Thomism and Scientific Indeterminism

Indeterminism is one of the most fundamental doctrines of Thomism, and the attitude of prominent contemporary thomists toward the idea of indeterminism such as upheld by its most profound exponent, Sir Arthur Eddington, is rather astonishing.

You will allow me to make a considerable, and perhaps disconcerting, detour before arriving at the precise point under discussion today.

Metaphysics treats of two fundamentally distinct kinds of indetermination: that of freedom, and that of contingency.

a) God's absolute freedom toward finite being is an inevitable consequence of his absolute necessity. In other words: absolute determination is the very source of the highest form of positive indetermination, which is essentially perfection.

b) Finite being implies a negative indetermination in that it may be or not be. Essence and existence remain distinct. The existing essence is not its existential determination, it never has its existence of its own right.(1) This form of indetermination is essentially imperfection.

Nevertheless, all finite beings participate of the first kind of indetermination, either in their freedom or in their spontaneity, according to the degree of their essential determination. The essential determination of the superior angels, for instance, is a principle of higher intellect, and therefore of greater freedom. Although the essence of all angels is simple, there are degrees of simplicity. Accordingly, the intellection of the inferior angels is more and more complex, and their freedom decreases in proportion.(2)

In other words, there exists a constant relation between the degree of essential determination and the degree of positive indetermination.

When we look down upon the angelic hierarchy which is essentially heterogeneous, in the direction of its degradation, we observe a tendency toward an ever increasing complexity, a tendency toward homogeneity. Inferior angels become more and more alike. If we go beyond the last scale of purely spiritual creatures, if we want to realise two beings participating in the same species, or any plurality of beings having in common a physical genus, we must

have recourse to a principle of pure indetermination, prime matter, which renders possible this individuation. The very essence of such beings must be composite. In cosmic beings, there is not only indetermination of the essence ~~xxx~~ relative to its existence: there is a negative indetermination within the very essence. An indetermination which must be pure potency, since with the form it must constitute an unum per se.

This last step brings us into a world of space and time, and introduces a new kind of contingency: that which we treat of in Philosophy of Nature.

This world is one of space, since material beings imply homogeneity, either accidental or substantial, a common physical genus being the cause of homogeneous opposition. Homogeneous exteriority is the philosophical definition of space.(3)

Such a universe is one of time, since complex essence entails complex existence which can only be realised successively. It must also be continuous, since it is that of the same being. Duratio successiva et continua is the philosophical definition of time. The principle of indetermination in cosmic essence is the root of time: cosmic essence must pursue its existence, and lose time in so doing. If it were determinate as that of the angels, it would have no history, and its duration would constitute an aevum; there would be no ~~history~~ time proper, and history would be merely of the accidental order as that brought about by thought and will in spiritual beings. (4)

The pursuit of an indefinitely remote existence cannot constitute an end in itself. In pursuing existence, cosmic beings are really striving after greater quidditative determination, which must culminate in a being whose essential form is above time proper - man: the principal subject, or subjectum attributionis, of Philosophy of Nature. (5) In fact, humanity as a whole, considered in its future definite state, is the ultimate term of this present rushing on of time.(6)

The various species of material forms are not determinate as angelic species. (I insist upon speaking of angelic universes, because ever since we have taken these beings less seriously - i.e. since Suarez - we attribute to natural beings such properties as are specific of purely spiritual creatures. Our Philosophy of Nature reeks with péchés d'angélisme, it is often no more than bad angelology.) Natural forms, because they are not in themselves sufficiently determinate, require prime matter as co-principle and subject. A form which is not capable of subsistence is, strictly speaking, not an essence.(7) Such a form can only constitute an essence together with, and as the act of ~~prima~~ matter. Hence, ~~such an essence cannot~~

such an essence cannot be considered as a purely determinate even in the order of essence, for its matter remains in potency to other forms. And this potency is in itself indeterminate, and to that extent, unintelligible.

Because of the pure potentiality of matter - the matrix from which all material forms are extracted - we must admit between two given forms, the possibility of an infinitude of intermediary forms, so that the existing specific varieties must be considered as actual and determinate segments of a continuum, rather than as the a priori determinations of the integers. The counting of segments may become an absolute operation once they are established. This doctrine must be upheld if we wish to avoid that of latitatio formarum which destroys the very notion of prime matter.

