



## Abstraction from Matter (III)

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# Abstraction from Matter\*

## XVIII. WHAT IS MEANT BY 'SCIENCE ABSTRACTS FROM MOVEMENT'

We have considered the sense in which there may be science proper insofar as abstraction is achieved only from individual sensible matter. It is also said that science must likewise abstract from movement inasmuch as "science is of necessary things . . . But every necessary thing, insofar as it is necessary, is immobile, since whatever is in motion, as such, may be or not be, either absolutely, or in some respect."<sup>1</sup>

### 1. *Science proper is of what is necessary*

The reason, then, why science requires abstraction from movement is that science concerns that which cannot be otherwise and is necessarily true, while whatever is in motion is unceasingly otherwise in the respect in which it is in motion. If science were of the thing that changes as changing, science could not remain true except by changing with the thing as it changed, so that what was true at one instant would be false at another. For that 'Socrates is walking' is true only so long as he is actually walking; so that, if there were a science of Socrates' walking, it would cease to be true and to be science when he halted. Such a science would share the conditions of sensation. Moreover, the truth achieved by such science would be of a baffling kind, since it would have to lapse over and over again even while Socrates *was* walking; for throughout the course of the walking itself there is a 'before' and an 'after' — divided by the indivisible of time, the instant — the before which is no longer and the after which is not yet. Now the truth about *this* movement (for there is no motion except in the existent singular) could not be achieved even in the evanescent instant that divides the past from the future, since there can be no movement in the indivisible of time, no more than there can be in a point, or in the *momentum* — the indivisible of motion. And this reminds us of those who

because they saw that all this world of nature is in movement, and that about that which changes no true statement can be made, they said that of course, regarding that which everywhere in every respect is changing,

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\* See the first parts of this study in *Laval théologique et philosophique*, Vol. XIII, 1957, n° 2, pp. 133-196, and Vol. XVI, 1960, n° 1, pp. 53-69.

1. ST. THOMAS, *In Boethium de Trinitate*, q.5, a.1, c. — St. Thomas here refers to Aristotle's *Post. Anal.*, I, c.6.

nothing could truly be affirmed. It was this belief that blossomed into the most extreme of the views above mentioned, that of the professed Heracliteans, such as was held by Cratylus, who finally did not think it right to say anything but only moved his finger, and criticized Heraclitus for saying that it is impossible to step twice into the same river ; for *he* thought one could not do it even once.<sup>1</sup>

## 2. *Illustration from Mathematics*

When discussing the necessity and immobility of the subject of science proper we may easily confuse this subject with a given instance of it, e.g., 'what movement in a straight line is' with 'this rectilinear one.' The latter is a given movement, the former is not. As mentioned before, 'what contingency is' is itself in no sense a contingent thing or event. A further difficulty arises from the fact that the mathematician may produce a line by the motion of a point, and is always making lines and figures rotate, as well as generating numbers of all kinds. But such 'motion' belongs either to the method he employs to get at a notion — for even point and line are made plain by construction — just as he uses rotation, the notion of which in no sense rotates. ('Motion,' 'rotation,' as well as 'potency' are in mathematics no more than metaphors.) For geometry would be destroyed if rotation should turn out to be forever something else and never just what it is ; while a given rotation may well yield something new. There would be no geometry as a science if the plane triangle could cease to have its three angles equal to two right angles,<sup>2</sup> or if the diagonal could become commensurate with the side of its square. There would be no arithmetic if two plus two were equal, now to four, now to five, — or if the same integer were now odd, now even ; the same number now rational, now surd.

Science, then, would be impossible if it had to bear directly upon subjects which can be other than they are : what we call science would be no more than history, i.e. narration. Movement is excluded from scientific knowledge inasmuch as it implies this kind of possibility. But this does not mean that there is no science about movable things,

1. ARISTOTLE, *Metaph.*, IV, c.5, 1010 a. Oxford transl.

2. It may be objected that when the triangle is bent over a sphere the angles become together greater than two right angles, so that this property of the triangle is variable. They who choose to see things in this way should logically hold that, since what is true of the spherical triangle is not true of the plane triangle, what was seen to be true of the latter has now come to be false of it. Furthermore, the spherical triangle is not arrived at by bending the flat one over a sphere, as if it were flexible, no more than a straight line becomes a curve when we draw a line that is the shortest distance between two points on the surface of a sphere, for this is a new kind of shortest distance between two points, just as the spherical triangle is a new kind of triangle that leaves the flat one unchanged. There would have been an error had we assumed that what is true of the plane triangle should also be true of the spherical one. As to wilting triangles, they can be handled by the application of calculus.

for, on the one hand, ' what it is to be movable ' or ' what mobility is ' or ' what movement is ' is quite immobile, as we have already pointed out ; while on the other hand this definition does apply to any given motion, just as ' rational animal ' applies to Socrates.

One might nevertheless raise the question of a necessary movement. If there were such a movement, how could we still assign immobility as a condition of science ? The answer is that there would still be immobility in the sense of necessary : it would be impossible not to be in movement.<sup>1</sup> Besides, it would be a given movement, a particular one as opposed to ' what necessary movement is,' and therefore not the direct subject of science.<sup>2</sup>

There is very little in the study of nature that meets this condition of science proper, and the ancients were quite aware of it.<sup>3</sup> Still, some solutions are definitive, such as those of Zeno's paradoxes in *Physics* VI — which are *ad hominem* — and *Physics* VIII which, as Sir David Ross points out, no one interested in this problem seems to read.<sup>4</sup>

1. *In IX Metaph.*, lect. 9.

2. *In Boethium de Trinitate*, q.5, a.2, c. et ad 4.

