

CHAPTER EIGHT

STATISTICAL PROBABILITY

The relation between a priori or statistical probability and the necessity of positing purpose in the operations of nature is well known. Assuming a random distribution of the material elements, the improbability that, for example, they should unite to form a whole of the complexity of any living organism is so high that its very possibility must be discounted. How inconceivable such an occurrence would be may be best understood by considering examples taken from human activities. That the works of art, though of a relative simplicity, should come to be by pure chance is admittedly unbelievable. This is especially true of the more complex artistic products. Thus, Bertrand Russell can write of Eddington's heuristic suggestion that all the books in the British Museum might have been produced by monkeys accidentally playing with typewriters:

There are here two kinds of improbability. In the first place some of the books in the British Museum might make sense, whereas the monkeys might have been expected to produce only nonsense. In the second place, there are many copies of most books, and the two copies are, as a rule, verbally identical. We can here secure plausibility by what is apparently an application of the mathematical theory of probability; given a chance selection of, say, a hundred letters, they will, in the immense majority of cases, not constitute a significant English sentence. Suppose now that a book contains 700,000 letters; the chance that selected at haphazard, they will all form themselves into significant sentences is infinitesimal.

This is the first improbability, but there is a second. Suppose you have in your hands two copies of the same book, and suppose you are considering the hypothesis that the identity between them is due to chance; the chance that the first letter in the two books will be the same is one in twenty-six; so is the chance that the second letter will be the same, and so on. Consequently, the chance that all the letters will be the same in two copies of a book of 700,000 letters is the 700000th power of $1/26$. (1)

In the instance cited by Russell, we are of course forced to reject the hypothesis in which it would be held that such events came about as a result of an indeterminate distribution of the letters of the alphabet. Where the number of alternatives is immensely high, an unbiased distribution cannot possibly account for a rational and complex order within any system. Such a radical violation of the Principle of Indifference (which must be assumed to apply where a random ordering is conditionally posited) implies directive control of the components of the system.

Now, as we noted above, in nature we also encounter this logical coercion to accept a directive factor in lieu of the hypothesis of an accidental, fortuitous ordering of the elemental parts of a thing. The difference between the natural and the artistic product is that, in nature, the regulative or directive influence is from within, while in art this influence operates from without. Because of the nearly contradictory position into which we would be forced were we to accept

the possibility that chance might account for living beings, the recourse to intention in the generation of such beings is necessary. This point is developed in the article by G.G. Bell from which we quoted in Chapter Three. The title of this article, it will be recalled, is "Mechanistic Replacement of Purpose in Biology". One of the theories Bell considers is that of the geneticists. These advocates of a purely materialistic approach toward nature would seek to explain the development of the extremely complex living organisms in terms of such "neutral" agents as genes and chromosomes. These agents were believed to explain the variations in structure which had been unaccounted for in Darwin's scheme of evolution. Bell writes:

Meanwhile the gap Darwin had left yawning, the geneticists set to work upon, discovering new material agents, genes and chromosomes, which seemed to control somatic development, and whose variation could be shown to spring inevitably from statistical laws. Here was mechanistic indeed. (2)

However, as Bell immediately notes, this dependence upon statistical distributions actually explained nothing. For the laws of probability are violated in the grouping of the very factors held to be the cause of the variations in the living being:

The flaw that has been chiefly observed to vitiate the geneticists' system was that of statistical improbability - the staggering unlikelihood that any grouping of genes and chromosomes could ever by random molecular chance be pulled out of the hat. (3)

It is precisely this "staggering unlikelihood", that a random selection should result in the combination of the agents posited as the cause of the development of the living being which negates the above theory. And so, the one alternative is clear: we must acknowledge the presence of a directive principle intrinsic to the living being other than its material constituents. The necessity of such a principle has been recognized by many thinkers, for the very reason which we have noted. Perhaps the most recent of these is Du Roux. However, further development of this particular point is not essential to our purpose. What we should now like to consider is another, and less evident, aspect of the relation between statistical probability and intention in nature.

With regard to this other aspect, the first thing worthy of note is that it is the very intention of nature which, from an a priori consideration, we must hold to be altogether improbable. This is shown by the fact that, when the improbable actually comes to be, we are forced to posit as its cause an agent which acts in intending the end. For we can no longer suppose that an unbiased selection is sufficient to explain that which, assuming such a selection, we could not possibly expect to happen. In nature, then, the improbable and the intended are identical.

Now, this would perhaps be without great significance were it not that the statistically probable has a very real foundation in nature. What we consider to be a priori most probable is not merely

an ideal projection into reality. That the elements of any loosely controlled physical system should fall into a general pattern whose principal characteristic is a low degree of organization, is the overwhelming rule of things. Without a determinate principle of order, the natural tendency, the "drift", of material things is toward the kind of distribution which we call random. This is exemplified in the so-called "games of chance." Thus, the play of cards, the throws of dice and the tossing of coins do not fall into definite patterns because of chance in the Aristotelian sense of this word - that is to say, there is no per accidens cause of such patterns. Rather, as is well known, games of chance and the resultant distributions are subject to very determinate laws. Accordingly, the opposition between intention and the statistically probable is not merely logical, but one rooted in nature.

The reality of the opposition which we have noted is brought out by Emile Borel in his work "Le Hasard". The particular occasion is a discussion of the fact that the molecules of a gaseous mixture may pass into improbable states. Because of the violation of the laws of probability involved therein, it was felt necessary to assume the existence of some sort of control factor whence Maxwell's famous "demon". That such a device is resorted to, notes Borel, establishes the truth that the order which reason introduces is in direct opposition to that which purely physical factors impose upon things. For, as he further notes, it is precisely the products of reason which are,

a priori, so exceedingly improbable. He writes:

...The argument of Maxwell's demon is simply a proof of the fact that human reason knows how to create order where the spontaneous play of mechanical forces would tend to augment the disorder. All the products of human industry, whether they be miles of railroad track or libraries filled with books, in which the apparent disorder of the characters is in reality an essentially superior order all these products are, a priori, infinitely improbable. (4)

What Borel writes of the relation between the products of human activity and the statistically probable applies, as well, to nature. Thus we can view statistical probability as revealing a conflict between the material principles and the intentions of nature; a conflict between the proper tendencies of the purely physical - on which the calculus of probabilities is based and which it represents - and the role that the material factors must play in the realization of nature's goals. And so, to attain its ends, nature must overcome the disruptive tendencies of the matter, and impose upon it the order required by the forms of being which it seeks. However, even when this is accomplished, the fundamental disproportion between the purely physical and the intentions of nature remains, and but assumes a slightly different form. For, as Borel next points out, increased disorder in nature as a whole is the price that must be paid for any complex organizations that are brought into existence. This is the case whether the productions in question be artistic or natural. Thus, writing of the miles of railroad track and the libraries filled with books, Borel states:

