the normative principles of their sexual activity'. The love of a man and a woman must be understood in all its aspects but 'contemporary culture often regards sexuality in a reductive way'. The Pope calls on world leaders to promote research and education in the 'area of natural methods of family planning'.

Your Eminences,
Your Excellencies,
Ladies and Gentlemen,

1. I am grateful to the Pontifical Academy of Sciences for organising this study session on the topic of the 'scientific bases of the natural regulation of fertility and associated problems'. I wish to thank Professor Nicola Cabibbo, the President of the Pontifical Academy of Sciences, for his kind greeting. Your decision to address this subject is an appropriate follow-up to your earlier research on population and on global demographic trends. By inviting highly qualified experts to share the results of their research, the Academy is once more fulfilling the purpose for which it was established: to provide valuable scientific insights into themes of special concern to the Church and to society.

2. At the invitation of the Academy, you are directing your attention to the scientific and technical aspects of fertility-related matters. The Church is grateful for your work, for she 'is the first to praise and commend the application of the human intellect to an activity in which man as a rational creature is so closely associated with his Creator'.¹ Your collective research will offer a better appreciation of the significant progress which has been made in the knowledge and understanding of the female fertility cycle. This knowledge helps couples in achieving as well as avoiding pregnancies. It should be of general interest that scientists have been able to demonstrate, by careful studies and with the assistance of many married couples, that *natural methods of regulating fertility, or family planning, are trustworthy and effective*, even in cases of very irregular ovarian cycles. The results of this

¹ *Humanae Vitae*, n. 16.

research, made available to couples, can increase the options available to them and can therefore give husbands and wives the opportunity to make important decisions in a free and responsible manner, in an interpersonal dialogue which is respectful of the integrity of both partners and faithful to their religious convictions and cultural sensitivities. Such a dialogue can only enrich and deepen the communion between them.

3. The Church is pleased to note the progress which has been made in the knowledge of human biology and of female fertility rhythms.² She considers these matters very important, since the sexual expression of love as a specifically human act *touches the very meaning of life and the dignity of the individuals involved*. Contemporary culture often regards sexuality in a reductive way, not in harmony with an integral vision of the human person. The love of a man and a woman must be understood in its fullest meaning, without dissociating the various aspects – spiritual, moral, physical, psychological – which comprise it. To ignore any one of these dimensions of love involves a serious risk to the unity of the person. The practice of the natural methods of family planning helps couples to embrace the normative principles of their sexual activity, which flow from the very structure of their persons and their relationship.

4. As a matter of fact, we can read in the body's reproductive system an indication of the design of the Creator. Knowledge of human sexuality and the reproductive system helps married couples discover the spousal dimension of the body and its place in God's design.³ Such a perspective provides an understanding of the *essential moral difference* between those methods which artificially interrupt a process which of itself is open to life and other methods – based on an ever deepening knowledge of the biological rhythms of the human body – which order sexuality inseparably to the communion of persons and to the gift of life. In fact, the conjugal act has its own total meaning; it engages the individual in such a way that the experience of communion and openness to life cannot be separated. When natural methods are adopted, the body is considered an expression of the person's profound nature; otherwise, the separation of the different aspects of human sexuality in a particular act leads to considering the body as an external object, which the subject uses in a way which denies an essential purpose of the act itself and therefore involves a denial of the essential values of the couple's interpersonal relationship. The practice of natural

² Cf. *Humanae Vitae*, n. 35.

³ Cf. *Familiaris Consortio*, n. 31.

methods contributes to openness and greater sensitivity of each partner towards the other; it is also a training in the ways of interdependence and mutual concern, through respect for the other person's biological and psychological rhythms.

5. From this distinguished Assembly I would like to appeal to the world's leaders to make the necessary means available for research and education in the area of natural methods of family planning. Indeed, it is the duty of States and international organisations which recognise the principle of freedom of conscience to facilitate access to *methods which respect the ethical convictions of couples*. The future of man and of society is at stake in this all important area of human behaviour, a matter which also has a direct influence on social development. For the struggle against underdevelopment and the response to population questions connected with it have an ally, not a foe, in methods which strengthen respect for human dignity. It is the whole of society which will benefit greatly from attention to these methods.

6. I am grateful to all of you for your co-operation with the Holy See. Through you I must also thank and encourage all those, including countless volunteers, who work with patience and special pedagogical skill to ensure that couples become familiar with natural methods of planning family size and learn how to apply them. I am also aware of the efforts being made to educate young people in their emotional life and their sexuality, as an essential preparation for marriage. This education often leads them to go against the current of contemporary opinion in matters of sex and human relationships. They need to understand clearly the profound reasons underlying their choice.

I entrust to the Lord your research which will allow important advances to be put before the international scientific community as a vital service to the integral development of individuals and couples. And I invoke Almighty God's abundant blessings upon you, your collaborators and the members of your families.

12 MAY 1995

*Address to the Working Group on the Subject
'Breast-feeding: Science and Society'*

The Pope observes that breast-feeding has both immunological and nutritional effects and can 'create a bond of love and security between mother and child'. This whole question is bound up with the sanctity of the family. John Paul II concludes by observing that this issue brings out the urgent need for a 'radical re-examination of many aspects of prevailing socio-economic patterns of work, economic competitiveness and lack of attention to the needs of the family'.

Your Eminences,
Your Excellencies,
Ladies and Gentlemen,

1. As always, it is a great pleasure to meet the distinguished participants in the study sessions organised by the Pontifical Academy of Sciences, and I thank Bishop James McHugh for his kind words of introduction. Today I am especially happy to extend my appreciation to the the Royal Society, which has co-sponsored this significant meeting.

True to its purpose and statutes, the Pontifical Academy of Sciences addresses itself to a wide range of scientific, social and ethical issues which have a bearing on the Church's service to the human family, a service which springs from the fundamental Gospel commandment of love. The Academy plays a resourceful role in helping the Church, in particular the Holy See, to fulfill this task of service with the benefit of the most expert scientific knowledge and insights. Your studies and enquiries contribute to the Church's supreme effort to journey hand in hand with humanity on its path through temporal realities towards man's great and inexorable transcendent destiny.

2. On this occasion you have been invited to share your expertise on the specific subject of: *breast-feeding: science and society*, as a part of the overall study which the Academy has been pursuing since 1990 on population and resources. As scientists you direct your enquiry towards a better understanding of the advantages of breast-feeding for the infant and for the mother. As your working group can confirm, in normal circumstances these include two major benefits to the child: protection against disease and proper nourishment. Moreover, in addition to these immunological and nutritional effects, this natural way of feeding can create a bond of love and

security between mother and child, and enable the child to assert its *presence as a person* through interaction with the mother.

All of this is obviously a matter of immediate concern to countless women and children, and something which clearly has general importance for every society, rich or poor. One hopes that your studies will serve to *heighten public awareness of how much this natural activity benefits the child and helps to create the closeness and maternal bonding* so necessary for healthy child development. So human and natural is this bond that the Psalms use the image of the infant at its mother's breast as a picture of God's care for man.¹ So vital is this interaction between mother and child that my predecessor Pope Pius XII urged Catholic mothers, if at all possible, to nourish their children themselves.² From various perspectives therefore the subject is of interest to the Church, called as she is to concern herself with the sanctity of life and of the family.

3. Worldwide surveys indicate that *two-thirds of mothers still breast-feed*, at least to some extent. But statistics also show that there has been a fall in the number of women who nourish their infants in this way, not only in developed countries where the practice almost has to be reinstated, but also increasingly in developing countries. This decline is traced to a combination of social factors such as urbanisation and the increasing demands placed on women, to healthcare policies and practices, and to marketing strategies for alternate forms of nourishment.

Yet the overwhelming body of research is in favour of natural feeding rather than its substitutes. Responsible international agencies are calling on governments to ensure that women are enabled to breast-feed their children for four to six months from birth and to continue this practice, supplemented by other appropriate foods, up to the second year of life or beyond.³ Your meeting therefore intends to illustrate the scientific bases for encouraging social policies and employment conditions which allow mothers to do this.

In practical terms, what we are saying is that *mothers need time, information and support*. So much is expected of women in many societies that time to devote to breast-feeding and early care is not always available. Unlike other modes of feeding, no one can substitute for the mother in this natural activity. Likewise, women have a right to be informed truthfully about the advantages of this practice, as also about the difficulties involved

¹ Cf. *Ps* 22:9.

² Cf. *Allocution to Mothers* (26 October 1941).

³ Cf. UNICEF, *Children and Development in the 1990s*, on the occasion of the World Summit for Children, New York (29-30 September 1990).

in some cases. Healthcare professionals too should be encouraged and properly trained to help women in these matters.

4. In the recent Encyclical *Evangelium Vitae* I wrote that: '*A family policy must be the basis and driving force of all social policies ... It is also necessary to rethink labour, urban, residential and social service policies so as to harmonise working schedules with time available for the family, so that it becomes effectively possible to take care of children and the elderly*'.⁴

Is this a vague utopia, or is it the obligatory path to the genuine well-being of society? Even this brief reflection on the very individual and private act of a mother feeding her infant can lead us to a deep and far-ranging critical rethinking of certain social and economic presuppositions, the negative human and moral consequences of which are becoming more and more difficult to ignore. Certainly, *a radical re-examination of many aspects of prevailing socio-economic patterns of work, economic competitiveness and lack of attention to the needs of the family is urgently necessary.*

5. I am therefore very grateful to all of you for offering your time and co-operation to this meeting co-sponsored by the Pontifical Academy of Sciences and the Royal Society. I look forward to the synthesis and report of your findings so that this information may be widely circulated to our Church agencies and interested institutions throughout the world. I pray for the success of your research and for your own personal well-being. May God's blessings of strength, joy and peace be with each one of you and the members of your families.

⁴ N. 90.

22 OCTOBER 1996

*Address to the Plenary Session on the Subject
'The Origins and Early Evolution of Life'*

*John Paul II refers to Pius XI's hope that the Academy would become a *Senatus scientificus*. In relation to the origins of life and the universe the Pope asks: 'How do the conclusions reached by the various scientific disciplines coincide with those contained in the message of Revelation? And if, at first sight, there are apparent contradictions, in what direction do we look for their solution?' John Paul II surveys the *Magisterium's* comments on the theory of evolution and adds that 'to tell the truth, rather than the theory of evolution, we should speak of several theories of evolution'. Those theories of evolution which 'consider the mind as emerging from the forces of living matter' are 'incompatible with the truth about man'. The human being, indeed, is 'called to enter into eternal life'.*

With great pleasure I address cordial greetings to you, Mr. President, and to all of you who constitute the Pontifical Academy of Sciences, on the occasion of your plenary assembly. I offer my best wishes in particular to the new Academicians, who have come to take part in your work for the first time. I would also like to remember the Academicians who died during the past year, whom I commend to the Lord of life.

1. In celebrating the sixtieth anniversary of the Academy's refoundation, I would like to recall the intentions of my predecessor Pius XI, who wished to surround himself with a select group of scholars, relying on them to inform the Holy See in complete freedom about developments in scientific research, and thereby to assist him in his reflections.

He asked those whom he called the Church's *Senatus scientificus* to serve the truth. I again extend this same invitation to you today, certain that we will all be able to profit from the fruitfulness of a trustful dialogue between the Church and science.¹

2. I am pleased with the first theme you have chosen, that of the origins of life and evolution, an essential subject which deeply interests the Church, since Revelation, for its part, contains teaching concerning the nature and origins of man. How do the conclusions reached by the various

¹ Cf. *Address to the Academy of Sciences*, n. 1 (28 October 1986); *L'Osservatore Romano* English edition (24 November 1986), p. 22.

scientific disciplines coincide with those contained in the message of Revelation? And if, at first sight, there are apparent contradictions, in what direction do we look for their solution? We know, in fact, that truth cannot contradict truth.² Moreover, to shed greater light on historical truth, your research on the Church's relations with science between the sixteenth and eighteenth centuries is of great importance.

During this plenary session, you are undertaking a 'reflection on science at the dawn of the third millennium', starting with the identification of the principal problems created by the sciences and which affect humanity's future. With this step you point the way to solutions which will be beneficial to the whole human community. In the domain of inanimate and animate nature, the evolution of science and its applications gives rise to new questions. The better the Church's knowledge is of their essential aspects, the more she will understand their impact. Consequently, in accordance with her specific mission she will be able to offer criteria for discerning the moral conduct required of all human beings in view of their integral salvation.

3. Before offering you several reflections that more specifically concern the subject of the origin of life and its evolution, I would like to remind you that the Magisterium of the Church has already made pronouncements on these matters within the framework of her own competence. I will cite here two interventions.

In his Encyclical *Humani Generis* (1950), my predecessor Pius XII had already stated that there was no opposition between evolution and the doctrine of the faith about man and his vocation, on condition that one did not lose sight of several indisputable points.³

For my part, when I received those taking part in your Academy's plenary assembly on 31 October 1992, I had the opportunity, with regard to Galileo, to draw attention to the need of a rigorous hermeneutic for the correct interpretation of the inspired word. It is necessary to determine the proper sense of Scripture, while avoiding any unwarranted interpretations that make it say what it does not intend to say. In order to delineate the field of their own study, the exegete and the theologian must keep informed about the results achieved by the natural sciences.⁴

² Cf. Leo XIII, *Providentissimus Deus*.

³ Cf. AAS 42 (1950), pp. 575-576.

⁴ Cf. AAS 85 (1993), pp. 764-772; *Address to the Pontifical Biblical Commission* (23 April 1993), announcing the document on *The Interpretation of the Bible in the Church*: AAS 86 (1994) pp. 232-243.

4. Taking into account the state of scientific research at the time as well as of the requirements of theology, the Encyclical *Humani Generis* considered the doctrine of 'evolutionism' a serious hypothesis, worthy of investigation and in-depth study equal to that of the opposing hypothesis. Pius XII added two methodological conditions: that this opinion should not be adopted as though it were a certain, proven doctrine and as though one could totally prescind from Revelation with regard to the questions it raises. He also spelled out the condition on which this opinion would be compatible with the Christian faith, a point to which I will return.

Today, almost half a century after the publication of the Encyclical, new knowledge has led to the recognition of more than one hypothesis in the theory of evolution. It is indeed remarkable that this theory has been progressively accepted by researchers, following a series of discoveries in various fields of knowledge. The convergence, neither sought nor fabricated, of the results of work that was conducted independently is in itself a significant argument in favour of this theory.

What is the significance of such a theory? To address this question is to enter the field of epistemology. A theory is a metascientific elaboration, distinct from the results of observation but consistent with them. By means of it a series of independent data and facts can be related and interpreted in a unified explanation. A theory's validity depends on whether or not it can be verified; it is constantly tested against the facts; wherever it can no longer explain the latter, it shows its limitations and unsuitability. It must then be rethought.

Furthermore, while the formulation of a theory like that of evolution complies with the need for consistency with the observed data, it borrows certain notions from natural philosophy.

And, to tell the truth, rather than *the* theory of evolution, we should speak of *several* theories of evolution. On the one hand, this plurality has to do with the different explanations advanced for the mechanism of evolution, and on the other, with the various philosophies on which it is based. Hence the existence of materialist, reductionist and spiritualist interpretations. What is to be decided here is the true role of philosophy and, beyond it, of theology.

5. The Church's Magisterium is directly concerned with the question of evolution, for it involves the conception of man: Revelation teaches us that he was created in the image and likeness of God.⁵ The Conciliar Constitution *Gaudium et Spes* magnificently explained this doctrine, which is pivotal to Christian thought. It recalled that man is 'the only creature on

⁵ Cf. *Gn* 1:27-29.

earth that God has wanted for its own sake'.⁶ In other terms, the human individual cannot be subordinated as a pure means or a pure instrument, either to the species or to society; he has value *per se*. He is a person. With his intellect and his will, he is capable of forming a relationship of communion, solidarity and self-giving with his peers. St. Thomas observes that man's likeness to God resides especially in his speculative intellect, for his relationship with the object of his knowledge resembles God's relationship with what he has created.⁷ But even more, man is called to enter into a relationship of knowledge and love with God himself, a relationship which will find its complete fulfilment beyond time, in eternity. All the depth and grandeur of this vocation are revealed to us in the mystery of the risen Christ.⁸ It is by virtue of his spiritual soul that the whole person possesses such a dignity even in his body. Pius XII stressed this essential point: if the human body takes its origin from pre-existent living matter, the spiritual soul is immediately created by God.⁹

Consequently, theories of evolution which, in accordance with the philosophies inspiring them, consider the mind as emerging from the forces of living matter, or as a mere epiphenomenon of this matter, are incompatible with the truth about man. Nor are they able to ground the dignity of the person.