3. Albertus Magnus, for instance, compares in this regard natural science and mathematics : " Constat autem ex his quae subtiliter in naturis considerata sunt, omnem diffinitionem aut rationem formarum physicarum conceptam esse cum materia, quae motui subjacet, aut mutationi, aut utrique : et ideo concipi oportet eam cum tempore secundum quod tempus est in re temporali. Propter quod etiam id quod scitur de hujusmodi, *multum miscetur opinioni*, et pertingere non potest ad confirmatum constantem et necessarium scientiae habitum, sicut dicit Ptolemaeus. Ex his autem quae in quadrivio bene probata sunt, scitur omnes scientias doctrinales medium suae demonstrationis accipere secundum rationem diffinitivam formae, quae licet esse habeat in physicis et extra physica non inveniatur, tamen rationem diffinitivam non habet conceptam cum materia physica, neque secundum principia essentialia dependet ad physicam materiam, sed extra eam accepit principia essentialia : et ideo in omni varietate physicorum inventa via in natura manet *univoca*, sicut circulus, et quadratum, et par et impar, et omnis proportio numeri et continui, et diapente, et diatesson in musicis, et conjunctio et praeventio et omnis stellarum respectus, et quaecumque alia sunt hujusmodi. Et sicut ista stantes habent formas secundum principia essentialia motum et mutationem evadentes, ita stantem de se generant speculationem, nihil opinionis habentem, sed potius scientiam necessariam de se praebentem : et ideo tales habitus per speculativum intellectum *adeptae* verae scientiae nomen acceperunt, et doctrinales et disciplinales vocantur, ideo quia *ex principiis non mutantibus* quae discipulus a magistro non acceptat nisi per terminorum notitias, docentur, experientia non indigentes, ut dicit Aristoteles libro quarto, sed simplici demonstratione Doctoris constante intellectu discipuli : propter quod etiam juvenes inexperti ut plurimum magis excellunt in ipsis : quod nullo modo possibile fuit in physicis speculabilibus, *in quibus experientia multo plus confert quam doctrina per demonstrationem*. Speculationes autem istae gradus sunt et manuductiones ad speculationem divinam, sicut optime loquens dicit Maurus Alubacher in epistola quam de contemplatione scripsit. Haec enim speculatio intellectus nostri non existit in eo quod est humanus, sed in eo quod ut divinum quoddam existit in nobis." *Metaphysica*, I, c.1.

4. Even Bertrand Russell insists that there are difficulties about nature which have been solved once and for all. And so he might agree with us, at least in principle. However, as Sir David points out : " Lord Russell constantly assures us that [Georg Cantor and

### 3. *Science and the possible*

The teaching of Aristotle and St. Thomas<sup>1</sup> that there can be science only of what is necessary and immobile must appear curious to the modern reader. But however strange their thinking may now appear, it can be worth while to learn what they had in mind when they set forth this proposition. We may begin with the term 'necessary'. In order to grasp what it means we must see how it is opposed to a special meaning of the word 'possible.'<sup>2</sup>

Generally speaking, the term 'possible' has two meanings: one is opposed to what is impossible, the other to what is necessary. That the first meaning is not opposed to the necessary is plain from the fact that if what is necessary were impossible it could not possibly be necessary; hence, what is necessary must also be possible in the first sense. The other meaning of 'possible' is opposed to 'necessary,' namely, to that which cannot not be. Possibility in this second sense is described as *potentia simul contradictionis*, a potency or possibility to be excluded from the subject of science proper.

The phrase *potentia simul contradictionis* is used because this kind of potency is of things that can be *and* not be; 'to be' and 'not to be' are contradictories. For instance, if Socrates could only lie down and never stand or sit, it would be false to speak of his standing as possible, in either sense of the word 'possible.' But if lying down he *can* stand, the potency to stand coincides exactly with the actuality of lying down: the two contradictories, lying down and not lying down, are simultaneous. Anything of which no more may be asserted than that it *can* be is not possible in the second sense of this term; both contradictories must be verified at once.

'Socrates is mortal' would not be a true instance of this kind of possibility, for, as we will explain in a moment, if he lives and is mortal of necessity he must die. Yet the possibility we now have in mind rules the *mode* of his inescapable death, for he may die at any time, by poison, run down by a truck, of old age and so forth. That Socrates must inevitably cease to be is therefore not incompatible with the contingency of the way he can cease to be. — All this may sound trivial, yet many philosophers have missed the two meanings of 'possible,' while St. Thomas is not merely ready to expose them with painstaking care, but to do so over and

Dedekind] have finally settled all the difficulties about space, time, and movement, and in particular those raised by Zeno. But he never seems to succeed in showing just how they have done so." *Aristotle's Physics*, Oxford, 1936, p.84.

1. *Post. Anal.*, I, c.6 (ST. THOMAS, lect. 13-14).

2. Why Aristotle sometimes uses the words *dynamis*, *dynaton*, and *endechomenon* interchangeably (St. Thomas does the same with *potentia*, *possibile*, and *contingens*) will be discussed elsewhere.

over.<sup>1</sup> Leibniz did not see the point of the distinction, and even nowadays it is ignored in discussions about propositions regarding future contingent events.

If Socrates can die, why does it follow that he must? If he can die by poison, does it follow that he shall? Now, if he can die by poison or not die by poison, why should he not likewise be destructible yet never be destroyed? The point is that, if 'mortal' allowed that he might cease to be or not, that he might live forever or not live forever, we would be positing some intermediate to the contradictories 'to be forever' and 'not to be forever.'

A man has, it is true, the capacity at once of sitting and of standing, because when he possesses the one he also possesses the other; but it does not follow that he can at once sit and stand, only that at another time he can do the other also. But if a thing has for infinite time more than one capacity, another time is impossible and the times must coincide. Thus if anything which exists for infinite time is destructible, it will have the capacity of not being. Now if it exists for infinite time let this capacity be actualized; and it will be in actuality at once existent and non-existent. . . . It is clear also on other grounds that it is impossible that the destructible should not at some time be destroyed. For otherwise it will always be at once destructible and in actuality indestructible, so that it will be at the same time capable of always existing and of not always existing. Thus the destructible is at some time actually destroyed.<sup>2</sup>

This is why *in perpetuis non differt contingere et esse*: in things that are forever there is no difference between 'to be possible' and 'to be in fact.'<sup>3</sup>

1. E.g., *Contra Gentiles III*, c.86: "Possibile enim quoddam est quod ad necessarium sequitur. Nam quod necesse est esse, possibile est esse: quod enim non possibile est esse, impossibile est esse; et quod impossibile est esse, necesse est non esse; igitur quod necesse est esse, necesse est non esse. Hoc autem est impossibile. Ergo impossibile est quod aliquid necesse sit esse, et tamen non sit possibile illud esse. Ergo possibile esse sequitur ad necesse esse. . . . Sed possibile vel contingens quod opponitur necessario, hoc in sua ratione habet, quod non sit necesse illud fieri quando non est. Quod quidem est quia non de necessitate sequitur ex causa sua. Sic enim dicimus quod Sortem sessurum esse est contingens, ipsum autem esse moriturum est necessarium, quia secundum horum ex causa sua de necessitate sequitur, non autem primum." — *In IX Metaph.*, lect.3: ". . . Possibile dupliciter dicitur. Uno modo secundum quod dividitur contra necesse; sicut dicimus illa possibilia quae contingunt esse et non esse. Et sic accepto possibili, non habet locum quod hic dicitur. Nihil enim prohibet quod antecedens sit contingens esse et non esse, consequens tamen sit necessarium; sicut patet in hac conditionali, si Socrates ridet, est homo. Alio vero modo possibile dicitur secundum quod est commune ad ea quae sunt necessaria, et ad ea quae contingunt esse et non esse, prout possibile contra impossibile dividitur."