However, because prime matter is ultimately a transcendental relation to the human form - prime matter would be contradictory if it were not essentially ordinated to a spiritual form; and because man is essentially corporeal, vegetative, sensitive, and rational; and since these various degrees admit of no intermediary terms : the inorganic, the plant, the brute, and man must be considered as limit-species: they are determined a priori.

But the various manners in which these limit-species may be participated in cannot be defined in philosophy for an objective reason. There can be no specific philosophical definition of a cabbage or a cow. They are plant and animal. But these are essences which may be variously participated in. The natural species constitute a hierarchy, but it is not a priori determinate as that of angelic species.

I will return to the analogy of the continuum. A continuum is indefinitely divisible. But that a continuum as divisible is divided is false, eventhough the indefini possibility of actual divisions is definitely true. But this possibility does not imply actual determinations. It would be false to say that a continuum x, a continuum, implies a certain number of determinations. Once the determinations are given, then they are true. If we said they were true before they were given, then we would destroy the very essence of a continuum. And it is important to note that this touches the quiddity of the continuum.

If we said that in prime matter all possible forms are already quidditatively predetermined, then pure potentiality itself would be of the quidditative order : prime matter not only become in itself intelligible and have a distinct idea in God, but from the fact that the potency of prime matter is reality, all possible natural beings would simultaneously and eviternally

exist. (8)

This does not mean, of course, that God does not know in his Scientia simplicis intelligentiae all the possible forms - eventhough all these possible forms are existentially incompossible; in like manner God has a definite idea of all the possible points on a line, eventhough it would be contradictory that all these possible and known points be actuated. The main issue is, however, that this possibility and knowledge do not render a continuum discontinuous, nor does his knowledge of all possible forms render them absolute.

Obviously, this doctrine may help to explain philosophically the biological theory of evolution by mutations.

Angelic forms are entirely determined "ad unum". Natural forms cannot be such becuae of their co-principle which implies pure potentiality and, therefore, cannot admit of complete actuation. In composite essence there remains a margin of indetermination. This margin is not only the root of their corruptibility: it is also the cause of indeterminacy in cosmic causation. For an effect is predetermined in its cause according to the manner in which the cause itself is determined. The margin of indetermination exceeding the form is the cause of contingency in nature.

It is important to note that this contingency is ultimately linked with time, and fundamentally speaking, they have the same cause: prime matter. For contingency in nature does not consist in the present as present, but in the relation of the present to the future. (9)

There is, however, a decreasing hierarchy of contingency in nature, for the margin if indetermination of a natural agent is in proportion to the perfection of the form. Thus certain causes may attain their intended effect sicut semper, others ut in pluribus, others again ut in paucioribus tantum, "secundum quod forma est magis vel minus determinata ad unum". Certain causes may even be entirely indifferent. (10)

Now an effect, in so far as it is not rigourously predetermined in its cause, is not determinately true in that cause, nor is it knowable as a determinately future phenomenon. Therefore, there can be no science proper of such phenomena, if by science we mean cognitio certa per causas. (11)

The important point in this doctrine of S. Thomas is that, apart from the subjective margin of indetermination due to our ignorance of present conditions, it affirms

objective contingency in nature. A contingency which must be distinguished from that introduced by a free agent, and which Aristotle and S.Thomas call "luck"(fortuna). Most contemporary authors fail to make this distinction. If we take the extreme case of natural contingency, casus or chance in the antonomastic sense, then "chance" and "luck" have profoundly different causes: the former is from nature, the latter from freedom.(12)

Hence, we must never oppose necessity and freedom. There may be an indefinite series of intermediary terms. These are impossible to grasp in the measure that they imply essentially obscure indetermination.

The marginof indetermination exceeding the form of natural causes is the ultimate and objective foundation of the distinction between experimental science and the disciplines. Philosophy, being cognitio certa per causas can only reach what is essential to nature, such as the hylemorphic composition of its substances, the necessity of contingency, the necessity of evolution, the necessity of this process culminating in humanity etc. Experimental science, in so far as it goes beyond mere truisms, can only treat of probabilities. But these probabilities may take incredible proportions, they may be what we call practical certainty, they go so far as to make most people believe they are absolute. But they are never reducible to the principle of contradiction as must be all principles of the disciplines. An experimental theory may be logically coherent, but because it is physico-mathematical, the main point remains whether it is really true.