But the place they occupy in the universe is so slight, and, besides, the expending of the utilizable energy in order to obtain these results, the disorder created in obtaining this order, the coal dissipated in order to assemble this iron, etc., are, in fact, so considerable, that one can neglect this creation of order; one can even neglect, it seems, all the biological phenomena in relation to the ensemble; the evolution of the universe toward the more probable states becomes thus an absolutely general law. (5)

The inference to be drawn from all this is perhaps clear to the reader; statistical probability provides us with another instance of what we have called "necessity from the matter". The purely material side of the world both resists and clashes with that which is intended by nature; as uniquely subject to the laws of probability, the matter tends toward ends inimical to those sought by nature; the order which arises from the matter in its free state - from "the spontaneous play of mechanical forces", in the works of Borel - is directly opposed to the order which nature seeks to impose upon the matter. We find a particularly apt phrase employed by St. Thomas to express such a relation between the matter and the intentions of nature. In the Summa Contra Gentiles, he speaks of "the victory of the form over the matter". (6) This phrase points to the initial disproportion between the matter and the form, of which statistical probability is a particular instance. We encounter the same notion in De Generatione Animalium. In that work, Aristotle writes of the generation of monsters, which, he notes, occurs when "the formal nature has not mastered the material nature." (7) It is easily seen how appropriate are such expressions to the question we have been discussing.

This antagonism between the tendency of the matter to fall into probability distributions and the intentions of nature is, indirectly, developed quite extensively in an article by R.S. Lillie. The precise point he seeks to make in the article to which we refer is that with which we began the present chapter: namely, that the evident effects of the random factor in nature necessitates recognition of a directive principle in order to render intelligible the mere existence of living beings. In marshaling the evidence which leads to such a conclusion, he calls attention to certain facts altogether pertinent to the problem which we have been considering. As did Borel in "Le Hasard", Lillie first emphasizes what he calls the "anti-organizing trend of purely physical processes." And, as was also true of Borel, he then stresses the universal drift toward disorganization, which finds expression in the second law of thermo-dynamics. Lillie writes:

If we may rely for our evidence on simple observation, it would seem that the tendency of random or unguided behavior in external nature is opposed to the development of complex organization and favorable to structural simplicity - in the sense of uniformity in the distribution of elements. This anti-organizing trend of purely physical processes is illustrated in ordinary large-scale mixing and stirring operations, as well as in the automatic increase of entropy in systems subject to the laws of thermo-dynamics (molecular or material systems in general). It is common experience that complex systems which are the seat of physical activity tend to become simpler when left to themselves, i.e., they lose organization. Recently Eddington has given the whole matter an admirably clear expression: (Entropy may most conveniently be described as the measure of disorganization of a system... We can see chance creeping where formerly it was excluded. (8))

Lillie next notes that, in view of the anti-organizing character of purely physical processes, we must assume the presence of an intrinsic principle of order in the development and continued existence of the living being. It is this principle - the form or, more specifically, the soul - which overcomes the elements' native motion toward simplicity of structure. Here, of course, we directly approach St. Thomas' notion concerning "the victory of the form over the matter."

Unless counteracted by directive action the casual or random element in nature tends to increase. If things are left to chance, not only does organization of any high degree of complexity fail to develop, but what organization there is tends to lapse or disappear. Hence in those cases, such as living organisms, where the existence and activity of the system depend on a special and complex organization, it appears necessary to assume the continued operation of a stable directive influence or factor which pervades the whole system and excludes or compensates casual factors as far as it is possible. (9)

In developing his argument - which, as we noted above, is principally concerned with proving the necessity of a "psychic factor" in living things - Lillie again relates physical processes to probability factors. In turn, these are related to the requirements of the organism. As he notes, a great deal of physical and chemical activity is involved in the maintenance and functioning of the living being. Because of this, the organism is constantly subjected to the disruptive tendencies inherent in physical processes. This is especially true, he adds, if there is an increase in its normal activity.

It is generally agreed that all physical action contains within itself an element of randomness, in correspondence with the part played in such action by probability factors (statistical conditions), as contrasted with directive or individually controlled (integrated) factors...In the living system a high degree of physical and chemical activity is the normal state, since the continued existence is directly dependent on a flux of material and energy, and this flux must be stable...if the vital organization and activity are to be maintained. But if this regulative effort is insufficient, disorganization becomes progressive, and this is more likely to happen if the organism maintains or increases its normal activity than if it remains at rest. (10)

As we see, Lillie implies that cessation of physical activity is a means of combating the resurgence of disorganization. He continues in this vein:

Hence the importance of rest in medical and surgical activity: the vis medicatrix naturae is then less effectively opposed by random or other anti-organising factors. These consist chiefly of the purely physical factors, which typically have a non-directive quality in correspondence with their dependence on probability factors or statistical conditions. (11)

He then relates rest of a means of counteracting the leveling effects of the physical to the measures adopted by nature to ensure the development of certain species of animals.

In correlation with this general natural condition we find that in many animals (especially the less prolific) the process of development is carried out under conditions of isolation (egg-cases, nests, uterine development) where random interference from the surroundings is reduced to a minimum. (12)

In the light of the above facts, Lillie concludes:

In general we may say that casual and vital activities are opposed to one another in their essential nature and tendency; this opposition expresses itself in many features of vital organization. (13)

He then goes on to show how, in so many ways, random and purposeful activities conflict in nature. At this juncture, however, we should like to develop another aspect of this truth, one to which Lillie also called attention. We refer to his remark concerning the isolation in which the embryonic development of many animals takes place. From this we see that, in addition to the direct control which it exercises over the matter by imposing form upon it, nature more or less guarantees that its efforts will not be frustrated by providing conditions favorable to the development of the organism. If such steps were not taken, probability factors, as representative of the purely physical, would perhaps regain their dominance.

Now, the instance cited by Lillie is not the only one in which nature resorts to indirect means in order to counteract random forces and thus achieve its goals. A more striking illustration of this - and one immediately related to statistical probability - is to be found in the initial operations leading to the perpetuation of many species of living things. In both the animal and vegetable kingdoms, the fertilization of the female cell involves purely physical factors; direct concurrence with the physical environment is necessary, and often under conditions where direct control by nature is impossible. For example, many species of plants depend for their survival upon casting their seeds to the four

wind - hardly an operation in which the chances for success of any given seed are favorable. In the nature of things, the aid of the wind and the physical characteristics of the seed that make transmission by air possible are conditionally necessary to the survival of the species. But intrinsically related to these physical conditions are others in now way amenable to the end sought - those which permit the random factor to gain control. The measure taken by nature to overcome this handicap is the only one open to it: vast profusion. While the probability that any given seed attain the desired goal is so slight as to be negligible, given a sufficiently large number of seeds, the probability that over-all success will result becomes more than favorable. And so, by cooperating with the statistics of the case, the species survives.