2. *De Coelo*, I, c.12, 281 b 15; 283 a 25, Oxford transl. (St. THOMAS, lect. 26-29).

3. St. THOMAS, *In III Physic.*, lect.7. Cf. *Contra Gentiles*, II, c.30.



XIX. EXCURSUS : A NEW MEANING OF 'SCIENCE AND  
THE POSSIBLE' <sup>1</sup>

We must be made aware that the type-writing-monkeys hypothesis <sup>2</sup> has given new meaning to 'science and the possible.' For we are told that random groupings of the letters of the alphabet could produce all the works in the *Library of Congress*. There is of course no doubt that all extant writings are in fact one set of possible arrangements of the elements of speech. But the hypothesis in question is not content merely to observe this possibility, it is determined to make of it an explanation of the actuality : it appears that random permutations of these elements could produce a set of groupings entirely similar to the one at hand, and therefore equally meaningful. Those who take the possibility of such an event in earnest <sup>3</sup> must of course maintain that anything produced by intellect or reason can be perfectly matched by a blind, purposeless agency in the way Socrates can meet his debtor not only by design but also by chance. Thus a man, as no more than one possible arrangement of electrical charges, could be the product of chance. Such reasoning seems to underlie at least one interpretation of evolution, namely, that new species are sufficiently accounted for by random mutations, 'selected' by irrational forces. Now, does this mean anything more than that new species arise because they are possible? On this basis the whole universe would be explained by stating that it is a possible one — as anyone can see from the fact that it exists.

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1. This digression may help to show what Aristotle and Aquinas meant by the term 'possible' as related to science.

2. "Concevons qu'on ait dressé un million de singes à frapper au hasard sur les touches d'une machine à écrire et que, sous la surveillance de contremaitres illettrés, ces singes dactylographes travaillent avec ardeur dix heures par jour avec un million de machines à écrire de types variés. Les contremaitres illettrés rassembleraient les feuilles noircies et les relieraient en volumes. Et au bout d'un an, ces volumes se trouveraient renfermer la copie exacte des livres de toute nature et de toutes langues conservés dans les plus riches bibliothèques du monde. Telle est la probabilité pour qu'il se produise pendant un instant très court, dans le récipient A, un écart de l'ordre du cent-millième dans la composition du mélange gazeux. Supposer que cet écart ainsi produit subsistera pendant quelques secondes revient à admettre que, pendant plusieurs années, notre armée de singes dactylographes, travaillant toujours dans les mêmes conditions, fournira chaque jour la copie exacte de tous les imprimés, livres et journaux, qui paraîtront le jour correspondant de la semaine suivante sur toute la surface du globe et de toutes les paroles qui seront prononcées par tous les hommes en ce même jour. Il est plus simple de dire que ces écarts improbables sont purement impossibles." Émile BOREL, *Le hasard*, Paris, Alean, 1938, pp.164-165.

3. Émile Borel was not one of them. The hypothesis is usually held by non-mathematicians who are unaware that within the limits of calculus itself there is nothing probable. They are like biologists who believe that in physics and chemistry all is entirely accessible to the human mind.

1. *Possibility and existence*

This view is an ancient one. It can be traced back to Democritus and Empedocles, and was given new form by Giordano Bruno, Spinoza, and Leibniz. Perhaps the latter states it most clearly, in his doctrine that all possible predicates are virtually contained in their subjects: "The notion of an individual substance contains once and for all everything that may ever happen to it (*enferme une fois pour toutes tout ce qui luy peut jamais arriver*) and, the contemplation of this notion can reveal all that may ever truly be asserted of it (*tout ce qui se pourra véritablement enoncer d'elle*); even as there may be seen in the nature of circle all the properties that can be inferred from it." In other words, contingency is only necessity in disguise. For, "God, seeing the individual notion or thisness (*heccité*) of Alexander, sees in it at the same time the foundation and reason of all the predicates which can be truly said of him, as, for instance, whether he would conquer Darius and Porus, even to knowing *a priori* (and not by experience) whether he died a natural death or by poison, which we can know only by history."

Notice that it is not the mere possible substance and predicates that are the issue, but real substance and its actual history. The point Leibniz is trying to make is that adequate knowledge of the possible has got to mean knowledge of what has been, is, and shall be. Of course we agree that if Caesar crossed the Rubicon it must no doubt have been possible — in both senses of 'possible.' But he did not by necessity cross the Rubicon, and might have taken many other courses which in fact he did not take. Why, then, should contemplation of his other possible predicates enable one to behold him actually crossing the Rubicon? How dare we assert that knowledge of all that is possible is vision of all that in fact exists? What happens to that which might have been, but in fact did not occur? Where are these 'all possible predicates' going to end?

Spinoza held that whatever is possible comes to be, whereas Leibniz confined the realm of real possibility to the compossible, in such a way that existence follows analytically, so to speak, from whatever is compossible.<sup>1</sup> This qualification might lead one to believe,

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1. Our example of impossibility would be "to stand and be seated at the same time," whereas to be standing in fact and to be able to sit down are compossible; able to stand, and able to sit down are simultaneously compossible with lying down. No amount of intuiting this compossibility will make us see that the one who is capable of these diverse positions shall have them in fact. Nothing actually follows from this kind of compossibility: the fact that I can stand does not entail that I shall (although the fact that I am destructible entails that I shall be destroyed, which is necessary as opposed to possible). Leibniz's compossibility is of another kind, for he seems to mean that things which are not impossible must come to be. Bertrand Russell's account of why, according to Leibniz, some things exist and others, equally possible, do not, is substantially correct, though not compatible, nor does it aim to be, with all that Leibniz wrote. "According



erroneously, that Leibniz's qualification is reducible to Aristotle's conditions of real possibility — as distinguished from what is possible in logic or in mathematics, where 'possible' and 'potency' are metaphors. Real possibility, such as that of walking, contains many things. These are in fact innumerable, and any account of such possibility must be largely incomplete. An adequate account would have to draw upon the whole unwieldy universe. However complete our knowledge of the conditions of any man's walking, it could not make us see him striding along. "... Anything which is possible is something possible at some time and in some way, with all the other qualifications which must be present in the notion."<sup>1</sup> Aristotle then goes on to show how natural possibilities differ from the rational. In nature, provided the required conditions are satisfied, the really possible, the physical potency, becomes actual — at least for the most part. "For the non-rational potencies are all productive of one

