

SCIENTIFIC CULTURE AND THE TEN STATEMENTS OF JOHN PAUL II*

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Introduction

From the very earliest days of his Pontificate, Karol Wojtyła has maintained a particular relationship with Science and its values. Just a few days after his election, he opened the doors of the Church to Science, giving life to a continuing relationship with the international scientific community. This relationship has played an invaluable role in eradicating the danger of a Nuclear Holocaust, and in confronting, through factual projects, the danger of an Environmental Holocaust in the undeclared war between the planet's North (the rich) and South (the poor). No better guide exists for the scientific community in undertaking this task than the Pope's ten statements, which have given life to a Scientific Culture in communion, not in conflict, with Faith.

The role of this pastoral work of the Pope is analysed in the context of modern culture in which – up until the arrival of John Paul II – the dominant part of atheist culture had raged, using popularisation of so-called science as an effective weapon for achieving the transformation of streams of falsehood into truth itself. Mystification of culture in the 20th century became a powerful arm of the two atheist cultures, Nazism and Stalinism, which had the common goal of outlawing Faith as Science's number one enemy. These two fearful cultures were deliberately blind to the fact that Science was not born in atheism's home, but in the heart of our Christian

* Original in Italian. English translation by Mrs Susan Biggin, edited by Mrs Jean Engster-Montgomery and Eng. Claude Manoli.

culture, with Galileo Galilei, as an act of Faith in He who made the world, and that Science was (and is) a source of values that are in communion, and not conflict, with Faith. It is these values that have been given a new life with the Apostolate of John Paul II, whose ten statements sum up the values of Science and its role within the culture of our time.

There are three chapters here. The first covers the ten statements followed by a brief discussion. The second chapter is dedicated to the ninth statement, which has special significance for this Symposium. John Paul II in fact says that Science is born in the Immanent but brings man towards the Transcendent. We shall see if this is true. The third chapter examines the so-called popularisation of science and the issuing cultural falsehoods. The conclusion gives a summary.

1. THE TEN STATEMENTS OF JOHN PAUL II

1.1. *Error and Forgiveness – The First Statement*

On the 30th March 1979, His Holiness John Paul II met with physicists of Europe at the Vatican, to open the doors of the Church to Science, thereby allowing the Catholic Culture to take back home what in truth are its own treasures of the Galilean Scientific Culture. John Paul II says:

Whatever is born of an act of Love must never be punished. If misunderstood, thus if it seems in error, this act of Love must be forgiven. Indeed, when understood, this act of Love will enrich our Faith.

This statement of John Paul II follows the teaching of Sant'Agostino on the preminent role of Love. In fact Sant'Agostino says: 'Love and do what you will'.¹ The relevance of 'Love' is of major significance for Galilean Science. At that time, no one understood that Science was born of an act of Faith and Love towards Creation. It escaped everyone, then, that, studying the material world, Galilei had uncovered the first footprints of the Creator of all things visible and invisible. And yet it was these traces that he said he wanted to seek, through an act of Faith in the Creator.

The Fundamental Laws of Nature enrich our Faith, but when they were discovered, they were confused with a detail that seemed offensive to the act of Faith: the fact that it is the Earth that moves, not the Sun. The three levels of scientific credibility had not yet been discovered, and it was there-

¹ 'Ama et fac quod vis' (*Epistolam Joannis ad Parthos*, tractatus 7, sect. 8).

fore difficult to understand how and why this apparent offence was linked to an act of Faith and Love towards Creation. This Act of Love enriched Faith, giving it, in the Immanent, the foundations of logical rigour that no one could have imagined possible, precisely because they were rooted in the material component of our very own existence.

Galilei studied stones in order to discover the Logic of Creation. He could have instead discovered chaos. Had Galilei not existed, we would know nothing about the existence of the Fundamental Laws of Nature. So two questions arise:

- what did Galilei know about the fact that the Fundamental Laws of Nature had to exist?

- and on what foundations was he able to conceive that these Laws had to be Universal and Immutable?

Imagining the existence of Universal and Immutable Fundamental Laws does not involve acts of Reason and nothing else, but of Faith in the Creator of the world.

Were it not for Galilean Science, we would not be able to say that Fundamental Laws of Nature, Universal and Immutable, exist; nor that these Laws lead to the unification of all the phenomena studied in the visible Universe, which appears to us with just four dimensions.

The Grand Unification brings with it the need for a Superworld, a scientific reality with forty-three dimensions: eleven of the 'boson' type and thirty-two of a 'fermion' nature.

We are beholding the most extraordinary conceptual synthesis of all time. And, we repeat, man has arrived at this magnificent synthesis through an act of Faith and Love towards Creation, born in the heart of our culture, an act of Faith that, in the first statement of John Paul II, receives its first and ultimate seal.

1.2. Science and Faith – The Second Statement

In 1979, John Paul II not only opened the doors of the Church to Science, but placed Science on the same pedestal as the values of Faith, saying: 'Science and Faith are both gifts of God'.

And indeed, Science studies the Fundamental Laws that govern the material structures of Creation. These laws could not exist if we were the children of chaos. These laws are the proof that in the Immanent there exists a rigorous Logic that is valid everywhere: from the heart of a proton to the edges of the Cosmos.

Among the innumerable forms of living matter, we are the only one that has been granted the gift of knowing how to decipher the footprints left in the Immanent by the Creator of all things visible and invisible.

It is this statement that led to a new alliance between John Paul II and the broadest scientific community ever brought together in the world – the WFS (World Federation of Scientists): ten thousand scientists from one hundred and fifteen nations, who, as we shall see, met with the Pope at the Erice Centre on the 8th May 1993.

1.3. *Science and Technology – The Third Statement*

We live in a culture that attributes to pure scientific research responsibilities that belong in their entirety to Technology (use of Science).

It is not the dominant atheist culture that came to the defence of Science against crimes it never committed (the arms race and irresponsible industrialisation), but John Paul II.

And the third statement of John Paul II is the proof:

The use of Science is not anymore Science; this is why Technology could either be beneficial or harmful to life's values and human dignity.

A clear distinction must be maintained between Science and the use of Science (which is given the name Technology). The great scientific discoveries must be distinguished from technologies for warfare, from reckless industrialisation, from genetic manipulation.

To succeed in deciphering what is written on a page of the Book opened by Galilei has no connection whatsoever with the use that political and economic aggression can make of that discovery.

By placing Science on the same pedestal as the values of Faith, John Paul II gives Science the power to defend itself from attacks of the dominant atheist culture, separating quite clearly Science (the study of the Logic of Creation) and Technology (the use of Science, whether for good or for evil).

For the first time in the History of the so-called modern era, a clear distinction is made between Science and Technology. This separation confers an extraordinary cultural dignity on the great scientific discoveries, and allows them to be distinguished from technological applications, from the violence wrought on the environment, from thoughtless industrialisation, and from genetic manipulation used against life and against the very dignity of this form of living matter, called man, made in the image and likeness of the Creator.

1.4. *Dangers of Technology and Scientific Truth – The Fourth Statement*

In a message to the WFS, John Paul II says:

Man could perish from the effects of technology that he himself develops, not from the truth that he discovers by means of scientific research.

This fourth statement of the Pope allows the great scientific discoveries to be distinguished from technology for warfare, from thoughtless industrialisation, from genetic manipulation. The effort made by John Paul II in defence of Science – as distinct from its use – has led a large percentage of the public finally to understand the radical difference that exists between Science and Technology. The declarations of the Holy Father have also encouraged scientists to speak out against the mystifications of the dominant atheist culture.

This statement of John Paul II allows us to understand that Science can be put to use for the common good, but that it can also be used for evil ends, and that the choice between good and evil is not scientific but ethical and cultural.

The Pope's earnest encouragement instilled in the scientific community of one hundred and fifteen countries the desire to create the International Committee 'Science for Peace', thereby bringing this community down from its ivory towers to get to work against the dominant culture and its mystifications, through the publication in 1982, of the Erice Statement.

Before the fall of the Berlin Wall, an awareness had arisen in our community of scientists of the need to leave the ivory towers, in order to let the wide public know about the profound difference that exists between 'scientific culture' and 'scientific popularisation'. Ten thousand scientists from one hundred and fifteen nations signed the Erice Statement, specifically since here, this time, the real and great Science was talking, in first person, without mediators. This document was drawn up by three people: Kapitza, Dirac² and the present author.

² A note about Kapitza and Dirac. Pëtr Kapitza was the only scientist in the USSR to have had the courage to say no to Stalin, who wanted him to direct the project for the most devastating bomb ever conceived: the one based on nuclear fusion. In the USA, the proposal of Oppenheimer was being discussed. He wanted to shut down the nuclear arms race. This proposal led to him being investigated, as if he knew about Stalin's decision. We would do well to remember that the great Kapitza (discoverer of superfluidity) was stripped of his title and reduced to living in hardship until the death of the greatest communist criminal in History. Dirac (father of the equation that opened up to Science the horizons of antimatter, never conceived by anyone before) worked on the project for the free world's first nuclear bomb, terrified that Hitler might arrive first.

1.5. *Missiles and the Heart of Man – The Fifth Statement*

To the scientists of Erice engaged in the study of how to overcome the danger of a Nuclear Holocaust in the horrific conflict between the two Superpowers (USA-USSR), John Paul II said:

As in the time of spears and swords, so today, in the missile age, to kill, more than arms, is the heart of man.

This statement of John Paul II made a decisive contribution to the effort undertaken by the largest East-West-North-South scientific community that ever existed, to examine the foundations for a scientific-technological agreement between the two Superpowers, designed to avoid the danger of a Nuclear Holocaust issuing from the USA-USSR confrontation.

The joint effort of John Paul II and the scientists signatories of the Erice Statement made a crucial contribution to the fall of the Berlin Wall, upholding with concrete facts the validity of this Great Alliance between the scientists of Erice and John Paul II.

1.6. *Scientific Voluntariate – The Sixth Statement*

With the danger of the Nuclear Holocaust overcome, the Holy Father initiated another action within the great movement of scientists, engaged for a long time in studying the danger of the Nuclear Holocaust, saying in one of His messages to the WFS:

Voluntary Science is one of the noblest expressions of love for one's fellow men.