6. With man, then, we find ourselves in the presence of an ontological difference, an ontological leap, one could say. However, does not the posing of such ontological discontinuity run counter to that physical continuity which seems to be the main thread of research into evolution in the field of physics and chemistry? Consideration of the method used in the various branches of knowledge makes it possible to reconcile two points of view which would seem irreconcilable. The sciences of observation describe and measure the multiple manifestations of life with increasing precision and correlate them with the time line. The moment of transition to the spiritual cannot be the object of this kind of observation, which nevertheless can discover at the experimental level a series of very valuable signs indicating what is specific to the human being. But the experience of metaphysical knowledge, of self-awareness and self-reflection, of moral conscience, freedom, or again, of aesthetic and religious experience, falls within the com-

⁶ N. 24.

⁷ *S. Th.*, I-II, 3, 5 ad 1.

⁸ Cf. *Gaudium et Spes*, n. 22.

⁹ '*Animas enim a Deo immediate creari catholica fides nos retinere iubet*' (*Humani Generis*, AAS 42, 1950, p. 575).

petence of philosophical analysis and reflection, while theology brings out its ultimate meaning according to the Creator's plans.

7. In conclusion, I would like to call to mind a Gospel truth which can shed a higher light on the horizon of your research into the origins and unfolding of living matter. The Bible in fact bears an extraordinary message of life. It gives us a wise vision of life inasmuch as it describes the loftiest forms of existence. This vision guided me in the Encyclical which I dedicated to respect for human life, and which I called precisely *Evangelium Vitae*.

It is significant that in St. John's Gospel life refers to the divine light which Christ communicates to us. We are called to enter into eternal life, that is to say, into the eternity of divine beatitude.

To warn us against the serious temptations threatening us, our Lord quotes the great saying of *Deuteronomy*: 'Man shall not live by bread alone, but by every word that proceeds from the mouth of God'.¹⁰

Even more, 'life' is one of the most beautiful titles which the Bible attributes to God. He is the *living God*.

I cordially invoke an abundance of divine blessings upon you and upon all who are close to you.

¹⁰ *Dt* 8:3; cf. *Mt* 4:4.

29 NOVEMBER 1996

*Address to the Study Week on
'The Emergence of Structure in the Universe at the Level of Galaxies'*

The Supreme Pontiff declares that the Academy helps to increase 'understanding between science and faith'. Past mutual incomprehension between these two realms of knowledge has been replaced by a common partnership and fruitful dialogue. The study of the structure of the universe brings scientists to realise that at certain points science seems to be reaching a mysterious frontier where new questions arise which overlap into the spheres of metaphysics and theology. As a result, the need for dialogue and co-operation between science and faith has become 'ever more urgent and promising'.

It gives me great pleasure once again to greet a gathering of the Pontifical Academy of Sciences on the occasion of your current study week. You are aware of my profound esteem for this dedicated body of men and women of science, and of my personal interest in your investigation of questions which are at the forefront of mankind's ever expanding knowledge of the universe. In saying this, I am expressing the Church's respect for scientific knowledge and her recognition of its immense value to humanity.¹

One of the purposes of your Academy is to provide the Holy See and the Church with a picture, as complete and up-to-date as possible, of the latest findings in the various fields of scientific investigation. In this way you contribute to increased understanding between science and faith. Sometimes in the past mutual incomprehension dominated this relationship. Happily, the Church and the scientific community can today look upon each other as partners in the common quest for an ever more perfect understanding of the universe, the theatre of man's passage through time towards his transcendent destiny. A fruitful dialogue is taking place between these two realms: the knowledge which depends on the natural power of reason and the knowledge which follows upon the self-revealing intervention of God in human history. The Eternal Father speaks to us in his Word and through the Holy Spirit whom he pours into our hearts.² The same God speaks to us in nature, and here too he speaks a language that we can decipher. *Both realms of knowledge are marvellous gifts of the Creator.*

¹ Cf. *Lumen Gentium*, n. 59.

² *Jn* 1:14; *Rm* 5:5.

A clear example of a shared interest between science and religion – indeed, of their *need* of each other – is provided by the subject of your present meeting: ‘The emergence of structure in the universe at the level of galaxies’. With this conference you are completing a general overview of the physical cosmos. It is extraordinary to think that, with the help of advanced and sophisticated techniques, you ‘see’ as it were not only the vastness of the universe, but also the unimaginable force and dynamism which pervade it. Even more fascinating is the fact that, since the signals from its farthest reaches are transmitted by light which moves at a finite speed, you can ‘see’ back into the remotest past epochs and describe the processes which are going on today. Well-established experimental results enable you to build a general scheme or model, tracing the whole evolution of the universe from an infinitesimal instant after the starting-point of time up to the present, and beyond, into the distant future. Certainly, not all is simple and clear in this general scheme, and a number of questions of the utmost importance engage you and your colleagues around the world.

One such question, the *emergence of structure*, constitutes the subject of your present conference and is of vital interest, especially when we consider that the emergence of structure appears as the pre-condition for the eventual emergence of life, and ultimately of man as the culmination of all that exists around him in the physical cosmos. Men and women of science such as yourselves ponder the vast and pulsating universe, and as you unravel its secrets you realise that at certain points science seems to be reaching a mysterious frontier where new questions are arising which overlap into the spheres of metaphysics and theology. As a result, the need for dialogue and co-operation between science and faith has become ever more urgent and promising. It is as if science itself were offering a practical vindication of the openness and confidence shown by the Second Vatican Council when it stated that ‘investigation carried out in a genuinely scientific manner and in accord with moral norms never truly conflicts with faith’.³

I thank you for what you are doing in your respective scientific fields. I hope and pray that he ‘by whose word the heavens were made’⁴ will sustain you in your noble endeavours, the results of which make the dialogue between science and religion more concrete and more firmly grounded in the truth. ‘May you be blessed by the Lord who made heaven and earth!’⁵

³ Cf. *Gaudium et Spes*, n. 38.

⁴ *Ps* 33(32):6.

⁵ *Ps* 115(114):15.

27 OCTOBER 1998

*Address to the Plenary Session on the Subject
'Changing Concepts of Nature'*

The Supreme Pontiff warns against the dangers of reducing man 'to a thing and in seeing him in the same way as the other natural elements'. Man must be perceived in his corporeal and spiritual unity. The concept of nature evokes the reality of God in his own essence and evokes the creation. It thus also expresses the meaning of history. The concept of nature when applied to man takes on a special meaning because man has a 'specific dignity' and to 'speak about human nature reminds us also that there exists a unity and a solidarity of the whole of mankind'.

Mr. President,
Members of the Academy,

1. I am happy to welcome you this morning and to extend to you my cordial greetings on the occasion of the Plenary Assembly of the Pontifical Academy of Sciences on 'changing concepts of nature'. I thank His Excellency Professor Nicola Cabibbo for the courteous words which he has just addressed to me. I cordially greet Msgr. Giuseppe Pittau, former Chancellor of your Academy, and Msgr. Marcelo Sánchez Sorondo, who has accepted to succeed him.

The reflections that you have engaged in are particularly opportune. In ancient times, Aristotle coined certain phrases which were taken up and deepened during the Middle Ages and which St. Thomas Aquinas used to draw up his theological doctrine. It is to be hoped and wished for that scientists and philosophers continue to make their contribution to theological research and to the different forms of human knowledge, in order to understand increasingly deeply the mystery of God, of man, and of the creation. The interaction between disciplines, in a fraternal dialogue,¹ can be very fertile because it broadens our vision of what we are and what we become.

2. Down the centuries, the concept of nature has been the subject of various disputes, above all else in the theological and philosophical field. The conception elaborated by Ulpian reduced nature to the biological and instinctive aspect of man.² In a certain number of contemporary theories, we find again this temptation to reduce the human being to purely material

¹ Cf. *Fides et Ratio*, n. 33.

² Cf. *Inst.* I, 2.

or physical reality, making man a being who behaves only like the other living species. The broadening of the scientific field has led to a multiplication of the meanings of this term. In some sciences, it refers to the idea of law or model; in others it is linked to the notion of regularity or universality; in yet others it evokes the creation understood in a general way or according to some aspects of the living being; in others, lastly, it represents the human person in his singular unity, in his human aspirations. It is also linked to the concept of culture to express the idea of the progressive formation of the personality of man, in which are associated elements which have been given to him – his nature – and elements which are acquired through contact with society: the cultural dimension by which man is fulfilled.³ Recent scientific and technological discoveries regarding the creation and man, in the infinitely small and the infinitely large, have modified in a considerable way the meaning of the concept of nature, applied to the created, visible, and intelligible order.

3. Faced with these conceptual differences in the field of scientific and technological research, it is wise to ask ourselves about the meanings of this concept because the repercussions for man and for the way in which scientists look at him are far from being negligible. The principal danger lies in reducing an individual to a thing and in seeing him in the same way as the other natural elements, thereby relativising man, whom God has placed at the centre of the creation. To the extent to which interest is paid first of all to the elements, one is tempted to no longer grasp the nature of a living being or of the created, taken in its entirety, and to reduce them to sets of elements which have multiple interactions. As a result, man is no longer perceived in his spiritual and corporeal unity, in relation to his soul, the spiritual principle in man that is like the form of his body.⁴

4. In Catholic philosophy and theology and in the Magisterium, the concept of nature has an importance which it is fitting to emphasise. It evokes first and foremost the reality of God in His own essence, representing in this way the divine unity of the 'holy and ineffable Trinity. Father, Son, and Holy Spirit, [which] is one God by nature, of one substance, of one nature, and of one majesty and power'.⁵ The same term also evokes the creation, the visible world which owes its existence to God and which is rooted in the creative act by which 'the world began when God's word

³ Cf. Aristotle, *Politica*, I, 2.

⁴ Cf. Council of Vienna, *Fidei Catholicae*, DzS, 902.

⁵ XI Council of Toledo, DzS, 525.

drew it out of nothingness'.⁶ According to the divine plan, the creation finds its own purpose in the glorification of its author.⁷ We thus perceive that this concept also expresses the meaning of history, which comes from God and which goes towards its end, the return of all created things to God. History cannot, therefore, be understood as cyclical history, because the Creator is also the God of the history of salvation. 'It is one and the same God who establishes and guarantees the intelligibility and reasonableness of the natural order of things upon which scientists confidently depend, and who reveals himself as the Father of our Lord Jesus Christ'.⁸

By means of his reason and his various intellectual operations, which are specific to the nature of man seen as such, man 'by his nature can discover the Creator'⁹ by contemplating the work of the creation, because the Creator makes Himself known through the greatness of His work. The beauty of this work and the interdependence of created realities encourage the wise to admire and to respect the principles specific to the creation. 'Nature, philosophy's proper concern, could contribute to the understanding of divine Revelation'.¹⁰ This rational knowledge does not, however, exclude another form of knowledge, based upon revealed truth and on the fact that the Lord communicates with men.

5. When it is applied to man, the summit of the creation, the concept of nature takes on a special meaning. Man is the only being on earth on whom God has bestowed a specific dignity which is derived from his spiritual nature, in which is found the impress of the Creator, because he was created in His image and likeness¹¹ and endowed with the highest faculties that a creature can possess: reason and will. These allow him to determine himself freely and to enter into communication with God, to respond to His appeal and to fulfill himself according to his specific nature. Indeed, being of a spiritual nature, man is able to grasp supernatural realities and reach eternal happiness, freely offered by God. This communication is made possible by the fact that God and man are two essences of a spiritual nature. This is what St. Gregory of Nazianzus expressed when he spoke about the Lord who had assumed our human nature: 'Christ heals fellow man through fellow man'.¹² In the point of view of this Father of Cappado-

⁶ *Catechism of the Catholic Church*, n. 338.

⁷ Cf. *Lumen Gentium*, n. 36.

⁸ *Fides et Ratio*, n. 34.

⁹ Cf. St. Thomas Aquinas, *S. Th.*, I-II, 71, 2.

¹⁰ *Ibid.*, n. 43.

¹¹ Cf. *Gn* 1:26.

¹² *Oratio*, 28, 13.

cia, the metaphysical and ontological approach enables us to understand the mystery of the Incarnation and the Redemption, by which Jesus, real God and real man, took on human nature.¹³ To speak about human nature reminds us also that there exists a unity and a solidarity of the whole of mankind. Indeed, man should be seen 'in the full truth of his existence, of his personal being and also of his community and social being'.¹⁴

6. At the end of this meeting of ours I encourage you to continue with your scientific work in a spirit of service rendered to the Creator, to man, and to the whole of the creation. In this way, human beings will praise God because everything comes from Him;¹⁵ will respect the dignity of every man and will find an answer to the fundamental questions about their origins and their ultimate end.¹⁶ They will take care of the creation 'for God willed creation as a gift addressed to man, an inheritance destined for and entrusted to him'¹⁷ and which is good by nature.¹⁸

Wishing you fertile work in a rich dialogue between the different disciplines that you represent, I most willingly bestow upon you my Apostolic Blessing.

¹³ Cf. *Gaudium et Spes*, n. 22.

¹⁴ *Redemptor Hominis*, n. 14.

¹⁵ Cf. 1 Co 29:14.

¹⁶ Cf. *Fides et Ratio*, n. 1.

¹⁷ *Catechism of the Catholic Church*, n. 299.

¹⁸ Cf. Council of Florence, *Cantate Domino*, DzS, 1333.

12 MARCH 1999

*Address to the Study Week on the Subject
'Science for Survival and Sustainable Development'*

John Paul II declares that man has the duty to limit the risks to creation by dedicating special attention to the natural environment. The imbalances between the rich and the poor countries must be addressed and international relations should have as their objective 'the promotion of the common good'. All people have a responsibility towards the safeguarding of the creation and in this context 'it is necessary to ensure that everyone, particularly young people who desire a better social life in the midst of creation, is educated in human and moral values'.

Mr. President,
Your Excellencies,
Ladies and Gentlemen,

1. I am pleased to welcome you on the occasion of the study week organised by the Pontifical Academy of Sciences on the subject of the contribution of science to world development. I thank your President for his kind words and I extend warm greetings to you all, assuring you of my appreciation of the service which you give to the human community. You have chosen to reflect on the serious risks facing the planet as a whole and, at the same time, to consider possible steps for the safeguarding of creation on the eve of the third millennium.

2. In today's world, more and more people condemn the increasing harm caused by modern civilisation to persons, living conditions, climate and agriculture. Certainly, there are elements linked to nature and its proper autonomy, against which it is difficult, if not impossible, to struggle. Nevertheless, it is possible to say that human behaviour is sometimes the cause of serious ecological imbalance, with particularly harmful and disastrous consequences in different countries and throughout the world. It suffices to mention armed conflict, the unbridled race for economic growth, the inordinate use of resources, the pollution of the atmosphere and water.

3. Man has the responsibility of limiting the risks to creation by paying particular attention to the natural environment, by suitable intervention and protection systems considered especially from the viewpoint of the common good and not only of viability or private profit. The sustainable development of peoples calls on everyone to place themselves 'at the service of all, to help

them to grasp this serious problem in all its dimensions, and to convince them that solidarity in action ... is a matter of urgency'.¹ Unfortunately, economic and political considerations and arguments frequently override respect for the environment, making the life of peoples impossible or placing them at risk in some parts of the world. In order that the world may be habitable tomorrow and that everyone may find a place in it, I encourage public authorities and all men and women of good will to question themselves about their daily attitudes and decisions, which should not be dictated by an unlimited and unrestrained quest for material goods without regard for the surroundings in which we live, and which should be capable of responding to the basic needs of present and future generations. This attention constitutes an essential dimension of solidarity between generations.

4. The international community is called to cooperate with the different groups concerned, to ensure that the behaviour of people, very often inspired by exaggerated consumerism, does not disrupt economic networks, natural resources or the safeguarding of the balance of nature. 'Mere accumulation of goods and services, even for the benefit of the majority, is not enough for the realisation of human happiness'.²

Similarly, the concentration of economic and political strength corresponding to special interests generates power centres which frequently act to the detriment of the interests of the international community. This situation leads to arbitrary decisions against which it is often difficult to react, thus exposing entire groups of people to serious harm. Parity and balance require research and decisions to be carried out with transparency, with the aim of serving the common good and the human community.

More than ever, it is important that a political, economic and legal order be established, based on clear moral principles, so that international relations will have as their objective the promotion of the common good, avoiding the manifestations of corruption which seriously damage individuals and peoples, and not tolerating the creation of unfair privileges and advantages which favour the richer countries and social groups, economic activities developed without regard for human rights, tax havens, and regions exempt from the rule of law. Such an order should have enough authority with national bodies to intervene on behalf of the most disadvantaged regions and to promote social programmes aimed solely at helping these regions to advance on the path of development. On this condition,

¹ *Populorum Progressio*, n. 1.

² *Sollicitudo Rei Socialis*, n. 28.

man will truly be a brother of every man and a co-operator with God in the management of the created order.