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to this view [Lord Russell says], everything that does not exist struggles to exist, but not all possibles can exist, because they are not all 'compossible.' It may be possible that A should exist, and also possible that B should exist, but not possible that both A and B should exist; in that case, A and B are not 'compossible.' Two or more things are only 'compossible' when it is possible for all of them to exist. Leibniz seems to have imagined a sort of war in the Limbo inhabited by essences all trying to exist; in this war, groups of compossibles combine, and the largest group of compossibles wins, like the largest pressure group in a political contest. Leibniz even uses this conception as a way of defining existence. He says: 'The existent may be defined as that which is compatible with more things than is anything incompatible with itself.' That is to say, if A is incompatible with B, while A is compatible with C and D and E, but B is only compatible with F and G, then A, but not B, exists by definition. 'The existent,' he says, 'is the being which is compatible with the most things.' — In this account, there is no mention of God, and apparently no act of creation. Nor is there need of anything but pure logic for determining what exists. The question whether A and B are compossible is, for Leibniz, a logical question, namely: Does the existence of both A and B involve a contradiction? It follows that, in theory, logic can decide the question what group of compossibles is the largest, and this group consequently will exist." *A History of Western Philosophy*, Simon and Schuster, New York, 1945, p.594. 'Struggle to exist' is of course a metaphor, since compossibility is the *raison suffisante* of what actually comes to be.

1. *Metaph.*, IX, c. 5, 1048 a. St. Thomas explains the passage as follows: "... In ratione possibilis oportet multa considerare. Non enim dicitur possibile respectu cuiusque, sed respectu alicujus determinati. Unde oportet possibile, esse aliquid possibile, ut puta ambulare vel sedere. Et similiter quod potest aliquid facere vel pati, non potest illud quocumque tempore facere aut pati; sicut arbor non potest fructificare nisi determinato tempore. Et ideo cum dicitur aliquid esse possibile, oportet determinare quando sit possibile. Et similiter oportet determinare quomodo sit possibile. Non enim possibile, quocumque modo potest agere aliquid vel pati; sicut aliquis sic potest ambulare, scilicet tarde, non autem velociter. Et simile est de aliis circumstantiis quae consueverunt determinari in definitionibus rerum; sicut quo instrumento, quo loco, et alia hujusmodi." — This may have been the reason why the Megarians could make their contention, that a thing is possible only when it actually is, appear likely. "There are some who say, as the Megaric school does, that a thing 'can' act only when it is acting, and when it is not acting it 'cannot' act, e.g. that he who is not building cannot build, but only he who is building; and so in all other cases." *Metaph.*, IX, c.3, 1046 b 25. Oxford transl.

effect each, but the rational produce contrary effects, so that if they produced their effects necessarily they would produce contrary effects at the same time ; but this is impossible. There must then be something else that decides ; I mean by this, desire or will.”<sup>1</sup> In other words, rational powers are of contradiction, and determined to one of the opposites by will, for the doctor can use his skill or refuse to do so ; or he can use it to heal but also to kill. Yet there is likewise a *potentia simul contradictionis* in nature, inasmuch as the powers of action or passion may be present or absent, as when an animal may lose its sight.<sup>2</sup> But this is precisely the kind of potency or possibility which Leibniz must deny.

Leibniz did not of course believe that we humans can achieve the adequate knowledge which he so confidently described. He thought nonetheless that we can approach it. Only the possible that is compossible with other things does in fact come to exist. (We would say ‘can come to exist.’) Adequate knowledge is approached as one discerns which possibilities are more favoured ; and this is to be achieved by a “logique des probabilités” along with infinitesimal analysis. (Again, we would say that the application of this logic and analysis must presuppose a given existential situation.) All the same, Leibniz was aware that sheer compossibility can hardly account for what actually comes to be ; he felt the need to posit some kind of *finalité*. But this finality has nothing to do with action for the sake of something ; ‘that for the sake of which’ is not conceived as a cause,

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1. *Ibid.* — Nature and reason are distinguished by the difference between contraries as in our knowing, and contraries as in fact. In fact a man cannot at the same time see and be blind ; but in knowing blindness, he must simultaneously grasp what sight is. For sight is implicit in the very notion of blindness, just as any positive term is essential to its negation, and the perception of one term as contrary is dependent upon the representation of its opposite. This supposes a radical difference between the corresponding subjects of any contrariety. So, if the differences between contraries are held to be finally one and the same, the real, as distinguished from the rational, will involve contradiction (which is the way some people want it) : just as one cannot conceive blindness without simultaneously conceiving sight, nor think death without thinking life, so one could not actually see without being actually blind, or be alive without being also dead. This impossibility cannot be escaped by anyone who refuses to allow a significant distinction between mind and nature. All the same, there are instances of simultaneous contrariety outside the mind — providing ample room for confusion. A plant, for instance, grows in contrary directions ; and a thing becoming white is neither determinately white nor not-white. But these cases differ widely from that of the mind ; the first involves parts that are quantitatively external to one another, while becoming remains this side of full actuality. — Cf. *Q. D. de Veritate*, q.23, a.1.

2. “. . . Aliae potentiae rerum mobilium, de quibus supra determinatum est, omnes sunt contradictionis, e contrario rebus sempiternis, quæ semper sunt in actu. Sed diversimode : nam potentiae rationales sunt contradictionis, eo quod possunt movere sic vel non sic, sicut supra dictum est. Potentiae vero irrationales operantur uno modo ; sed et ipsae sunt contradictionis per hoc, quod possunt adesse, et non esse, sicut animal potest amittere potentiam visivam.” *In IX Metaph.*, lect.9.

but as an end-result that follows from compossibility — the true cause of coming to be.