The aim of this great plan was to study the Planetary Emergencies. In 1993 the Pope came to Erice to meet with the WFS scientists representing 115 Nations. The presence at Erice of John Paul II on the 8th May 1993 crowned a series of meetings and initiatives whose roots lie in the Papal *Magister*. For this extraordinary Pope has known how to open the doors of the Church to Science, without ideological, political, or racial distinction, and beyond any geographical barrier. In so doing, he has been able to give new drive to the culture of our time such that, after endless cultural mystification that threatened the very values of human dignity, great scientific discoveries have managed to penetrate the heart of the culture of our time – so-called modern, but in reality pre-Galilean and so very dispossessed of the truth.

The Earth belongs to everyone: rich and poor, believers and non-believers. A careful examination is needed of the vital features of this

satellite of the Sun, a study that leads to a use of Science with the aims of peace, progress, and the defence of Nature. Do this, says the Pope, putting into action another form – one of the most noble – of love for your fellow man: the Scientific Voluntary.

And so it was that the international scientific community, encouraged by John Paul II, put into action the Scientific Voluntary, carrying out in a global collaboration (East-West-North-South) fifty-five pilot projects whose results allowed the conclusion that it is possible – provided that there is the political will – to face and resolve the Planetary Emergencies in the new millennium, giving future generations the hope of a life of well-being and brotherhood, in communion with all people of the Earth.

It should not be forgotten that the Earth is threatened by the danger of an Environmental Holocaust in an undeclared and hidden war between rich (North) and poor (South). John Paul II urges the scientists of the WFS to commit themselves through the Scientific Voluntary to a study of the state of health of this space shuttle on which we have been graced to have been born.

The third millennium has need of the fundamental values of our culture, which is based on Love, to create a new society where Brotherhood, Charity, Forgiveness and Friendship among people triumph. This statement of John Paul II forms the foundation stone on which the whole of Humanity, in a Great Alliance between Science and Faith, can build the Hope to defeat the danger of an Environmental Holocaust. The results obtained from the pilot projects are the only material proof that the scientific community has been able to give to the G8 governments to convince them of the fact that, if there is political will, it is possible to defeat the Planetary Emergencies.

1.7. The Use of Science for the Good of Humanity – The Seventh Statement

Were it not for political and economic violence, scientific discoveries would find one single route for application: that whose goal is to improve the quality of life and the defence of dignity for all creatures travelling on this satellite of the Sun.

Science would continue to progress in deciphering the Book of Nature, and neither the arms race nor irresponsible industrialisation would exist. In a world in which a culture of Love, Brotherhood and Solidarity triumphed, the use of Science would serve only good purposes,

and would correspond to a continuation of the Work of Creation. Indeed, the seventh statement of the Holy Father says:

The use of Science for the good of humanity is a living testimony of an extraordinary continuity and a constant unity with the work of Creation.

The use of Science for the purpose of good has been the force behind the study and research that have led the world to carry out pilot projects for defeating the Planetary Emergencies. The seventh statement clearly shows that it is vital for the struggle against the Planetary Emergencies to take a firm place within modern culture.

1.8. *Love and Frontiers – The Eighth Statement*

In 1990, the Holy Father as a consequence of the meetings with the WFS scientists, made an appeal, while in Aversa, to convince all, scientists and non scientists, of the need to promote a Civilisation based on Love, saying:

Love conquers all, demolishes frontiers, shatters the barriers between human beings. Love creates a new society.

1.9. *The Transcendent and the Immanent – The Ninth Statement*

The great appeal of our existence lies in the duality that characterises all we do, moment by moment, day by day, during the course of our lives. The two supporting columns of this duality are Science in the Immanent, and Faith in the Transcendent. In a message to the WFS, the Pope says:

Science has its roots in the Immanent but leads man towards the Transcendent.

This statement by John Paul II has been taken up most enthusiastically by one illustrious member of the WFS – Professor Čerenkov – as indeed by the entire international scientific community. Chapter 2 gives a closer examination.

1.10. *The Great Alliance Between Faith and Reason – The Tenth Statement*

The tenth statement projects the necessary alliance for the culture of the third millennium into the future. John Paul II in fact says:

The non-believers are thinkers; the believers are thinkers who pray; together, believers and non-believers act in good faith to implement the Great Alliance between Faith and Reason.

The future will be dominated by two factors. One is linked to our Transcendental Sphere, and is Faith. The other is part of our existence in the Immanent and makes increasing reference to the rigorous component of our thought and our activity, and is Reason.

Within the Great Alliance between Faith and Reason lies a strong source of hope, such that the world may see the defeat of those who show contempt for Faith or Reason. Although of Islamic faith, Professor Abdus Salam³ loved the Pope. He was convinced that the world's future had to be built on a Great Alliance between Faith and Reason, and that Science should have been taught from the world's altars.

2. LET US SEE IF IT IS TRUE THAT 'SCIENCE IS BORN IN THE IMMANENT BUT BRINGS MAN TOWARDS THE TRANSCENDENT'

This chapter – as we have already noted – is dedicated to the ninth statement of the Holy Father, who says:

Science has roots in the Immanent but brings man towards the Transcendent.

Let us see if this is true.

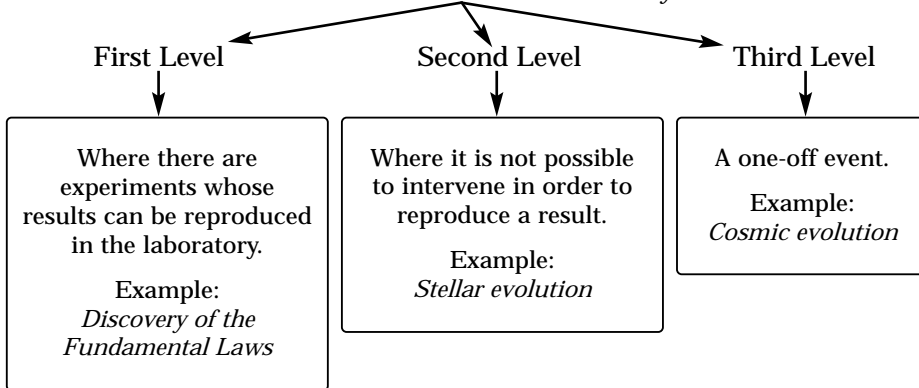
2.1. *Reason According to Believers and the Three Levels of Scientific Credibility*

For believers, Reason is a God-given gift and has allowed us to discover:

- Language, from which collective and permanent memory is born, thanks to Writing.
- Rigorous Logic, which has given rise to the great constructions of Geometry, Arithmetic, Analysis, Algebra, Topology.
- Science (with its three levels), which allows the certainty that the world is not ruled by chaos but rather by a rigorous Logic with laws that are valid from the heart of a proton (a millionth of a billionth of a centimetre) to the fringes of the Universe (a million billion billion kilometres).

³ A note about Professor Abdus Salam: Nobel Laureate for his exceptional contribution to the understanding of the electro-weak forces, he dedicated his life to the young Galilean talents of developing countries. He held John Paul II in the highest regard, and considered the tenth statement to be a contribution of fundamental value to the culture of our time.

- *A Note on the Three Levels of Scientific Credibility.*



All the levels should be formulated in a rigorous way, and there should be no contradiction among them. An example of the link between the three levels of scientific credibility: Cosmic Evolution must be formulated in a rigorously mathematical way, and must be based on the discoveries of the Fundamental Laws made at the first level.

No phenomena known in the Galilean sense (i.e. rigorously reproducible) exist that cannot be explained as a consequence of the Logic of Creation: this represents the greatest conquest of Reason in the Immanent.

This study, undertaken by Galilei just four centuries ago, leads us to conceive of the existence of a reality even more exciting than the one we are used to – a reality of extraordinary symmetry which we hinted at in Section 1.1, and to which the name Superworld has been given.

2.2. Reason According to Atheists

For the atheist culture, Reason is the outcome of Biological Evolution of the Human Species. The Biological Evolution of the Human Species (BEHS), however, lies below the third level of scientific credibility. It is far from being comparable with Cosmic Evolution inasmuch as BEHS lacks rigorous mathematical formulation and is not based on reproducible experiments at the first level. If BEHS were Science at the first level, then the equation of BEHS should exist that leads to the outcome of Reason. And that is not all. There are innumerable forms of living matter. None of these, however, has been able to discover Science, or rigorous Logic, or Collective Memory. BEHS is unable to explain how it is that we are the only form of living matter that has the faculty of Reason.

2.3. Atheism is Self-Contradictory

Atheism is a contradictory logical construction. In fact, it denies the existence of the Transcendent.

If everything finds expression within the Immanent alone, then what BEHS would have is true: Reason is born and dies in the Immanent Sphere of our existence.

Since the greatest conquests of Reason are (as we have said) Language, Logic and Science, then Mathematics (the rigorous form of Reason) should be able to demonstrate that God does not exist, and Science should be able to discover that God does not exist.

Mathematics has not demonstrated the Theorem of the Denial of God and Science has not discovered the scientific proof of the non-existence of God.

If everything finds expression within the Immanent alone, how is it possible that there is no Theorem of the Denial of God, nor the scientific discovery of the non-existence of God? Here is the contradictory nature of the logical construction of Atheism.

2.4. The Transcendent Solves the Contradiction of Atheism

In the Logical Structure of the Believer, there exists the Transcendental Sphere, and Reason is a gift of God.

God has given us this unique privilege that has allowed us the Three Great Conquests. Logical Mathematics is not able to demonstrate the Theorem of the Existence of God in that, if it could, God could be Mathematics alone. God instead is everything. The same is true for Science. If Science were to manage to discover God, then God would have to be just Science. But instead, God is everything. It is the task of philosophical thought to demonstrate that God exists through the Transcendental Sphere of our existence and its connections with the Immanent Sphere of everyday life.

2.5. To Discover the Logic of Creation

If Language were sufficient to discover Science, this would have been discovered at the dawn of civilisation. If rigorous Logic were sufficient to discover Science, this would have been discovered by the Greeks.