5. All those who have a responsibility in public life are also called to develop professional and technological training, and to implement training periods, especially for young people, enabling them to take an active part in national growth. Likewise, it is essential to train managers for developing countries and to carry out technological transfers towards these countries. This promotion of social balance, founded on the sense of justice and effected in a spirit of wisdom, will ensure respect for people's dignity, enable them to live in peace, and enjoy the goods produced by their land. Furthermore, a well-organised society will be able to respond more rapidly to catastrophes which occur, in order to give assistance to peoples, especially the poorest and consequently most deprived.

6. Your efforts to work out reliable projections constitute a precious contribution to ensuring that individuals, especially those who have the responsibility of guiding the destiny of peoples, fully assume their responsibilities to future generations, removing the threats arising from negligence, gravely mistaken economic or political decisions, or lack of long-term planning.

The strategies to be adopted, as well as the necessary national and international measures, should have as their primary aim the well-being of individuals and peoples, so that all countries will enjoy 'a wider share in the benefits of civilisation'.³ By means of an equitable sharing of the funds allocated by the international community and low-interest loans, it is important to promote initiatives based on impartial solidarity, capable of supporting correctly targeted activities, a concrete application of the best adapted technologies and research corresponding to the needs of local peoples, thus ensuring that the fruits of technological and scientific progress do not exclusively benefit major companies and the more advanced countries. I therefore invite the scientific community to continue its research to better discern the causes of the imbalances linked to nature and to man, in order to anticipate them and to propose replacement solutions for situations which become intolerable.

These initiatives should be based on a conception of the world which places man at the centre and respects the variety of historical and environmental conditions, making sustainable development possible, capable of responding to the needs of the entire population of the world. This is espe-

³ *Populorum Progressio*, n. 1.

cially a question of having a long-term perspective in the use of natural resources, ensuring that present resources are not exhausted by irrational and uncontrolled intervention.

7. People sometimes have the impression that their individual decisions are without influence at the level of a country, the planet or the cosmos. This could give rise to a certain indifference due to the irresponsible behaviour of some individuals. However, we must remember that the Creator placed man in creation, commanding him to administer it for the good of all, making use of his intelligence and reason. From this, we can be assured that the slightest good act of a person has a mysterious impact on social transformation and shares in the growth of all. On the basis of the covenant with the Creator, to which man is called to turn continually, everyone is invited to a profound personal conversion in their relationship with others and with nature. This will enable a collective conversion to take place and lead to a life in harmony with creation. Prophetic actions, however slight, are an opportunity for a great number of people to ask themselves questions and to commit themselves to new paths. Consequently, it is necessary to ensure that everyone, particularly young people who desire a better social life in the midst of creation, is educated in human and moral values; it is also necessary to develop every person's social sense and attentiveness to others so that all may realise what is at stake in their daily attitudes for the future of their country and the world.

8. At the end of our meeting, I ask the Lord to fill you with the spiritual strength needed to continue your efforts in a spirit of service to humanity and with a view to a better future on our planet. To all of you and to your loved ones I cordially impart my Apostolic Blessing.

13 NOVEMBER 2000

*Address to the Plenary Session on the Subject
'Science and the Future of Mankind'*

The Pope reflects upon the 'ethical responsibility of scientific research because of its consequences for man'. There is a humanistic dimension to science, not least because each researcher forms a part of his own research project. 'Truth, freedom and responsibility are connected in the experience of the scientist' and he has a 'duty to serve more fully the whole of mankind'. Carried out in this way, science encounters the Church in a 'fruitful dialogue'. Scientific progress must also be human progress and to be such it must be based on 'the conditions of charity and service'.

Mr. President,
Distinguished Ladies and Gentlemen,

1. With joy I extend to you my cordial greetings on the occasion of the plenary session of your Academy, which, given the Jubilee context in which it is taking place, takes on special significance and value. I would like, first of all, to thank your President, Professor Nicola Cabibbo, for the kind words that he addressed to me on behalf of you all. I extend my keenly-felt expression of thanks to you all for this meeting and for the expert and valued contribution which you offer to the progress of scientific knowledge for the good of humanity.

Continuing, and almost completing, your deliberations of last year, you have dwelt over the last few days on the stimulating subject of 'science and the future of mankind'. I am happy to observe that in recent years your study weeks and plenary assemblies have been dedicated in an increasingly explicit way to investigating that dimension of science which we could define as anthropological or humanistic. This important aspect of scientific research was also addressed on the occasion of the Jubilee of Scientists, celebrated in May, and, more recently, on the occasion of the Jubilee of University Teachers. I hope and wish that reflection on the anthropological contents of knowledge and the necessary rigour of scientific research can be developed in a meaningful way, thereby offering illuminating indications for the overall progress of man and society.

2. When one speaks about the humanistic dimension of science, thought is directed for the most part to the ethical responsibility of scientific research because of its consequences for man. The problem is real and has given rise to constant concern on the part of the Magisterium of the Church, espe-

cially during the second part of the twentieth century. But it is clear that it would be reductive to limit reflection on the humanistic dimension of science to a mere reference to this concern. This could even lead some people to fear that a kind of 'humanistic control of science' is being envisaged, almost as though, on the assumption that there is a dialectical tension between these two spheres of knowledge, it was the task of the humanistic disciplines to guide and orientate in an external way the aspirations and the results of the natural sciences, directed as they are towards the planning of ever new research and extending its practical application.

From another point of view, analysis of the anthropological dimension of science raises above all else a precise set of epistemological questions and issues. That is to say, one wants to emphasise that the observer is always involved in the object that is observed. This is true not only in research into the extremely small, where the limits to knowledge due to this close involvement have been evident and have been discussed philosophically for a long time, but also in the most recent research into the extremely large, where the particular philosophical approach adopted by the scientist can influence in a significant way the description of the cosmos, when questions spring forth about everything, about the origins and the meaning of the universe itself.

At a more general level, as the history of science demonstrates to us rather well, both the formulation of a theory and the instinctive perception which has guided many discoveries often reveal themselves to be conditioned by philosophical, aesthetic and at times even religious and existential prior understandings which were already present in the subject. But in relation to these questions as well, the analysis of the anthropological dimension or the humanistic value of science bears upon only a specific aspect, within the more general epistemological question of the relationship between the subject and the object.

Lastly, reference is made to 'humanism in science' or 'scientific humanism' in order to emphasise the importance of an integrated and complete culture capable of overcoming the separation of the humanistic disciplines and the experimental-scientific disciplines. If this separation is certainly advantageous at the analytical and methodological stage of any given research, it is rather less justified and not without dangers at the stage of synthesis, when the subject asks himself about the deepest motivations of his 'doing research' and about the 'human' consequences of the newly acquired knowledge, both at a personal level and at a collective and social level.

3. But beyond these questions and issues, to speak about the humanistic dimension of science involves bringing to the fore an 'inner' or 'existential' aspect, so to speak, which profoundly involves the researcher and

deserves special attention. When I spoke some years ago at UNESCO, I had the opportunity to recall that culture, and thus also scientific culture, possesses in the first instance a value which is 'contained within the subject itself'.¹ Every scientist, through personal study and research, completes himself and his own humanity. You are authoritative witnesses to this. Each one of you, indeed, thinking of his own life and his own experience, could say that research has constructed and in a certain way has marked his personality. Scientific research constitutes for you, as it does for many, the way for the personal encounter with truth, and perhaps the privileged place for the encounter itself with God, the Creator of heaven and earth. Seen from this point of view, science shines forth in all its value as a good capable of motivating an existence, as a great experience of freedom for truth, as a fundamental work of service. Through it, each researcher feels that he is able himself to grow, and to help others to grow, in humanity.

Truth, freedom and responsibility are connected in the experience of the scientist. In setting out on his path of research, he understands that he must tread not only with the impartiality required by the objectivity of his method but also with the intellectual honesty, the responsibility, and I would say with a kind of 'reverence', which befit the human spirit in its drawing near to truth. For the scientist, to understand in an ever better way the particular reality of man in relation to the biological-physical processes of nature, to discover always new aspects of the cosmos, to know more about the location and the distribution of resources, the social and environmental dynamics, and the logic of progress and development, becomes translated into a duty *to serve more fully the whole of mankind*, to which he belongs. For this reason, the ethical and moral responsibilities connected to scientific research can be perceived as a requirement within science, because it is a fully human activity, but not as control, or worse, as an imposition which comes from outside. The man of science knows perfectly, from the point of view of his knowledge, that truth cannot be subject to negotiation, cannot be obscured or abandoned to free conventions or agreements between groups of power, societies, or States. Therefore, because of the ideal of service to truth, he feels a special responsibility in relation to the advancement of mankind, not understood in generic or ideal terms, but as the advancement of the whole man and of everything that is authentically human.

4. Science conceived in this way can encounter the Church without difficulty and engage in a fruitful dialogue with her, because it is precisely

¹ Cf. *Insegnamenti*, III/1 (1980), pp. 1639-1640.

man who is 'the primary and fundamental way for the Church'.² Science can then look with interest to biblical Revelation which unveils the ultimate meaning of the dignity of man, who is created in the image of God. It can above all meet Christ, the Son of God, the Word made flesh, the perfect Man. Man, when following him, also becomes more human.³

Is it not perhaps this centrality of Christ that the Church is celebrating in the Great Jubilee of the Year 2000? In upholding the uniqueness and centrality of God made Man, the Church feels that she is given a great responsibility – that of proposing divine Revelation, which, without in any way rejecting 'what is true and holy' in the various religions of mankind,⁴ indicates Christ, 'the way, the truth, and the life',⁵ as the mystery in which everything finds fullness and completion.

In Christ, the centre and culmination of history,⁶ is also contained the norm for the future of mankind. In Him, the Church recognises the ultimate conditions allowing scientific progress to be also real human progress. They are the conditions of charity and service, those which ensure that all men have an authentically human life, capable of rising up to the Absolute, opening up not only to the wonders of nature but also to the mystery of God.

5. Distinguished Ladies and Gentlemen! In presenting you with these reflections on the anthropological contents and the humanistic dimension of scientific activity, it is my heartfelt desire that the discussions and investigations of these days will produce much fruit for your academic and scientific endeavour. My hope and wish is that you can contribute, with wisdom and love, to the cultural and spiritual growth of peoples.

To this end, I invoke upon you the light and the strength of the Lord Jesus, real God and real Man, in whom are united the rigour of truth and the reasons of life. I am pleased to assure you of my prayers for you and your work, and I impart upon each of you my Apostolic Blessing, which I willingly extend to all those you hold dear.

² *Redemptor Hominis*, n. 14.

³ Cf. *Gaudium et Spes*, n. 41.

⁴ Cf. *Nostra Aetate*, n. 2.

⁵ *Jn* 14:6.

⁶ Cf. *Tertio Millennio Adveniente*, nn. 9-10.

11 NOVEMBER 2002

*Address to the Plenary Session on the Subject
'The Cultural Values of Science'*

The Pope stresses that science in itself represents a 'value for human knowledge and the human community', and observes that thanks to science we are able to appreciate the 'wonder of being human'. At the same time, scientists are called upon to use their knowledge 'for the benefit of the entire human family' and so science must not be without ethics and should be applied to beneficial and positive effect. Indeed, the scientific community can help and serve the peoples of the world 'in ways no other structures can'. His Holiness wonders whether at a time of globalisation scientists could not do more in this direction, and declares that they can, adding that the Pontifical Academy of Sciences, as it prepares to celebrate its fourth centenary, can be a part of this endeavour. In this way, declares John Paul II, science can make 'a priceless contribution to peace and harmony among peoples'.

Dear Members of the Pontifical Academy of Sciences,

It gives me great pleasure to greet you on the occasion of your plenary meeting, and I offer a particularly warm welcome to the new members among you. Your discussion and reflection this year focuses on 'The Cultural Values of Science'. This theme allows you to consider scientific developments in their relation to other general aspects of human experience.

In fact, even before speaking of the cultural values of science, we could say that science itself represents a value for human knowledge and the human community. For it is thanks to science that we have a greater understanding today of man's place in the universe, of the connections between human history and the history of the cosmos, of the structural cohesion and symmetry of the elements of which matter is composed, of the remarkable complexity and at the same time the astonishing coordination of the life processes themselves. It is thanks to science that we are able to appreciate ever more what one member of this Academy has called 'the wonder of being human': this is the title that John Eccles, recipient of the 1963 Nobel Prize for Neurophysiology and member of the Pontifical Academy of Sciences, gave to his book on the human brain and mind (J.C. Eccles, D.N. Robinson, *The Wonder of Being Human: Our Brain and Our Mind*; Free Press, New York, 1984).

This knowledge represents an extraordinary and profound value for the entire human family, and it is also of immeasurable significance for the disciplines of philosophy and theology as they continue along the path of *intellectus quaerens fidem* and of *fides quaerens intellectum*, as they seek an ever

more complete understanding of the wealth of human knowledge and of Biblical revelation. If philosophy and theology today grasp better than in the past what it means to be a human being in the world, they owe this in no small part to science, because it is science that has shown us how numerous and complex the works of creation are and how seemingly limitless the created cosmos is. The utter marvel that inspired the first philosophical reflections on nature does not diminish as new scientific discoveries are made. Rather, it increases with each fresh insight that is gained. The species capable of 'creaturely amazement' is transformed as our grasp of truth and reality becomes more comprehensive, as we are led to search ever more deeply within the realm of human experience and existence.

But the cultural and human value of science is also seen in its moving from the level of research and reflection to actual practice. In fact, the Lord Jesus warned his followers: 'everyone to whom much is given, of him will much be required' (*Lk* 12:48). Scientists, therefore, precisely because they 'know more', are called to 'serve more'. Since the freedom they enjoy in research gives them access to specialized knowledge, they have the responsibility of using it wisely for the benefit of the entire human family. I am thinking here not only of the dangers involved in a science devoid of an ethic firmly grounded in the nature of the human person and in respect of the environment, themes which I have dwelt on many times in the past (cf. *Addresses to the Pontifical Academy of Sciences*, 28 October 1994, 27 October 1998 and 12 March 1999; Address to the Pontifical Academy for Life, 24 February 1998).

I am also thinking of the enormous benefits that science can bring to the peoples of the world through basic research and technological applications. By protecting its legitimate autonomy from economic and political pressures, by not giving in to the forces of consensus or to the quest for profit, by committing itself to selfless research aimed at truth and the common good, the scientific community can help the world's peoples and serve them in ways no other structures can.

At the beginning of this new century, scientists need to ask themselves if there is not more that they can do in this regard. In an ever more globalized world, can they not do more to increase levels of instruction and improve health conditions, to study strategies for a more equitable distribution of resources, to facilitate the free circulation of information and the access of all to that knowledge that improves the quality of life and raises standards of living? Can they not make their voices heard more clearly and with greater authority in the cause of world peace? I know that they can, and I know that you can, dear members of the Pontifical Academy of Sciences! As you prepare to celebrate the Academy's Fourth Centenary next

year, bring these common concerns and aspirations to the international agencies that make use of your work, bring them to your colleagues, bring them to the places where you engage in research and where you teach. In this way, science will help to unite minds and hearts, promoting dialogue not only between individual researchers in different parts of the world but also between nations and cultures, making a priceless contribution to peace and harmony among peoples.

In renewing my warm wishes for the success of your work during these days, I raise my voice to the Lord of heaven and earth, praying that your activity will be more and more an instrument of truth and love in the world. Upon you, your families and your colleagues I cordially invoke an abundance of divine grace and blessings.

ADDRESSES
OF
HIS HOLINESS POPE JOHN PAUL II
TO THE PONTIFICAL ACADEMY
OF SOCIAL SCIENCES



His Holiness, John Paul II meets the Members of the Pontifical Academy of Social Sciences, 27 April 2001



His Holiness, John Paul II meets the Members of the Pontifical Academy of Social Sciences, 27 April 2001



His Holiness, John Paul II meets the Members of the Pontifical Academy of Social Sciences, 11 April 2002



His Holiness John Paul II meets the Members of the Pontifical Academy of Social Sciences, 11 April 2002

INTRODUCTION

The Pontifical Academy of Social Sciences was established in January 1994 by Pope John Paul II, who spoke as follows in his *Motu Proprio*:

Over the last century the Church has strengthened her 'citizenship status' by perfecting her social doctrine ... [thanks to] close collaboration, on the one hand, with Catholic social movements, and on the other, with experts in the social sciences ... John XXIII ... stressed that the social doctrine must always strive to take into account 'the true state of affairs' by maintaining a constant dialogue with the social sciences ... Facing the great tasks which the future has in store, this interdisciplinary dialogue, already fostered in the past, should now be given new expression. ... Today I establish the Pontifical Academy of Social Sciences ... with the aim of promoting the study and progress of the social, economic, political and juridical sciences, and thus offering the Church the elements which she can use in the study and development of her social doctrine.