Such a position is easily reached by means of a threefold confusion: by identifying (a) the possible opposed to the necessary, with the possible opposed to the impossible; (b) and simultaneously the possible opposed to the impossible with the necessary, on the grounds that whatever is possible is necessarily possible; (c) the true and the possible, ignoring that something may be false, yet possible; or possible though not true — e.g., to say that Socrates is standing when he is in fact sitting down, is false, yet, though sitting down, it is possible that he stand. Thus, by a fallacy of equivocation, making univocal use of the term 'possible' we have ruled out all *potentia simul contradictionis*.<sup>1</sup> Now we understand the basic principle: "Principium meum est, quicquid existere potest, et aliis compatibile est, id existere." This plainly means that whatever is compatible, was, is, or shall come to be. Elephants came to be because they are compossible permutations of the stuff they are made of, and compossible with the rest of the world. We might have known as much, of course, but how does this explain the kind of beasts they are, or why they should be at all? It is difficult to see how Leibniz's theory — namely, that to be actual the possible must be of the compossible kind — could be anything more than mere tautology in disguise. The aim of his *Characteristica Universalis* was to replace thinking by calculation, i.e. by a mechanical concatenation of tautologies.<sup>2</sup>

The hypothesis referred to at the beginning of this section contains still another fallacy of equivocation, based upon univocal use of the term 'chance,' as if whatever happens at random happened by chance understood as an accidental cause. There was a further fallacy — one of *latius hos* — in concluding that a certain event may always be the product of chance because it may at one time be the effect of a *per se* cause and at another of an accidental one. Let us first face the ambiguity of 'What happens at random happens by chance.' I throw a pair of dice at random. Now, they are not thrown by chance, for it was by deliberate purpose that I threw them at random. Hence, if the expression 'good luck,' or 'good fortune,' is used when desirable numbers turn up, it is not being used in the sense that the accidental discovery of treasure by a man digging a well

1. The identification of 'possible' with the opposite of necessary would mean that this *potentia* holds sway over all; which leads in turn to the paradox that 'everything is contingent' except that everything is contingent; in other words, 'the necessary is impossible' — except that it is necessarily impossible.

2. Hobbes held a somewhat similar view of reasoning. "Per ratiocinationem . . . intelligo computationem. Computare vero est plurium rerum simul additarum summam colligere, vel una re ab alia detracta, cognoscere residuum. Ratiocinari igitur idem est quod addere et subtrahere." *Opera philosophica*, Wolesworth, 1839-1845, vol. I, p. 3.

is called good fortune. I mean that we have changed the imposition of the term on the basis of a certain similarity, in respect to uncertainty, between the result of a random cast and the casual or fortuitous event. But in obtaining a desirable pair of numbers on the dice no chance is involved in the true sense of this term — unless someone accidentally nudged me and thus favoured the shot. Because, as I throw the dice at random I am quite aware of the alternatives, so that no matter which sides turn up, I cannot normally ascribe the result to chance, unless the meaning of this term be extended — as in ‘the laws of chance.’ And it may be worth remarking that chance in this extended sense, becomes a very equivocal term indeed, since it now means ‘degrees of probability,’ whereas true chance is always highly improbable. Similarly, if I bring down a duck with shot, this event may not be attributed to chance because of the random distribution of the pellets. There may perhaps have been a good reason why this particular pellet struck the game, but my intention will not explain it, because my intention was not set upon this pellet. Many pellets were stuffed into my cartridge (at random) so that the ‘chance’ (probability) of striking the goal might be enhanced. Nature is doing much the same in producing huge amounts of spores or of sperm most of which will fortunately never reach fruition. Yet without such enormous calculated waste, all living species would soon be extinct. So that, though it be by chance that this spore germinates, there is very little ‘chance’ that germination will not take place somewhere.

## 2. *Science and accidental cause*

To show, in turn, how easily the term ‘accidental cause’ lends itself to fallacies of equivocation, we have only to examine several of its meanings.<sup>1</sup>

1. *In V Metaph.*, lect.3 : “Sciendum autem est, quod aliquid potest dici causa per accidens alterius dupliciter. [a] Uno modo ex parte causae ; quia scilicet illud quod accidit causae, dicitur causa per accidens, sicut si album dicatur causa domus. [b] Alio modo ex parte effectus ; ut scilicet aliquid dicatur causa per accidens alicujus, quod accidit ei quod est effectus per se. Quod quidem potest esse tripliciter. [i] Uno modo, quia habet ordinem necessarium ad effectum, sicut remotio impedimenti habet ordinem necessarium ad effectum. Unde removens prohibens dicitur movens per accidens ; sive illud accidens sit contrarium, sicut cholera prohibet frigiditatem, unde seamonaea dicitur infrigidare per accidens, non quia causet frigiditatem, sed quia tollit impedimentum frigiditatis, quod est ei contrarium, scilicet choleram : sive etiam si non sit contrarium, sicut columna impedit motum lapidis, unde removens columnam dicitur per accidens movere lapidem superpositum. [ii] Alio modo, quando accidens habet ordinem ad effectum, non tamen necessarium, nec ut in pluribus, sed ut in paucioribus, sicut inventio thesauri ad fossionem in terra. Et hoc modo fortuna et casus dicuntur causae per accidens. [iii] Tertio, quando nullum ordinem habent, nisi forte secundum existimationem ; sicut si aliquis dicat se esse causam terraemotus, quia eo intrante domum accidit terraemotus.” Cf. *In II Physicorum*, lect.8.

(a) 'The doctor builds' is an instance of accidental cause by reason of something accidentally connected with the *per se* cause (the builder as such) considered on the part of the cause itself. To be a doctor, red-headed, a husband, tall, walking, and so on, is incidental to the builder ; it is nonetheless true to say that this doctor builds, if he does, or this red-headed fellow builds, etc. There is in fact no end to such possible incidentals, some of which arise unceasingly, such as the advancing age of the builder, or his growing baldness ; that he be fifty years old today may be false tomorrow, for instance, or if false today, it may be true tomorrow or at some later time. However, not all accidental causes, so-called by reason of something connected with the *per se* cause, are accidental in quite the same sense. It is *per accidens* that a man builds a house, else he could not be a man unless a builder. But it is not *per accidens* that the builder is a man (unless building comprise nests, ant-hills, hives, beaver-dams, and so on), eventhough he is not a builder simply qua man. Similarly, any given builder must of necessity have some age, one that advances necessarily as he builds, for he and his building are measured by time. In the latter cases, accidental is not opposed to necessary. Notice how inescapable is this infinity of accidental causes related to any builder. In a sense, they comprise the whole universe, inasmuch as the builder is in fact at such a place and such a time, as well as constantly elsewhere and later ; and he will be one of so many people unceasingly varying in number, or one of so many kinds of animals, of living beings, of beings, and so on. But if the range of this kind of accidental causality is infinite, not every instance of it is equally close to the *per se* cause. That the builder, for example, be a man is more immediate and necessary than that he must of necessity be an animal, or a mammal. To live at this address rather than at that one is more accidental to the builder than to have been trained by a man in his fifties rather than by one in his sixties ; that he be a husband is less incidental than that he should be bald. This sort of accidental causality reveals a new infinity then, one of degrees of relationship to the *per se*. Now, because all incidentals, however near to or remote from the *per se* cause, no matter how necessary or contingent they may be, are always a reason why the *per se* cause (the builder), is also an accidental cause (the builder qua man or qua bald), some are inclined to put all incidentals on the same level — now concluding that all incidentals are equally necessary, now that all are equally contingent. In either case utter confusion and unintelligibility must result : something the Anaxagorean *Nous* might be called upon to unscramble. It is the old story. The incidentals are there, hence they have got to be there ; or, the incidentals are plainly incidental, therefore they are all equally incidental. Aristotle never falls into such over-simplifications.