The above is of particular interest because it provides indirect proof of the thesis proposed in the present chapter - that probability distributions are an instance of something arising "*ex necessitate materiae*". The point here is that, in so profusely developing its instruments of reproduction, nature indicates its awareness of the obstacle presented by the random factors. For only if nature is seeking to compensate the antagonistic tendencies of its material instruments is its procedure rational. It surely does not intend that each and every seed reach fertile soil - if this were to occur, the world would be an intolerable jungle of vegetation. A close parallel to nature's

procedure is that adopted by man in the hunting of birds. In order to ensure success, a large number of bird-shot are placed in the shell. But it would be altogether contrary to the intention of the hunter were every pellet to lodge itself in the quarry - for evident reasons. Allowing for the differences in each case, it is thus that we must interpret nature's prolific efforts. Far from being instances either of blind over-production or of aborted intention, these efforts are designed to overcome the disruptive effects of random distribution.

We thus find that the material principles again manifest a negative function in nature. Indeed, their native bias - as brought out in the laws of probability - is toward ends inimical to those sought by nature. When nature's goal is the existence of, say, a living being, this bias must be overcome by the subjection of matter to form. When direct action in furtherance of this goal is not immediately possible, nature must either accept defeat or else engage in counteraction of a compensatory character. But whatever the success of nature's efforts in this regard, the conditions which demand them must be acknowledged as being necessarily involved in the existence of the material universe. For the material principles whose tendencies must at times be overcome are required for the existence of all that nature seeks. And this duality on the part of the matter is, as we say in the case of corruptibility, of the essence of necessity from the matter.

The general conclusion to be drawn is that nature presents a strong undercurrent of the sort of irrational cause which the materialists believe to be the only true cause. Interwoven with the finality characteristic of nature is that which may be altogether repugnant to the end. For the matter evidences an essential disordination with respect to the goals and functions of particular agents and natures. With an absolute necessity, the matter chosen for its congruence to form entails attributes in every way opposed to the form. In other cases, the material conditions necessary to the realization of the desired end tend to frustrate the action leading to this end. And to impede these harmful derivatives is impossible: they must be accepted if the natural thing is to be brought into existence.

REFERENCES

Introduction:

- (1) Metaphysics, Book 5, Ch. 4, 1015a37-39

Chapter One:

- (1) I Physica, lec. 1, n. 5:
"...causae autem dicuntur ex quibus aliquis dependet secundum
suum esse vel fieri."
- (2) 2 Physica, lec. 10, n. 15:
"...causa sit ad quam sequitur esse alterius."
- (3) 5 Metaphysics, lec. 1, n. 751:
"Sciendum est autem, quod principium et causa licet idem subiecto,
differunt ratione. Nam hoc nomen Principium ordinem quendam
importat; hoc verò nomen Causa, importat influxum quendam ad
ad esse causati."
- (4) Cursus Philosophicus, T. 2, Q. X, art. 1, 196b:
"Causa est principium alicuius per modum influxus seu derivationis,
ex qua natum est aliquid consequi secundum dependentiam in esse."
- (5) 2 Physica, lec. 5, n. 3:
"Dicit ergo primo quod uno modo dicitur causa ex quo fit aliquid
cum insit, sicut aes dicitur causa statue at argentum causa
phialae."
- (6) 2 Physica, lec. 5, n. 8:
"Nam 'elementa', idest litterae, sunt causae syllabarum; et similiter
terra est causa vasorum et argentum phialae; et ignis et similia,
corpora scilicet simplicia, sunt causae corporum; et similiter
quaelibet partes sunt causa totius... et omnia ista habent unam
rationem causae, prout dicitur causa id ex quo fit aliquid; hoc
enim est commune in omnibus praemissis."
- (7) 2 Physica, lec. 5, n. 4:
"Secundo modo dicitur causa species et exemplum; et hoc dicitur
causa inquantum est ratio quidditativa rei; hoc enim est per
quod sciamus de unoquoque quid est."

- (8) The distinction here is between the "forma partis" and the "forma totius". It is only in the definition of the latter that the matter is posited. 7 Metaphysics, lec. 9, n. 1469: "forma totius, quae est ipsa quidditas speciei, differt a forma partis, sicut totum a parte: nam quidditas speciei, est composita ex materia et forma, non tamen ex hac forma et ex hac materia individuum."
- (9) 2 Physica, lec. 5, n. 35: "Uterius autem dicit quod alio modo dicitur causa a quo est principium motus vel quietis; sicut consiliarius dicitur causa, et pater filii, et omne commutans commutati."
- (10) Ibid., n. 6: "Quantum autem modum causae ponit, quod aliquid dicitur causa ut finis; et hoc est cuius causa aliquid fit, sicut sanitas dicitur ambulationis. Et hoc patet quia respondetur ad questionem factam propter quid: cum enim querimus propter quid ambulat? dicimus ut sanetur..."
- (11) 5 Metaphysics, lec. 2, n. 775: "Finis autem est causa efficientis... quantum ad rationem causalitatis. Nam efficiens est causa inquantum agit: non autem agit nisi causa finis."
- (12) Ibid., lec. 3, n. 782: "Sciendum autem est, quod licet finis sit ultimus in esse in quibusdam, in causalitate tamen est prior semper. Unde dicitur causa causerum, quia est causa causalitatis in omnibus causis. Est enim causa causalitatis efficientis, ut iam dictum est. Efficiens autem est causa causalitatis et materiae et formae. Nam facit per suum motum materiam esse susceptivam formae, et formam inesse materiei..."
- (13) Metaphysics, Book 5, Ch. 2, 1013b25-28
- (14) De Veritate, Q. 22, a. 2: "sicut influere causae efficientis est agere, ita influere causae finalis est appeti et desiderii."
- (15) As Aristotle notes: "The active power is a cause in the sense of that from which the process originates; but the end, for the sake of which it takes place, is not 'active'. (That is why 'health' is not 'active' except metaphorically.)" De Generatione Et Corruptione, Book I, Ch. 7, 324b-13-15.

- (16) 3 Metaphysica, lec. 6, n. 832:
"...necessarium etiam dicimus sic se habere, quod non contingit aliter se habere."
- (17) Summa Theologiae, Ia, Q. 82, a. 1, c.:
"Necesse est enim quod non potest necesse..."
- (18) Summa Contra Gentiles, Book 2, cap. 83:
"...quod necesse est esse, impossibile est non esse."
- (19) Metaphysics, Book 5, ch. 5, 1015b
- (20) Physics, Book 2, Ch. 9, 199b34
- (21) 2 Physics, lec. 15, n. 2:
"Ad cuius evidentiam sciendum est, quod necessitas quae dependet ex causis prioribus, est necessitas absoluta, ut patet ex necessario quod dependet ex materia. Animal enim esse corruptibile, est necessarium absolute: consequitur enim ad hoc quod est animal, esse compositum ex contrariis."
- (23) Ibid.:
"Quod autem habet necessitatem ab eo quod est posterius in esse, est necessarium ex conditione, vel suppositione; ut puta si dicatur, necesse est hoc esse si hoc debeat fieri: et huiusmodi est ex fine, et ex forma inquantum est finis generationis."
- (22) Ibid.:
"Similiter etiam quod habet necessitatem ex causa formali, est necessarium absolute; sicut homines esse rationales, aut triangulum habere tres angulos aequales duobus rectis, quod reducitur in definitionem trianguli. Et similiter quod habet necessitatem ex causa efficiente, est necessarium absolute; sicut necessarium est esse alternationem noctis et diei propter motum solis."
- (24) Metaphysics, Book 5, ch. 5, 1015a22-25
- (25) 2 Physics, lec. 15, n. 1:
"Quaerere igitur utrum in rebus naturalibus sit necessarium simpliciter aut ex suppositione, nihil aliud est quam quaerere utrum in rebus naturalibus necessitas inveniatur ex fine aut ex materia."
- (26) De Partibus Animalium, Book 4, ch. 11, 692a6-8
- (27) Ibid., ch. 12, 694a23-27.