The Academy held its first plenary session on 24-26 November 1994. In his address John Paul II spoke as follows: 'Appealing to your expertise today, the Church wants to intensify dialogue with researchers in the social sciences for mutual enrichment and to serve the common good'. The Pope added:

Epistemology plays an even more essential role for the social sciences than it does for the natural sciences. The same instruments of analysis can be used differently, according to the vision of man they are intended to serve. On the other hand, although the Church expects a great deal from the analyses proposed by the social sciences, she is also convinced that her social teaching can supply the appropriate methodological principles to direct research and to provide useful elements for building a more just and fraternal society, a society which is truly worthy of man.

At its first session the Academy made a selection of three major topics on which it decided to concentrate its reflections over subsequent years: 'work and employment', 'democracy' and 'intergenerational solidarity'. At

its fourth plenary session in 1998 it decided to add a fourth major topic, which was becoming of urgent importance at a general level – ‘globalisation’. In his addresses, John Paul II expressed satisfaction that these topics had been selected and gave advice on how they should be approached as they were successively tackled by the Academy. This is not the place to present the procedures chosen by the Academy for its deliberations, except to mention that since the outset it has been agreed that the study of a new topic should always begin with a paper on the current doctrine of the Church on it and that this paper should be used as a point of reference in subsequent interchanges.

Work and Employment

In his address of 22 March 1996, the Pope recalled the basic principles of Christian teaching on human work. He stressed in particular that:

Every economic system must have respect for man and his dignity as its first principle. It is right to remind those who in one way or another are employers of the three great moral values of work. First and foremost, work is the principal means of exercising a specifically human activity. For every person it is also the normal means of meeting his material needs and those of his brothers and sisters for whom he is responsible. But in addition, work has a social function.

The Holy Father also stressed the serious problem of unemployment:

Lack of work, unemployment and underemployment lead many of our contemporaries, in both the industrialised societies and those with a traditional economy, to *question the meaning of their life* and to despair about the future.

The address delivered on 25 April 1997 stated:

In your current research, the detailed study of *labour laws* is of great interest ... The demands of the market, deeply marked by competition, must not go against the primordial *right of every man to have work* ... I would like to stress that when she enunciates this principle, the Church does not at all mean to condemn the deregulation of the market in itself, but asks that it be envisaged and implemented with respect for the *primacy of the human person* ... For, unfortunately, experience shows that a market economy, left to unconditional freedom, is far from bringing the greatest possible advantages to individuals and societies.

On 6 March 1999 John Paul II developed the argument of his address from the fact that ‘employment is certainly a major challenge in international life’. Among his many recommendations we find, for instance:

It presupposes a sound distribution of work and solidarity between all persons of a working age who are able to do so. In this spirit, it is not normal for some professional categories to be preoccupied with preserving acquired benefits, which can only have negative repercussions on employment in a country ... A considerable number of young people are among those painfully affected by unemployment ... all political, economic and social leaders are called to redouble their efforts on behalf of young people ... to work together to offer them professional training ever more suited to the current economic situation ... The globalisation of the economy and of employment also calls for the globalisation of responsibilities.

Democracy

On 27 April 1997, when the Academy had just held a preliminary seminar on this topic, the Pope asked the question: 'But how can someone who is not properly protected at the economic level and even lacks the basic necessities be guaranteed participation in democratic life?'. A year later he stressed that:

the issues on the complex theme of democracy ... await study and guidelines suitable for directing researchers, political authorities and nations in this millennial passage between the 20th and 21st centuries. How important is this period ... from which we expect a strong message of reconciliation and peace for the Church and for the world!

On 26 February 2000 John Paul II not only pleaded for 'the *free and responsible participation of all citizens in public affairs*' and for 'the *principle of subsidiarity*'. He also raised the serious question of values:

There is a tendency to see intellectual relativism as the necessary corollary of democratic forms of political life. In such a view, truth is determined by the majority and varies in accordance with passing cultural and political trends. ... As Christians we firmly believe that, if there is no ultimate truth to guide and direct political activity, then ideas and convictions can easily be manipulated for reasons of power. As history demonstrates, *a democracy without values easily turns into open or thinly disguised totalitarianism*. Thus, it is important that Christians be helped to show that the defence of universal and unchanging moral norms is a service rendered not only to individuals but also to society as a whole: such norms represent the ... solid guarantee of ... genuine democracy.

Globalisation

The permanent concern of John Paul II about the directions followed by globalisation is apparent in his addresses even before the Academy decided to make this one of its main topics of study. In his second address of 23 March 1996 he declared: 'In relation to *the globalisation of problems*, I appreciate your contribution to suggest an approach that pays greater attention to the demographic division of work and to the *situation in developing countries*'.

A year later he stressed three major concerns about the orientations of globalisation:

It is essential that political activity assure a balanced market in its classical form by applying the principles of subsidiarity and solidarity, according to the model of the *social State* ... All things considered, the reality of 'globalisation', viewed in a balanced way with its positive potential and the fears it raises, is a call not to postpone the harmonisation of *the 'demands of the economy' with the demands of ethics* ... It should nevertheless be recognised that within the framework of a 'world' economy, the ethical and juridical regulation of the market is objectively more difficult. Indeed, to achieve it effectively the domestic political initiatives of the different countries do not suffice, what is needed is an 'increased co-ordination among the more powerful countries' and the consolidation of a democratic global order with agencies where 'the interest of the whole human family be equally represented'.

On 23 February 2000, the Pope expounded his ideas about this democratic component of the global order that had to be achieved:

There is no doubt that the new millennium will see the continuation of the phenomenon of globalisation, that process by which the world moves ever closer to becoming a homogeneous whole. In this context it is important to remember that the health of a political community can be gauged in no small way by the *free and responsible participation of all citizens in public affairs*. ... The proper autonomy of each social class and organisation, each in its own sphere, must be defended and upheld. This is nothing other than the *principle of subsidiarity*. ... The global challenges that the human family faces in the new millennium also serve to highlight another dimension of the Church's social doctrine: its place in *ecumenical and interreligious cooperation*.

The cultural and ethical aspects of globalisation were the main focus of his address of 27 April 2001:

Since the collapse of the collectivist system ... humanity has entered a new phase which ... has brought with it not only a growing interdependence of economies and social systems, but also a spread of novel philosophical and ethical ideas based on the new working and living conditions now being introduced in almost every part of the world. The Church carefully examines these new facts in the light of the principles of her social teaching. In order to do this, she needs to deepen her objective knowledge of these emerging phenomena ... The affirmation of the priority of ethics corresponds to an essential requirement of the human person and the human community. But not all forms of ethics are worthy of the name. ... The Church on her part continues to affirm that ethical discernment in the context of globalisation must be based upon two inseparable principles:

– First, the inalienable value of the human person, source of all human rights and every social order. The human being must always be an end and not a means, a subject and not an object, nor a commodity of trade.

– Second, the value of human cultures, which no external power has the right to downplay and still less to destroy. Globalisation must not be a new version of colonialism. It must respect the diversity of cultures which, within the universal harmony of peoples, are life's interpretative keys.

John Paul II then concluded:

The Church will continue to work with all people of good will to ensure that the winner in this process will be humanity as a whole, and not just a wealthy elite that controls science, technology, communication and the planet's resources to the detriment of the vast majority of its people.

Intergenerational Solidarity

Although it had been selected by the Academy for future consideration in November 1994, the topic of intergenerational solidarity was not discussed prior to the brief seminar during the 2002 plenary session held in order to launch a specific programme. In his address of 11 April 2002, the Pope welcomed this undertaking:

Solidarity between generations must receive greater attention, with special care for the weaker members of society, children and the elderly. ... The industrial age saw States set up social welfare plans to assist families, giving special attention to the education of youth

and to pension funds for retirees. ... One can only rejoice at this progress even though it benefits only a small portion of the world's population. ... I invite people who have the responsibility of government and those who make decisions that affect society to be particularly careful by reflecting on future long-term decisions ... It is only right to give great importance to educating the younger generations in a spirit of solidarity and a real culture of openness to the universal and attention to all people, regardless of their race, culture or religion.

Edmond Malinvaud
President of the Pontifical Academy of Social Sciences

25 NOVEMBER 1994

Address to the Plenary Session on the Subject 'The Study of the Tension Between Human Equality and Social Inequalities from the Perspective of the Various Social Sciences'

John Paul II surveys the Social Teaching of the Church since the nineteenth century and declares that the contribution of the social sciences is of importance in 'finding solutions to people's concrete problems, solutions based on social justice'. The Pope stresses the 'central place of the human person' in development. The Church does not undertake scientific analyses but promotes a series of fundamental principles in relation to man's place in society: 'the dignity of the person, his social nature, the universal destination of goods, solidarity, subsidiarity ... charity'. The creation of the Pontifical Academy of Social Sciences 'testifies to the Church's favourable attitude to the positive and human sciences'.

Your Eminences,
Ladies and Gentlemen, Members of the Academy,

1. It is a great joy to me to meet you on the occasion of the opening session of the Pontifical Academy of Social Sciences, established by the *Motu Proprio Socialium Scientiarum Investigationes* of 1 January 1994. In 1991, in view of the increasing importance of social issues, I announced my intention to create an Academy on the occasion of the centenary of *Rerum Novarum*, to gather specialists in social sciences from all over the world. You have accepted my invitation to become its first members: you represent the great disciplines of the social sciences: philosophy, sociology, demography, history, law, political science, economics, whose recent developments are raising questions which are decisive for the future of humanity. I am deeply thankful for your contribution to the Church, which needs your reflection, fostered by close contact with modern social realities. I would like to express my sincere gratitude to your President, Professor Edmond Malinvaud, for his warm words and for agreeing to direct your noble assembly's first research project. I am pleased to greet Cardinal Roger Etchegaray, President of the Pontifical Council for Justice and Peace, with which the Academy will co-ordinate the planning of its various initiatives and will consult for its activities.

2. During the 19th century, the Church was challenged by the frequently tragic effects of early industrialisation on the condition of workers, as well as by anthropology, which was developed at that time. Her reaction was first and foremost motivated by her pastoral concern: to shed the light

of the Gospel on the ever new challenges which men must face; she sought to denounce the blatant injustices to which both liberal and socialist theories led; for the onset of the industrial age coincided with the emergence of liberal and socialist ideologies which are unfortunately reappearing in various forms in the contemporary world.¹ At the same time, the Magisterium and many episcopates saw the need to promote human and spiritual reflection and formation, indispensable if each human being is to be able to find his proper place in society.

Man has central place in society

3. At the end of this second millennium, the development of a technical and materialistic society is still burdening our contemporaries with numerous threats: the spread of unemployment, which creates precarious situations and weakens human beings, particularly youth and families, the many forms of rejection, which marginalise an ever greater number of people, the rise in radical movements, which aggravate tensions, the persistent imbalance between North and South, which drives whole peoples towards ever greater poverty.

Beginning with the Encyclical *Rerum Novarum*, ‘the Magna Carta which must be the basis of all Christian activity in social affairs’,² the Church has expressed in a consistent teaching all the moral principles contained in Revelation and developed by the Magisterium in the course of history; this social teaching provides moral criteria for decision and action in personal, family and social life: it presents the integral vision of man, of his intrinsic dignity, his spiritual nature and his ultimate destiny.³

4. Since the appearance of these ‘new things’, the Magisterium has not ceased, in season and out of season, to recall the essential principles of her social teaching: man always has priority over the socio-economic systems in which he participates; human realities are for man, who has a ‘central place within society’⁴ and cannot be considered a mere element:⁵ he has an inalienable natural dignity.⁶

¹ Cf. Leo XIII, *Rerum Novarum*; John Paul II, *Centesimus Annus*, n. 13.

² Pius XI, *Quadragesimo Anno*.

³ Cf. John Paul II, *Centesimus Annus*, n. 11.

⁴ *Centesimus Annus* n. 54; cf. Pius XI *Quadragesimo Anno*.

⁵ Cf. *Centesimus Annus*, n. 13.

⁶ *Gaudium et Spes*, n. 84, § 2.

My predecessors, Pius IX and Leo XIII in particular, with their Encyclicals *Quanta Cura* and *Quod Apostolici Muneris*, forcefully showed the Church's attention to this social issue and to the dangers of philosophies which give absolute primacy to economics and politics to the detriment of the individual, who 'is and ... ought to be the beginning the subject and the object of every social organisation'.⁷

5. A glance at the social situations existing in the world, in both industrialised and developing countries, shows how important it is to reinforce the contribution of the social sciences, with a view to finding solutions to people's concrete problems, solutions based on social justice.

It is well known, for example, that the negative effects of the current economic situation in many countries too often jeopardise social programmes whose *raison d'être* should be the protection of the weakest. The Church is deeply sensitive to this factor. At the international level, it appears that numerous macro-economic reform projects fail to consider the human dimension, so that it is always the weakest who feel the harmful effects of heavy cuts in public spending. Hence it should be remembered that no model of economic growth which neglects social justice or marginalises human groups is sustainable in the long term, even from the purely economic point of view.

You will help to understand man's central place in society

The forthcoming United Nations Conference in Copenhagen on social development will be an important moment for the international community: we should, in fact, reflect on the conditions necessary for creating a human, economic and political environment which is favourable to this social development, especially by firm commitment to the struggle against poverty and to job creation.

This summit conference is one of a series of events of international importance destined to influence social philosophy in the world at the end of the century. As we could see at the International Conference on Population and Development in Cairo, there is a real awareness in all States that the new challenges in the political arena are giving rise to technical questions but also involve one's understanding of human life and the preservation of essential values. Your Academy will help to understand the central place of the human person in the whole development programme.

⁷ *Gaudium et Spes*, n. 25, § 1.

6. However, as she has stressed many times, the Church is not competent to undertake scientific analyses: neither has she technical solutions to offer; she does not wish to support any theoretical model for the explanation of social phenomena, nor any concrete social system.⁸ However, she defends man's primordial place according to God's design, and she recalls the duties which derive from his dignity as a human person living in society.

The economy, systems of production and exchange, the State and rights, are always at the service of the concrete individual and not the other way round. By virtue of his proper dignity, man has inalienable rights. He also has the duty to work for the common good, to bear fruit,⁹ to transform the social order¹⁰ and to enable each, by just and equitable sharing, to have his place in society and to enjoy the fruits of the earth; several basic principles of the Church's social teaching fit into this perspective, such as the right to private property, which is nevertheless subordinate to the universal destination of goods.¹¹ On the other hand, according to the principle of subsidiarity, the human being enjoys legitimate autonomy of decision and action and the freedom to exercise his rights to the full; he must be protected from the possible arbitrary authority of institutions and of social and political structures. Indeed, man retains his share of responsibility in the different communities to which he naturally belongs: the family, his cultural milieu, associations, the nation and the community of nations.¹² However, this principle cannot be separated from that of solidarity, which requires each person as a member of the human community, to play an active part in the destiny of society and to feel responsible for the well-being of all.

Principles of human dignity are valid in all forms of society

7. The Church's Magisterium considers the sciences, whatever their aim and research methods, to be at the service of man. Nevertheless, no science can ultimately claim to explain the whole of reality. On the contrary, outside its scientific context, a science becomes an ideology that claims to explain the whole of the universe and of history.¹³ However, awareness of the limits of scientific progress must not become a refusal to be open to the transcendent dimension.

⁸ Cf. *Sollicitudo Rei Socialis*, n. 41.

⁹ Cf. *Optatam Totius*, n. 16.

¹⁰ Cf. Paul VI, *Populorum Progressio*, n. 42.

¹¹ Cf. *Laborem Exercens*, n. 14.

¹² Cf. *Christifideles Laici*, n. 42; *Catechism of the Catholic Church*, nn. 1883-1885, 1894, 2209.

¹³ Cf. Pius XI, *Mit Brennender Sorge*; John XXIII, *Mater et Magistra*, Ch. IV.

8. Epistemology plays an even more essential role for the social sciences than it does for the natural sciences. The same instruments of analysis can be used differently, according to the vision of man they are intended to serve.

On the other hand, although the Church expects a great deal from the analyses proposed by the social sciences, she is also convinced that her social teaching can supply the appropriate methodological principles to direct research and to provide useful elements for building a more just and fraternal society, a society which is truly worthy of man. By working within the framework of the Church's social doctrine, which asserts that order in collective life is not arbitrary, you will demonstrate that the social sciences display all their fruitfulness when they work within the perspective of the order of creation.

The social doctrine of the Church seeks to reconcile the affirmation of man's freedom, of his spiritual nature made for a life of relationships, of his capacity to progress in knowledge, with the objective nature of the created order. Thus she does not fear to rely on a metaphysical and rational anthropology that makes it possible to take into account the mystery of man and his destiny, which cannot be reduced to any specific cultural conditioning or determinism. The principles of the dignity of the person, his social nature, the universal destination of goods, solidarity, subsidiarity, which the Church's social teaching deduces from the anthropology of creation, remain valid in all forms of society as appeals to overcome the constraints that in the end practical systems always impose upon human beings.