(b) From a quite different point of view a cause may be called accidental by reason of that which may occur to its effect, i.e. when



something happens to the *per se* effect of an agent. There are three different types of such accidental causality.

(i) When the additional effect is related to the *per se* effect by necessity. For example, if to reach a certain place I must walk a muddy path, the walking through mud is incidental though necessary ; or, if I pull down a column and the stone on top of it falls to the ground, I will be called the moving, though incidental, cause of this inevitable fall. Another instance of *removens prohibens* would be the opening in a cloud which accounts for a shaft of sunlight reaching the earth at such or such a spot. Taken in this sense, the accidental cause is not, as such, opposed to a necessary one. My awareness or non-awareness that the stone must fall if I pull away the column will not make its fall less necessary ; yet it remains accidental in this particular sense of accidental. Nowadays, 'cause' is mostly used in the sense of *removens prohibens*.

(ii) The second type of accidental causality, is so called by reason of an effect which merely occurs to the effect intended *per se*, with no trace of necessary connection. This type is confined to causes acting for a purpose. It is essential to it that whatever happens to the effect should happen neither necessarily, so far as the agent is concerned, nor for the most part, but so seldom that there can be no reason to expect it. For example, a man digs a well for water and discovers a treasure. Digging at this spot he cannot fail to discover the treasure ; the discovery is nonetheless purely contingent to what he intended as he dug. He is an accidental cause of this piece of good luck, no matter how predictable it was to his neighbour who knew all the time there was a treasure at that spot and in fact suggested digging for water precisely there. Strange to say, the neighbour could thus become the *per se* cause of a strictly contingent event.<sup>1</sup> Notice how 'that for the sake of which' — namely, a good to be achieved or a harm to be avoided — is essential to this type of accidental cause, meaning that the treasure is a thing the man would have dug for had he known it was or might be there. Similarly, had Socrates intended or expected to meet his debtor in the market today, or thought he might be there, the encounter would no longer be fortuitous.<sup>2</sup> In other words, whatever happens by chance in this

1. *Contra Gentiles*, III, c.92 : " Patet etiam quod etiam homo qui sciret thesaurum esse ibi, posset alium ignorantem mittere ad fodendum sepulcrum in loco eodem, ut, praeter intentionem suam inveniret thesaurum. "

2. *In II Physicorum*, lect.8 : " Sed nunc hoc debet fieri manifestum, quod utrumque [scil. fortuna, quae est agens a proposito, et casus, qui est agens a natura] continetur in iis quae aguntur propter finem : sicut si aliquis sciret se recepturum pecuniam in foro, ivisset ad deportandum eam ; sed si non venit propter hoc, per accidens est quod adventus eius fiat *reportationis gratia*, idest habeat effectum. Et sic patet quod fortuna est causa per accidens eorum quae sunt propter aliquid. *Item*, manifestum est quod est causa eorum quae sunt in minori parte ; quia ista reportatio pecuniae dicitur fieri a fortuna, quando



sense of the word — the second meaning of accidental cause, taken from the effect — must be something which the agent would deliberately pursue or avoid ; if what occurs accidentally to an effect intended by the agent were indifferent to him, one would not speak of fortune or chance in the sense here described. It follows that if there are to be chance events in nature, i.e. outside human agency, they will suppose that nature too, in her own way, acts for the sake of something, namely, to achieve a good or to avoid harm.<sup>1</sup>

(iii) Finally, a cause is termed 'accidental' when in fact there exists no connection at all between what are thought to be cause and effect — *nisi forte secundum existimationem*. These supposed connections may be mere fancies, like the delusion of the good wife who believed herself cause of an earthquake because it occurred just as she dropped her bucket of coal ; or who reversing the relationship between sunrise and her getting up, believed the sun ought to rise because she had got up. These examples, adapted from Aristotle, may seem trivial ; yet they help bring to light more subtle illusions of this kind. In fact science is in some measure an attempt to rid our minds of such delusive appearances of causality. An instance would be the age-long belief that man's abode ought to be at the geometrical center of the universe. Leibniz's belief that compossibility is the proper cause of whatever comes to be is another case not much less ludicrous ; nor does it appear that the idea of random mutations, by their very randomness causing the rise of good species, makes a much better showing. Such relations of causality are utterly fictitious, in the pejorative sense of this term. (In mathematical physics, agent and final causes are vain, cumbersome fictions ; and therefore chance as well, if taken in the second meaning of accidental cause in our last division.) Perhaps one might say that Hume believed all causality to be of this type.

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reportat ad villam veniens neque ex necessitate neque frequenter. *Item est in iis quae fiunt a proposito : quia reportatio pecuniae quae dicitur fieri a fortuna, est finis aliquarum causarum, non secundum seipsum sicut in iis quae fiunt a natura, sed est finis eorum quae fiunt secundum propositum et ab intellectu. Sed si aliquis hoc proposito iret ut pecuniam reportaret, vel semper aut frequenter reportaret quando venit, non diceretur esse a fortuna ; sicut si aliquis frequenter aut semper madefacit sibi pedes quando vadit ad locum lutosum, et hoc licet non intendat, tamen hoc non dicitur esse a fortuna.*" The latter would be a case of accidental cause in the sense of (b, i).

1. In the *Physics* (II, cc.4-6) where Aristotle treats of chance in nature, he nonetheless first analyses fortune. The reason is that the latter, occurring as it does in rational agents, is more obvious as to us ; whereas in nature, chance is more hidden, even as is final causality itself. Regarding this causality, though *causa causarum*, it comes last in the division of causes and required more proof than the other species of cause. St. Thomas explains why. "Et quia de fine videbatur minus quod esset causa, propter hoc quod est ultimum in esse, unde etiam ab aliis prioribus philosophis haec causa est praetermissa, ut in primo libro praehabitu est, ideo specialiter probat de fine quod sit causa." *In V Metaph.*, lect.2.