To discover Science, it is not sufficient to think and reflect (Language), or to resort to rigorous reasoning (Mathematical Logic). To discover Science (Logic of Creation), there is one single route: to present rigorously

formulated questions to the Creator. This requires an act of humility: recognition that the Creator is more intelligent than any of us – philosophers, thinkers, mathematicians, logicians, scientists. It is necessary to surrender ourselves before the intellectual Majesty of He who made the world.

It was Galilei who understood this. He it was who said that the footprints of the Creator were to be found in the stones (just as in the Stars). Galilei brought the Logic of the Stars into common matter (stones, string, wood), through an act of Faith and Love towards Creation.

In pre-Galilean thinking, for atheists and believers alike, matter could not be a depository of fundamental truth. The Fathers of the Church were the first to say that Nature is a Book written by God. Galilei had the privilege of understanding that the characters of that Book had by nature to be mathematical, and that it was not enough to reflect on the heavens and Stars.

All preceding cultures attributed to the heavens properties that lay above those of the stones. Galilei brought the Logic of Creation into stones and common matter, saying that our intellect has a power below that of the Creator. And thus it is necessary to bow before His intellectual Majesty and ask humbly how He has made the world. In other words, what rigorous Logic – of all possible logics – did He follow to make the world as it appears to our eyes and our intellect? The significance of a rigorous and reproducible experiment is precisely that intended and experienced by Galilei: to present in humility a question to the Creator.

2.6. Ten Thousand Years Compared with Four Centuries

This is how, in just four centuries, we have managed to decipher a good part of the Logic of the Creator. And we have managed to understand just how right was the humility of Galilei. In fact, from the dawn of civilisation right up to Galilei – in other words, for a good ten thousand years – all that man thought he had discovered about how the world was made, without ever carrying out an experiment, turned out to be wrong. Still today, Galilean teaching rules the logic of all the scientific laboratories in which the Fundamental Laws of Nature are studied.

Here is a last example of enormous interest today. No one can tell us if the Superworld exists or not. And yet this theoretical reality has been placed on rigorous and mathematical foundations. It is on these foundations that we believe we have understood so many properties of the world in which we live. But even so, the Galilean proof to be certain of the existence of the Superworld is lacking.

Logical rigour is not sufficient; Galilean proof is needed, in that this is the reply the Creator gives to our questions. To know more about the Logic of Creation, as always, it is necessary to present the right questions to He who made the world. This is how, in just four centuries, we have reached the threshold of the Superworld.

2.7. From the Immanent to the Transcendent

Science has the goal of understanding what God has written, using the rigour of Mathematics. Galilei said and thought that the Fundamental Laws of Nature are in fact expressed as precise mathematical equations. What did the father of Science know, how did his studies of oscillating pendulums or stones rolling down an inclined plane allow him to deduce that rigorous laws had to emerge? Chaos, randomness, whim might just as possibly have appeared instead: one day like this, a year later quite different. One law for Pisa, another for the Moon.

Galilei instead was thinking in terms of fundamental and universal laws, expressible in rigorously mathematical form. Together, these laws were to represent, and *de facto* do represent, the Logic of Creation.

'In that stone there is the hand of the Lord. By studying *common objects* I will discover the Laws of He who has made the world'. This was the Faith that inspired Galilei to challenge the dominant culture of his time. He simply wanted to read the Book of Nature, written by the Creator in mathematical characters.

The Book of Nature reveals to us how the world has been made: the work of Creation. This opus could have been written in no other way but rigorously, in mathematical characters. It is the scientist, in the first person, who has to strive in order that everyone should know how to read that astonishing and fascinating Book.

In it is written how the world is made. Since it is dealing with a construction, its language has to be rigorous. Knowing how to read it means making available for the benefit of man the laws that rule the Cosmos, in communion, not in antithesis, with the word of God, that is, the Bible. The Bible is written in a simple way, so that everyone can understand it; its purpose is not to explain how the Immanent part of our existence is made. Instead, it has the goal of tracing out for man the path that leads to the Lord. Science gives us the certainty of not being children of Chaos, but of a rigorous Logic. Who is the Author of this Logic? Atheism replies: no one. This is why Science, born in the Immanent, brings man towards the Transcendent, because it is absurd that a rigorous Logic does not have an Author.

2.8. *'The Light of the World'*

The twentieth century will go down in History as the era in which the use of Science (Technology) was at the service of political violence. This era led to the tragic dark periods of Nazism and Stalinism.

Professor Pëtr Kapitza, discoverer of superfluidity and expelled from university, reduced to living – as noted in Section 1.4 – without income until the death of Stalin for having refused to manage the Soviet H bomb project, defined John Paul II as being the:

Light of the World set alight to dispel the tragic shadows of Nazism and Stalinism.

2.9. *The Berlin Wall was to Fall in the Fourth Millennium. Instead ...*

During the seventies, various meetings were held at Erice behind closed doors, to reflect on the danger of an East-West Nuclear Holocaust. Participants in the meetings included a number of twentieth-century giants of Galilean Science. These included Paul Dirac, Eugene Wigner, Pëtr Kapitza, Edward Teller, Isidor Rabi, Victor Weisskopf, Richard Feynman and Robert Wilson. As we have mentioned before, Kapitza had had the courage to say no to Stalin, who wanted him as director of the Soviet H bomb project. This refusal had cost him expulsion from all university and scientific duties, with consequences that can easily be imagined. Kapitza fell from being a prominent member of academia (discoverer of superfluidity) to maintenance technician of electrical equipment until the death of Stalin. Along with Wigner and Teller, Dirac had participated in the Manhattan Project, refusing any payment. Teller and Wigner were the fathers of the American H bomb project.

The conclusion of these meetings was: conflict is to be avoided at all costs. However, sooner or later, unfortunately, something will happen.

Kapitza feared the arrival of someone crazy and irresponsible at the head of the USSR.

Had this happened, the first shot would have been fired by the USSR. And in a nuclear exchange, first shot means certain victory. Unfortunately – even without an irresponsible leader in the USSR – there was always the potential weakness, typical of a free and democratic system, to contend with.

If in the USA – through normal democratic process – a weak president had been elected, the USSR head, while in no way an irresponsible criminal but a politician educated on Leninism and Stalinism, might

have decided to grasp the opportunity with both hands. And to fire – on the basis of some pretext devised for the purpose – the first shot. But only a country whose governmental structure lacked the check of public opinion – and no other – could take advantage of the temporary weakness of the political adversary. The USSR held a potential for warfare twice that of the USA.

Conclusion: the USSR would have taken over Europe. And we would have had many centuries of ‘real socialism’. The United States of America would never have envisaged a war to free Europe. They would have accepted the *modus vivendi*, just as they had accepted the surrender of eastern Europe to Soviet Imperialism.

The prediction, in the closed-door discussions of these scientific summits, was that our culture would have been reborn – not as a result of liberation by the USA – but rather as a consequence of the slow shift, very slow but inexorable, of ‘real socialism’ towards democracy and freedom. Estimated timescale: several centuries, perhaps a thousand years.

No one had predicted the arrival of John Paul II and that the Berlin Wall would fall.

This Pope brought about a rebirth of our culture with its values and conquests before the beginning of the third millennium. In this rebirth, right at the front, lies Galilean Science. The closed-door discussions held at Erice over the course of many years have convinced me of the importance of a totally unexpected and unforeseeable fact. A fact that in the history books of future millennia will be described as a miraculous event: the totally unpredicted irruption of this Pope into the History of the world. The Berlin Wall fell in the second millennium, not the fourth.

3. SO-CALLED SCIENTIFIC POPULARISATION AND THE MOST SERIOUS OF ALL CULTURAL LIES: SCIENCE AND FAITH ARE ENEMIES

Atheist culture has used so-called *popularisation of science* to endorse so much cultural untruth. It has never spoken of Galilean truth nor has it ever talked about how Science came into being. Instead, through its propaganda campaigns, it has spread the most serious of cultural falsehoods, which would have ‘Science and Faith as enemies’. And the pillar underlying this lie would have us believe that Science cannot be a source of values.

3.1. *The Values of Science and Faith are Closely Linked*

We will now see, instead, that Science is a source of values, and that these values are in perfect harmony with the values of Faith, not in antithesis. Below is a short summary of the values that Science has in common with Faith.

Revolution

We begin with the concept of revolution. When a scientific discovery arises, the dominant culture loves to point out that a real revolution has taken place.

The scientific revolution has never produced deaths or injuries. The concept of 'revolution' derives from the discovery that it was the Earth and the other satellites of the Sun that move, going around in their orbits. It was the 'revolution of the orbits' that gave life to Galilean Science. The term 'revolution' intended to emphasise the impact of the 'revolution of the orbits' of the planets on the history of the world. With the passage of time, cultural mystification is at work such that the scientific term 'revolution of the orbits' comes to take on the meaning of 'socio-political revolution' like the October Revolution that led to the first example of a Republic with Atheism as State religion, causing many millions of victims.

Instead, following a scientific revolution, everyone is richer than before. It would be more correct to speak of construction, rather than revolution. In Science, there is never denial of the past: it is improved, taken on board and built on. It is as if, when climbing an immense mountain, what we took to be the summit opens up a panorama never before observed – and, as if this were not enough, with it comes the discovery that there is another, even higher, peak.

The term scientific *revolution* does not in any way justify social revolution. But this is what the dominant atheist culture indeed did, in order to persuade that, after all, scientific rigour had necessarily to go down the road of *revolution*, understood in the commonly accepted sense of revolt, with attendant massacres and horrors of every type.

Racism

A scientist cannot say:

I am unable to believe in this new scientific discovery because it was made by a man whose skin has a different colour from mine.

Science is an intellectual activity that rejects racism outright.

Universality

Man has always been in search of universal values. Science shows that Universal Laws exist. The Weak Forces that produce measurable phenomena in our laboratories are the same as those that make the Sun work. The light produced by a match is analogous to that produced by the Stars. The Gravitational Force, which makes a stone fall downwards and that holds us to the Earth is the same Force that oversees the formation of our Solar System and of the Galaxies.

Elevation of the Individual

Science exalts the individual and his work. The value of a scientist is not established by the power of the military tank, but by his intellect and research labours.