Chapter Two:

- (1) Metaphysics, Book 1, Ch. 3, 983b7-10
- (2) Ibid., 983b-a
- (3) I Metaphysica, lec. 4, n. 73:
"Nam id est ex quo res est, principium rei esse videtur: huiusmodi autem est materia; nam ex materia dicimus materiam esse, ut ex ferro cultellum. Item, illud ex quo fit aliquid, cum sit et principium generationis rei, videtur esse causa rei, quia res per generationem procedit in esse. Ex materia autem primo res fit, quia materia rerum factioni praexistit....Tertio illud videtur esse rerum principium, in quod finaliter omnia per corruptionem resolvuntur. Nam sicut principia sunt prima in generatione, ita sunt ultima in resolutione. Et hoc etiam materia manifeste contingit. - Quarto, cum principia oportet manere, id videtur esse principium, quod in generatione et corruptione manet. Materiae autem, quam dicebant esse substantiam rei, manet in omni transmutatione; sed passiones mutantur, ut formae, et omnia quae adveniunt supra substantiam materiae. Et ex his omnibus concludebant, quod materia est elementum et principium omnium eorum quae sunt."
- (4) Metaphysics, Book 1, Ch. 3, 982b10-18
- (5) Physics, Book 2, Ch. 1, 193a9-11
- (6) Ibid. 11-16
- (7) Ibid. 16-27
- (8) Physics, Book 1, Ch. 8, 191a24-31
"The first of these who studied science were misled in their search for truth....So they say that none of the things that are either comes to be or passes out of existence, because what comes to be must do so either from what is or from what is not, both of which are impossible. For what is cannot come to be (because it is already), and from what is not nothing could have come to be (because something must be present as a substratum)."
- (9) Metaphysics, Book 1, Ch. 3, 984a17-25
- (10) Ibid., 984b-1-3
- (11) Ibid., 5-8

- (12) I Metaphysica, lec. 7, n. 118:
 "Aliud vero in quo conveniebant isti philosophi cum antiquis est, quod sicut antiqui neglexerunt ponere causam ex qua motus inest rebus, ita et ista licet illa indivisibilia corpore dicerunt esse per se mobilia."
- (13) Metaphysics, Book 1, Ch. 3, 984b-985a
- (14) Ibid., 985a18-21
- (15) Ibid., 21-29
- (16) De Anima, Book II, lec. 8, n. 324:
 "Empedocles...augmentum viventium non attribuit animae, sed motui gravium et levium..... Dicebat igitur, quod augmentum plantarum in deorsum, causatur ex motu terrae, quae est in compositione plantas, et naturaliter deorsum fertur, propter sui gravitatem. Augmentum autem in sursum causatur ex motu ignis, qui propter sui levitatem naturaliter sursum fertur."
- (17) De Partibus Animalium, Book I, Ch. 1, 640b5-17
- (18) In II Physicorum, lec. 12, n. 1:
 "Post hoc autem dicendum est quomodo se habet necessarium in rebus naturalibus; utrum scilicet necessitas rerum naturalium semper sit ex materia, vel aliquando etiam ex materia et movente, vel aliquando ex forma et fine."
- (19) Ibid.:
 "Et necessitas querendi haec est ista: quia omnes antiqui naturales reducunt effectus naturales in hanc causam, assignando rationem de eis, scilicet quod necesse est ea sic evenire propter materiam; utpote quia calidum natum est esse tale et facere talem effectum, et similiter frigidum, et omnia similia, necesse est fieri vel esse ea quae ex eis causantur."
- (20) Ibid., n. 3:
 "...sicut si dicamus quod Iupitur pluit, idest Deus vel natura universalis, non propter hunc finem, ut frumentum augmentet, sed pluvia provenit ex necessitate materiae. Oportet enim, inferioribus partibus ex propinquitate solis calefactis, resolvi vapores ex aquis; quibus sursum ascendentibus propter calorem, cum pervenerint ad locum ubi deficit calor propter desertitiam a loco ubi reverberantur radii solis, necesse est quod aqua vaporabiliter ascendens congeletur ibidem, et conge-
 latione facta, vapores vertantur in aquam; et cum aqua fuerit generata, necesse est quod cadit deorsum propter gravitatem."

- (21) Ibid.:
"...et cum hoc fit, accidit ut frumentum augeatur. Non tamen propter hoc pluit ut augeatur; quia similiter in aliqua loco frumentum destruitur propter pluviam, ut cum est collectum in area. Non tamen propter hoc pluit, ut destruantur frumentum, sed hoc casu accidit, pluvia cadente; et eodem modo videtur casu accidere quod frumentum crescat per accidens, pluvia cadente."
- (22) Ibid.:
"Unde videtur quod nihil prohibeat sic etiam esse in partibus animalium, quae videntur esse sic dispositae propter aliquem finem: utpote quod aliquis dicat quod ex necessitate materiae contingit quod quidem dentes, anteriores scilicet, sint acuti et apti ad dividendum cibum, et maxillares sint lati et utiles ad conterendum cibum. Non tamen ita quod propter istas utilitates natura fecerit dentes tales vel tales: sed quia dentibus sic factis a natura propter necessitatem materiae sic decurrentis, accidit ut talem formam consequerentur, qua forma existente sequitur talis utilitas. Et similiter potest dici de ceteris aliis partibus, quae videntur habere aliquam determinatam formam propter aliquem finem."
- (23) Ibid., n. 4:
"...ideo ad hanc objectionem escludendam, dicunt quod a principio constitutionis mundi, quatuor elementa convenerunt ad constitutionem rerum naturalium, et factae sunt multae et variae dispositiones rerum naturalium; et in quibuscumque omnia sic acciderunt apta ad aliquam utilitatem, sicut si propter hoc facta essent, illa tantum conservata sunt, eo quod habuerunt dispositionem aptam ad conservationem, non ab aliquo agente intendente finem, sed ab eo quod est per se ipsum, id est a casu. Quaecumque vero non habuerunt talem dispositionem sunt destructa, at quotidie destruntur; sicut Empedocles dixit a principio fuisse quosdam generatos, qui ex una parte erant boves, et ex alia parte erant homines."
- (24) Bertrand Russell is taken as representative on this point. For him, a "substance" or a "thing" is viewed as simply a unique sort of process somehow retaining a kind of identity. He writes: "a 'thing' or a piece of matter is not to be regarded as a single persistent substantial entity, but as a string of events having a certain kind of causal connection with each other. This kind is what I call 'quasi-permanence'." Human Knowledge, Its Scope and Limits, Simon and Schuster, 1948, p. 458.

