the Pontifical Academy of Sciences

# The Invariability of Natural Law and the Supreme Government of God in the World

## Address to the Plenary Session of the Academy

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

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

#### Speculative sciences and practical sciences

As we are here with you, illustrious members of the Academy, to inaugurate the new year of this Pontifical Academy of Sciences, our thought cannot but return once again to our unforgettable and incomparable predecessor, the founder of this most noble scientific Institute, and remember him in those white vestments to which the white snow of the alps seemed a prelude and a greeting of paternal stature – the snow being pressed down one day with his bold and confident steps, risking dangers, abysses and storms, intent upon reaching not only the peaks of the mountains of nature, but also the summits of speculative and practical truth. As he climbed it seemed as if the mountains were rising with him and the fields were descending with him: *ascenderunt montes, descenderunt valles*,1 – the mountains rose, the valleys sank down – and when he descended, he

marvelled again at the whiteness of the Cathedral of his Milan, which was like a brilliant alpine mountain with spectacular peaks rising in the middle of the Lombard plains. You, too, have climbed the mountains of knowledge, of the speculative sciences, of calculation, of astronomy, of the vortices of the stars, and of the nebulae; and you have descended to the plains of the practical sciences using the thousands of forms of art, technology and experiment; for it is the great power of the human speculative intellect to be able to put its hand into practice and become a practical intellect, making the immutable laws and the materials of nature a guide and support for its actions, which are always regulated and sustained by the government and the providence of God.

### Character and objective value of natural laws

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

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

bodies.

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

## The atomic era

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

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

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

In truth, properly speaking, this involves only one single great law of nature, which manifests itself above all in the so-called 'periodic system of the elements'. Lothar Meyer and Demetrius Mendeleev in 1869, on the basis of the scanty chemical data known at the time, cleverly suggested it and gave that system its first provisory form. It had, however, many lacunae and incoherences; its profound meaning was still obscure; nevertheless it suggested an intimate affinity between the chemical elements and a uniform structure of their atoms from equal

subatomic particles. Later, the picture became clearer year after year, the defects and the imperfections disappeared, and the profound meaning was revealed. We restrict ourself here to remembering briefly some of the more important stages in this quest: the discovery of radioactive elements by the Curies; the atomic model of Rutherford, and the laws governing it as proposed for the first time by Bohr; the discovery of isotopes through the work of Francis William Aston; the first fragmentations of nuclei by means of natural alpha rays, and a short while later the synthesis of new heavy nuclei by bombardment with slow neutrons; the discovery of the transuranics proposed by Fermi, and the production of transuranic elements in large quantities, and among these first of all of plutonium, which constitutes the active part of the bomb, and is obtained in the gigantic 'Uranium Piles'; in a word, a coherent development and improvement of the natural system of the chemical elements in fullness and in profundity!

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

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

### The law of nature participating in the eternal law of God

But law means order; and universal law means order in great things as well as small. It is an order deriving immediately from the intimate tendencies innate in natural things; an order that nothing can create by itself or give of itself to itself, as no being can give itself to itself; an order that signifies the Order of Reason in a Spirit which has created the universe and on which 'depend Heaven and the whole of nature';[4] an order which those tendencies and energies received as they came into being and through which both collaborate for a well-ordered world. This marvellous assemblage of natural laws, which the human spirit, with tireless observation and accurate study, discovered, adding victories upon victories over the occult resistances of the forces of nature, what else is it but an image, through pale and imperfect, of the great idea and of the great divine design, which in the mind of God the Creator is conceived as a law of this universe since the days of His eternity? Then, in the inexhaustible thinking of His wisdom, He prepared the heavens and the earth, and then, creating the light on the abysses of chaos, cradle of the universe also created by Him, He gave a beginning to motion and to the flight of time and of centuries, and called into being, into life and activity, all things according to their species and their kind, to the most imponderable atom. How rightly every intellect which contemplates and penetrates the heavens and weighs the stars and earth should exclaim, turning to God: *Omnia in mensura et numero et pondere disposuisti*[5] ('You have disposed everything in measure and number and weight'). Do

you not feel, within your souls, that the firmament which enwraps us and the globe which we tread narrate together with your telescopes, with your microscopes, with your scales, with your rules, with your multiform devices, the glory of God, and reflect, as you look, a ray of that uncreated wisdom which *attingit a fine usque ad finem fortiter, et disponit omnia suaviter*?6 ('Reaches mightily from one end of the earth to the other and disposes all things well').