And here the entire sum of contribution must be recognised. Albert Einstein is inconceivable without Max Planck, James Maxwell, Isaac Newton and Galileo Galilei. All scientists, giants of Science: all believers.

Intellectual Stimulus

Science spurs man on to reach out for further conquests. There is no rest in our endeavour to extend and improve our knowledge. Instead, an ideology is put forward as if it were the final goal of an intellectual conquest. And this holds man back, century after century, on frontiers created from abstract speculations, which in no time at all become dogma.

Science accepts the dogma of the Transcendent. But it rejects dogma of the Immanent.

Humility

The scientist in his daily work faces problems he is unable to resolve. Galilei took more than a decade to understand friction and thereby arrive at the formulation of the first law of motion. Einstein dedicated eleven years, from 1905 to 1916, to get to the bottom of the significance of Galilei's experiments of the fall of material bodies. Eleven years, to manage to succeed in writing one equation. Science is made up of unresolved problems. Something happens, and we move on to the next thing. And there our difficulties begin again. Einstein worked for the last thirty years

of his life in an attempt at unification of all the Forces of Nature. It was the great, *unfinished* opus. How can a man who is unable to reply to a question be arrogant? Science, as we have said before, is made up of unresolved questions. This is why it is based on a pillar of intellectual humility. Arrogance is born of ignorance.

Truth

Should a scientist tell a lie, he would be excluded from the scientific context. For Science, something that is true has to be reproducible. The scientist, when he comes to understand something or make a discovery, has to explain in full detail how he has arrived at that result. Whoever, no matter what the colour of his skin, and wherever, and at any given moment, he has to be able to reproduce that scientific truth. Mystification and falsehood lie outside scientific activity.

Reflection on Facts

Science teaches us to reflect, to not rush to conclusions without checking every consequence of a discovery in the known sectors of the fundamental structures of Creation. Science trains us for objective, not emotive, judgement. It relies on facts, experimental proof that is reproducible, the baptism of Galilean scientific legitimacy. It does not rely on words and abstract formulae. Nor does it make sense to say that a theory is mathematically beautiful or ugly. It can be only true or false, although it also happens, almost always, that when a piece of research reaches its conclusion, when in a specific field everything has finally been understood, then the mathematical formulation turns out to be more elegant than anticipated.

Goodness and Tolerance

Science teaches intellectual goodness and tolerance. Extremes have to be understood, not defeated. Things that appear to be poles apart can both turn out to be necessary for a description of the fundamental phenomena of Nature. Just one example should suffice: the wave and particle property. Light, for a long time, was considered to be a particle phenomenon. Then wave-like. And the two descriptions seemed to be mutually exclusive. Instead, light is at one and the same time both wave and

particle. Many centuries have been needed to come to this understanding. The wave-particle *duality* is valid not only for light, but for all particles. This duality is one of the most significant conquests in the history of scientific thought.

Fight Against Preconceptions

Science fights an unceasing battle against preconceptions: even if centuries are needed to dismantle them. The great difference between Classical Physics and Modern Physics lies in the fact that a tiny quantity (the so-called *Planck's Constant*) was considered to be exactly zero. Another enormous quantity (the speed of light) was considered infinite. Three hundred years to break down two preconceptions.

Generosity

Science also has important facets of generosity. To explain to others the results of a discovery is something that enriches both scientist and listener. Science teaches that there exists a form, absolutely perfect, of generosity and love for our neighbour. He who gives up a piece of bread carries out an action of good, but clearly suffers if he has little bread. He who gives away what he knows, loses nothing, even if he ends up giving away everything he has.

Freedom of Thought

Freedom of thought is of vital importance for Science. This includes respect for that form of living matter known as man, and therefore respect for his dignity. Of all the forms of living matter, we in fact are the only one which has been granted the privilege of understanding the Logic He followed in creating the reality in which we live and of which we are made. This unique privilege is the source of the highest dignity to which one can aspire: that of being made in the image and likeness of the Creator of all things visible and invisible. To read the Book of Nature, written by the Creator, one needs to be free of any prejudice. The only guide being the replies given by He who has made the world when we put forward a question. The intellectual freedom to put a question to He who has made the world has to be absolute.

3.2. *If We Were to Live in the Era of Science*

If we lived in the era of Science, these values would form an integral part of so-called modern culture. In fact, they are truths that render Science an intellectual activity that is in perfect communion with religious thought. We are dealing with two essential components that make up our existence: one that operates within the Immanent, Science; the other that operates within the Transcendent, Faith.

And this is the conclusion one comes to. Science, by studying the Immanent in the most rigorous way that human intellect has ever been able to conceive, discovers a series of truths, whose values are in perfect harmony with those that the same form of living matter, called *man*, learns from the Revealed Truth.

Four centuries after the time of Galilei, that which the father of Science was able to see with a pure act of Faith and Love towards Creation becomes visible in dazzling clarity: Nature and the Bible are both works by the same Author.

The Bible – said Galilei – is the word of God. Nature instead is His writing.

If we lived in the era of Science, these truths would be the cultural heritage of everyone.

3.3. *The Other Cultural Mystifications of 'Scientific' Popularisation*

Scientific Culture has the duty to correct the cultural mystifications of popularisation of science, mystifications that might at first sight seem mistakes committed in good faith. But the fact that they are all bound to a common cultural substrate confirms that they are not. In fact, the mystification that Faith and Science are in antithesis is not the only instance where falsehood is elevated to truth by popularisation of science. There are many more. Here are a few examples.

Popularisation of Science has:

- *confused Science with Technology.*
- *never explained that the three great conquests of Reason are: Language, Logic and Science.*
- *always kept silent regarding the Galilean distinction of the three levels of scientific credibility.*
- *attributed to Science the responsibilities of the Planetary Emergencies; these responsibilities belong to political violence*

(planet packed with chemical, bacteriological and nuclear bombs) and economic violence (irresponsible industrialisation).

- *elected itself spokesman* of ideas (for example: scientific materialism) that are in total contradiction with the conquests of scientific thought.
- *endorsed* as frontiers of true and great Science research activities that still lie below the third level of scientific credibility (for example: BEHS, biological evolution of the human species).

Our epoch will go down in History as that in which *cultural mystification* has raged: *falsehood becomes truth*.

The main author of this *mystification* has been the *dominant culture*, first Marxist then leftist.

In this way, Science and Technology have been deliberately confused. And blame continues to be laid at the feet of Science, blame that instead belongs to political violence. Violence which, in the twentieth century, had examples of terrifying power in Hitler and Stalin, who exploited the use of Science (Technology) for political ends, not for progress or civilisation.

3.4. *If Everything is Science, Nothing is Science*

'Scientific Culture' is the only form of defence against cultural pollution, maintained Dirac, Kapitza and Fermi. If everything is Science then nothing is Science. And it is impossible to explain that scientific Marxism is the exact opposite of Science. It is thus necessary to distinguish Science from the other conquests of Reason – i.e., from Mathematical Logic and Language.

The umbrella of Language covers Poetry, Art, Philosophy and all intellectual activity that is not concerned with reading the Book of Nature in order to decipher the Logic followed by He who has made the world. Using Language, in all its forms, everything can be said and its contrary. Language – as Borges says – has the supreme aspiration of 'magnificent' structures such as a Poem can have, leaving aside Logic and Science, which is the Logic of the Creation.

Scientific knowledge is engaged full time in studying – in a Galilean reproducible way – this Logic. The key to distinguishing this activity from all others lies in intellectual humility, without which scientific knowledge would never have been born nor able to grow. This intellectual humility, which is vital for scientific knowledge, is not always present – in fact,

often quite the reverse – in intellectual activities that contribute to the growth of non-scientific knowledge. This is why there is only one Science, while there are many forms of Art, Literature and Philosophy and other intellectual activities, often in contradiction one with another. This has been the case in the past and will continue to be so in the future. Even so, it is philosophical thought that produces fundamental contributions in the study of the Transcendental Sphere of our existence.

The contradiction intrinsic in Language's very structure is surmounted when Philosophy comes into play: its roots allow an understanding of how and why this contradiction does not have to extend beyond the conquests of Language.

In other words, the fact that there are various forms of Poetry, Art, Music cannot be taken as a basis on which to build a humanistic culture in contrast with Scientific Culture. The contradiction lies in the Creativity of Language itself, from which arise various expressions of our way of hearing and seeing the world. It is right that it is so. It is required by Language's very structure. It is here that the links with the Transcendental Sphere of our existence come into being, links that extend to Logic and Science through the creative processes of these great conquests of Reason in the Immanent. Creativity in Language finds its maximum structure in philosophical thought, without which it would not be possible to reflect on the Transcendental Sphere of our life. It is at this frontier that Philosophy expresses the highest creative power.

Creativity in Science has to coincide with the Logic chosen by He who has made the world to create the reality we are made of and in which we live. We scientists are not able to invent the existence of the third lepton. We can imagine its existence on the basis of experimental results, which can suggest new avenues for us to follow.

But whether the third lepton exists is known to the Creator, before any scientist in the world. It is He who has decided to include this 'third column' in the structure of Creation.

We have been granted the privilege of discovering that it does indeed exist.

With Mathematical Logic, the significance of Creativity is different. It is a legitimate act of the intellect to invent a new mathematical structure: with its rules and theorems. This structure does not necessarily have its correspondence in the Logic of Creation.

In order for this mathematical-logical structure to exist, the only condition is the principle of non-contradiction. But the principle of non-contradiction arises in philosophical thought, an integral part of Language. Logic

formulates this principle rigorously, and uses it to underpin any of its structures. A structure – completely invented by the intellect – must not lead to a theorem and the negation of the theorem itself.

Having said this, the problem of the role of Mathematics in the Logic of the Creation remains open: this topic has impassioned the very best mathematicians of all time. There is no doubt that a formidable logical-mathematical structure can exist (and therefore be non-contradictory), without there being any correspondence with the reality of the world in which we live and of which we are made.

This in no way diminishes the fascination of the Creativity in the two conquests of Reason (Language and Logic), which, as distinct from Science, do not fall under Galilean-type experimental confirmation.