Intensifying dialogue with social science research

9. Among the fundamental values of the Church's social doctrine, a special place should be reserved for charity, because this represents the first category of life in society; charity makes it possible to take into account the free and voluntary action that consists in loving one's neighbour as oneself. It is the virtue which will endure to the end of history¹⁴ and the duty on which moral life is based.¹⁵ Charity 'as the queen of all virtues, all commandments, all counsels, ... gives to all of them their rank, order, time and value'.¹⁶ Love is demonstrated by kindness to others, the concern for reciprocity in relationships and the sense of true communication.¹⁷ Hence this society which you are studying is not composed of strangers¹⁸ but fellow citizens redeemed by Christ.

¹⁴ Cf. *Mt* 25; *1 Co* 13.

¹⁵ Cf. *1 Jn* 4:11.

¹⁶ St. Francis de Sales, *Traité de l'amour de Dieu*, 8, 6.

¹⁷ St. Thomas Aquinas, *S. Th.*, II-II, 23, 1.

¹⁸ Cf. *Ep* 2:19.

10. In the Encyclical *Centesimus Annus*, I said that the Magisterium wished to encourage analysis of the complex conditions in which men work, produce and exchange goods and services, satisfy their vital needs, share the resources resulting from work, determine the respective powers and responsibilities of families, businesses, unions and the State. By examining and interpreting scientific data, it is your task to make your contribution to the Church's progress. According to the first article of its Statutes, the Academy is established 'for the purpose of promoting the study and advancement of the social, economic, political and juridical sciences, thereby making elements available which can be used by the Church to deepen and develop her social teaching'. This is why your Academy is open to experts in different fields who desire to serve the truth. Our intention is to gather all the grains of truth present in the various intellectual and empirical approaches, in the image of St. Thomas Aquinas who remains an example for philosophical and theological reflection.

The creation of the Pontifical Academy of Social Sciences testifies to the Church's favourable attitude to the positive and human sciences, which have the right to a just autonomy. It is in line with the efforts of the Church, which tirelessly seeks to enlighten consciences on the ethical dimension of the concrete choices which men and societies are led to make. Through its research, the Academy will show the harmony and continuity between the discoveries of the social sciences at the service of mankind, the principles of natural morality and the Church's social teaching.

Appealing to your expertise today, the Church wants to intensify dialogue with researchers in the social sciences¹⁹ for mutual enrichment and to serve the common good. She hopes to perceive yet more clearly the complexity of the causes that lead to sometimes inhuman situations and can burden people or institutions with dangers which risk seriously jeopardising the dignity of humanity and the future of the world. This understanding of social realities will make it possible to discern the ethical stakes and to present them in a clearer way to our contemporaries. And it is up to the Church to continue to develop and perfect her social teaching by closely collaborating with Catholic social movements and experts in the social disciplines, of which you are the illustrious representatives in this new Academy.

Ladies and Gentlemen, members of the Academy, at the end of our meeting, as I assure you once again of my respect and my very best wishes for your work, I invoke the assistance of the Spirit of truth and the Blessings of the Lord upon you.

¹⁹ Cf. *Centesimus Annus*, n. 59.

22 MARCH 1996

*Address to the Plenary Session on the Subject
'The Future of Labour and Labour in the Future'*

The Supreme Pontiff observes increasing social inequalities between the North and the South of the world and declares with regard to employment that 'in economic life it is essential to respect human dignity'. He goes on to say that social prosperity and growth cannot 'be achieved to the detriment of individuals and peoples'. In the more specific area of work, 'every economic system must have respect for man and his dignity as a first principle' and for progress truly to serve man 'all men must be integrated into the productive system or the service of the social body'.

Mr. President,
Ladies and Gentlemen of the Academy,

1. The second plenary session of the Pontifical Academy of Social Sciences, in which you are inaugurating your institution's regular work after a preliminary period of organisation, gives me the opportunity to express my deep gratitude. My thanks are first addressed to you, Mr. President, for your courteous words. I would like to express all my esteem to you, for you are ensuring that rigorous working procedures and intense collaboration between the members of the Academy are established in order to encourage fruitful research. I address my cordial greetings to all the members of your new institution; I thank them for being willing to examine modern social issues, with competence and great intellectual availability, in order to help the Church fulfil her mission to our contemporaries.

2. Observing the rapid increase of social inequalities between North and South, between the industrialised and the developing countries, but also within the nations normally considered rich, you have chosen *employment as your first subject for reflection*. This is particularly appropriate in contemporary society where political, economic and social upheavals call for *a new division of labour*. I appreciate this decision which corresponds to one of the Church's constant concerns; as I recalled in the Encyclical *Laborem Exercens*, 'through work, man not only transforms nature adapting it to his own needs, but he also achieves fulfilment as a human being and indeed, in a sense, becomes 'more a human being''.¹ This concern was cen-

¹ N. 9.

tral to the Encyclical *Rerum Novarum*, in which Leo XIII forcefully affirmed that in economic life *it is essential to respect human dignity*.²

The Church offers principles of reflection and judgement

In your work you are careful to link the Church's social teaching with scientific and technical aspects. In this way you show the true position of the social doctrine, which does not offer concrete proposals and must not be confused 'with tactical attitudes or with the service of a political system'.³ The Church does not intend to replace political authorities or those who make economic decisions, in order to engage in concrete activities which belong to their area of competence or responsibility in the management of public affairs. The Magisterium desires to recall the *conditions of possibility, at the anthropological and ethical level, for a social process* that must be centred on the individual and the collective whole, so that each person may be fulfilled. It offers 'principles for reflection, criteria of judgement and directives for action', showing that the Word of God applies 'to people's lives and the life of society, as well as to the earthly realities connected with them'.⁴

3. Thus it is first an *anthropology belonging to the long Christian tradition* which scientists and leaders of society must be able to accept; for 'all social action involves a doctrine'.⁵ This does not exclude the legitimate plurality of concrete solutions insofar as the fundamental values and dignity of man are respected. The scientist or the one who holds responsibility in public life cannot base his activity on principles drawn from the positive sciences alone, which leave aside the human person, while considering social structures and mechanisms. They cannot take into account man's spiritual nature, his deep desire for happiness and his supernatural destiny which transcend the biological and social aspects of life. To cling to this attitude, legitimate as an epistemological procedure, would be to treat man 'as a means of production'.⁶ All that has to do with the good, with values and with conscience transcends the scientific process and pertains to the spiritual life, to freedom and to the responsibility of people, who are inclined by nature to seek the good.

² Cf. n. 32.

³ Paul VI, *Evangelii Nuntiandi*, n. 38.

⁴ *Sollicitudo Rei Socialis*, n. 8.

⁵ Paul VI, *Populorum Progressio*, n. 39.

⁶ Pius XI, *Quadragesimo Anno*.

Work is a service to one's brothers and sisters

Hence social prosperity and growth cannot be achieved to the detriment of individuals and peoples. If liberalism or any other economic system favours only those who possess capital and makes work only a means of production, it becomes the source of serious injustices. Legitimate competition, which stimulates economic development, must not go against the *primordial right of every man to have work through which he can earn a living for himself and his family*. For, how can a society consider itself rich, if in its midst there are numerous people who lack the basic necessities? As long as a human being is injured and disfigured by poverty, in a certain way the entire society will be blighted.

4. With regard to work, *every economic system must have respect for man and his dignity as its first principle*. 'It is always man who is the purpose of ... work'.⁷ It is right to remind those who in one way or another are employers of the three great moral values of work. First and foremost, *work is the principal means of exercising a specifically human activity*. It is the 'fundamental dimension of man's existence on earth: man's life is built up every day from work, from work it derives its specific dignity'.⁸ For every person it is also *the normal means of meeting his material needs and those of his brothers and sisters for whom he is responsible*. But in addition, work has a *social function*. It is a testimony to solidarity between all men; each is called to make his contribution to communal life and no member of society should be excluded from the field of work or marginalised. For exclusion from the systems of production almost inevitably brings a wider social exclusion, with the phenomena of violence and family breakdown in particular.

In contemporary society, where individualism is more and more pronounced, it is important for men to realise that their most humble and unassuming personal activity, particularly in the world of work, is a service to their brothers and sisters in humanity, and a contribution to the well-being of the community as a whole. This responsibility derives from the obligation of justice. Indeed, each individual receives much from society and must in turn be able to give according to his own talents.

5. Lack of work, unemployment and underemployment lead many of our contemporaries, in both the industrialised societies and those with a traditional economy, to *question the meaning of their life* and to despair

⁷ *Laborem Exercens*, n. 6.

⁸ *Ibid.*, I, n. 1.

about the future. It is appropriate to recognise that for progress truly to serve man, it is necessary that *all men be integrated into the productive system or the service of the social body*, so that they may be its agents and share its fruits. *This is particularly important for young people* who rightly expect to earn their living, to be integrated into the fabric of society and to start a family. How can they have confidence in themselves and be recognised by others if they cannot find their place in professional networks? In periods when full employment is no longer possible, it is the duty of the State and of businesses to create a *better distribution of tasks among all workers*. Professional institutions and workers themselves ought, for the good of all, to accept this division and perhaps a relative loss of acquired benefits. This is as much a principle of *human justice and social morality* as of Christian charity. No one can reason in a purely individualistic way or in too strongly a corporatist spirit. Everyone is invited to take all his brothers and sisters into account. Therefore we should educate our contemporaries, so that they can be aware of the limited nature of economic growth, in order not to be misled by the erroneous and illusory view apparently offered by the myth of permanent progress.

The Church relies on your insights

6. You have wished to broaden your research to include its political and demographic implications. Your assessment of the international situation will be a valuable contribution to showing the numerous factors connected with economic development. In relation to *the globalisation of problems*, I appreciate your concern to suggest an approach that pays greater attention to the demographic division of work and to the *situation in developing countries*, which cannot be ignored when choosing international strategies. There must be no lack of solidarity in the face of the difficulties they encounter in their slow political and economic transition.

7. Ladies and gentlemen of the Academy, on the occasion of your second plenary session I would like to assure you once again of my confidence and esteem. The Church relies on you for enlightenment in the areas where there is an ever broader awareness of the urgent need for decisions that will lead to a future of greater solidarity and brotherhood within nations and among all peoples of the earth. As I express my fervent best wishes for your work, I invoke the Spirit of truth and the Lord's blessings upon you.

25 APRIL 1997

*Address to the Plenary Session on the Subject
'The Right to Work: Towards Full Employment'*

The Pope declares that the Social Teaching of the Church is 'continuously enriched with new perspectives and aspects in relation to cultural and social developments'. Turning to the question of labour, the Pope says that every man has the right to work by which to support himself and his family. The market must therefore be 'envisaged and implemented with respect for the primacy of the human person'. Addressing the question of world poverty, the Pope warns against some of the dangers of 'globalisation' and calls for an economy based upon 'subsidiarity and solidarity'. Democracy is linked to employment and democracy to be real must be based upon 'a correct conception of the human person'.

Mr. President,
Dear Academicians,

1. I am pleased to meet you on the occasion of the plenary session of the Pontifical Academy of Social Sciences, dedicated to a *reflection on the theme of work*, already begun last year. The choice of this theme is particularly appropriate, for human work 'is a key, probably the essential key, to the whole social question'.¹ The deep economic and social transformations we are experiencing make the theme of work more and more complex and it has serious human repercussions, for it gives rise to anxieties and expectations in many families and many persons, especially the young.

I thank your President, Professor Edmond Malinvaud, for his courteous words and for the availability he is showing to the very young Pontifical Academy. I renew my gratitude to you all for the generosity with which in this institution you put your expertise not only at the service of science, but also of the Church's social doctrine.²

Demands of market must respect primacy of human person

2. In fact *the service which the Magisterium must give* in this area has become more demanding today, because it must address a situation in the contemporary world that is changing with extraordinary speed. Of course, the *Church's social teaching*, to the extent that she proposes principles based

¹ *Laborem Exercens*, n. 3.

² Cf. *Statutes*, art. 1.

on the natural law and the Word of God, does not vary with the changes of history. However, these principles can be constantly clarified, especially in their concrete applications. And history shows that the *corpus* of *social doctrine* is continuously enriched with new perspectives and aspects in relation to cultural and social developments. I am pleased to stress the *basic continuity* and *dynamic nature* of the Magisterium in social matters at the time of the 30th anniversary of the Encyclical *Populorum Progressio*, in which Pope Paul VI, on 26 March 1976 after the Second Vatican Council and on the way opened by Pope John XXIII, proposed a penetrating reinterpretation of the '*social question*' in its *world dimension*. How can we fail to recall the prophetic cry he uttered making himself the voice of the voiceless and the most underprivileged peoples? Paul VI wanted in this way to awaken consciences and show that the objective to reach was integral development through the advancement 'of every man and of the whole man'.³ To mark the 20th anniversary of that document, I published the Encyclical *Sollicitudo Rei Socialis*, in which I returned to the theme of solidarity and examined it in greater depth. During these last 10 years, many social events, especially the collapse of the communist systems, have considerably changed the face of the earth. Given the speed of social change, it is right today to verify and evaluate continuously. This is the role of your academy which, three years after its foundation, has already made some enlightening contributions; its progress is particularly promising for the future.

3. In your current research, the detailed study of *labour laws* is of great interest, especially if one considers the current trend of 'market instability'. This is a topic which the Magisterium has addressed several times. Personally, I reminded you last year of the moral principle according to which the demands of the market, deeply marked by competition, must not 'go against the primordial *right of every man to have work* through which he can earn a living for himself and his family'.⁴ Returning to this topic today, I would like to stress that when she enunciates this principle, the Church does not at all mean to condemn the deregulation of the market in itself, but asks that it be envisaged and implemented with respect for the *primacy of the human person*, to which economic systems must be subject. History amply demonstrates the failure of regimes characterised by planning that is harmful to civil and economic freedoms. But nevertheless, this does not justify models that are diametrically opposed to them. For, unfortunately,

³ Cf. *Populorum Progressio*, n. 14.

⁴ Address of 22 March 1996, n. 3; *L'Osservatore Romano* English edition, n. 14 (3 April 1996).

experience shows that a market economy, left to unconditional freedom, is far from bringing the greatest possible advantages to individuals and societies. It is true that the amazing economic vitality of certain newly industrialised countries seems to confirm the fact that the market can produce wealth and well-being, even in poor regions. But in a broader perspective, one cannot forget *the human price* of these processes. Above all, one cannot forget the persistent scandal of *serious inequalities* between the different nations and between persons and groups within each country, as you emphasised at your first plenary session.⁵

4. There are still too many poor people in the world who have no access to the least portion of the opulent wealth of a minority. In the framework of the 'globalisation' of the economy, still called 'internationalisation',⁶ if the easy transfer of resources and production systems, effected only in virtue of the criterion of maximum profit and unbridled competition, increases opportunities for employment and well-being in certain regions, at the same time it ignores other less privileged regions and can aggravate *unemployment* in countries with a long-standing industrial tradition. The 'globalised' organisation of work, profiting from the extreme privation of developing peoples, often entails grave situations of exploitation that mock the elementary demands of human dignity.

With regard to these orientations, it is essential that political activity assure a balanced market in its classical form by applying the principles of subsidiarity and solidarity, according to the model of the *social State*. If the latter functions moderately, it will also avoid a system of excessive assistance that creates more problems than it solves. On this condition, it continues to be an *expression of authentic civilisation*, an indispensable tool for the defence of the most underprivileged social classes, often crushed by the exorbitant power of the 'global market'. Indeed, today we profit from the fact that new technologies make it possible to produce and trade almost without restriction in every part of the world, to reduce unskilled manpower and impose on it numerous constraints, by relying, after the end of the 'blocs' and the gradual disappearance of borders, on a new supply of poorly paid workers.

⁵ Cf. *The study of the tension between human equality and social inequalities from the perspective of the various social sciences* (Vatican City, 1996).

⁶ Cf. *Centesimus Annus*, n. 58.

Problems of employment are linked with those of democracy

5. Moreover, how is it possible to underestimate the risks of this situation, not only according to the demands of social justice, but further, according to the broadest perspectives of civilisation? In itself, a balanced and well-regulated world market can bring with prosperity the development of culture, democracy, solidarity and peace. But one can expect very different effects from *an unbridled market* which, under the pretext of competitiveness, prospers *by exploiting man and the environment to excess*. This type of market, ethically unacceptable, can only have disastrous consequences, at least in the long term. It tends to confirm, generally in the material sense, the living cultures and traditions of peoples; it eradicates fundamental and common ethical and cultural values; it risks creating a great void of human values, '*an anthropological void*', quite apart from most dangerously compromising *the ecological balance*. So how is it possible not to fear an explosion of deviant and violent behaviour which would create powerful tensions in the social body? Freedom itself would be threatened, and even the market which had profited from the absence of hindrances. All things considered, the reality of 'globalisation', viewed in a balanced way with its positive potential and the fears it raises, is a call not to postpone the harmonisation of the '*demands of the economy*' with the demands of ethics.

