Address to the Plenary Session ‘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 illumined by the 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 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 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.
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.

1 Cf. *Veritatis Splendor*, n. 63.

2 Cf. *Ps* 139:15; *Pr* 24:12.

3 Second Vatican Council, *Gaudium et Spes*, n. 25.

4 *Ibid.*, n. 34.

5 Congregation for the Doctrine of the Faith, *Donum Vitae*, n. 1.