**From this comes the closed unity of natural laws**

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

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

Yes; it is a unity closed with the key of that universal order of things against which, inasmuch as it depends on the first Cause of a Creative God, God himself cannot act; because, if He should do so, He would operate against His own prescience or His will or His goodness; now, in Him 'there is no change, nor the shadow of variation'.7 But if this order is considered dependent on secondary causes, God possesses its key and can leave it closed, or open it and operate beyond it. Could it be that God, in creating the universe, made Himself subject to the order of secondary inferior causes? Is not this order subject, indeed, to Him, emanating from Him, not as necessity of nature, but from arbitrary will? Hence He can act beyond the instituted order when He pleases; for instance, by working the effects of secondary causes without recourse to them, or producing other effects, to which they do not extend.8 Thus the Great Doctor St. Augustine wrote: *Contra naturam non incongrue dicimus aliquid Deum facere, quod facit contra id quod novimus in natura … Contra illam vero summam naturae legem … tam Deus nullo modo facit, quam contra se ipsum non facit*9 (it is not incongruous to say that God acts contrary to nature in as far as it is contrary to that which we knew in nature … But just as He does not act against Himself, so in no way does He act contrary to that truly supreme law of nature). What works then are these? They are works of which God alone holds the key to their secret and which He reserved for Himself in the passage of time

amid the particular order of subordinated causes, ‘subsequent works’, as the Divine Poet sang, ‘to which nature never heated the iron, nor beat the anvil’.10 Before such works, extraordinary either because of the substance of the fact itself, or because of the person in which they manifest themselves, or because of the manner and order in which they are accomplished,11 people and scientists stand astonished. The miracle is born when the effects are manifest and the cause concealed. But the ignorance of the hidden cause, which astonishes the unbeliever, sharpens the eyes of the faithful and of the learned, who, within certain limits, know and measure how far the work of nature, with its laws and forces, reaches; beyond that point they see the work of a superior, hidden and omnipotent hand, that hand which created the universal order of things, and in the process of the particular orders of cause and effect marked the moment and circumstances of its marvellous intervention.12

**Such a conception fills the scientist with enthusiasm …**

This divine government of the universe certainly cannot but arouse a feeling of admiration and enthusiasm in the scientist, who in his research discovers and recognises the traces of the wisdom of the Creator and supreme Legislator of Heaven and earth, Who with the hand of an invisible pilot guides all the creatures ‘to different ports – through the great sea of being – each one endowed with the instinct which carries it’.13 Yet what are the tremendous laws of nature if not a shadow and mere idea of the depth and immensity of the divine design in the grandiose temple of the universe? ‘The supreme privilege of the scientist’, wrote Kepler, ‘is to recognise the spirit and retrace the thought of God’. Often – we have to confess our human weakness – before the vision of things and the images of our senses, that thought becomes dim and retreats; but if the thought of God enters the work of the scientist, he does not confuse it which the movements or images he sees within or outside himself; and that disposition of soul to search for and recognise God gives him, in his laborious study, the proper enthusiasm and copious compensation for all the labours endured in the interest of research and discovery, and, far from making him proud and conceited, teaches him humility and modesty.

**… but also with humility**

Certainly, the more deeply the cultivator of knowledge and sciences pushes his research into the wonders of nature, the more he feels his insufficiency to penetrate and exhaust the wealth of the design of the divine construction and of the laws and norms which govern it; and you have heard the great Newton saying with incomparable beauty and emphasis: ‘I do not know how I appear to the world, but to myself I appear like a child, who plays on the shore of the sea and rejoices, because he finds every now and then a smoother pebble and a less well-known shell than usual, while the great ocean lies before him unexplored’. These words of Newton, today, after three centuries, in the modern ferment of the physical and natural sciences, sound more than ever true. Of Laplace we hear that, while he was lying ill and the friends who where around him were remembering his great discovery, he replied, smiling bitterly: ‘that which we know is small, but that of which we are ignorant is immense’. No less acutely did the illustrious Werner von Siemens, who discovered the principle of the self-excitation of the dynamo, attest at the 59th reunion of German

scientists and doctors: ‘The more intimately we penetrate into the harmonious order of the forces of nature, regulated by eternal, immutable Laws – and nevertheless profoundly veiled from our knowledge, so much so that we feel the more spurred to a humble modesty – the more restricted the sphere of our cognition appears to us, the more alive becomes our effort to attain more and more from this inexhaustible source of knowledge and power, and the higher grows our wonder before the infinite ordaining wisdom, which permeates all of creation’.