- (25) C.G. Bell, "Mechanistic Replacement of Purpose in Biology", Philosophy of Science, January, 1948, p. 50.
- (26) Op. cit., pp. 32-33.
- (27) The Philosophical Review, 1944, pp. 365-366.
- (28) Ibid., p. 371.
- (29) Ibid., p. 371.
- (30) Ibid., p. 399.
- (31) Ibid., p. 378.
- (32) Ibid., p. 372.
- (33) Ibid., p. 363.
- (34) Ibid., p. 372.
- (35) Philosophy of Science, January, 1947.
- (36) Quoted from "The Development of American Philosophy", Kaelder and Sears, Houghton Mifflin Co., 1940, pp. 443-444.
- (37) "Philosophies of Science", F.S. Crofts & Co., 1942, pp. 250-251.

(38)
Chapter Three:

- (1) De Principiis Naturae, n. 5:
"Ad hoc autem quod sit generatio, tria requiruntur: scilicet ens in potentia, quod est materia; et non esse actu, quod est privatio; et id per quod fit actu, quod est forma. Sicut quando ex cupro fit idolum, cuprum quod est in potentia ad formam idoli, est materia; hoc autem quod est infiguratam sive indispositum, est privatio; figura autem a qua dicitur idolum est forma..."
- (2) Ibid., n. 1:
"Sed duplex est esse: scilicet esse essentiale, sive esse substantiale rei, ut hominem esse; et hoc est esse simpliciter. Est autem aliud esse accidentale, ut hominem esse album; et hoc est esse secundum quid..."
- (3) Physics, Book I, ch. 7, 190b-1-5

(4) De Principiis Naturae, n. 3:

"Sicut autem omne quod est in potentia potest dici materia, ita omne a quo habet aliquid esse, quodcumque esse sit illud, sive substantiale, sive accidentale, potest dici forma..... Et quia forma facit esse in actu, ideo dicitur quod forma est actus: quod facit esse actu substantiale, dicitur forma substantialis, et quod facit actu esse accidentale, dicitur forma accidentalis. Et quia generatio est motus ad formam, duplici formae respondet duplex generatio. Forma substantiali respondet generatio simpliciter; formae accidentali respondet generatio secundum quid. Quando enim introducitur forma substantialis, dicitur aliquid fieri simpliciter, sicut dicimus homo fit, vel homo generatur; quando autem introducitur forma accidentalis, non dicitur aliquid fieri simpliciter, sed fieri hoc; sicut quando homo fit albus, non dicitur simpliciter hominem fieri vel generari, sed fieri vel generari album."

(5) Ibid., n. 11:

"Et est sciendum, quod quaedam materia habet compositionem formae: sicut aes, cum sit materia respectu idoli, ipsum tamen aes est compositum ex materia et forma; et ideo aes non dicitur materia prima, quia habet formam. Illa autem materia quae intelligitur sine qualibet forma et privatione, sed est subiecta formae et privatione, dicitur materia prima, propter hoc quod ante ipsam non est materia alia; et haec dicitur hyle, hoc est chaos vel confusio, graeca."

(6) The distinctions to be drawn are the following: "Something comes to be per se from being in potency; but something comes to be per accidens from being in act or from non-being... because matter, which is being in potency, is that from which something comes to be per se, because this is what enters into the substance of the thing made. But something comes to be per accidens from privation, or from the preceding form, insofar as it happens that the matter, from which something comes to be per se, is under such form or under such privation; as the statue comes to be per se from bronze, but it comes per accidens from that which does not have such a figure or from that which has some other figure." - "Ex ente igitur in potentia fit aliquid per se, ex ente autem in actu, vel ex non ente, fit aliquid per accidens... quia materia, quae est ens in potentia, est id ex quo fit aliquid per se; haec est enim quae intrat substantiam rei factae. Sed ex privatione vel forma praecedente fit aliquid per accidens, inquantum materia ex qua fit aliquid per se, conveniebat esse sub tali forma vel sub tali privatione; sicut status ex aere fit per se, sed ex non habente talem figuram ex habente aliam figuram, fit status per accidens." - In 2 Phys., lec. 14, n. 8.

(7) Op. cit., p. 378.

(8) Ibid., p. 259.

- (9) Ibid., p. 369.
- (10) It was shown previously that the subject of substantial form must be a potency correlative to the actuality of such form. If this were not the case, it could not be the subject of the form. And if this potency is denied, it means that the matter can receive only accidental form. For, as St. Thomas states: "...it is impossible for one and the same thing to have several substantial forms; because, since the substantial form makes a thing to be, not in this or that way, but simply, and establishes this or that thing in the genus of substance; if the first form does this, the second form at its advent will find the subject already established with substantial being and consequently will accrue to it accidentally..." - "Et iterum impossibile est unius et eiusdem rei esse plures formas substantiales; nam cum forma substantialis faciat esse non solum secundum quid, sed simpliciter, et constituat hoc aliquid in genere substantiae, si prima forma hoc facit, secunda adveniens, inveniens subiectum iam in esse substantiali constitutum, accidentaliter ei adveniet." - Q.D. De Potentia, Q. 3. a.9 ad 9.
- (11) Summa Theologica, Ia, Q.76, a.4, ad 4: "Et ideo dicendum est, secundum Philosophum, De Gen. et Corr., quod formae elementorum manent in mixto non actu, sed virtute; manent enim qualitates propriae elementorum licet remissae, in quibus est virtus formarum elementarium. Et huiusmodi qualitas mixtionis est propria dispositio ad formam substantialem corporis mixti, puta formam lapidis, vel animati cuiuscunque."
- (12) Q.D. De Potentia, Q. 3, a. 5: "Dicendum, quod secundum ordinem cognitionis humanae processerunt antiqui in consideratione naturae rerum. Unde cum cognitio humana a sensu incipiens in intellectum perveniet priores philosophi circa sensibilia fuerunt occupati, et ex his paulatim in intelligibilia pervenerunt. Et quia accidentales formae sunt secundum se sensibiles, non autem substantiales, ideo primi philosophi omnes formas accidentis esse dixerunt, et solam materiam esse substantiam."
- (13) De Anima, Book I, ch. 2, 404a27-30
- (14) Philosophy of Science, January, 1948

Chapter Four:

- (1) De Partibus Animalium, Book I, ch. 1, 640b13-15
- (2) Op. cit., p. 363 and p. 372.
- (3) De Prin. Naturae, n. 15: "Et dictis ergo patet tria esse principia: scilicet materiam, formam et privationem; sed non sunt haec sufficientia ad generationem. Quod enim est in potentia, non potest se reducere ad actum; sicut curruum quod est in potentia ad idolum, non facit se idolum, sed indiget operante, ad hoc quod forma idoli exeat de potentia in actum. Forma etiam non potest se extrahere de potentia in actum; et loquor de forma generati, quam dicimus esse terminum generationis; forma enim non est nisi in facto esse; quod autem operatur est in fieri, dum res fit. Oportet ergo praeter materiam et formam aliquid principium quod aget; et hoc dicitur causa efficiens, vel movens, vel agens, vel unde est principium motus."
- (4) Quaestiones Disputatae De Potentia, Q. 2, a. 1: "Agere vero nihil aliud est quam communicare illud per quod agens est actu, secundum quod est possibile."
- (5) Summa Contra Gentiles, Book I, ch. 28: "Nihil agit nisi secundum quod est actu. Actio igitur consequitur modum actus in agente. Impossibile est igitur effectum qui per actionem educitur, esse in nobiliori actu quam sit actus agentis..."
- (6) Ibid., Book 2, ch. 46: "Similitudo effectus ad causam agentem attenditur secundum formam effectus quae praescribitur in agente: agens enim agit sibi simile in forma secundum quam agit."
- (7) Utilizing the notions of the experimental science of his day, St. Thomas stressed the causality of material factors in nutrition, but, he insisted, such causality was purely instrumental in character. Comm. in De Anima, Book 2, lec. 8, n. 331: "Necesse est enim omne alimentum decoqui: quod quidem fit per ignem: unde ignis aliquo modo operatur ad alimentum, et per consequens ad augmentum: non quidem sicut agens principale, hoc enim est anima. Et ideo dicere, quod ignis quodammodo concocum est augmenti et alimenti, sicut instrumentum concocum est principale agentis, verum est; non tamen est principaliter causa ut principale agens, sed hoc modo causa est anima..."

- (8) Quaestiones Disputatae De Potentia, Q. 3, a. 7:
 "...secundum ordinem causarum, esse ordinem effectuum, quod
 necesse est propter similitudinem effectus et causae. Nec
 causa secunda potest in effectum primae causae per virtutem
 propriam, quamvis sit instrumentum causae primae respectu
 illius effectus. Instrumentum enim est causa quodammodo
 effectus principalis causae, non per se vel virtutem
 propriam, sed in quantum participat aliquid de virtute
 principalis causae per motum eius, sicut dolores non est
 causa rei artificatae per formam vel virtutem propriam,
 sed per virtutem, artificis a quo movetur et eam quocummodo
 participat."
- (9) Summa Contra Gentiles, Book 3, ch. 65:
 "Nullum particulare agens univocum potest esse simpliciter
 cause speciei: sicut hic homo non potest esse causa speciei
 humanae; esset enim causa omnis hominis, et per consequens
 sui ipsius, quod est impossibile."
- (10) Summa Theologiae, 1a, Q. 104, a. 1:
 "Manifestum est autem quod si aliqui duo sunt ejusdem speciei,
 unum non potest esse per se causa formae alterius, in quantum
 est talis forma, quia sic esset causa formae propriae, cum
 sit eadem ratio utriusque..."
- (11) Op. cit.:
 "Est autem causa hic homo huius hominis, per se loquendo.
 Hic autem homo est per hoc quod natura humana est in hac
 materia, quae est individuationis principium. Hic igitur
 homo non est causa hominis nisi in quantum est causa quod
 forma humana fiat in hac materia. Hoc autem est esse princi-
 pium generationis huius hominis. Patet ergo quod nec hic homo,
 nec aliquid aliud agens univocum in natura, est causa nisi
 generationis huius vel illius rei."
- (12) Ibid.:
 "Oportet autem ipsius speciei humanae esse aliquam per se
 causam agentem: quod ipsius compositio ostendit, et ordinatio
 partium, quae eodem modo se habet in omnibus, nisi per accidentia
 impediatur... Haec autem causa est Deus, vel mediate vel immediate..."
- (13) Summa Theologiae, 1a, Q. 6, a. 1:
 "Similitudo autem effectus in causa univoca invenitur uniformiter;
 in causa autem equivoca invenitur excellentius, sicut calor
 excellentiori modo est in sole quam in igne."
- (14) Ibid., Q. 104, a. 1:
 "...et hoc est esse causa secundum fieri, sicut cum homo generat
 hominem, et ignis ignem. Et ideo quaecumque naturalis effectus
 est natus impressionem agentis recipere secundum eandem rationem
 secundum quam est in agente, tunc fieri effectus dependet ab
 agente, non autem esse ipsius."

Chapter Five:

- (1) Op. cit., pp. 250-251.
- (2) Summa Theologiae, I-IIae, Q. 1, a. 2:
"Tamen considerandum est quod aliquid sua actione vel motu tendit ad finem dupliciter: uno modo, sicut seipsum ad finem movens, ut homo; alio modo, sicut ab alio motus ad finem, sicut sagitta tendit ad determinatum finem ex hoc quod movetur a sagittante, qui suam actionem dirigit in finem. Illa ergo quae rationem habent, seipsa movent ad finem; quia habent dominium suorum actuum per liberum arbitrium, quod est facultas voluntatis et rationis. Illa vero quae ratione carent, tendunt in finem per naturales inclinationes, quasi ab alio mota, non autem a seipsis: cum non cognoscant rationem finis, et ideo nihil in finem ordinare possunt, sed solum in finem ab alio ordinantur."
- (3) Ibid.:
"Et ideo proprium est naturae rationalis ut tendat in finem quasi se agens vel ducens ad finem; naturae vero irrationalis, quasi ab alio mota vel ducta; sive in finem apprehensum, sicut bruta animalia, sive in finem non apprehensum, sicut ea quae omnino cognitione carent."
- (4) Summa Contra Gentiles, Book 4, ch. 19:
"Res autem naturalis per formam qua perficitur in sua specie, habet inclinationem in proprias operationes et proprium finem, quem per operationes consequitur: qualis enim est unumquodque, talis operatur, et in sibi convenientia tendit."
- (5) Summa Theologiae, I-IIae, Q. 6, a. 1:
"Quod autem nullam notitiam finis habet, etsi in eo sit principium actionis vel motus; non tamen eius quod est agere vel moveri propter finem est principium in ipso, sed in alio, a quo ei imprimatur principium suae motionis in finem. Unde huiusmodi non dicuntur movere seipsa, sed ab aliis moveri."
- (6) Ibid., Q. 26, a. 1:
"Est enim quidem appetitus non consequens apprehensiones ipsius appetentis, sed alterius; et huiusmodi dicitur appetitus naturalis. Res enim naturales appetunt quod eis convenit secundum suam naturam. non per apprehensionem propriam, sed per apprehensiones instituentis naturam..."