The preceding arguments are constructed from a purely ontological viewpoint. Scientific methodology will lead us to the same conclusion. And the former may be considered as a sapiential explanation of the latter.

Experimental science, which can never attain its formal object but through an artistic operation (13) - for the scientist performs experiments - can never reach but a universal concept based on measurement and on the repetition of experiments. The following text from Eddington is typical of this idea:" The physical quantity (so discovered), is primarily the result of the operations and calculations; it is,so to speak, a manufactured article - manufactured by our operations."(14) Incomplete induction, which is that of the experimental sciences, can never furnish anything but a universal based on fabrication by which it must be defined. It can never attain to the necessity of a universal proper,immediate

object of science strictly taken as "cognitio certa per causas". Not that this universal is essentially a work of art, but it is only reached by means of an artistic operation which is essential to the definition of known ~~experimental~~ experimental properties. The definition must take account of the operation, precisely because we must avoid subjectivism. If we abstract from the operation, we can no longer know what we are talking about.(15)

In other words, experimental science can never attain to the first degree of abstraction. But just as nature itself tends toward ~~the first degree~~ an ever increasing determination, experimental science tends toward the first degree of abstraction. (16)

Determinists are therefore right when they claim that if experimental science can reveal no absolute laws, then experimental science is not an absolute science. No scientist today claims to formulate <u>experimentally</u> a deterministic law.(17) And by laws we here mean laws of governance, as distinct from laws of identity and of atomicity, which are merely truisms and do not in themselves concern the relation of past or present to future. (We may find an analogy between the identical laws which form the subject-matter of relativity theory, and the absolute laws of celestial bodies in greek and medieval astronomy.)(18)

The main reason why Planck holds to determinism in physics is because, so long as any choice remains, determinism will always be preferable to indeterminism, for the simple reason that a definite answer to a question is always preferable to an indefinite one: "weil eine bestimmte Antwort auf eine Frage immer wertvoller ist als eine unbestimmte".(19) And I am sure all indeterminists will agree with him wherever such an answer is possible. But there are many reasons why nature should not agree with our preferences. Writings in defense of determinism are always astonishingly clear. But so is Molinism, and that is undoubtedly the trouble with it.(20)

In practice, it is of course difficult to know just where subjective indeterminism, due to errors of observation and general ignorance, begins, and where it ends. The aim of experimental science is to reduce so far as possible this subjective margin. That is why it is silly to say that the indeterminist surrenders to ignorance. ~~[illegible]~~ Rather the determinists ~~[illegible]~~ lay claim to knowledge of more than is true.

From the viewpoint of scientific methodology, the important issue is that even if there were determinism in nature, the scientist could never define it experimentally. Such a definition could only be based on an incompossible infinite multitude of experiments.

Let us imagine an intelligence contemplating a finite spatio-temporal universe from beginning to end. This is an ideal case for complete observation. Finally, when "la farce est jouée", our super-physicist establishes that all phenomena have taken place with perfect regularity and have inserted themselves in the differential equation suggested at the very outset. Could he therefrom deduct that this universe was governed by deterministic laws of governance? He probably would if he had no imagination. But if he is really trying to explain what has happened, and not just talk natural history, then he shall show, by imagining a large number of other possibilities, that the present development was merely a highly probable one, and that it has in fact occurred. If he desired to prove that this was the only possible case, then he would have recourse to philosophy. But there he would learn about objective margins of indetermination.

Causality in Philosophy and causality in Physics are of a profoundly different nature, as has been sufficiently shown by Prof. Renoirte.(21) Physical causality merely expresses the metrical coherence of phenomena. It is more, I should say, of the nature of formal causality.