However, it is of fundamental importance to distinguish Science from the other two conquests of the Reason of the Immanent, in that, if everything is Science, then nothing is Science, with all the devastating cultural consequences, some of which are referred to in this Section.

3.5. *Cultural Pollution*

Kapitza said:

Cultural pollution is the most difficult Planetary Emergency to overcome.

Here is an example. In the USSR, very few knew of the ecological disasters caused by the triumphs of the ‘five-year plans’ made known everywhere through propaganda campaigns, even in the western world, where they were taken as models of unprecedented development. In Italy, Communist Party members made great reference to them. No one, however, spoke of the ecological disasters of *Semipalatinsk* (100 times worse than Chernobyl), the ‘Aral Sea’ (50% of its waters destroyed), the ‘City of Sulphur’ (an area as large as half of Piedmont, contaminated to the point where the population had to go around wearing gas masks). These were the times of the cold war and no one dared to hope for a collapse of the USSR. But even so, the hero of Science, Pëtr Kapitza, considered it necessary to start immediately to fight cultural pollution in countries that were free; in those dominated by the USSR it was unthinkable. Dirac said:

It is easy to declare ourselves as free men where there is democracy and freedom. Try doing this where political violence rages. Kapitza understood the consequences.

Cultural pollution has its roots in political and economic violence,

which, by dominating the media (TV, radio, press and other channels), has enabled so many flagrant cultural mystifications to become 'truth'.

A terribly effective arm of cultural pollution is pseudo-scientific confusion, an essential component of popularisation. To cite meaningless data as if they were Galilean proofs of scientific truth; to introduce apparently valid arguments with bibliographic references that add nothing to the inexistent proof of the point in question: this is the technique of cultural pollution that siphons off valuable energy from the struggle for the triumph of Scientific Culture.

3.6. *Science, Art and Mysticism*

According to a number of scholars, the pillars supporting our existence are: 'Science' (rational approach), 'Art' (aesthetic approach) and 'Mysticism' (religious approach). These theories have nothing new to say about the conquests of Reason. Rather, they go backwards in time because they ignore Galilean teaching. In fact, they confuse the Transcendental Sphere of our existence (to which Mysticism belongs) with the Immanent Sphere (to which Science belongs). Furthermore, they include in the so-called 'rational approach' both Science and Mathematics, confusing Science with Logic. Galilei teaches that, to discover Science, the rigour of Mathematical Logic (thus, the rational approach) is not sufficient.

If it were so, the Logic of Creation would have been discovered by the Greeks, two thousand years before Galilei. If mathematical rigour sufficed, we could say that the Superworld existed. The Galilean thesis is based on 'Language', 'Logic' and 'Science' and it could not be more rigorous in distinguishing the three conquests of Reason. Art in fact belongs to Language.

Summary and Conclusions

The ten statements of John Paul II have given life to a Scientific Culture that lies in communion, and not conflict, with Faith. In the 1980s, this Culture strove to make a real contribution to overcoming the risk of a Nuclear Holocaust. Then, with the fall of the Berlin Wall came the need to avoid the danger of an Environmental Holocaust created by the political and economic violence that fired the undeclared War between the planet's North (the rich) and South (the poor). Once again, Scientific Culture in communion with Faith took action to avoid the latent danger of an Environmental Holocaust, by implementing pilot projects related to the Planetary Emergencies, through the scientific voluntariate of its community.

Atheist Culture, using as its arm public dissemination of what is passed off as Science, has instead wanted all to believe that Science and Faith are enemies. It has always confused Science with Technology, has never explained that the three towering conquests of Reason are: Language, Logic and Science, never mentioned the Galilean distinction between the three levels of scientific credibility, and has laid at Science's feet the responsibility for the Planetary Emergencies – responsibility that instead belongs to political violence (planet packed with chemical, bacteriological and nuclear bombs) and economic intemperance (unaccountable industrialisation). Atheist Culture too has acted as spokesman of ideas, such as scientific materialism, that lie in utter contradiction with the conquests of scientific thought, and has endorsed as frontiers of real and true Science, research activities that still lie below the third level of scientific credibility (for example: biological evolution of the human species: BEHS).

Had Atheist Culture itself discovered Science, then the ten statements of John Paul II would never have been conceived. These represent the cultural guide to the concrete deeds of which the Holy Father has been author, right from the very first days of his Pontificate. And it is this guide that has made possible the birth of a Scientific Culture in communion, not antithesis, with Faith. The influence of the Great Alliance with Science and its values has enabled the danger of the Nuclear Holocaust to be overthrown (Erice Statement), and allowed the creation of scientific and technological foundations from which to confront issues of the Environmental Holocaust (pilot projects for the Planetary Emergencies).

The 20th century will take its place in History for having seen the fall of the Berlin Wall and the start of an undeclared War between North (the rich) and South (the poor). The third millennium has need of a Scientific Culture that is the fruit of the Great Alliance between the two most important conquests of Reason, which are Science, in the Immanent of our existence, and the God-given gift connected with Reason in the Transcendent of our being, Faith. We would do well to recall that St. Paul and all our theological tradition define Faith as a gift from God. A gift linked to Reason, as described by St. Thomas of Aquinas:

*Naturalis ratio per creaturas in Dei cognitionem ascendit, fidei vero cognitio a Deo in nos e converso divina revelatione descendit.*⁴

⁴ 'Natural reason ascends to a knowledge of God through creatures and, conversely, the knowledge of faith descends from God to us by divine revelation' (ScG IV 1, 3349).

While emphasising the rational aspect of Faith, the entire Christian biblical tradition attributes it to the inner touch by the Spirit of God (*instinctus Dei invitantis* by St. Thomas of Aquinas) that awakens the dynamism of freewill. Faith is thus considered by Christian theology as a gift from God within man's Reason, which under the impulse of this same freewill, and aided by the Holy Spirit, accepts the gift.

We are the only form of living matter that has been granted the privilege of the gift of Reason and freewill. Let us seek to use it well. The third millennium must open up man's heart to hope through a Scientific Culture in synergy with Faith, not in antithesis. This is why, as this remarkable Pope teaches, Science must do all in its power to ensure the triumph of the values of the Galilean Scientific Culture.

ADDENDUM

ELEMENTS OF SCIENTIFIC RIGOR
IN THE THEORY OF EVOLUTION1. *Premise*

During this Conference the problem of 'evolution' was discussed. My paper (*Scientific Culture and the Ten Statements of John Paul II*) was not intended to deal with this problem. On various occasions, I have made remarks on the need for a 'rigorous' attempt to describe 'evolution', especially as it regards the Human Species. This paper is a coherent synthesis of my attempt to encourage our colleagues in the biological Sciences to introduce the Galilean rules in their research work concerning evolution.

2. *More About the Three Levels of Scientific Credibility*

The scope of this work is to lay out a rigorous, Galilean-type scientific foundation for the Biological Evolutionism of the Human Species. As mentioned in my paper, Galilei teaches that three levels of scientific credibility exist. Let me elaborate on the three levels, since the understanding of these levels is closely related to the scientific rigor that is needed in the description of the Biological Evolutionism of the Human Species.

The first is that which entails: (1) mathematical rigor as a fundamental referent in the formulation of a problem, (2) the invention of an instrument capable of carrying out the key experiment for giving an answer to the problem, and (3) the reproducibility of the result obtained. The reproducible result is one of the foundation blocks of Galilean Science. It is obvious that the result also must be expressed in mathematically rigorous terms, and it is this that permits the elaboration of a theory able to describe not only the reproducible result that is obtained thanks to the invention of the original instrument, but also to point out further experiments to be conducted with new instruments in order to put the new theoretical formulation to the scrutiny of further experimental tests. An example of present day frontier of Physics: the Superworld. We think that a description of the phenomena known so far requires a Space-Time with 43 dimensions: 11 boson-

ic and 32 fermionic. The elaboration of the mathematical structure that describes this reality has arrived at the conclusion that new particles must exist; we have dedicated the last decade to the search for these particles without being able to obtain any reproducible experimental proof.

The Superworld theory is an example in which there is mathematical rigor in the formulation of the problem but there is no reproducible experimental proof. Therefore it could be that the Superworld theory is not part of the Logic of Nature. This is what the years to come will tell. The Superworld is an example of first-level Galilean Science to the extent that the experimental tests are susceptible to direct control: in case of doubt it is possible to intervene by repeating the experiments and by inventing new instruments that allow us to overcome doubts that may arise in the course of data analysis for a particular experiment. An experiment that we are able to keep totally under control, here on Earth.

The *second level* of scientific credibility is that in which it is not possible to keep the experimental test under control. There is mathematical rigor in the formulation of the problem and there is the invention of new instruments for observing the effects searched for, but there is no direct intervention. An example: the theory of stellar evolution. In one part of the sky, we observe the birth of a Star. In another part, the shining of a Star born for some time. In yet another part, the death of a Star. Different observations of many Stars being born, of others that are living and still others that are collapsing, allow the elaboration of a theory of stellar evolution. There is mathematical rigor. Reproducibility is guaranteed by the observation of different examples of Stars as they are being born, during their lifetime and as they are dying. What is missing, however, is the possibility of direct intervention. In cases of doubt we cannot turn off or turn on a Star. We cannot change the characteristics of a particular star in order to scrutinize, through experimental tests, a finding that could be born from the theory of stellar evolution's mathematical elaboration itself. This theory is strongly linked to the first-level Galilean Science. Example: in the theory of stellar evolution no astrophysicist could have imagined the existence of neutron stars. It was first necessary to discover neutrons here on Earth by conducting Galilean-type experiments at the first level of scientific credibility. It was the discovery of the neutron that permitted the elaboration of mathematical models that led to the theoretical hypothesis of the existence of neutron Stars. Quite recently, the observation of certain stellar phenomena has been interpreted as indicating the possible existence of 'quark Stars'. The existence

of this new class of particles, the quarks themselves, however, was discovered here on Earth by conducting Galilean-type experiments at the first level of scientific credibility. This is the link that should exist between the second and the first level.