- (7) Quaestiones Disputatae De Veritate, Q. 25, a. 1:
"Quia vero Res naturalis in suo esse naturali determinata est; et una eius est inclinatio ad aliquam rem determinatum; unde non exigitur aliqua apprehensio, per quam secundum rationem appetibilitatis distinguatur res appetibilis a non appetibili. Sed haec apprehensio praexigitur in instituyente naturam, qui unicuique naturae dedit inclinationem propriam sibi convenientem."
- (8) In 2 Physicorum, lec. 1, n. 5:
"...ergo natura nihil aliud est quam principium motus et quietis in eo in quo est primo et per se et non secundum accidens."
- (9) In 2 Physicorum, lec. 12, n. 1:
"Et hoc valet ad quaestiones de providentia. Ea enim quae non cognoscunt finem, non tendunt in finem nisi ut directa ab aliquo cognoscente, sicut sagitta a sagittante; unde si natura operetur propter finem, necesse est quod ab aliquo intelligente ordinetur; quod est providentiae opus."
- (10) Ibid., lec. 14, n. 8:
"Unde patet quod natura nihil est aliud quam ratio cuiusdam artis, scilicet divinae, indita rebus, quae ipsae res moventur ad finem determinatum..."
- (11) Op. cit.
- (12) Physics, Book 2, ch. 1, 193a2-6:
"That nature exists, it would be absurd to try to prove; for it is obvious that there are many things of this kind, and to prove what is obvious by what is not is the mark of a man who is unable to distinguish what is self-evident from what is not."
- (13) In II Physicorum, lec. 13, n. 2:
"Omnia quae fiunt naturaliter, aut fiunt sicut semper, aut sicut frequenter; sed nihil eorum quae fiunt a fortuna vel per se vano, idest a casu, fit semper vel frequenter. Non enim dicimus quod a fortuna vel a casu fit, quod multoties pluit in hieme; sed diceremus esse a casu si forte multum plueret sub cane, idest in diebus canicularibus; et similiter non dicimus quod fit a casu quod causa sit in diebus canicularibus; sed si hoc esset in hieme."
- (14) Ibid.:
"Omnia quae fiunt, aut fiunt a casu, aut fiunt propter finem; quae enim accidunt praeter intentionem finis, dicunt accidere casualiter; sed impossibile est ea quae fiunt semper vel frequenter, accidere a casu; ergo ea quae fiunt semper vel frequenter, fiunt propter aliquid."

Sed omnia quae fiunt secundum naturam, fiunt vel semper vel frequenter, sicut etiam ipsi confitebantur; ergo omnia quae fiunt a natura, fiunt propter aliquid."

(15) Philosophy of Science

(16) "The Problem of Knowledge", Yale University Press, New Haven 1950, pp. 189-190.

(17) In II Physicorum, lec. 14, n. 7:

"Haec enim dicuntur esse secundum naturam, quaecumque ab aliquo principio intrinsicè moventur continuo, quousque perveniant ad aliquem finem; non in quodcumque contingens, neque a quocumque principio in quocumque finem, sed a determinato principio in determinatum finem: semper enim ab eodem principio proceditur in eundem finem, nisi aliquid impedit."

(18) Ibid., lec. 13, n. 3:

"...in quibuscumque est aliquis finis, et prioris et consequentis omnia aguntur causa finis. Hoc supposito sic argumentatur. Sic aliquid agitur naturaliter, sic aptum natum est agi: hoc enim significat quod dico naturaliter, scilicet aptum natum. Et haec propositio convertitur, quia sicut aliquid aptum natum est agi, sic agitur: sed oportet apponere haec conditionem, nisi aliquid impedit. Accipiamus ergo primum quod non habet instantiam, quod sicut aliquid agitur naturaliter, sic aptum natum est agi. Sed ea quae fiunt naturaliter, sic aguntur quod inducuntur ad finem; ergo sic apta nata sunt agi, ut sint propter finem: et hoc est naturam appetere finem, scilicet habere aptitudinem naturalem ad finem. Unde manifestum est quod natura agit propter finem."

(19) Ibid.:

"Et hoc quod dixerat, manifestat per exemplum. Similiter enim ex prioribus pervenitur ad posteriora in arte et in natura; unde si artificialia, ut domus, fierent a natura, hoc ordine fierent quae nunc fiunt per artem; ut scilicet prius institueretur fundamentum, et postea erigerentur parietes, et ultimo superponeretur tectum. Hoc enim modo natura procedit in iis quae sunt terrae affixa, scilicet in plantis: quarum radices quasi fundamentum terrae infiguntur; scilicet vero ad modum parietis elevatur in altum; frondes autem supereminunt ad modum tecti. Et similiter si ea quae fiunt a natura, fierent ab arte, hoc modo fierent sicut apta nata fieri a natura; ut patet in sanitate, quam contingent fieri

et ab arte et a natura; sicut enim natura sanat calefaciendo et infrigidando, ita et ars. Unde manifestum est quod in natura est alterum propter alterum, scilicet priora propter posteriora, sicut et in arte."

(20) Ibid., n. 4:

"...ars quaedam facit, quae natura non potest facere, sicut domum et alia huiusmodi: in iis vero quae contingit fieri et ab arte et a natura, ars imitatur naturam, ut patet in sanitate, ut dictum est: unde si ea quae fiunt secundum artem, sunt propter finem, manifestum est quod etiam ea quae fiunt secundum naturam, propter finem fiunt, cum similiter ea habeant priora ad posteriora in utrisque. Potest tamen dici quod haec non est alia ratio a praemissa; sed complementum est explicatio ipsius."

(21) Ibid., n. 5:

"...sumitur haec ratio ab iis quae manifestius in natura propter aliquid operari videntur. Unde dicit quod naturam operari propter aliquid maxime est manifestum in animalibus, quae neque operantur per artem, neque per inquisitionem, neque per deliberationem; et tamen manifestum est in operationibus eorum, quod propter aliquid operantur. Propter quod quidam dubitaverunt utrum aranei et formicae et huiusmodi animalia operentur per intellectum, vel per aliquod aliud principium. Sed tamen ex hoc fit manifestum quod non operantur ex intellectu, sed per naturam, quia semper eodem modo operantur; canis enim hirundo similiter facit nidum, et canis araneus similiter facit telum, quod non esset si ab intellectu et arte operarentur: non enim canis aedificator similiter facit domum, quia artifex habet iudicare de forma artificiatum, et potest variare. Ulterius autem procedenti de animalibus ad plantas, in eis etiam apparent quaedam esse facta ut utilis ad finem, sicut folia sunt utilis propter cooperimentum fructuum. Unde si hoc est a natura et non ab arte, quod hirundo facit nidum et araneus telum, et plantae producant folia gratia fructuum, et radices sunt in plantis non sursum, sed deorsum, ut accipiant nutrimentum a terra; manifestum est quod causa finalis invenitur in iis quae fiunt et sunt a natura, natura scilicet propter aliquid operante."

(22) Ibid., n. 6:

"Dicit quod cum natura dicatur dupliciter, scilicet de materia et forma, et forma est finis generationis, ut supra dictum est; hoc autem est de ratione finis, ut propter ipsum fiant alia; sequitur quod esse et fieri propter aliquid, inveniat in rebus naturalibus."