But the main point under discussion is whether, even if we take causality in the philosophival sense of the term, there can be effects without causes. Stoics and Aristotelians are divided on this problem. The former hold that all phenomena must have a definite cause. And given the cause, the effect follows of necessity. If an isolated cause is not sufficient to explain an effect, then we must have recourse to other causes which, taken together, become one sufficient cause, in which all future phenomena are predetermined. In Aristotle's opinion, not all what happens has a cause. What is by accident has no cause. And even a sufficient cause may be impeded in the production of its effect.(22) The cause of a chance phenomenon is not a real cause because it is infinite and indeterminate: causa per accidens est infinita et indeterminata. (23)

Certain prominent contemporary thomists have not only failed to distinguish chance from luck, they have added that unpredictability is not essential to chance. But this is because they have confounded chance as a cause with the phenomenon resulting from this cause. (24) Obviously, if we consider two causal lines when they have already assumed a direction, we can predict their

accidental intersection. But this prediction assumed a determination which already ~~xxxxxxxx~~ takes us beyond the field of contingency, whereas the true cause of chance is anterior to this determination.(25)

God alone, not in his scientia simplicis intelligentiae, but in his scientia visionis, in his eternal decrees which imply not only intellect, but will, sees future phenomena with infallibility. If his knowledge were were dependent upon and derived from the causes considered in themselves, he could not know future contingent phenomena, because these causes are not sufficiently determined. And if He could, then even Molina could have dispensed with his scientia media.(26)

If the weather is bad today, we may not conclude that yesterday it was determinately true that the weather would be bad today. We would be foolish not to accept a highly probable prediction of the weather-man, but the weatherman himself would be a fool if he thought his prediction had metaphysical necessity, no matter how perfect his knowledge of past conditions.(27)

Why then all this indignation at the statements of modern physicists? For example, if at the instant t' the electron e is in the orbit b , this does not mean that at the instant t it was determinately true that at the instant t' the electron e would be in the orbit b.

If I isolate a small number of atoms in a short space of time, I can make no predictions whatsoever as to the future position of the electrons within this space of time. But this isolation is artificial. If I dispose of a great number of atoms, then I can make predictions with increasing probability. But the main point is that no matter how much I increase number and time, I can never arrive at absolute certitude, unless I had under hand an actually infinite multitude of elements and infinite time. But in this impossible hypothesis all becomes tautological.(28) Number may increase but it cannot bring us beyond probability. For instance, the more scholastic philosophers I know, the more I observe that in their field they take themselves very seriously and are remarkably deficient in sense of humour. So that of the next one I am to meet I can predict with increasing probability that he has no sense of humour. Nevertheless, from this observation I may not conclude that the contrary is absolutely impossible. So grave a conclusion could only be warranted by showing that irrisibility is of the essence of scholasticism. This, I am confident, cannot be done.

That a great deal of indetermination, positive or negative, on the part of the individual constituents of an ensemble is perfectly compatible with a law for the ensemble was quite clear to S.Thomas: "The majority of men follow their passions, which are movements of

the sensitive appetite, in which movements heavenly bodies can co-operate: but few are wise enough to resist these passions. Consequently astrologers are able to foretell the truth in the majority of cases, especially in a general way. But not in particular cases; for nothing prevents man resisting his passions by his free-will."(29)

There is in nature not only an essential and objective indetermination due to its imperfection. The degree of essence gives rise to a positive indetermination in the order of activity according to its degree of indetermination. If this positive indetermination is not freedom as it can be only in spiritual beings, it is at least spontaneity as opposed to necessity. And just as there are degrees of freedom, there are degrees of spontaneity. This is difficult to grasp, and with reason. But neither can we understand clearly what is contingent, and if we did we would certainly be wrong. There are degrees of infra-spiritual immateriality. An animal is more immaterial, less corporeal than a plant, and one plant less than the other. In biology, the behaviour of superior animals appears to be much more spontaneous than that of the protozoa : it is much more difficult to foresee and to express in metrical terms. In philosophy, we can assign another objective reason to this fact. Life is essentially heterogeneous. A living being is an organised being. Now the basis of experimental measurement is homogeneity. Hence, in the measure that the form emerges above the matter, the activity of a being escapes the rigour of metrical definition. Biological sciences will naturally be more statistical than the physical sciences.