It is interesting that even accidental causes are not always opposed to necessity. The above divisions make this clear. The first case (*a*), for instance, may be one of absolute necessity, for the builder of houses is necessarily a man ; or it may be one of hypothetical necessity, for this bald builder cannot now build without being bald — even though his baldness be purely incidental. Neither is the first instance (*b, i*) of a cause accidental by reason of the effect opposed to necessity, for if I pull away the column, the stone must fall, or, if the earth is exposed to the sun and there is a break in the clouds, more light will reach the surface of the earth. (However, we may not say that the clouds opened so that sunlight might reach the earth, though this may in fact be good or harmful for the crops. To make such a statement would be contrary to the rule that effects must be related to causes proportioned to these effects — *causis debent proportionaliter respondere effectus*.<sup>1</sup>) Only in the second case (*b, ii*) is accidental cause opposed to necessity. Yet, even this one must be qualified. For if a man digs a well deep enough at the very spot where the treasure is buried, he must of necessity discover it. But if this occurred always or frequently, (*b, ii*) would become a case of (*b, i*). Such necessity makes some people believe that there is no difference between these various cases of accidental cause, namely, that (*b*) is reducible to (*a*) ; (*b, ii*) either to (*b, i*) or to (*b, iii*) : (*b, ii*) to (*b, i*) inasmuch as digging the well at this spot must result in discovery of the treasure already there ; (*b, ii*) would be reducible to (*b, iii*) inasmuch as the man who so discovers the treasure would believe it was there so that he might discover it, as if he were the *per se* cause of this good fortune — for the fortuitous character of good fortune is soon forgotten. There is nonetheless all the difference in the world between (*i*) the necessity of following a muddy path to reach a certain place ; (*ii*) to discover unexpectedly something worth while or harmful ; (*iii*) to believe that there is an order of effect to cause, *per se* or *per accidens*, where there is nothing of the kind.

Now notice what can result from an easy confusing of one type of accidental cause with another. If the accidental cause termed chance (*b, ii*) be identified with that called *removens prohibens* (*b, i*), the result will at once be a case of causality, *per se*, necessary, yet utterly fortuitous in the sense of (*b, ii*). If I draw your chair away just as you are about to seat yourself, yet by some sort of curious reasoning can maintain that, though I foresee the result quite clearly, I do not in the least intend it, then I become *per se* cause of your fall, necessary cause of it, yet chance cause of it. Democritus seems to be in this position, since he holds that a concourse of atoms formed the whole universe by chance and that all happens of necessity. It is

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1. If we fail to obey this rule, the doctrine of final causality can be made to look grotesque, as Aristotle shows in *Physics*, II, c.8.

noteworthy that several pre-Socratics went so far as to see in chance (*automaton*) the supreme universal cause, yet felt no need to analyse its nature. There is of course a sense in which chance, being *ens per accidens*, has no nature and is undefinable. This may be the reason they failed to analyse the notion of chance which *is* definable. But to proceed in this way is to attempt explanation of the known in terms of the unknown, of *per se* in terms of *per accidens*. This is precisely what we do when we say that order is the *per se* effect of disorder, and reason of unreason. And so we reverse the adage 'whatever is *per accidens* must be reduced to something *per se*.' Notice how the reverse of this statement may follow logically from its misinterpretation. For most authors, ancient and modern, understand it to mean that in a proposition like this one, 'Socrates was accidentally (cf. *b, ii*) run down by a truck,' we are ignoring the *per se* causes of his death, namely, the mass and consistency of Socrates, his inattention, the weight and momentum of the truck, and so on, and that we thus overlook the fact that under these circumstances he could not fail to die. But this is a bad blunder. The term 'accidentally,' in our report of Socrates' fatal accident, overlooks nothing. Rather it acknowledges the truth that, in spite of the determinate reasons for his death, the fact remains that Socrates was unaware of what was about to happen as he crossed the street then and there. Any rational agent who cannot keep all circumstances under control is liable to be an accidental cause of the type (*b, ii*). The pseudo-explanation by means of no more than determinate causes rests on a twofold confusion. First, the accidental cause (*b, ii*) is identified with (*b, i*); second, it is assumed that whatever happens necessarily (e.g., *b, i*) is a *per se* effect, as if, in our first example, the wish to reach a certain spot (A) were quite the same as the willingness to walk through mud (B). The whole point is that (B) is not *per se* intended, though inevitable, and even *per se* connected with (A). The truck is not the cause of Socrates' unfortunate end, though his death necessarily follows when it strikes him. Nor is the driver the *per se* cause, though he could see that Socrates was done for a few seconds before the actual impact. And it is a blessing that traffic courts appreciate this better than writers on philosophy.

Now let us see how 'whatever is *per accidens* must be reduced to something *per se*' can logically be turned into its converse. It is by reading *per se* causality into what is in fact accidental. The sophism here is more subtle. To illustrate, let us return to an earlier example: Socrates goes to the market place for the sole purpose of buying vegetables; he there chances upon a debtor of his whom he had wanted to meet all along. The usual analysis of this event is as follows: both Socrates and his debtor were bound to reach the market at such a spot and time, no matter what their respective intentions; so how could they fail to meet? The fortuitous character of this

meeting seems swallowed up, as it were, by *per se* causes. But such an analysis is pointless, for it excludes exactly that which makes the meeting fortuitous (*b, ii*), namely, the different reasons why Socrates and his debtor go to that place at that time, and their desire to meet or avoid each other if they knew where or how, and the absence of all expectation on the part of each that the encounter would happen then and there. *Per se* agency is of course present. But the duty of reducing the *per accidens* to something *per se* does not mean that in the end *per se* must replace it. The agent and his express purpose are essential here, while something, which he would pursue or avoid if he had foreknowledge, happens unexpectedly to what he intends, or in lieu of what he intends, in this particular action. In other words, the fortuitous occurs (1) to a *per se* agent who (2) would have acted for the sake of, or would have sought to avoid, something which happens outside of his intention. The encounter may be quite expected and foreseen by a third person who knows the intentions of Socrates and his debtor, and to this third party, will therefore not be fortuitous; but if he did not know that they did not intend or expect either to meet or avoid one another on this particular occasion, the third person would be ignorant of the encounter qua fortuitous.

Now, how can the converse of our adage come to be stated as a logical conclusion? It is simple enough. To reduce accidental causality in the fashion described, is actually to identify the two. The *per se* is watered down to *per accidens*. Let us recall the impossible enthymeme mentioned on an earlier page: since Socrates can meet his debtor just as effectively by chance as by design, it follows that everything can be accounted for by chance. Now an application of Occam's razor will be made: but whatever can be accounted for by chance requires no other cause. Therefore the proposition 'whatever happens *per se* is reducible to what is *per accidens*' should be preferred to its converse. Now, 'random mutations' means the same as 'mutations produced by chance'; therefore chance can account for all there is in nature. But does it? And, if so, how? What would be thought of a christian science forever ready with the pious declaration that everything found its explanation in the fact that God made it or could make it?