6. It should nevertheless be recognised that within the framework of a 'world' economy, the ethical and juridical regulation of the market is objectively more difficult. Indeed, to achieve it effectively the domestic political initiatives of the different countries do not suffice; what is needed is an 'increased co-ordination among the more powerful countries' and the consolidation of a *democratic global order* with agencies where 'the interests of the whole human family be equally represented'.⁷ Agencies, at the regional or world level, are not lacking. I am thinking in particular of the United Nations Organisation and of its various agencies providing social assistance. I am also thinking of the role played by institutions such as the International Monetary Fund and the World Trade Organisation. It is urgent that, in the field of freedom, a culture of 'rules' should be reinforced which is not limited to a mere commercial function but takes charge, through reliable juridical tools, of *the protection of human rights* in all the parts of the world. The more 'global' the market, the more it must be balanced by a '*global*' culture of solidarity, attentive to the needs of the weakest. Unfortunately, despite grand declarations of principle, this reference to values is

⁷ *Ibid.*, n. 58.

increasingly jeopardised by the resurgence of *selfishness* among *nations or groups*, and at a deeper level, by a widespread *ethical and cultural relativism*, which is a threat to the perception of man's very meaning.

7. But here – and the Church will never tire of repeating it! – is the Gordian knot to be cut, the crucial point on which economic and political perspectives must be focused, to explain their foundations and the possibility of their convergence. It is therefore right that you have included in your agenda, together with the problems of employment, those of *democracy*. The two problems are inevitably linked. In fact, democracy is only possible 'on the basis of a correct conception of the human person',⁸ which involves the recognition of the right of each person to take an active part in public life with a view to achieving the common good. But how can someone who is not properly protected at the economic level and even lacks the basic necessities be guaranteed participation in democratic life? When even *the right to life* from conception to its natural end is not fully respected as an absolutely inalienable right, democracy is undermined and the formal rules for participation become an alibi that conceals *the tyranny of the strong over the weak*.⁹

8. Dear Academicians, I am most grateful for your reflections on these essential subjects. At stake is not only an ever more pertinent ecclesial witness, but the construction of a society that fully respects *the dignity of man* who can never be considered an object or a commodity, because he bears *God's image* within him. The problems facing us are immense, but future generations will ask us to account for the way in which we have exercised our responsibilities. Further, we are accountable to the Lord of history. The Church therefore relies very much on your work, marked by scientific rigour, attentive to the Magisterium and, at the same time, open to dialogue with the multiple tendencies of contemporary culture.

I invoke an abundance of divine Blessings upon each one of you.

⁸ *Ibid.*, n. 46.

⁹ Cf. *Evangelium Vitae*, nn. 20 and 70.

23 APRIL 1998

*Address to the Plenary Session on the Subject
'Democracy – Some Acute Questions'*

The Supreme Pontiff expresses happiness at the fact that the Academy in its researches has borne in mind the Church's social doctrine, which is always 'open to new developments and applications'. The Church wishes to ensure that the Gospel message permeates cultural, economic and political realities. The Academy is called upon to play a 'role of mediation and dialogue between faith and science'.

Venerable Brothers in the Episcopate and the Priesthood,
Distinguished Ladies and Gentlemen,

1. I am pleased to welcome you as you gather in the Vatican for the fourth plenary session of the Pontifical Academy of Social Sciences, which has as its subject 'Democracy – Some Acute Questions'.

I extend a cordial greeting to each of you, and in particular I thank your President, Prof. Edmond Malinvaud, for expressing the sentiments of all and for explaining the purpose of this session.

In these four years since the foundation of the Academy, in plenary meetings and in study sessions you have chosen as the central themes of your research and analysis two questions of vital importance for the social doctrine of the Church: first, work and employment, and now democracy.

I congratulate you and express my deep gratitude for the fruitful work you have already accomplished in such a short time. The acts of the plenary session and the book on the problems concerning democracy, which you have already published and kindly sent to me, show not only a great wealth and variety of content, but at the same time offer concrete applications for making the world more human, more united and more just.

2. I was able to note with pleasure how all the research you have carried out has always kept in mind the fundamental orientation of the *Church's social doctrine*, from the memorable Encyclical *Rerum Novarum* of Leo XIII to the more recent *Laborem Exercens*, *Sollicitudo Rei Socialis* and *Centesimus Annus*.

The Church's teachings on social matters form a doctrinal corpus that is always open to new developments and applications. In fact, as I wrote in *Centesimus Annus*: 'The Church has no models to present; models that are real and truly effective can only arise within the framework of different his-

torical situations, through the efforts of all those who responsibly confront concrete problems in all their social, economic, political and cultural aspects, as these interact with one another'.¹

The Church's social doctrine is not called to concern itself with the technical aspects of the various social situations, in order to formulate her own solutions. The Church proclaims the Gospel and wants to manifest in all its richness the newness that characterises it. The Gospel message must permeate the various cultural, economic and political situations. In this effort of inculturation and spiritual reflection, the Academy of Social Sciences is also called to make its particular contribution. As experts in the social disciplines and as Christians, you are called to play a role of mediation and dialogue between faith and science, between ideals and concrete situations, a role that is sometimes one of pioneers, because you are asked to indicate new paths and new solutions for solving in a more equitable way the burning issues of today's world.

3. A few moments ago, your President, Prof. Malinvaud, stressed how in this fourth plenary session your intention is to study the complex theme of democracy which you have divided into *three great issues of investigation*: the relation between democracy and values; the role of civil society in democracy; the relation between democracy and supranational and international aspirations.

These are subjects that await study and guidelines suitable for directing researchers, political authorities and nations in this millennial passage between the 20th and 21st centuries. How important is this period of preparation for the Great Jubilee of the Year 2000, from which we expect a strong message of reconciliation and peace for the Church and for the world!

Distinguished and dear academicians, may the Spirit of the risen Lord accompany you in this journey of analysis and research. I am following you with keen attention and, as a token of my closeness to your work, I cordially impart to you, the members of the Pontifical Academy of Social Sciences, a special Apostolic Blessing, which I extend to the experts you have invited, your co-workers and all your loved ones.

¹ N. 43.

6 MARCH 1999

*Address to the Plenary Session on the Subject
'Towards Reducing Unemployment'*

John Paul II declares that globalisation can have both positive and negative effects for workers. He points to the very harmful consequences of unemployment and lays stress upon the negative repercussions of black-market labour. He says that much must be done to help young people in relation to employment and calls for effective solidarity in combating unemployment wherever it is found. A business must not be seen solely in economic or competitive terms but must involve solidarity and participation. Company directors and decision-makers should 'base their actions on human capital and on moral values'. Much must also be done with regard to the imbalance between poor and wealthy countries. The Pope concludes by calling for 'an ever more human economy'.

Mr. President,
Ladies and Gentlemen of the Academy,
Ladies and Gentlemen,

1. I am pleased to welcome you on the occasion of the fifth general assembly of the Pontifical Academy of Social Sciences. I sincerely thank Mr. Edmond Malinvaud, your President, for the message he has just addressed to me on behalf of you all. My gratitude also goes to Msgr. Marcelo Sánchez Sorondo and to all those who throughout the year have been involved in coordinating your work.

For the third consecutive year, you are continuing your reflections on the theme of work, thereby showing the importance that should be given to this subject not only at the economic level, but also in the social realm and for the growth and development of individuals and peoples. The human person must be at the centre of the employment question.

Employment is a major international challenge

2. Society is subject to many changes as a result of scientific and technological advances and the globalisation of markets; all these can be positive factors for workers, since they are a source of development and progress; but they can also pose numerous risks to people by using them as cogs in the economy and in the unbridled quest for productivity.

Unemployment is a source of distress and 'can become a real social disaster';¹ it weakens individuals and entire families, making them feel marginalised because they can scarcely meet their basic needs and they feel neither recognised nor useful to society; this leads to the spiral of indebtedness, from which it is difficult to escape, but which calls for understanding on the part of public and social institutions, and support and solidarity from the national community. I am grateful to you for seeking new ways to reduce unemployment; concrete solutions are certainly difficult, since the mechanisms of the economy are complex and are almost always of a political and financial nature. Many things also depend on the norms governing taxes and trade unions.

3. Employment is certainly a major challenge in international life. It presupposes a sound distribution of work and solidarity between all persons of a working age who are able to do so. In this spirit, it is not normal for some professional categories to be preoccupied with preserving acquired benefits, which can only have negative repercussions on employment in a country. Furthermore, the parallel system of black-market labour seriously damages a country's economy, since it represents a refusal to participate in national life through social contributions and taxes; likewise, it places some workers, especially women and children, in an uncontrollable and unacceptable state of submission and servility, not only in poor countries but also in industrialised nations. It is the authorities' duty to see that everyone has the same opportunities regarding employment and the work code.

4. Work is an essential element for everyone. It contributes to his personal growth because it is an integral part of his everyday life. Idleness offers no interior motivation and does not allow a person to plan for the future; not only does it bring 'loss and great want',² but it is also the enemy of a good moral life.³ Work also ensures every individual a place in society, through the justifiable feeling of being useful to the human community and through the growth of fraternal relations; furthermore, it enables him to participate responsibly in the life of his country and to contribute to the work of creation.

¹ *Laborem Exercens*, n. 18.

² *Tb* 4:13.

³ Cf. *Si* 33:29.

Effective solidarity is more necessary than ever

5. A considerable number of young people are among those painfully affected by unemployment. When they enter the job market, they often have the impression that they will have difficulty in finding a place in society and in being acknowledged for their real worth. In this area, all political, economic and social leaders are called to redouble their efforts on behalf of young people, who must be considered one of a nation's most valuable assets, to work together to offer them professional training ever more suited to the current economic situation and to formulate a policy vigorously geared to employment for everyone. In this way, confidence and renewed hope will be given to young people, who at times can have the impression that society does not really need them; this will noticeably reduce disparities between social classes, as well as the phenomena of violence, prostitution, drugs and delinquency, which are continually on the rise. I encourage all who have a role in the intellectual and professional formation of young people to guide, support and encourage them, so that they can be integrated into the working world. For them a job will mean the recognition of their abilities and efforts and will open a personal, family and social future for them. In the same way, through appropriate education and the necessary social assistance, it would be advisable to help families experiencing difficulty for professional reasons, and to teach low-income individuals and families how to balance their budget and not to be enticed by the illusory goods marketed by consumer society. Indebtedness is a situation from which it is often difficult to escape.

6. Since employment cannot increase indefinitely, for the sake of human solidarity it is important to envisage a reorganisation and better distribution of work, without forgetting the necessary sharing of resources with the unemployed. Effective solidarity among all is more necessary than ever, particularly for those who have been unemployed for a long time and for their families, who cannot remain in poverty and destitution without the national community being actively mobilised; no one should be resigned to the fact that some remain unemployed.

7. In a business, wealth is not only created by the means of production, capital and profit, but comes first and foremost from the men and women who, through their work, produce what then becomes consumer goods or services. Hence all wage-earners, each at his own level, must have their share of responsibility, working for the common good of the business and, ultimately, for all society.⁴ It is essential to have confidence in people, to

⁴ Cf. *Sollicitudo Rei Socialis*, n. 38.

develop a system that gives priority to the sense of innovation on the part of individuals and groups, to participation and solidarity,⁵ and that fundamentally encourages employment and development. The utilisation of people's skills is a driving force of the economy. Looking at a business solely in economic or competitive terms entails risks; it endangers human stability.

Need for a fundamental change in consciences

8. Company directors and decision-makers should be aware that it is essential to base their actions on human capital and on moral values,⁶ in particular, on respect for individuals and their inalienable need to have a job and to live on the fruits of their professional activity. Nor should we forget the quality of a business' organisation, the participation of all in its smooth functioning, as well as a renewed attention to peaceful relations between all the workers. I earnestly appeal for an ever greater mobilisation of those variously involved in social life and of all unions and management personnel to commit themselves, each in their own way, to serving the individual and humanity through decisions in which the human person, especially the weakest and the neediest, has the central place and has his specific responsibility truly recognised. The globalisation of the economy and of employment also calls for the globalisation of responsibilities.

9. The imbalances between poor and wealthy countries continue to grow. Industrialised nations have a duty in justice and a serious responsibility towards developing countries. Disparities are becoming more and more glaring. Paradoxically, some countries having natural wealth above or below ground are subject to unacceptable exploitation by other countries in such a way that entire populations cannot benefit from the wealth of their own land or from their work. These nations should be given the opportunity to develop their own natural resources by involving them more closely in world economic activity.

10. The point of departure for a revitalisation of employment is an ethical duty and the need for a fundamental change in consciences. All economic development that does not take account of the human and moral aspect will have a tendency to crush the human person. The economy, labour and business are first and foremost at the service of persons. Strategic choices cannot be made to the detriment of those who work in a firm.

⁵ Cf. *Ibid.*, n. 45.

⁶ Cf. *Veritatis Splendor*, nn. 99-101.

It is important to offer a job to all our contemporaries through a just and responsible allocation of work. Undoubtedly, we can also envisage a review of the relationship between salary and work, in order to reaffirm the value of manual labour, which is often difficult and is considered secondary. In fact, salary policies should take into account not only a business' productivity, but also its employees. Too large a difference between salaries is unjust, for it devalues a certain number of indispensable jobs and creates social disparities that are damaging to everyone.

11. To meet the challenges that society must face on the threshold of the third millennium, I appeal to the Christian community to give ever greater support to those who are struggling for the cause of employment, and to walk with men and women on the path of an ever more human economy.⁷

In this spirit, I thank you for the valuable service you offer the Church by being particularly attentive to social phenomena that are important for individuals and for humanity as a whole. As I entrust you to the intercession of St. Joseph, patron of workers, and of the Virgin Mary, I cordially impart my Apostolic Blessing to you, to your families and to all your loved ones.

⁷ Cf. *Centesimus Annus*, n. 62.

23 FEBRUARY 2000

*Address to the Plenary Session on the Subject
'Democracy – Reality and Responsibility'*

The Supreme Pontiff affirms that the Academy 'helps to ensure that social doctrines do not ignore the spiritual nature of human beings'. He adds that the Church values the democratic system as long as it is founded upon certain principles. Indeed, a democracy without values can turn into totalitarianism. In the context of globalisation, citizens should participate in their political community and the 'principle of subsidiarity' should be implemented. Equally, there must be ecumenical and inter-religious cooperation to make 'genuine democracy, value-based democracy, a reality for the men and women of the twenty-first century'.

1. I am pleased to greet you on the occasion of the sixth plenary session of the Pontifical Academy of Social Sciences. I thank your President, Professor Edmond Malinvaud, and all of you, the Academy members, for your dedication and commitment to the work which you undertake for the good of the Church and of the human family.

As you are well aware, the Church's social doctrine is meant to be a vehicle through which the Gospel of Jesus Christ is brought to bear on the different cultural, economic and political situations facing modern men and women. It is in this precise context that the Pontifical Academy of Social Sciences makes a most important contribution: as experts in the various social disciplines and as followers of the Lord Jesus you enter into that *dialogue between Christian faith and scientific methodology* which seeks true and effective responses to the problems and difficulties which beset the human family. As my predecessor Pope Paul VI said, *all social action involves a doctrine*,¹ and the Academy helps to ensure that social doctrines do not ignore the spiritual nature of human beings, their deep longing for happiness and their supernatural destiny which transcends the merely biological and material aspects of life. The Church's task – her right and her duty – is to enunciate the basic ethical principles governing the foundation and proper functioning of society, within which men and women make their pilgrim way to their transcendent destiny.

2. The subject chosen for the Academy's sixth plenary session, *Democracy – Reality and Responsibility*, represents a most important topic for the

¹ Cf. *Populorum Progressio*, n. 39.

new millennium. While it is true that the Church offers no concrete model of government or economic system,² she ‘values the democratic system inasmuch as it ensures the participation of citizens in making political choices, guarantees to the governed the possibility both of electing and holding accountable those who govern them, and of replacing them through peaceful means when appropriate’.³

At the dawning of the Third Millennium, a serious question confronts democracy. There is a tendency to see intellectual relativism as the necessary corollary of democratic forms of political life. In such a view, truth is determined by the majority and varies in accordance with passing cultural and political trends. From this point of view, those who are convinced that certain truths are absolute and immutable are considered unreasonable and unreliable. On the other hand, as Christians we firmly believe that ‘if there is no ultimate truth to guide and direct political activity, then ideas and convictions can easily be manipulated for reasons of power. As history demonstrates, *a democracy without values easily turns into open or thinly disguised totalitarianism*’.⁴

Thus, it is important that Christians be helped to show that the defence of universal and unchanging moral norms is a service rendered not only to individuals but also to society as a whole: such norms ‘represent the unshakable foundation and solid guarantee of a just and peaceful human coexistence, and hence of *genuine democracy*’.⁵ In fact, democracy itself is a means and not an end, and ‘*the value of a democracy stands or falls with the values which it embodies and promotes*’.⁶ These values cannot be based on changeable opinion but only on the acknowledgment of an objective moral law, which ever remains the necessary point of reference.