One might object that the inorganic world, since its form implies a certain degree of determination, must also be endowed with spontaneity. Now spontaneity is a specific property of living beings. - This difficulty is easily solved. The active principle of the inorganic world is extrinsic to nature. If the inorganic had in itself an active principle, it would be a living being. (Obviously, I am taking "active principle" in a philosophical sense). But the active principle of the inorganic world is of necessity a vital cause, and therefore endowed with spontaneity. There is no spontaneity in the inorganic world considered in itself, but the inorganic world "considered in itself" is an incomplete abstraction. From the constancy of its course we may merely deduct that the free agent which rules this course is constant. (30)

They who would have nature governed by deterministic laws arex really attributing to nature exclusively divine properties. God alone is absolute determination, so much so that it gives rise to absolute positive indetermination. God alone is pure intelligibility. And anything that falls short of pure intelligibility, even if all that it is is intelligible, implies objective obscurity, in proportion to its limitation, in the measure that it is not.

Because of this spontaneity, and because of these contingent fluctuations which are essential to nature, philosophy of mobile being taken as a science in the strict sense of the word, cannot give us a complete knowledge of nature. In this science we can only define things dialektikoos , as Aristotle puts it. If we desire a sufficient and more adequate knowledge of cosmic reality, we must also define it phusikoos . And this is what we do in the experimental sciences. It is in philosophy of science, the sapiential function of philosophy of nature aided by mathematics, that we combine these two modes of definition.

For philosophy of nature is both science and wisdom. Metaphysics is wisdom because it has as formal object being, and thereby it can reflect upon itself, explain itself by its principal ~~object~~ subject - God, and defend itself against the natural doubt of human intelligence. But metaphysics, from the very fact that it has being as its object, it also covers somehow all the inferior sciences which treat of particular beings or particular aspects of beings, and may judge them, defend these sciences and use them, just as theology uses philosophy in general. Reflecting on mathematics, metaphysics becomes philosopphy of mathematics, which is only materially mathematical, eventhough the data used be formally mathematical. And just as there is a metaphysics of mathematics, there is a metaphysics of philosophy of nature. (31)

Philosophy of nature participates in this second sapiential function of metaphysics in which it goes beyond its limits as a science and as a wisdom relative to itself. But philosophy of nature will not be wisdom simpliciter (32) since it cannot reflect upon its object "ens mobile" which it attains only under the aspect of mobility.

But this very mobility implies in turn two distinct aspects: one which is necessary , and another which evades the grasp of cognitio certa per causas, but which may be overtaken by the experimental sciences.

Just as the quidditative intuition of the divine essence by the Saints gives them no comprehensive knowledge of that essence and its infinite participability; and just as metaphysics grasps the very quiddity of beings without knowing the various ways in which it may be participated, philosophy of nature cannot tell us all the devious ways of this world of "fluxibilia et non semper eodem modo se habentia, propter materiam."(33) But once experimental science has revealed the trend of these fluctuations, philosophy of nature may reflect upon them, which it can safely do without going beyond the realm of mobility. It may judge, defend, and use the experimental science. A philosophy of nature which neglects this function is not ~~a wisdom, and~~

wisdom, and therefore, not even philosophy of nature. The same should be said of social philosophy. Without the social experimental sciences, our definitions are merely dialectical, and we speak of human rights and human beings as if they were angelic, and purely spiritual personalities.

This sapiential function, however, would be devoid of meaning, if the subordinate sciences did not enjoy perfect autonomy in their own field. In fact, experimental science can be useful to the philosopher only in so far as it has established itself in its own right.

(1) ...ipsa natura vel quidditas angeli est possibilis respectu esse quod a Deo habet. Comm. in II Sent., dist.3, q.1, a.3. - All latin quotations are from S.Thomas unless otherwise indicated.

(2) Libertas a necessaria coactione nobilius invenitur in Deo quam in angelo, et in uno angelo quam in alio, et in angelo quam in homine. Ibid., dist.25, q.1, a.4.

(3) Space as we know it intuitively is constituted not only by the homogeneous opposition of individuals, but by the ~~xxxxx~~ homogeneous parts of a single individual. Nevertheless, the former case would be sufficient. The separate substances of human beings are homogeneously exterior to oneanother although in themselves they are not quantitative. We may thus conceive a hyper-space without time, profoundly distinct, and just as unimaginable as the ~~xxxxx~~ heterogeneous exteriority constituted by substance and accidents, will and intellect, Gabriel and Raphael etc.

(4) Cf. John of S.Thomas, Cursus Philosophicus, edit. Reiser, vol.II, p.369 et sq.; Cursus Theologicus, edit. Desclée, vol.II, p. 97.