Moving on to the third. This level of scientific credibility refers to phenomena that occur only one time. At first glance it could seem that the third level contradicts the notion of 'experimental reproducibility'. This is not so. The third level does not in fact leave the first level out of consideration. An example of a phenomenon that happens only one time is that which is described by cosmic evolution. The Cosmos has the Physics of pre-Big Bang as its initial phase. Then comes the Big Bang with Time intervals that range from billionths of billionths of billionths of billionths of billionths of a second (10^{-45} : Planck's Time) to the Time needed for cosmic evolution with the energy of the vacuum (Alan Guth's Time: 10^{-34} sec) to the evolutionary period in which – other than gravitational force – enter into play the Three Fundamental Forces (strong subnuclear, weak subnuclear and electromagnetic) of the so-called Standard Model with its three building blocks of fundamental particles, each of which is composed of two 'quarks' and two 'leptons'. The Time intervals in play for this phase of cosmic evolution are tenths of billionths of a second. And so one arrives at the few seconds necessary for making the Cosmos with the particles familiar to us (protons, neutrons and electrons) and finally the plasma of these particles in the sea of 'photons' that lasts a few hundreds of thousands of years (according to the most recent data, the Time interval is 380 thousand years). At this point the Cosmos, made essentially of protons, electrons and photons, passes into the phase in which the Stars and the Galaxies are born. According to the most recent theories, it could be 'Black Holes' (made with the very primitive form of matter which existed much before the one of the 'Standard Model' particles) that act as nuclei for the formation of galactic structures in which stars are born. The duration of this phase of cosmic evolution is millions of years. After 15 billion years we reach the present with ourselves, the Sun, the Earth, the Moon, the oceans, the mountains, the sunrises and sunsets, the Cathedrals, Michelangelo's Pietà and the incredible detail that in this cosmic evolution there is, in addition to the inert matter, also the living matter, both vegetable and animal. Among the countless forms of living matter there is one and only one that is endowed with Reason. It is in fact thanks to Reason that it has been possible to discover Permanent Collective Memory, rigorous Logic and Science.

3. *The Evolution of the Universe: an Example of the Third Level*

Cosmic evolution is Galilean Science to the extent that it is formulated in rigorous mathematical terms and linked to the first level. From the pre-Big Bang on, everything is based on that which has been discovered at the first level. It is not possible to prove experimentally the reproducibility of cosmic evolution.

No one knows how to make a Big Bang to verify the details that we would like to put under experimental testing. We can only conduct experiments to understand what happens as we come close to the Big Bang. Today we have arrived at a tenth of a millionth of a second (10^{-10} sec). Keeping in mind that Planck's Time lasts 10^{-45} sec, it is wise not to forget that a good 35 orders of ten separate us from the instant before inflationary expansion bursts forth. These 35 powers of ten are the measure of our ignorance in the rigorous knowledge of that which we call the 'theory of cosmic evolution'.

This theory helps us to understand just how difficult the study of phenomena belonging to the third level of Galilean scientific credibility is.

4. *The Evolution in Terms of Galilean Rigor and Experimental Reproducibility*

To this level, we repeat, belong all the phenomena that happen only one time, as in the example of the Biological Evolutionism of the Human Species. Our species being the only form of living matter endowed with Reason, it is well to subject the 'theory of Biological Evolutionism of the Human Species' to Galilean-type rigor.

There are those who say that this 'theory' represents the frontier of Galilean Science. We would like this to be true. To accomplish this, however, it is necessary to establish for this theory a foundation in mathematical rigor and experimental reproducibility. Doing this requires an analysis that is attentive to the phenomenon called 'evolutionism'. Evolution exists at the level of elementary particles, at the level of aggregates made up of inert matter, and at the level of aggregates of living matter.

First of all, a clarification. While being studied, the phenomenon called 'evolution' can reveal itself only in 'Space-Time'. The first rigorous study of evolution at the level of elementary particles concerns electrons. It is not by chance that the electron itself is the first example of an 'elementary particle' (discovered by Thomson in 1897).

Dirac, fascinated by the discovery of Lorentz that Space-Time could not be a real quantity but instead a complex one (if Space is real, Time must be imaginary, and vice versa), decided to study with rigor the evolution of the electron in Time and Space. This was how he discovered his equation.

The rigorous study of evolutionism at the level of elementary particles brought Dirac to discover a reality that no philosopher, no poet, no thinker of any epoch or civilization was able to imagine. This reality begins with antiparticles and brings us to the discovery of antimatter, antistars and antigalaxies to arrive at our world, which seems to be made up only of matter, stars and galaxies, without any antistars or antigalaxies. An experiment to be conducted in the year 2008 in the International Space Station will tell us if it is really true that in the course of cosmic evolution every trace of antimatter was broken down in order to build up a Universe, like the one in which we are living, that consists only of matter. If in our laboratories we had discovered that antimatter could not exist, the problem of a Universe made only of matter would not exist. This is not so. The existence of antimatter was confirmed in a rigorously Galilean manner in 1965. Nevertheless, in the Universe there is no more antimatter.

It is possible to formulate in a mathematically rigorous mode the theory of cosmic evolution that cancels out antimatter at a certain point. According to this theory of cosmic evolution, we are here thanks to the fact that, in the process of 'cancellation', a tiny fraction (one part in 10 thousand million (10^{10})) of matter prevailed over antimatter. No one could say if this theory is that which corresponds to the cosmic reality of which we are a minimal part. The only certainty is that this theory will be scrutinized closely via Galilean-type experimental tests in the years to come.

Starting from the evolution of an elementary particle we have arrived at the problems of cosmic evolution. This means that we have passed from typical structures of the subnuclear world (10^{-17} cm) to galactic structures that reach to the confines of the Universe (10^{29} cm); better still, if the inflationary evolutionism of Alan Guth is true, to even greater cosmic distances. The theory of evolution in the study of inert matter, from the heart of a proton to the confines of the Cosmos, enables one to interlink within a single structure everything that happens in zones of space that are differentiated by at least 46 powers of ten. We have done this using the three levels of Galilean scientific credibility.

This is the most rigorous knowledge we have when dealing with the concept of the evolution of the fundamental structure of inert matter. Let us call this level number 1. The Table below describes the details of this level.

Table 1. EVOLUTION AND SCIENCE

LEVEL NUMBER ONE

I Evolution in the Fundamental Structure of Inert Matter:

- I-1 **Evolution** in Space-Time of the lightest electrically charged lepton: the **Dirac equation**.
- I-2 **Evolution** in the description of the elementary processes involving inert matter: the **Feynman diagrams** and the problem of **Renormalization** (i.e. no divergent results in theoretical calculations).
- I-3 **Evolution** in the Universe and in its structure.
 - I-3-1 The Physics of the **Pre-Big-Bang**.
 - I-3-2 The Physics of the **Big-Bang**.
 - I-3-3 The basic structure of matter and of the Fundamental Forces in the Evolution of the Universe: from the **Planck Scale** to present day.
 - I-3-4 **The origin of Galaxies** and their **distribution** in Space-Time.
 - I-3-5 **The origin of a Star** and its evolution (Gravitational, Electroweak and Strong Forces).
 - I-3-6 **The origin** of condensed forms of cold matter (Planets, Asteroids, Comets and others).

The level number 2 refers to the evolution of the macroscopic structure of inert matter. This and the other levels are schematically given in the Table 2 below.

Table 2. EVOLUTION AND SCIENCE

LEVEL NUMBER TWO

II EVOLUTION IN THE MACROSCOPIC STRUCTURE OF INERT MATTER.

II-1 The crystals.

II-2 Other forms of conglomerate matter and the understanding of their properties.

THE OTHER LEVELS

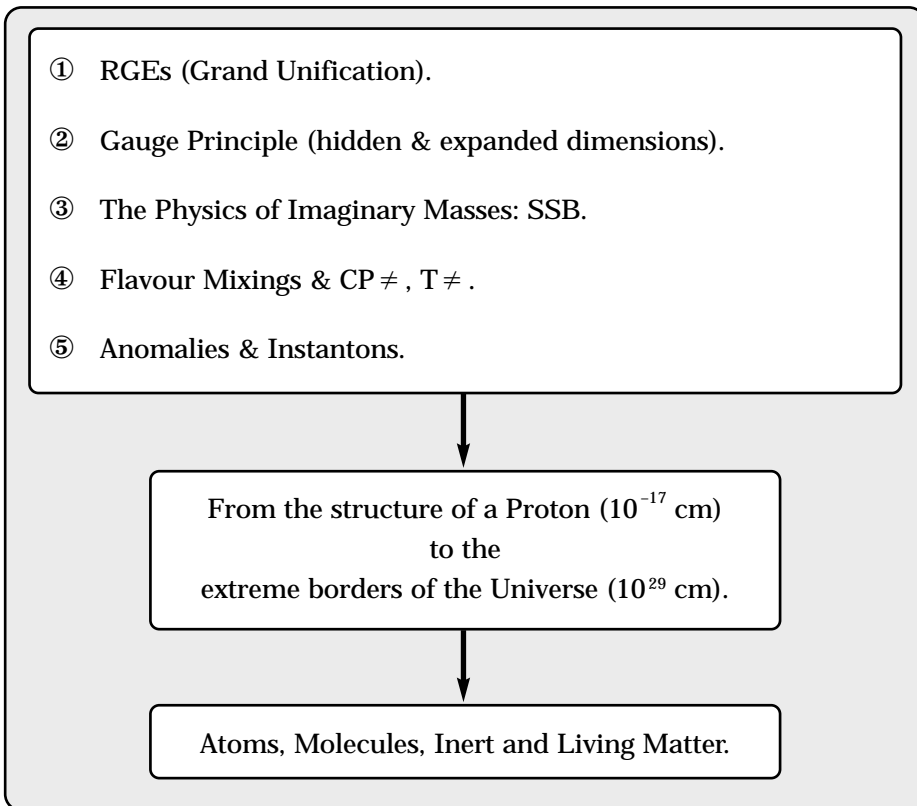
III THE TRANSITION FROM INERT MATTER TO LIVING MATTER.IV **EVOLUTION** IN THE ENORMOUS VARIETY OF 'NON-ANIMAL' LIVING MATTER.V **THE TRANSITION** FROM 'NON-ANIMAL' TO 'ANIMAL' FORMS OF LIVING MATTER.VI **THE EVOLUTION** IN THE ENORMOUS VARIETY OF 'ANIMAL' FORMS OF LIVING MATTER.VII **THE TRANSITION** FROM THE INNUMERABLE POSSIBILITIES OF NON-REASONING LIVING FORMS OF MATTER TO THAT OF LIVING MATTER WITH 'REASON'.VIII **THE EVOLUTION** OF THE SPECIFIC FORM OF LIVING MATTER CALLED 'THE HUMAN SPECIES'.IX **THE DISCOVERY OF COLLECTIVE MEMORY**, i.e. **WRITTEN LANGUAGE**.X **THE DISCOVERY OF LOGIC** AND OF ITS MOST RIGOROUS FORM: **MATHEMATICS**.XI **THE DISCOVERY OF SCIENCE: THE LOGIC OF NATURE**.XII **REFLECTIONS** ON HOW IT HAPPENS THAT WE ARE THE **ONLY FORM OF LIVING MATTER** WITH 'REASON'.