3. At the same time the Church refuses to espouse that extremism or fundamentalism which, in the name of an ideology purporting to be scientific or religious, claims the right to impose on others its own concept of what is right and good. *Christian truth is not an ideology*. Rather it recognises that changing social and political realities cannot be confined within rigid structures. What the Church does is constantly to reaffirm the transcendent dignity of the human person, and constantly to defend human rights and freedom. The *freedom* which the Church promotes

² Cf. *Centesimus Annus*, n. 43.

³ *Ibid.*, n. 46.

⁴ *Ibid.*, n. 46.

⁵ *Veritatis Splendor*, n. 96.

⁶ *Evangelium Vitae*, n. 70.

attains its fullest development and expression only in openness to and acceptance of the truth. 'In a world without truth, freedom loses its foundation and man is exposed to the violence of passion and to manipulation, both open and hidden'.⁷

4. There is no doubt that the new millennium will see the continuation of the phenomenon of globalisation, that process by which the world moves ever closer to becoming a homogeneous whole. In this context it is important to remember that the 'health' of a political community can be gauged in no small way by the *free and responsible participation of all citizens in public affairs*. In fact, such participation is a 'necessary condition and sure guarantee of the development of the whole individual and of all people'.⁸ In other words, smaller social units – whether nations themselves, communities, ethnic or religious groups, families or individuals – must not be namelessly absorbed into a greater conglomeration, thus losing their identity and having their prerogatives usurped. Rather, the proper autonomy of each social class and organisation, each in its own sphere, must be defended and upheld. This is nothing other than the *principle of subsidiarity*, which requires that a community of a higher order should not interfere in the internal life of a community of a lower order, depriving the latter of its rightful functions; instead the higher order should support the lower order and help it to coordinate its activity with that of the rest of society, always with a view to serving the common good.⁹ Public opinion needs to be educated in the importance of the principle of subsidiarity for the survival of a truly democratic society.

The global challenges that the human family faces in the new millennium also serve to highlight another dimension of the Church's social doctrine: its place in *ecumenical and interreligious cooperation*. The century just past has seen enormous progress in multilateral initiatives to defend human dignity and promote peace. The era upon which we are now embarking must see a continuation of such efforts: without the concerted and united action of all believers – indeed of all men and women of good will – little can be accomplished to make genuine democracy, value-based democracy, a reality for the men and women of the twenty-first century.

5. Distinguished and dear academicians, I express once more my appreciation of the valuable service which you render in bringing Christian

⁷ *Centesimus Annus*, n. 46.

⁸ *Sollicitudo Rei Socialis*, n. 44.

⁹ Cf. *Centesimus Annus*, n. 48.

enlightenment to those areas of modern social life where confusion about essentials often obscures and suffocates the lofty ideals planted in the human heart. With prayers for the success of your meeting I cordially impart to you my Apostolic Blessing, which I willingly extend to your families and your loved ones.

27 APRIL 2001

*Address to the Plenary Session on the Subject
'Globalisation: Ethical and Institutional Concerns'*

The Pope observes that 'the market economy seems to have conquered virtually the whole world' and emphasises that the Church looks to the Academy 'for the insights which will make possible a better discernment of the ethical issues involved in the globalisation process'. He adds that it is necessary to 'avoid reducing all social relations to market factors' and thus states that globalisation must 'serve solidarity and the common good'. There are dangers that cultural deconstruction brought by globalisation will have damaging effects on human communities, and that biomedical discoveries will not be subject to sufficient control. An ethical approach to globalisation is required which will recognise the 'inalienable value of the human person' and the 'value of human cultures'.

Ladies and Gentlemen of the Pontifical Academy of Social Sciences,

1. Your President has just expressed your pleasure at being here in the Vatican to address a subject of concern to both the social sciences and the Magisterium of the Church. I thank you, Professor Malinvaud, for your kind words, and I thank all of you for the help you are generously giving the Church in your fields of competence. For the seventh plenary session of the Academy you have decided to discuss in greater depth the subject of globalisation, with particular attention to its ethical implications.

Since the collapse of the collectivist system in Central and Eastern Europe, with its subsequent important effects on the Third World, humanity has entered a new phase in which the market economy seems to have conquered virtually the entire world. This has brought with it not only a growing interdependence of economies and social systems, but also a spread of novel philosophical and ethical ideas based on the new working and living conditions now being introduced in almost every part of the world. The Church carefully examines these new facts in the light of the principles of her social teaching. In order to do this, she needs to deepen her objective knowledge of these emerging phenomena. That is why the Church looks to your work for the insights which will make possible a better discernment of the ethical issues involved in the globalisation process.

2. The globalisation of commerce is a complex and rapidly evolving phenomenon. Its prime characteristic is the increasing elimination of barriers to the movement of people, capital and goods. It enshrines a kind of tri-

umph of the market and its logic, which in turn is bringing rapid changes in social systems and cultures. Many people, especially the disadvantaged, experience this as something that has been forced upon them, rather than as a process in which they can actively participate. In my Encyclical Letter *Centesimus Annus*, I noted that the market economy is a way of adequately responding to people's economic needs while respecting their free initiative, but that it had to be controlled by the community, the social body with its common good.¹ Now that commerce and communications are no longer bound by borders, it is the universal common good which demands that control mechanisms should accompany the inherent logic of the market. This is essential in order to avoid reducing all social relations to economic factors, and in order to protect those caught in new forms of exclusion or marginalisation.

Globalisation, *a priori*, is neither good nor bad. It will be what people make of it. No system is an end in itself, and it is necessary to insist that globalisation, like any other system, must be at the service of the human person; it must serve solidarity and the common good.

3. One of the Church's concerns about globalisation is that it has quickly become a cultural phenomenon. The market as an exchange mechanism has become the medium of a new culture. Many observers have noted the intrusive, even invasive, character of the logic of the market, which reduces more and more the area available to the human community for voluntary and public action at every level. The market imposes its way of thinking and acting, and stamps its scale of values upon behaviour. Those who are subjected to it often see globalisation as a destructive flood threatening the social norms which had protected them and the cultural points of reference which had given them direction in life. What is happening is that changes in technology and work relationships are moving too quickly for cultures to respond. Social, legal and cultural safeguards – the result of people's efforts to defend the common good – are vitally necessary if individuals and intermediary groups are to maintain their centrality. But globalisation often risks destroying these carefully built up structures by exacting the adoption of new styles of working, living and organising communities. Likewise, at another level, the use made of discoveries in the biomedical field tend to catch legislators unprepared. Research itself is often financed by private groups and its results are commercialised even before the process of social control has had a chance to respond. Here we

¹ Cf. nn. 34, 58.

face a Promethean increase of power over human nature, to the point that the human genetic code itself is measured in terms of costs and benefits. All societies recognize the need to control these developments and to make sure that new practices respect fundamental human values and the common good.

4. The affirmation of the priority of ethics corresponds to an essential requirement of the human person and the human community. But not all forms of ethics are worthy of the name. We are seeing the emergence of patterns of ethical thinking which are by-products of globalisation itself and which bear the stamp of utilitarianism. But ethical values cannot be dictated by technological innovations, engineering or efficiency; they are grounded in the very nature of the human person. Ethics cannot be the justification or legitimation of a system, but rather the safeguard of all that is human in any system. Ethics demands that systems be attuned to the needs of man, and not that man be sacrificed for the sake of the system. One evident consequence of this is that the ethics committees now usual in almost every field should be completely independent of financial interests, ideologies and partisan political views. The Church on her part continues to affirm that ethical discernment in the context of globalisation must be based upon two inseparable principles:

– First, the inalienable value of the human person, source of all human rights and every social order. The human being must always be an end and not a means, a subject and not an object, nor a commodity of trade.

– Second, the value of human cultures, which no external power has the right to downplay and still less to destroy. Globalisation must not be a new version of colonialism. It must respect the diversity of cultures which, within the universal harmony of peoples, are life's interpretive keys. In particular, it must not deprive the poor of what remains most precious to them, including their religious beliefs and practices, since genuine religious convictions are the clearest manifestation of human freedom. As humanity embarks upon the process of globalisation, it can no longer do without a common code of ethics. This does not mean a single dominant socio-economic system or culture which would impose its values and its criteria on ethical reasoning. It is within man as such, within universal humanity sprung from the Creator's hand, that the norms of social life are to be sought. Such a search is indispensable if globalisation is not to be just another name for the absolute relativisation of values and the homogenisation of life-styles and cultures. In all the variety of cultural forms, universal human values exist and they must be brought out and emphasised as the guiding force of all development and progress.

5. The Church will continue to work with all people of good will to ensure that the winner in this process will be humanity as a whole, and not just a wealthy elite that controls science, technology, communication and the planet's resources to the detriment of the vast majority of its people. The Church earnestly hopes that all the creative elements in society will cooperate to promote a globalisation which will be at the service of the whole person and of all people. With these thoughts, I encourage you to continue to seek an ever deeper insight into the reality of globalisation, and as a pledge of my spiritual closeness I cordially invoke upon you the blessings of Almighty God.

11 APRIL 2002

*Address to the Plenary Session on the Subject
'Intergenerational Solidarity'*

John Paul II observes that globalisation has 'revolutionised the system of social interactions and relations' and has both negative and positive results. He goes on to say that 'solidarity between generations must receive greater attention' and adds that political and economic leaders must strive to ensure that globalisation does not widen the gap between the rich and the poor. People should be brought more fully into the processes of government and there should be a shared worldwide effort to achieve the 'universal common good'. Invoking 'respect for basic anthropological and spiritual values', the Pope affirms that market laws should be subjected to solidarity 'so that individuals and societies are not sacrificed by economic changes at all levels and are protected from the upheavals caused by the deregulation of the market'.

Mr. President,
Your Excellency,
Distinguished Academicians,

1. I am delighted to welcome you on the occasion of the eighth general assembly of the Pontifical Academy of Social Sciences. In particular, I greet Mr. Edmond Malinvaud, your President, to whom I express my gratitude for his expression of respect on your behalf. I thank Bishop Marcelo Sánchez Sorondo and all who coordinate the work of your Academy. With your interdisciplinary richness, you have chosen to continue your reflection on the subjects of democracy and globalisation, thus beginning your research on inter-generational relations. Such a step is valuable for developing the Church's social teaching, for educating peoples and for the participation of Christians in public life in every kind of responsibility for social life.

2. Your analysis also aims at shedding light on the ethical dimension of the decisions that the leaders of civil society and every human being must make. The increasing interdependence among people, families, businesses and nations, as well as among economies and markets – known as globalisation – has revolutionised the system of social interactions and relations. If it has positive developments, it also harbours disturbing threats, notably the exacerbation of inequalities between the powerful economies and the dependent ones, between those who benefit from new opportunities, and those who are bypassed. This fact invites you to think about the subject of solidarity in a new way.

3. In this connection, with the progressive lengthening of the span of human life, solidarity between generations must receive greater attention, with special care for the weaker members of society, children and the elderly. Formerly, in many places, solidarity between generations was a natural family attitude; it also was a duty of the community which had to exercise it in a spirit of justice and equity, making sure that each person have his just share in the fruits of work and in all circumstances live with dignity. The industrial age saw States set up social welfare plans to assist families, giving special attention to the education of youth and to pension funds for retirees. It is fortunate that a sense of responsibility has developed in people thanks to a real national solidarity, so as not to exclude anyone and to give access to a social benefits coverage to all. One can only rejoice at this progress even though it benefits only a small portion of the world's population.

In this spirit, it is first of all the responsibility of the political and economic leaders to do everything possible to ensure that globalisation will not take place to the detriment of the least favoured and the weakest, widening the gap between rich and poor, between rich nations and poor nations. I invite people who have the responsibility of government and those who make the decisions that affect society to be particularly careful by reflecting on future long-term decisions and by thinking how to create economic and social balances, by putting in place systems of solidarity that take into account the changes caused by globalisation and by keeping these methods from further impoverishing substantial parts of peoples, or even, of whole countries.

4. At the global level, collective decisions must be taken and carried out in a process encouraging the responsible participation of all people, called to build their future together. In this perspective, the fostering of democratic models of government will allow the population as a whole to take part in the administration of the *res publica*, 'on the basis of a correct conception of the human person',¹ and with respect for basic anthropological and spiritual values. Social solidarity implies putting aside the simple pursuit of particular interests, which must be evaluated and harmonised 'in keeping with a hierarchy of balanced values; ultimately, it demands a correct understanding of the dignity and the rights of the person'.² Thus it is only right to give great importance to educating the younger generations in a spirit of solidarity and a real culture of openness to the universal and attention to all people, regardless of their race, culture or religion.

¹ *Centesimus Annus*, n. 46.

² *Ibid.*, n. 47.

5. The leaders of civil society fulfil their mission when they seek above all the common good with absolute respect for the dignity of the human person. The importance of the questions our societies have to face and the challenges for the future should stimulate a common will to seek the common good for the harmonious and peaceful development of societies and the well being of all. I invite the administrative bodies that serve the human community, inter-governmental or international organisms, to support the work of the nations with rigour, justice and understanding, in view of the 'universal common good'. Thus in a gradual way the modalities of a globalisation will be guaranteed that is no longer imposed but controlled.

Actually, it corresponds to the political sphere to regulate the market, to subject market laws to solidarity, so that individuals and societies are not sacrificed by economic changes at all levels and are protected from the upheavals caused by the deregulation of the market. Once again, therefore, I encourage social, political and economic leaders to go further in the way of cooperation among persons, businesses and nations, so that the stewardship of our earth will be at the service of persons and peoples and not just of profit. Men and women are called to leave behind their selfishness and show each other greater solidarity. In its journey to greater unity, solidarity and peace, may today's humanity pass on to the coming generations the goods of creation and the hope of a better future!

As once again I express my esteem and gratitude for your service to the Church and humanity, I invoke upon you the assistance of the risen Lord and wholeheartedly impart my Apostolic Blessing to you, your families and all your loved ones.

FACSIMILE OF A LETTER OF PROF. MAX PERUTZ
AND ADDITIONAL PHOTOGRAPHS

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14 January 2002

Monsignor Marcello Sánchez Sorondo
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Dear Monsignor Sorondo,


It seems that my days are numbered and I feel like expressing to you and the President my deep appreciation of having been a Member. I received the Pope's telegram appointing me to the Academy at the same moment as the news of the attempt to assassinate him. It roused a terrible conflict of emotion in me, on the one hand my great pleasure about this Honour, and on the other hand my deep sorrow at that tragic crime.

I first attended a study-week in 1961, in fact organized it myself, which you could almost call 'The Birth of Molecular Biology'. People presented an extraordinary series of exciting new discoveries, and I first met some of the protagonists from other countries. Since then I have attended and organized other study-weeks and much enjoyed that privilege, but the greatest privilege was being a Member of that unique body, a truly international Academy, covering all the natural sciences. I came across there many more people whom I would never otherwise have met, such as the Indian physicist Menon, and then there was the wonderful setting, that Renaissance court, looking over the back of St. Peter's like the view of the Matterhorn from Zermatt. I think that the Pontifical Academy is a unique institution and I very much hope that the Holy Father and his successors will continue to give it their support.

I should be delighted if you were able to communicate any of this letter to the Holy Father and assure him again how much I appreciated my Membership.