(5) Anima mensuratur tempore secundum esse quo unitur corpori; quamvis prout consideratur ut substantia quaedam spiritualis, mensuretur aevo. Q. de Potentia, q. III, a.10, ad 8.

(6) Ibid., q. V, a.5. - Time will then proceed from an unmoveable term, and as such may go on indefinitely.

(7) Anima sensibilis cum non sit res subsistens, non est quidditas, sicut nec aliae formae materiales, sed est pars quidditatis, et esse suum est in concretione ad materiam; unde nihil aliud est animam sensibilem produci, quam materiam de potentia in actum transmutari. Ibid., q.III, a.11, ad 11.

8) ...quod aliqua forma non subito imprimatur subjecto, contingit ex hoc quod subjectum non est dispositum, et agens indiget tempore ad hoc quod subjectum disponat. Et ideo videmus statim cum materia est disposita per alterationem praecedentem, forma substantialis acquiritur materiae...Quod enim agens naturale non subito possit disponere materiam, contingit ex hoc quod est aliqua proportio ejus quod in materia resistit, ad virtutem agentis. Ia IIae, q. 103, a. 7.

(9) Neque enim contingentia rei consistit nisi in ordine ad futurum, quia quod jam est praesens vel praeteritum, extra contingentiam est in eo in quo jam est; solum autem est contingens in eo in quo deest, et quod futurum restat. Si ergo contingens fundat de se futuritionem contingentem et impedibilem, ergo indeterminatam; et ita quandiu est in statu futuritionis, est in statu indeterminationis. John of S. Thomas,

Curs.Theol., vol.II, p.412.

(10) Comm. in I Periherm., lect. 13 & 14; in II Physic., lect.10; In VI Metaph.; etc.

(11) ...in istis causis effectus futuri non habent certitudinem absolutam, sed quamdam, inquantum sunt magis determinatae causae ad unum quam ad aliud; et ideo per istas causas potest accipi scientia conjecturalis de futuris, quae tanto magis erit certa, quanto causae sunt magis determinatae ad unum; sicut est cognitio medici de sanitate et morte futura, et judicium astrologi de ventis et pluviis futuris." In I Sent., dist. 38, q.1, a. 5.

(12) ...omne quod est a fortuna est a casu, sed non convertitur. - Casus non solum est in hominibus, qui voluntarie agunt, sed etiam in aliis animalibus, et etiam in rebus ~~xxxxxxx~~ inanimatis. - Ostendit (Philosophus) in quibus maxime casus differat a fortuna. Et dicit quod maxime differt in illis quae fiunt a natura; quia ibi habet locum casus, sed non fortuna. Cum enim aliquid fit extra naturam in operationibus naturae, puta cum nascitur sextus digitus, tunc non dicimus quod fiat a fortuna, sed magis ab eo quod est per se frustra, idest a casu. Et sic possumus accipere aliam differentiam inter casum et fortunam, quod eorum quae sunt a casu, causa est intrinseca, sicut eorum quae sunt a natura; eorum vero quae sunt a fortuna, causa est extrinseca, sicut eorum quae sunt a proposito. In II Physic., lect.10.

(13) "Art" is here taken in the strictly scholastic sense of recta ratio factibilium .

(14) The mathematical theory of relativity, Introd.

(15) The formal object of experimental science is not mobile being as measurable, but as measured. This is how we understand Eddington's "pointer readings". Paradoxically, as Einstein, he thereby escapes that subjectivism which he accused of by his opponents. "But the physicist is not generally content to believe that the quantity he arrives at is something whose nature is inseparable from the kind of operations which led to it; he has an idea that if he could become a god contemplating the external world, he would see his manufactured physical quantity forming a distinct feature of the picture." loc.cit.

(16) This is perhaps what John of S.Thomas means in the following text: Experimentalis cognitio non dicit abstractionem intelligibilem, qua cognoscitur res per suam quidditatem, praesertim quia apud nos experientia semper dependet ab aliquibus sensibilibus. Et sic est diversa abstractio a scientia , quae procedit a priori, quantum est ex se. Curs. Phil., ~~xxxxxxxx~~ vol.I,p.828.

(17) Cf. Eddington, New Pathways in Science, p.295 et sq.