In truth our knowledge of nature is modest in extension and often imperfect in content. In a treatment of the electromagnetic theory of light one could read the words: ‘Could it be that a God wrote these formulae?’. Certainly Maxwell’s equations are clever; and they, like every similar advancement in theoretical physics, suppose and imply, so to speak, a simplification and idealisation of concrete reality, without which a fruitful mathematical treatment is impossible. So often today can one propose only rules instead of laws, or only partial solutions instead of general solutions! Wherever a regular behaviour appears in the cooperation, at first sight without any rule, of innumerable particular phenomena, the scientist has to be satisfied with assigning the character and the form of the behaviour of the masses according to considerations of probability, and, ignorant of the dynamic basis for the particular, to formulate statistical laws.

The progress of science is incessant. It is true that the successive stages of its progress have not always followed the path which from first observations and discoveries leads directly to the hypothesis, from the hypothesis to the theory, and finally to the certain and unquestionable attainment of the truth. There are instead cases where the investigation follows a sort of curve; cases, in other words, in which theories that seemed to have already conquered the world and reached the apex of undisputed doctrines, acceptance of which brought esteem in the realm of sciences, fall again to the level of hypotheses, to remain perhaps, later, completely abandoned. Notwithstanding, however, the inevitable uncertainties and deviations that any human effort brings with it, the progress of sciences knows no pauses nor leaps, while the researchers of truth pass on from one to the other the investigating torch, to illuminate and develop the pages of the book of nature, thick with enigmas. Just as in things which develop naturally, notes the Angelic Doctor St. Thomas, the perfect is reached little by little from the imperfect, so it happens to men concerning the cognition of truth. In fact, from the beginning they have conquered a little of the truth, and then step by step they have arrived at a fuller measure of it, not attributing the origin of the world and things in general to chance or to fortune; but intuiting the truth with more careful perspicacity, they deduced from the available indications and from reason that natural things are ordered by a providence. Indeed, how would one find the invariant and certain path in the motion of the sky and the stars and in the other effects of nature, if all this were not governed by a super-eminent intellect?14

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

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

Looking from this higher observatory at the world and the universe which are at the feet of God, it is not hard to understand how natural things act so unavoidably and conform without exception to the tendencies of their various natures, but which no natural tendency can oppose to the supreme Creator, Preserver, and Governor Who stands above the things sanctioned by Him and given to creatures, while He remains free for His own wise reasons to impede or change the effects and activities of such tendencies in a different direction for particular cases. In the presence of the marvellous reality of the cosmos, which the scientist contemplates, studies and scrutinises, the universal spirit devised by Laplace, with his formula which, at least according to the concept of materialists, should also include events dependent on thought and on free will, appears as a utopian fiction; instead, infinitely real truth is that divine Wisdom which knows and measures every smallest atom with its energy, and assigns to it its place in the framework of the created world, that supreme Wisdom whose glory penetrates throughout the whole of the universe and shines with the greatest light in heaven.17

1 *Ps* 103:8.

2 *De Anima*, III, 8.

3 Bk. XIX, Ch. 7.

4 *Paradiso*, Canto XXVIII, 42.

5 *Ws* 11:21.

6 *Ibid.* 8:1.

7 *Jm* 1:17.

8 Cf. *S. Th.*, I, 105, 6.

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

10 *Paradiso*, Canto XXIV, 101.

11 Cf. *S. Th.*, loc. cit., a. 8.

12 Cf. *S. Th.*, loc. cit., a. 7.

13 *Paradiso*, Canto I, 112-114.

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

15 *Rm* 11:33.

16 *Ibid.* 1:19-20.

17 *Paradiso,* Canto I, 1 ff.

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