All these levels need to be fully understood before we reach the level where we need to think about how we happen to be the only form of living matter with 'Reason' (level XII).

In fact, the extraordinary characteristic of the world in which we live is that the Hardware is the same for all forms of matter: from the most elementary inert element (the electron) to the most advanced form of matter with Life and Reason (the Human Species).

The Table below (Table 3) illustrates the five points that represent the Hardware.

Table 3. THIS HARDWARE (i.e. OUR OWN) OBEYS THE FOLLOWING LOGIC



More detailed information on the Hardware is given in Table 4.

Table 4. DETAILED INFORMATION ON THE HARDWARE

- ① RGEs (α_i ($i = 1, 2, 3$); m_j ($j = q, l, G, H$)) : $f(k^2)$.
- GUT ($\alpha_{\text{GUT}} \cong 1/24$) & GAP ($10^{16} - 10^{18}$) GeV.
 - SUSY (to stabilize $m_F/m_P \cong 10^{-17}$).
 - RQST (to quantize Gravity).
- ② Gauge Principle (hidden and expanded dimensions).
- How a Fundamental Force is generated: SU(3); SU(2); U(1) and Gravity.
- ③ The Physics of Imaginary Masses: SSB.
- The Imaginary Mass in SU(2) \times U(1) produces masses (m_{W^\pm} ; m_{Z^0} ; m_q ; m_l), including $m_\nu = 0$.
 - The Imaginary Mass in SU(5) \Rightarrow SU(3) \times SU(2) \times U(1) or in any higher Symmetry Group (not containing U(1)) \Rightarrow SU(3) \times SU(2) \times U(1) produces Monopoles.
 - The Imaginary Mass in SU(3)_c generates Confinement.
- ④ **Flavour Mixings & CP \neq , T \neq .**
- No need for it but it is there.
- ⑤ **Anomalies & Instantons.**
- Basic Features of all Non-Abelian Forces.

NOTE:

q \equiv quark and squark;	m_F \equiv Fermi mass scale;
l \equiv lepton and slepton;	m_P \equiv Planck mass scale;
G \equiv Gauge boson and Gaugino;	k \equiv quadrimomentum;
H \equiv Higgs and Shiggs;	C \equiv Charge Conjugation;
RGEs \equiv Renormalization Group Equations;	P \equiv Parity;
GUT \equiv Grand Unified Theory;	T \equiv Time Reversal;
SUSY \equiv Supersymmetry;	\neq \equiv Breakdown of Symmetry Operators.
RQST \equiv Relativistic Quantum String Theory;	
SSB \equiv Spontaneous Symmetry Breaking.	

The five basic steps in our understanding of nature. ① The renormalization group equations (RGEs) imply that the gauge couplings (α_i) and the masses (m_j) all run with k^2 . It is this running which allows GUT, suggests SUSY and produces the need for a non point-like description (RQST) of physics processes, thus opening the way to quantize gravity. ② All forces originate in the same way: the gauge principle. ③ Imaginary masses play a central role in describing nature. ④ The mass-eigenstates are mixed when the Fermi forces come in. ⑤ The Abelian force QED has lost its role of being the guide for all fundamental forces. The non-Abelian gauge forces dominate and have features which are not present in QED.

Since the Hardware is the same, the following remarks are in order.

It could very well have been that the basic Hardware was there, but not Life itself.

It could have been that the basic Hardware and Life were there, but no Consciousness (free will).

It could have also been that the basic Hardware plus Life plus Consciousness were there, but no Reason.

These points are illustrated in Table 5.

It happens that Reason is there with its three great achievements: Language, Rigorous Logic and Science as reported in Table 6.

Table 5.

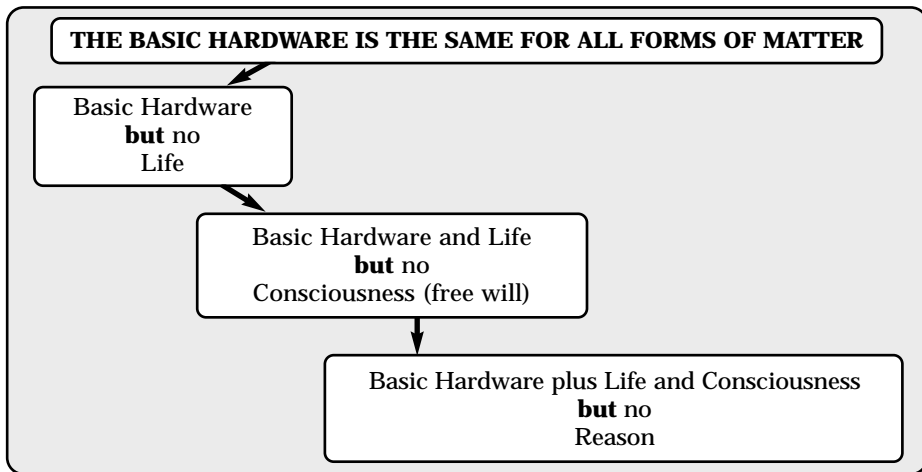
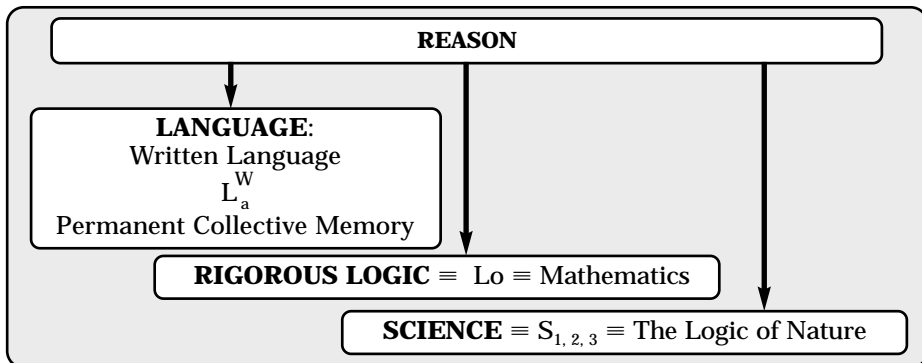
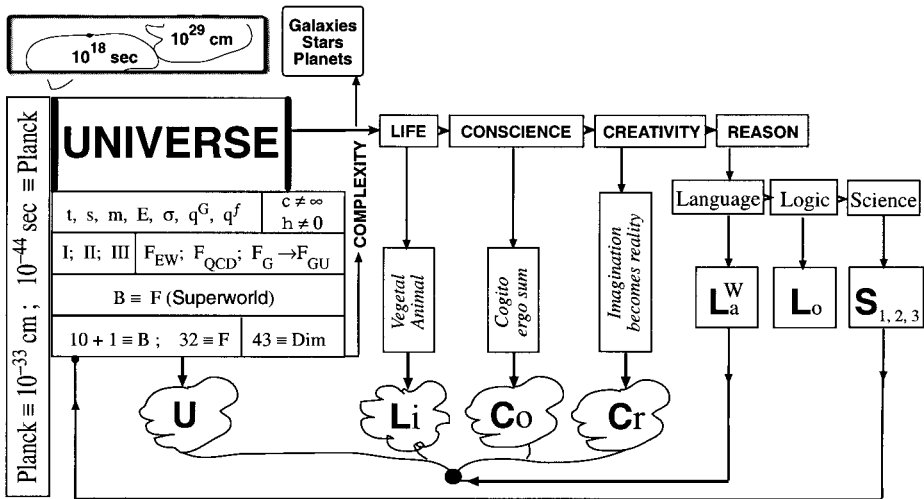


Table 6.



5. Conclusion

To conclude: when we speak about evolution we should not forget the basic constituents of Galilean Science: mathematical rigor and experimental reproducibility. The Biological Evolutionism of the Human Species is below the third level of Galilean Science, as can be deduced when we compare this form of evolution with the evolution of the Universe. The Figure below is a synthesis of all I have said regarding the rigorous description of the concept called 'evolution'. A full explanation of this Table would bring us too far out. I have decided to show it to you in order to give you an idea of how complex it is to describe 'evolution' when we want to include all we think we know of the world where we live.



We would like to encourage our colleagues engaged in the study of biological evolution to follow our suggestions in order to reach the goal of bringing the Biological Evolutionism of the Human Species to the third level of Galilean Science, like cosmic evolution.

DISCUSSION ON THE PAPER BY ZICHICHI

JAKI: I've struggled with myself during your presentation whether to make a comment or not, but I decided I had to speak up. When you made the statement – I leave aside such impossible statements of yours that John Paul II opened the doors of the Church to science and similar things – but when you referred to the intellectual humility of Galileo I felt I had to say something, because already from your previous statements, when it came to the history of physics, I felt very uneasy. Now, with respect to the intellectual humility of Galileo, I would like to say in brief only this much: had Galileo's utter pride prevailed, Newtonian science would have never been born. That utter pride forced Galileo to stick with the strictly circular orbit of planets, that utter pride of Galileo, and I'm talking only of scientific matters, that utter pride of Galileo forced him to ignore Kepler's work, the *Stella Martis*, which contained the elliptical orbit of planets, and the utter pride of Galileo forced Galileo to ignore two other books of Kepler, one of them the *Harmonice mundi*, which contained the two other laws of Kepler, and, had it not been for a little-known English scientist, astronomer, his name was Jeremiah Horrocks, who died at the age of 21, just the year he was taken away by the bubonic plague, who put together a readable summary of Kepler's achievements, and had it not been for Horrock's teacher Wallis in Cambridge, Newton would have never learnt of the three laws of Kepler, and without those three laws we would neither have Galilean science, nor Newtonian science, nor Einsteinian science. I deeply resent the fact that an eminent scientist like you, a physicist, can run roughshod over elementary facts in the history of modern physics.