(18) "In the present stage of science the laws of physics appear to be divisible into three classes - the identical, the statistical and the transcendental. The "identical laws" include the great field-laws which are commonly quoted as typical instances of natural law - the law of gravitation, the law of conservation of mass and energy, the laws of electric and magnetic force and the conservation of electric charge. These are seen to be identities, when we refer to the cycle so as to understand the constitution of the entities obeying them; and unless we have misunderstood this constitution, violation of these laws is inconceivable. They do not in any way limit the actual basal structure of the world, and are not laws of governance." Eddington, quoted by Bertrand Russell in Encyclopaedia Britannica, art. Relativity: philosophical consequences.

(19) Max Planck, Wege zur physikalischen Erkenntnis, Leipzig, 1933, p. 201.

(20) One must read Mineur's pathetic exclamations in defense of determinism (Science et Loi, Ve Semaine Internationale de Synthèse, Paris 1934, p.72 et sq.) to get an idea of what incredible superstition a scientist is capable of. If determinism is so clear to him that it needs no proof, and if Mineur himself has decreed that physical laws be absolute, then I cannot see what could be done about it. There is no remedy against this cartesian "clarté". But neither can I see that it matters.

(21) La théorie physique, Rev. Néo-Scolastique, 1923, p. 349 et sq.; ibid. Physique et Philosophie, 1936, p.51 et sq.

(22) Stoici, posuerunt fatum in quadam serie, seu connexione causarum, supponentes quod omne quod in hoc mundo accidit habet causam; causa autem posita, necesse est effectum poni. Et si una causa per se non sufficit, multae causae ad hoc concurrentes accipiunt rationem unius causae sufficientis; et ita concludebant quod omnia ex necessitate eveniunt... Sed hanc rationem solvit Aristoteles... Dicit enim quod non omne quod fit habet causam, sed solum illud quod est per se. Sed illud quod est per accidens non habet causam; quia proprie non est ens...Similiter haec est falsa, quod posita causa etiam sufficienti, necesse est effectum poni : non enim omnis causa est talis (etiamsi sufficiens sit) quod ejus effectus impediri non possit. Comm. in I Periherm., lect.14 ; also Ia, q.115, a. 6, and Cajetan's Comm.; John of S.Thomas, Curs. Theol., vol.II, q.14, disp. 19, o. - The expression "hypothetically necessary laws" so widely accepted, is, I think, a most unfortunate one, and seems to imply a contradiction in terms. Of what use is necessity if it is only hypothetical ? "...non enim ideo aliquid est necessarium, quia non habet impedimentum, sed quia est necessarium, ideo impedimentum habere non potest. Et ideo

(17) Cf. Eddington, New Pathways in Science, p.295 et sq.

(18) "In the present stage of science the laws of physics appear to be divisible into three classes - the identical, the statistical and the transcendental. The "identical laws" include the great field-laws which are commonly quoted as typical instances of natural law - the law of gravitation, the law of conservation of mass and energy, the laws of electric and magnetic force and the conservation of electric charge. These are seen to be identities, when we refer to the cycle so as to understand the constitution of the entities obeying them; and unless we have misunderstood this constitution, violation of these laws is inconceivable. They do not in any way limit the actual basal structure of the world, and are not laws of governance." Eddington, quoted by Bertrand Russell in Encyclopaedia Britannica, art. Relativity: philosophical

20. It should be understood that in this paper I am merely treating of the general idea of indeterminism. The application of this idea to the metrical aspect and behaviour of cosmic reality and to the specific problems of modern science requires a very fundamental transcription which I have attempted elsewhere. Cf Het probleem der physische wetten, in the Dutch periodical Kultuurleven (Antwerp), July 1934; also a paper on Le problème de l'indéterminisme, presented at the 1935 session of the Académie Canadienne Saint-Thomas d'Aquin (publ. Quebec, 1937).