### 3. *Explanation and possibility*

There is nonetheless a sense in which science does have the duty of showing that a thing is possible. In geometry, for instance, it is possible to construct an equilateral triangle, which therefore 'exists.' In mathematics, constructibility implies existence; if our triangle is possible, if it *can* be constructed, then it is by that very fact a valid object of mathematical science. For instance, having constructed a plane triangle, it will now be possible to extend its base, which reveals

that the exterior angle so produced is equal to the two opposite interior angles ; from which we can now demonstrate that the angles of any plane triangle are equal to two right angles. This property follows necessarily from what a plane triangle is. In nature, however, possibility will not be quite of this kind, and will never of itself provide a basis for profitable reasonings. Anyone can see that elephants are possible, for example, but this possibility is known by hind-sight and throws no further light on what an elephant is, or *how* he is possible. To show how the elephant is possible as we do the equilateral triangle, we would need to know its inner essential design and there perceive how such a beast can come to be. Even from such knowledge, which no doubt would need to draw upon the whole universe, we could never conclude that elephants do in fact exist. To achieve this conclusion we would have to show how, from previously existing things (A), elephants (B) necessarily proceed, on the assumption that if A, then B.

An analogy may clarify the distinction which I am trying to establish. There are two ways in which a man may know a motor-car. Without in the least understanding how it functions, he may own and drive one. He will then be quite aware that motor-cars are possible, for he has immediate experience of his own. But he will have knowledge of these machines in a very different sense, if he also knows how they function and how they are manufactured. Now the man who is satisfied with randomness without aim as sufficient explanation for the origin of species will be like a person who would find a sufficient reason for motor-cars in the simple fact that they exist. The latter individual may attempt to render his position more acceptable by arguing that no contradiction or impossibility is involved in the notion that random changes in ores might well result in the special metals and alloys needed for a motor-car ; that random scrambling of these metals could explain the formation of the proper parts ; and that further scrambling could result in the final assembly of this convenient means of transportation. But does this sort of elaboration really help ? Surely its only function is to camouflage a basic position which remains unchanged : motor-cars are possible, they *can* be, and this explains the fact that they are. It explains nothing of course. Actually it is a statement that explanations are not to be sought.

Now if we are right to reject a pseudo-theory of this sort as accounting for motor-cars, why are we not right to reject a similar tale offered as explanatory of the nature and origin of species ? Are the works of nature manifestly so much less intelligible than man's ? And if they were, shall we diminish their obscurity by denying purpose in them ? The fact is that to understand the simplest forms of life is harder for us than to grasp the structure and workings of our most complex machines, because there is in nature so much more to be known, so much more intelligibility than man can achieve. Natural Selection, as Darwin put it, " is a power incessantly ready for action,



and is immeasurably superior to man's feeble efforts, as the works of Nature are to those of Art." Perhaps we should ask ourselves if the very superiority of nature's works, and the consequent difficulty man must face in understanding them, have anything to do with tendencies to ruthless over-simplification, such as that which leads to a theory of unguided randomness as proper and sufficient cause of all natural things.

In fact, though, most knowledge of possibility in nature is of the hind-sight type, and even when we reach some understanding of concrete possibility we can never do away with the first. For instance, we know that there are planetary systems, and several hypotheses are in vogue to account for their formation. Now suppose we eventually learned how they in fact come to be, as we know why eclipses occur; we would then understand how they are concretely possible, yet this possibility would not be the reason they exist, any more than the mere possibility of the universe can be the cause of its existence. Having shown that planetary systems are possible, we might see that they are necessarily possible — a possibility opposed to the impossible; but this is as much as we could hope for. The study of nature may therefore be viewed as progress from what is known to be possible because it is there, like an oak tree, toward understanding of the proper reason of its possibility — which is the same as knowledge of its causes. Still, it must not be forgotten that the latter possibility will never account for the fact, no matter how exhaustive the knowledge of all that is required for its possibility. Planetary systems or elephants remain contingent things, no matter how clear it may become that they can exist. All of which goes to show how essential it is to distinguish the possible as opposed to the necessary, from the possible as opposed to the impossible — and how easily the one is taken for the other.

Let us return to our random mutations. There is an analogy between throwing dice at random and the way nature produces individuals and new species, an analogy like that Darwin saw between conscious and unconscious selection. We observe random distributions of spores, and very few of these come to fruition. Now, is there anything unscientific in observing that without this huge waste there would soon be no mushrooms? Is it unreasonable to see that this is reasonable? Must we refuse to see that if nature did not resort to random mutations, new species would not arise? If nature's randomness is analogous to the sort we use on purpose, as in casting dice, we simply cannot identify it with accidental causality of the type (*b, ii*) without destroying the analogy. Both instances of the random, however, can be partly reduced to the accidental causality (*b, i*) inasmuch as no purpose determines which particular sperm will fecundate the ovum, or which pellet will strike the game — so far as my



intention is concerned, any pellet will do. Lavishness and waste are part of a method used by both art and nature to defeat uncertainty in the face of contrariety — *removens prohibens*. Like the average hunter, nature is simply not equipped to achieve results with economy. There is no reason in the world why randomness in nature should not be purposeful.

It is interesting to note that they who seek in aimless random mutations a principle of natural selection, appeal nonetheless to a prior principle, namely, the 'struggle for existence.' Why should living things 'struggle' to exist? And what is meant by 'favourable' mutations? If these expressions are mere metaphors, why does science use them at all? If more direct language is impossible, we may surely ask why. The reader will remember that to make intelligible Leibniz's compossibles as invested with power to lift themselves into existence, Lord Russell explained that "Leibniz seems to have imagined a sort of Limbo inhabited by essences all trying to exist; in this war, groups of compossibles combine, and the largest group of compossibles wins, like the largest group in a political contest." Empedocles too, though he taught that order in nature is the product both of necessity and chance, nonetheless had recourse to Love and Strife as basic principles, but, like the *Nous* of Anaxagoras, they amount to no more than a *deus ex machina*.

There is a type of mind averse to any intelligibility we may achieve by granting purpose in nature, by granting, for example, that eyes were produced for the sake of seeing. It is obviously more simple to say that we can see because we have eyes, or can walk because we have legs. If a man is satisfied with the latter type of reason, if he frowns upon 'eyes are for the sake of seeing and are produced for that reason,' there is little to be done about it. But there is nothing to prevent us from understanding why he can find such a choice possible, just as we can account for Descartes' faith in a clarity which turns out to be utterly obscure.

Finally, it would be unjust to imply that all scientists scorn the notion of purpose in nature as scientifically perverse. Very eminent biologists, such as Lucien Cuénot and C. H. Waddington, and even physicists, such as Niels Bohr, maintain that living things are unintelligible without purpose.

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(*To be continued.*)

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