ZICHICHI: Well, I've written a book on Galilei which has 150 quotations. In this book I proved that the acceleration by gravity could have been measured ten thousand years before with the invention of the inclined plane. Without the measurement of the acceleration of gravity, Newton could have done nothing, despite the discoveries of Kepler and all you

mentioned. The key point was the measurement of the acceleration by gravity. Point number two: how can you explain, due to the fact that you think you are right, that for ten thousand years the error in the measurement of time was always one second every day, and after Galilei, now, we've 2 minutes in 20 billion years, and I could do my gadget in 1965 at the level of a few picoseconds thanks to Galilei, not to anyone else. You quoted the circular orbits, and if you read my book, which I would be pleased to send to you, this is the proof that Galilei was a man of faith. Why? Because when he received the news, the discovery of the Mars orbit, which could not be circular but elliptic, as you correctly pointed out, Galilei said, 'No. God could not choose imperfect geometrical objects'. This is the proof of Galilei's faith. You should read my book. In my book I write down all the discoveries of Galilei. And if you read the book and you disagree, write to me, say, page number x, this is wrong. I was very careful in listing the incredible number of correct discoveries made by Galilei. The story of the orbit is fantastic proof against all members of the dominant atheistic culture who claim Galilei was not a man of faith, that he was just afraid of the Church. No. Galilei wrote that he wanted to look for the footprint of the Creator. He died convinced that Kepler made a mistake, because he was thinking about the fact that the orbits had to be perfect geometrical figures, due to the act of creation. So, the proof of Galilei being a man of faith is exactly what you have stated.

MÖSSBAUER: I would like to come to the 10^{-33} centimetres and to the 10^{-44} seconds. We don't know how to quantize gravitation, apart from string theory where nothing is proved. It is mathematical philosophy, you're right, so we don't know how to quantise it.

ZICHICHI: Correct. But the point I wanted to emphasize is that your compatriot Planck was the first man on this planet to realise that the units, centimetre, second and gramme, are just mankind, anthropomorphic: what would be the correspondent values for length, time and mass if the basic unit in nature were taken to be the fundamental constants: the speed of light, Planck action and Newton gravitation? This was the great achievement of Planck. I insist in saying that Planck has not been correctly given the right tribute for this incredible achievement. When we knew nothing about the unification of the fundamental forces, he realised: what are you talking about? Centimetres, no! Let us use the fundamental constants. What are the units? Fantastic. They are still there.

CABIBBO: He was made a member of this Academy on the first possible occasion.

ZICHICHI: Yes, and he should be celebrated, because he is really one of the greatest of them all; it is incredible what he did. And people forget, they start mentioning other people.

PAVAN: I had difficulty in following you and in understanding everything you said, but, since we don't have much time for discussion, I would like you to explain to me what you mean by atheist culture has used so-called popularisation of science to enclose so much cultural untruth. Are you against the popularisation of science?

ZICHICHI: No. I'm for the popularisation of science in a correct way. For example, make a list of the greatest scientists in the history of science who've said science and faith are in contradiction. No one, zero. Nevertheless, if you take a taxi and you tell the taxi driver: 'I'm a scientist, I'm coming from the Vatican', he will tell you: 'Professor Pavan, how can there be a scientist who goes to the Vatican?' I was asked this question in 1979. Now it's different, because in Italy I've been involved quite a lot, but in 1979, and for many years, I was questioned like this, 'You are a scientist, and you go to Church?' *Ubi major est, minor cessat*. You must pick up the most important of all effects if you want to understand anything. You must pick up the number one: how can you justify the existence of this life? This is mystification. I'm against the erroneous popularisation of science. This is why I'm trying to help honest people. I don't know your country, so I can only speak about Italy, but in Italy science popularisation is dominated by atheists at the 99% level.

PAVAN: Not in Brazil.

ZICHICHI: I'm very glad.

VICUÑA: Over these days, Professor Zichichi, you have insisted that science and technology can be differentiated clearly, and we scientists can be searching for the truth and people with wrong intentions can be using this knowledge for technology in various fields, and I would like to come again with a comment I made the other day to you, but there wasn't any time to pursue it, that there are areas in which science and technology cannot be

clearly differentiated, and what I see from my standpoint is that there are many scientists these days in these areas some of whom are colliding with ethical norms that we would all like to respect, and therefore I don't see a scientist anymore as I would like to see, so immaculate just looking for the truth, and some of them are getting into areas which are related to technology, and I don't think they are using the tools and the methods that we would have dreamed for scientists who are after the truth or pure knowledge only.

ZICHICHI: A telegraphic answer: science is the study of the logic of nature. In so far as you study the logic of nature you do science. As soon as you go out of this, you are out of science. I've been involved in technological inventions, in scientific discoveries, so I know exactly that these two items can be clearly classified, and it is in the interest of science, because if you start with a confusion, then the confusion will go on and we should not forget that we reached the stage where John Paul II was the only person on the planet who stood up and made his important declaration when we were accused of being the authors of the earth packed with H bombs. Enrico Fermi is not the father of the Hiroshima bomb; that was Hitler. Edward Teller is not the father of the H bomb; that was Stalin. But try to ask people around, and you see the answer. Why? Because the atheistic popularisation of science has deliberately created the confusion between science and the application of scientific discoveries, i.e. technology. Science is the study of the logic of nature, period.

VICUÑA: Mr. President, one very short question: is the human genome project science or technology, Professor Zichichi?

ZICHICHI: Technology. Applied science. I'm sorry but this is the truth. When you will reach the end, you'll discover the Maxwell equations.

CABIBBO: I don't think many of the people here would agree with you, but we will put it on record as your opinion.

GERMAIN: Je peux dire un mot. Notre confrère Zichichi nous a décrit une science idéale, qui est, d'ailleurs, l'idéal que j'ai de cette science, mais avec sa volonté de distinguer complètement science et technologie. Alors il se met dans une position très facile: pour les scientifiques, les choses ne sont pas aussi simples. Je pense à beaucoup de ce que vous avez dit et puisque c'est la conclusion de notre Conseil, je pense que ce que nous avons à faire,

c'est justement de sauver la science là où elle apparaît dans le monde, et elle apparaît dans le monde avec les applications, et là alors il faut en quelque sorte éduquer le peuple, nos concitoyens pour qu'ils apprennent, dans cette espèce de monde dans lequel nous nous trouvons, dans lequel effectivement les applications de la science sont partout, à faire une distinction. Mais dire: 'La science est parfaite et la technologie est tout-à-fait infernale', est une position très facile. Vous êtes un physicien théoricien, alors là c'est facile. Pour d'autres qui ont constamment à faire avec des questions pratiques qui intéressent tout notre peuple, alors la situation n'est pas aussi facile. Par conséquent, je suis d'accord avec vous, malheureusement je crois que votre conférence se place dans un monde idéal qui n'est pas celui dans lequel nous nous trouvons. Merci.

ZICHICHI: Je vous remercie beaucoup, mais je dois dire que je n'ai pas dit que la technologie est tout méchante, non, j'ai dit, 'La science c'est l'étude de la logique de la nature'. Cette logique peut être utilisée pro et contre, mais le choix entre pro et contre n'est pas scientifique, c'est culturel.

GERMAIN: Oui, mais alors, si vous vous désintéressez de savoir comment les applications de la science sont faites, vous vous en désintéressez en disant: 'La société se débrouillera à faire ce qui est favorable, et à ne pas faire ce qui est défavorable'. Nous ne pouvons pas nous en désintéresser. Dans cette Académie nous devons dire à nos concitoyens: 'Oui, la science arrive dans un état des choses compliqué et mélangé, et c'est très difficile'. Alors, il faut les aider à comprendre, parce que c'est eux finalement qui choisissent. Mais nous devons participer, et ce que je reproche c'est qu'avec votre position vous dites: 'C'est pour les autres, alors nous, nous avons bonne conscience'.

ZICHICHI: Alors, je répète: la science on ne peut pas la confondre avec ses applications, il faut être rigoureusement logique. Alors, s'il y a une chose qu'on appelle mathématique, ça c'est mathématique, on ne peut pas la confondre avec une autre discipline.

GERMAIN: Les mathématiques, ça c'est facile.

ZICHICHI: La science est la logique de la nature; étudier la logique de la nature c'est science. Les applications de la science sont la technologie. Ce n'est pas moi qui le dit, c'est la rigueur logique. Si on commence à réfléchir, on arrive à cette conclusion. Je pense que nous avons intérêt à faire de la

culture scientifique, et à mettre au point les choses avec une grande clarté et rigueur. Donc, il faut dire au grand et vaste public qui ne fait pas de science que l'on aurait pu avoir les mêmes résultats scientifiques sans avoir une seule bombe. Vous êtes d'accord ou non? Evidemment. Pourquoi a-t-on les applications néfastes de la science? Parce que les applications de la science ont toujours échappé au contrôle des scientifiques, il ne faut pas oublier ça.

GERMAIN: Mais bien sûr, mais bien sûr. Mais c'est normal, je trouve, que les applications de la science échappent au contrôle des scientifiques. Mais les scientifiques doivent s'en occuper.

ZICHICHI: Il ne faut pas dire ça à moi, parce que je m'en suis occupé plus que tous mes collègues en moyenne. Les applications de la science dites technologies, peuvent être avec le signe plus et le signe moins.

GERMAIN: D'accord, d'accord.

ZICHICHI: C'est cela que je dis.

GERMAIN: D'accord.