poni. Et si una causa per se non sufficit, multae causae ad hoc concurrentes accipiunt rationem unius causae sufficientis; et ita concludebant quod omnia ex necessitate eveniunt... Sed hanc rationem solvit Aristoteles... Dicit enim quod non omne quod fit habet causam, sed solum illud quod est per se. Sed illud quod est per accidens non habet causam; quia proprie non est ens...Similiter haec est falsa, quod posita causa etiam sufficienti, necesse est effectum poni : non enim omnis causa est talis (etiamsi sufficiens sit) quod ejus effectus impediri non possit. Comm. in I Periherm., lect.14 ; also Ia, q.115, a. 6, and Cajetan's Comm.; John of S.Thomas, Curs. Theol., vol.II, q.14, disp. 19, o. - The expression "hypothetically necessary laws" so widely accepted, is, I think, a most unfortunate one, and seems to imply a contradiction in terms. Of what use is necessity if it is only hypothetical ? "...non enim ideo aliquid est necessarium, quia non habet impedimentum, sed quia est necessarium, ideo impedimentum habere non potest. Et ideo

alii melius distinxerunt secundum naturam rerum, ut scilicet dicatur illud necessarium, quod in sua natura determinatum est solum ad esse; impossibile autem quod est determinatum solum ad non esse; possibile autem quod ad neutrum est omnino determinatum, sive se habeat magis ad unum quam ad alterum, sive se habeat aequaliter ad utrumque, quod dicitur contingens ad utrumlibet." ibid.

(23) Comm. in II Physic., lect. 8.

(24) John of S.Thomas, Curs.Phil., vol.II, p.510: Dicitur (fortuna) causa, et non effectus, quia id, quod est effectus, est fortuitum seu ex fortuna proveniens, non fortuna ipsa. -
(25) Curs. Theol., vol.II, p. 420: Nec distingui debet inter contingentiam, et indifferentiam seu indeterminationem, ut aliqui faciunt: quia contingens dicitur aliquid ex causa indifferenti ad utrumlibet in actu primo, et antequam de facto producat; ergo antequam effectus producatur, ex eadem parte, ex qua habet contingentiam, habet [illegible] indeterminationem, scilicet ex causis: extra causas autem nondum aliquid habet, vel si aliquid habet determinate, ibi [illegible] amittet contingentiam ubi habet determinationem.

(26) Verbi gratia, cursus Socratis subjacet [illegible] certitudini divinae scientiae, prout est in actu; et hoc non habuit semper, quia quandoque erat in potentia tantum, et secundum quod sic tantum erat, non erat subjicibilis certitudini divinae scientiae; si enim Deus vidisset ipsam causam, ut Socratem, et non vidisset immediate effectum [illegible] in esse suo sicut nos futura cognoscimus, numquam potuisset istud scire... In I Sent., dist.38, q.1, a.5, ad 6.

(27) Si enim similiter se habet veritas et falsitas in praesentibus et et futuris, sequitur ut quidquid verum est de praesenti, etiam fuerit verum de futuro, eo modo quo est verum de praesenti...ergo si ante unum diem verum fuit dicere quod erit album, sequitur quod semper fuit verum dicere de quolibet eorum, quae facta sunt, quod erit...Sequitur ergo ex praemissis quod omnia, quae futura sunt, necesse est fieri...Ergo est falsum, scilicet quod omne quod est verum esse, verum fuerit determinate dicere esse futurum. In I Periherm., lect.13.

(28) In causis autem creatis non possunt cognosci futura contingentia, quantumcumque causae accumulentur: quia illae omnes contingentiam non sufficiunt exhaurire, nisi forte causae istae sumantur ut determinatae a Deo, et subjectae ipsi decreto sic causanti determinationem futuritionis. John of S.Thomas, Curs. Theol., vol.II, p.410.

(29) Ia, q.115, a.4, ad 3.

(30) Quod autem motus coeli est voluntarius secundum activum principium non repugnat unitati et conformitati coelestis motus, ex hoc quod voluntas ad multa se [illegible] habet et non est determinata ad unum; quia, sicut natura determinatur ad unum per suam virtutem, ita voluntas determinatur ad unum per suam sapientiam, qua voluntas dirigitur infallibiliter ad unum finem. Summa Contra Gentes, III, 2:

(31) The need of metaphysical reflection on the content of philosophy of nature, and the confusion of metaphysics as wisdom and as science, are probably responsible for the wide acceptance of the Wolfian division of philosophy by modern scholastics.

(32) Cf. Jacques Maritain, Science et Sagesse, p.67 et sq.

(33) S. C. Gent., lib.III, c.86.