With kindest regards to you and the President,

Yours,



Facsimile of a letter of Prof. Max Perutz to the Chancellor of the Pontifical Academy of Sciences written shortly before his death in which he praises the work of the Academy and expresses the hope that the Pope and his successors will 'continue to give it their support'



His Holiness Pius XI with Prof. Guglielmo Marconi and Father Giuseppe Gianfranceschi, S.J., 12 February 1931



His Holiness Pius XI arrives by car outside the Pontifical Academy of Sciences,
Casina Pio IV, 18 December 1938



Msgr. Giovanni Battista Montini, Substitute of the Secretariat of State, with Father Agostino Gemelli, O.F.M., President of the Academy, in the courtyard of the Pontifical Academy of Sciences, Casina Pio IV, December 1940



His Holiness Servant of God Pius XII meets the Academicians, 24 April 1955



His Holiness Paul VI meets Prof. Pietro Salviucci,
Chancellor of the Pontifical Academy of Sciences, 3 October 1964



His Holiness Paul VI meets the Academicians, 19 April 1975



His Holiness John Paul II addresses the Members of the Pontifical Academy of Sciences, 12 November 1983

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 enough to elevate oneself to incomparable heights, and to approach
 such magnificence, 64,
 the Church does not fear the progress of science. She undertakes willingly
 a dialogue with the created world and applauds the wonderful
 discoveries that scientists are making in that world. Every true s. is for
 her a friend, and no branch of learning is shunned by her, 184,
 (the Church) does not see here merely the magnificent use of the
 intellect. She discovers also the exercise of high moral values which
 confer on the s. the aspect and the merit of an ascetic, at times of a
 hero, to whom mankind must pay an ample tribute of praise and
 gratitude, 188,
 the Church has always valued, and in a particularly forceful way at the
 conclusion of the Council, the seekers of truth that scientists are,
 whose paths are not alien to her own, 212,

collects, assimilates, deepens and perfects all that is of value in the vast heritage of the study and reflection of those who preceded him; and he makes use of this patrimony of human knowledge amassed before him as a point of departure, to leap boldly forth towards new conquests, for the profit of his own generation and of those that follow, 192,

constitutes a high service to humanity, XXXVI,

dialogue with, XIV, XVIII, XX, LI, LIII, 233, 243, 282, 296, 299, 315, 319, 329, 370, 375, 376, 377, 380, 387, 391,

the divine government of the universe certainly cannot but arouse a feeling of admiration and enthusiasm in the s., 116,

do not be mistaken, like those philosophers and scientists who thought that our cognitive faculties know only their own mutations and sensations, 107,

during recent decades, a significant change of attitude has led many scientists to be concerned not only with the effectiveness of their work, but with its meaning as well, 328,

the fine self-confidence of early days has for many given place to a salutary unease, so that the soul of the s. today is more easily open to religious values, and glimpses, beyond the prodigious achievements of science in the material domain, the mysteries of the spiritual world and the gleams of the divine transcendence, 185,

the general law of nature which the s. formulates with patient observation and diligence in his laboratory is much more and better than a mere description or intellectual calculation, 111,

if the s. turns his gaze from the present state of the universe to the future, he will be forced to realise that the world is growing old, both in the macrocosm and in the microcosm, 137,

in the face of the prodigies of eternal wisdom, the investigating thoughts of the s. are blind and mute, and give way to that humble, admiring adoration that sees before it the marvel of creation, in which his eye can discern a sudden flash of the power of God, 118-9,

is called in a new way to *openness*: with all respect for the methodological requirements of abstraction and specialised analysis, one may never neglect the unified orientation of knowledge, XXIII, 284, 293, 294, 296, 297, 304, 358, 376,

is dedicated to the study of natural phenomena, XLI,

it is certainly not necessary to remind you, Gentlemen, that the spectre of most terrible calamities, capable of overwhelming and razing to nothing the whole inhabited earth, rises in fact from the most advanced laboratories of modern physical science? Can we remain silent about such prospects? No matter how great is the responsibility

of politicians in this regard, yet the full responsibility of men of science also remains, 194,

it may be said that your life as scientists is spent in reading from the great book of nature. We have another book, one which communicates to us the thoughts of God concerning the world, the inspired book, the holy book. This book gives us the decisive answers that science cannot give, 189,

the knowledge of God as unique Creator is a conviction shared by many modern scientists, 141,

the labour of the s., however disinterested and courageous, loses its ultimate motive if his life is not orientated towards the acquisition of spiritual values, of justice and of charity, 155,

men of science deserve honour and gratitude, 192,

must honestly consider the question of the earthly future of mankind and, as a responsible person, help to prepare it, preserve it, and eliminate risks; we think that this solidarity with future generations is a form of charity to which a great many men are sensitive today, in the framework of ecology. But at the same time, the s. must be animated by the confidence that nature has in store secret possibilities which it is up to intelligence to discover and make use of, in order to reach the development which is in the Creator's plan, 209,

the natural order of things is the subject of research carried out by, xvii,

Pius XI's love for science flowed into his solicitude towards scientists, 125,

Pius XII reminded that in the hands of man science can become a double-edged weapon capable both of curing and killing, 78,

and the problem concerning the state and quality of primitive matter, 139,

proceeds, against all difficulties and obstacles, to further discoveries, pursuing his research with constancy and perseverance, 112,

recent decades have witnessed the beginning of a new dialogue between scientists and religion, 329,

(religion) might seem to be absent when it not merely permits, but directs, the s. to obey only the laws of truth. But looking more closely, it will be seen to be still beside him, to encourage him in his difficult task of exploration, assuring him that truth exists, that it is intelligible, splendid, divine; and also to remind him at every step that thought is an instrument for the conquest of truth and that it should be used with such respect for its own laws that one feels continually the transcendent responsibility that it imposes, 181,

require the assistance of the Spirit, xxxiv,

respectful attention with which the Church considers the mission of the s. In her eyes, you are the seekers and explorers of the mysterious realities of creation; in other words, those who fulfil in the highest

degree the task which God entrusted to man when He created him: that of conquering the earth, of uncovering the secrets of nature. For nature is full of secrets, and it cannot be doubted that those who strive to discover them – and you know better than we do, what patient and painstaking research this entails! – are responding to the Creator's original purpose and clear will, 192,

the Sacred Birth which is about to be celebrated is the s.'s great feast, it is the particular solemnity of the cultivators of science, 62,

scientific research, by absorbing as it can all the knowing capacity of the seeker, can seem to provide sufficient satisfaction and repletion for the intellectual and spiritual activity of man; how it can succeed in annulling, not only the knowledge, but even the desire of knowledge of God; to such a degree that finally atheism appears to some scientists to be a logical position, satisfying thought and justifying reality, 194,

the s. of today, penetrating with his investigations more deeply into nature than his predecessor of a hundred years ago, knows that inorganic matter is stamped with the mark of mutability, 135,

(scientists) are, in a way, more fully men than other men, it is in the first place because you have developed to a high degree the potentialities of what is noblest and likeliest to God in man, 192,

scientists are the interpreters of the book of nature, 143,

should raise knowledge to the level of love, to the level of charity and understanding: *sunt qui scire volunt ut aedificent et charitas est*, xxxvii, 260, since *Deus veritas est*, the most intimate, most supreme, most beneficent, most extensive participation to which God could elevate, is the constant quest for truth, 61,

sometimes the s. has to be satisfied with assigning the character and the form of the behaviour of the masses according to considerations of probability, and, ignorant of the dynamic basis for the particular, to formulate statistical laws, 118,

'The supreme privilege of the s.', wrote Kepler, 'is to recognise the spirit and retrace the thought of God', 116-7,

teaching of truth is a prerogative of, xv,

there are therefore created things whose usefulness is so evident, so clear, that they do not need explanation: to that category belong the high intelligences of the scientists which, for this reason, must spread beneficial light around them, 59,

truth, freedom and responsibility are connected in the experience of the, LII, 384,

uneasiness and anxiety will be dissipated on the day on which men will become aware and will feel that the s. is animated by a sincere spirit of

- service towards humanity, that he desires nothing so much as to enlighten men, to assist them, to ensure their progress and happiness, 189,
- the very composition of the Academy, which gathers men of science regardless of nationality, religion or belief, effectively emphasises this universality of science, 211,
- Vos estis lux mundi* (Mt 5:14), these words can also be applied to the Academians, to the men of sciences, 58, 60,
- what do the hand and the brain of the s. do?, 106-7,
- what use, what practical and useful employment should science, or rather men of science, and their brilliant pupils the technicians, make of the conquests of science? To this query only one reply is possible: everything must tend towards the good of all mankind, 194,
- whether it is a question of genetics, of biology, of the employment of atomic energy, of many other fields which affect what is essential in man, the upright s. cannot but question himself as to the bearing of his discoveries on this psycho-physiological complex which is, in a word, a human person, 188,
- will be assisted by the sense of the divine, xxxvi, 258,
- will become an increasingly rich source of that beneficial charity which truth is, 26,
- work in a worthy way, xxxvi, 213,
- the work of scientists will have no rest until it finds an easy and sure way to govern the process of splitting the atomic nucleus, 113-4
- scientists as believers,
- John Paul II on, xvi-xviii, xxi, xxix, xxxiv, xxxvi, xxxviii, 230, 244, 258, 267, 283, 289, 325, 329, 339,
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 Paul VI on, XXXVIII, 209, 210,
 Pius XI on, 31,
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 see also *intergenerational solidarity*
- soll das Werk den Meister loben – doch der Segen kommt von oben*, i.e. the work
 should praise the master, but the blessing comes from above (Schiller), 55
- sophoi* Greeks, XX
- space, outer, XXII, XLIX-LI, LIII,
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 'the problem of cosmic radiation in interplanetary space', address to
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 space exploration on mankind', address to the PAS study week on
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 'the nuclei of galaxies', address to the PAS plenary session and study
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 'the problem of stellar populations', address to the PAS plenary
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*Spiritus Sancto mentem fuisse nos docere quomodo ad coelum eatur, non
 quomodo coelum gradiatur* (Baronius Card. Caesar), 342
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 theologian, the true,
 it is a duty for theologians to keep themselves regularly informed of
 scientific advances in order to examine, if such be necessary, whether or
 not there are reasons for taking them into account in their reflection or
 for introducing changes in their teaching, 340,
 the majority of theologians did not recognise (in Galileo’s condemnation) the
 formal distinction between Sacred Scripture and its interpretation, 340,

- theologians might well ask, with respect to contemporary science, philosophy and the other areas of human knowing, if they have accomplished this extraordinarily difficult process as well as did these medieval masters, 298,
- today, astrophysicists study the origins of the universe and theologians and exegetes study the creation of the universe as God's gift to man, in a happy complementarity, without suspicion or competition, 329
- Theresa of the Child Jesus (Theresa of Lisieux), St., 18, 228
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- Thomas Aquinas, St. (the 'Angelic Doctor'), XXIII, XXVIII, LII, 22, 51-2, 82, 85, 88, 92, 98, 102, 106, 108, 115-6, 118, 130-1, 223-4, 258, 299, 373, 377, 379, 409, 410
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- truth,
- the Academy will become an increasingly rich source of that beneficial charity which t. is, 26, 212,
- as a friend of t., the Church both admires and encourages the advance of knowledge, together with that of the arts and of all things, and sees it as a beautiful and good thing to exalt the spirit and to promote good, 85,
- the astronomer seeks a t. which far surpasses that of mathematics, or of general laws of physics, or of material objects which he can measure, move, or control, 155,
- to be honoured by the scientist, xiv-xviii,
- cannot be obscured or abandoned to free conventions or agreements between groups of power, societies, or States, lii, 387,
- cannot be subject to negotiation, lii, 387,

(the Church) master of t. and virtue, 85,
 continue your search without tiring and without ever despairing of the t., 189,
 created things are words of t., 143,
Dilatentur spatia veritatis, dilatentur spatia charitatis, 44, 47,
 the disinterested search for t., the tireless pursuit of the secrets of the
 universe are, in fact, among the highest values, the most enthralling
 ideals to which a man can devote his life, 203,
 faith and reason are like two wings on which the human spirit rises to the
 contemplation of, xvii,
 from science to faith; from faith to the intuitive vision of the First and
 most important T., Source of all T., 88,
 if our flesh comes from the dust of the earth and is destined to return to
 it, then our spirit is immortal and, coming from God, it attempts once
 more to climb to God on the ladder of science but never actually
 managing to satiate its thirst for t., 99,
 infinitely real t. is that divine Wisdom which knows and measures every
 smallest atom with its energy, and assigns to it its place in the
 framework of the created world, that supreme Wisdom whose glory
 penetrates throughout the whole of the universe and shines with the
 greatest light in heaven, 120,
 in the same way that nature, whose t. is measured in the Divine mind, is
 the daughter of God, so too is the t. of our sciences, arrived at in our
 own minds, the grandchild of God, 82,
 in you, perspicacious investigators of nature, our predecessor of
 venerable memory recognised the great friends of t., 84,
 is a form of beneficial charity, xv, 26,
 is one of the noblest prerogatives of man, xxiii, 284,
 is the goal of the whole universe (*finis totius universi est veritas*), xxiii, 258,
 just as in things which develop naturally, notes the Angelic Doctor St.
 Thomas, the perfect is reached little by little from the imperfect, so it
 happens to men concerning the cognition of t., 118,
 the knowledge of God as unique Creator, a conviction shared by many
 modern scientists, is certainly the extreme limit which natural reason is
 capable of reaching; but it does not constitute the last frontier of t., 141,
 man has in his greatest school only two books. In the book of the
 universe the human mind searches for the t. of the good things created
 by God; in the book of the Bible and of the Gospels the human
 intellect, together with his will, search for a t. which is beyond reason,
 sublime as is the intimate mystery of God and only known to Him, 85,
 the most inspired scientists of the past and present have come to the lofty
 conclusion that they are heralds of a t. identical and the same for all

peoples and races that walk the earth and look up at the sky; a t. resting, in its essence, on an *adaequatio rei et intellectus*, which is nothing but the acquired conformity, more or less perfect, more or less complete, of our intellect with the objective reality of natural things, in which the t. of our knowledge consists, 107,

the mysteries of t., which for centuries have been hidden and buried in the universe, are gradually unfolded by you, 84,

philosophy and the sciences develop with analogous and compatible methods, taking advantage of empirical and reasonable elements in different measures and working together in harmonious unity toward the discovery of the t., 131,

[philosophy is] a light which is capable of revealing to the scientist the t. which science is unable to attain by its own methods, 146,

philosophy itself should never attempt to define truths which are drawn solely from observation and from the use of scientific methods, 149,

the Pontifical Academicians, through their work and our Institution, will work ever more and ever more effectively for the progress of the sciences. Of them we do not ask anything else, since in this praiseworthy intent and this noble work is that service in favour of the t. that we expect of them, 20,

the researchers of t. pass on from one to the other the investigating torch, to illuminate and develop the pages of the book of nature, thick with enigmas, 118,

the Roman Pontiffs and the Catholic Church have always fostered the research of the learned in the experimental field as well, and such research has opened up the way to the defence of the deposit of supernatural truths entrusted to the Church, 20,

science, when it is real cognition, is never in contrast with, xv, 20,

science, which has encountered the Creator in its path, philosophy, and, much more, revelation, in harmonious collaboration because all three are instruments of t., like rays of the same sun, contemplate the substance, reveal the outlines, and portray the lineaments of the same creator, 141,

science which is the true knowledge of things is never contradictory to the truths of Christian faith, 197,

scientific t. becomes a decoy from the moment when it is considered adequate to explain everything, without being linked up with other truths and above all with subsistent t., which is a living and freely creative Being, 155,

the scientist who stands on the edge of this immense torrent finds relief in that cry of t. with which God defines Himself: 'I am Who am', 135,

the seekers of t. that scientists are, 212,
 set aside all personal bias, and accommodate yourselves with docility to
 every indication of t. which comes to light, 144,
 since *Deus veritas est*, the most intimate, most supreme, most beneficent,
 most extensive participation to which God could elevate, is the
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 such is the vigour, the allurement, the beauty and the impalpable life of
 t., that she breaks free from the appearance of that immense reality
 which surrounds us, 81,
 such then is the joy of knowing and learning, even a little, of the
 measureless sea of t. which surrounds us, 83,
 there is a mysterious mutual kindred tie between Good and T., as the
 Academicians know because of their scientific activities, 23 f.,
 there is God himself who is called T., 25, 33,
 these sciences which can so well 'elevate the human family to a more
 sublime understanding of t., goodness and beauty, and to the
 formation of judgments which embody universal values', can also
 prepare man to discover and accept the whole t., provided these
 sciences do not incorrectly consider 'the methods of investigation
 which these sciences can use as the supreme rule for discovering the
 whole t.', 197-8,
 thought is an instrument for the conquest of t., 181,
 through new and broader avenues, humanity is advancing, but always
 like a pilgrim, towards a deeper knowledge of the laws of the
 unexplored universe, as it is spurred on by the natural thirst for t., 118,
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 a t. loves another t. and, like sisters, daughters of the same mother,
 Divine T., they embrace in the presence of God, 84,
Veritas liberabit vos (Jn 8:32), 26,
 we are neither responsible for creation nor are we the creators of T.:
 neither our doubts, nor our opinions, nor our carelessness, nor our
 negations can alter it, 81-2,
 what takes place here, beloved sons, what you do, is also Good – the
 Good that is called t., from which the T. takes its name, form,
 appearance, but which is real Good, Good which is also specifically
 and valuably beneficial, 25,
 when the number of intellects amongst such well-known and firm friends
 of science and t. increases, it cannot be doubted that science and t. can
 only gain by this, and in a notable fashion, 32,

which inferior things communicate to you in all their variety and diversity is not that which *odium parit*, but is the t. which rises above the divisions and disagreements of souls, and unites geniuses in fraternal accord and in a love of the t., 84,
woe to them who make use of falsely taught sciences to make men leave the right path! They are likened to stones maliciously placed in the path of the human race. They are the obstacles on which men stumble in their search for t., 150,
'Worse than in vain does any quit this shore to fish for t., the fisher's art unknowing – He'll not return the same man he was before' (V. Monti), 83,
your souls, illustrious Academicians, crave and search for the t., which throbs in all we see, hear, smell, taste, touch and feel in all its many ways, 81,
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