(23) In I Physicorum, lec. 15, an. 7-8

"...forma est quoddam divinum et optimum et appetibile. Divinum quidem est, quia canis formae est quaedam participatio similitudi-

nis divini esse, quod est actus purus: unumquodque enim in tantum est actu in quantum habet formam. Optimum autem est, quia actus est perfectio potentiae et bonus eius: et per consequens sequitur quod sit appetibile, quia unumquodque appetit suam perfectionem."

"Cum forme sit quoddam bonus et appetibile, materia, quae est aliud a privatione et a forma, est apta nata appetere et desiderare ipsam secundum suam naturam.

(24) Op. cit.

(25) Ibid., p. 442.

(26) In II Phys., lec. 14, n. 3:

"...licet ars agat propter aliquid, tamen in iis quae fiunt secundum artem, contingit fieri peccatum; quia aliquando grammaticus non recte scribit, et medicus quandoque potat aliquem medicinali potionem non recte. Unde manifestum est quod contingit peccatum esse etiam in iis quae sunt secundum naturam, quamvis natura propter aliquid operetur. In arte istam, eorum quae propter aliquid fiunt, quaedam fiunt secundum artem, et recte fiunt; quaedam autem sunt, in quibus artifex fallitur non secundum artem agens: et in his contingit peccatum, arte propter aliquid agente. Si enim ars non ageret ad determinatum finem, qualitercumque ars opereretur, non esset peccatum; quia operatio artis aequaliter se haberet ad omnia, hoc ipsum igitur quod in arte contingit esse peccatum, est signum quod ars propter aliquid operetur. Ita etiam contingit in naturalibus rebus; in quibus monstra sunt quasi peccata naturae propter aliquid agentis, inquantum deficit recta operatio naturae. Et hoc ipsum quod in naturalibus contingit esse peccatum, est signum quod natura propter aliquid agat."

(27) Ibid.:

"Unde in substantiis quas in principio mundi Empedocles dixit esse constitutas bovigines, idest ex media parte boves et ex media homines, si non poterant pervenire ad aliquem finem et terminum naturae, ut scilicet conservarentur in esse; non hoc fuit quia natura non intendit, sed quia haec non possibilia salvari, generate sunt non secundum naturam, sed corrupto aliquo naturali principio; sicut nunc etiam accidit aliquos monstruosos partus generari propter corruptionem seminis."

(28) Ibid., n. 4:

"Ubicumque sunt determinata principia et determinatus ordo procedendi, ibi oportet esse determinatum finem propter quem alia fiant; sed in generatione animalium est determinatus ordo procedendi; quia oportet primum fieri semen, et non statim a principio est animal; et ipsum

semen non statim est induratum, sed a principio est molle, et quodam ordine ad perfectionem tendit: ergo in generatione animalium est determinatus finis. Non ergo propter hoc accidunt monstra et peccata in animalibus, quia natura non agit propter aliquid."

Chapter Six:

(1) *Physics*, Book II, ch. 8, 198b23-27

(2) *In II Phys.*, loc. 15, n. 3:

"Et dicit quod quidam opinantur quod generatio rerum naturalium proveniat ex necessitate absoluta materie; ut puta si aliquis diceret quod paries aut domus taliter sit ex necessitate materie, eo quod gravis nata sunt decorem ferri, levis vero supereminere: et propter hoc lapides graves et duri remanent in fundamento, terro vero lapidibus superponitur tanquam levior, ut patet in parietibus constructis ex lateribus, qui ex terra conficiuntur; sed in summo ponuntur ligna, scilicet in tecto, quas sunt maxime levia. Ita etiam existimabant dispositiones rerum naturalium provenisse tales ex necessitate materie; ut puta si dicatur quod homo habet pedes inferius et manus superius propter gravitatem aut levitatem humorum".

(3) *Ibid.*, n. 4:

"Et sicuti est in domo, similiter est in omnibus aliis, in quibus contingit agere propter aliquid: in omnibus enim huiusmodi non consequuntur dispositiones generatorum aut factorum sine principiis, quas habent necessarium materiam, per quam apta nata sunt sic disponi. Non tamen res factae aut generatae sic disponuntur propter hoc, quod principia materialia sunt talia, nisi sicut propter dicit causam materiale; sed sic disponuntur propter aliquam finem, et principia materialia quaeruntur ut sint propter huius dispositioni, quam requirit finis..."

(4) *Philosophy of Science*, April, 1948, p. 127.

(5) *Op. cit.*:

"Est enim serr huiusmodi, idest talis dispositionis aut formae: quare oportet quod sit talis, idest ut habeat talem materiam: et est huiusmodi, idest talis dispositionis aut formae, propter hoc, idest propter aliquam finem. Sed tamen iste finis, qui est sectio, non posset prevenire nisi esset ferrea: necessarium est ergo serram esse ferream, si debeat esse serram, et si debeat esse eius finis, quod est opus ipsius."

(6) Ibid.:

"Sic igitur patet quod in rebus naturalibus est necessarium ex suppositione, sicut et in rebus artificialibus: sed non ita quod id quod est necessarium, sit sicut finis; quia id quod necessarium est, ponitur ex parte materiae; sed ex parte finis ponitur ratio necessitatis. Non enim dicimus quod necessarium sit esse talem finem, quia materia talis est; sed potius e converso; quia finis et forma talis futura est, necesse est materiam talem esse. Et sic necessitas ponitur ad materiam, sed ratio necessitatis ad finem."

(7) De Partibus Animalium, Book I, ch. 1, 640a-640b

(8) Op. cit.

(9) Op. cit., n. 6:

"Manifestus est enim quod in scientiis demonstrativis, principium demonstrationis est definitio: et similiter finis, qui est principium et ratio necessitatis in iis quae fiunt secundum naturam, est quoddam principium sumptum a ratione et definitione; finis enim generationis est forma speciei, quam significant definitionem. Et hoc etiam patet in artificialibus; sicut enim demonstrator in demonstrando accipit definitionem ut principium, ita et aedificator in aedificando, et medicus in sanando; ut quia talis est definitio domus, oportet hoc fieri et esse ad hoc quod domus fiat: et quia haec est definitio sanitatis, oportet hoc fieri ad hoc quod aliquis sanetur..."

(10) In I Post. An., lec. 16, n. 5:

"Ponamus ergo duas definitiones domus, quarum una sumatur a causa materiali, quae sit talis: Domus est cooperimentum constitutum ex lapidibus, cemento et lignis. Alia sumatur ex causa finali, quae sit talis: Domus est cooperimentum prohibens non a pluvia, frigore et calore. Potest ergo prima definitio demonstrari ex secunda, hoc modo: Omne cooperimentum prohibens nos a pluvia, frigore et calore oportet quod sit constitutum ex lapidibus, cemento et lignis; domus est huiusmodi; ergo, etc. Patet ergo quod definitio, quae sumitur a fine, est principium demonstrationis; illa autem, quae sumitur a materia, est demonstrationis conclusio. Potest tamen utraque coniungi, ut sit una definitio, hoc modo: Domus est cooperimentum constitutum ex dictis, defendens a pluvia, frigore et calore. Talis autem definitio continet totum quod est in demonstratione, scilicet medium et conclusio; et ideo talis definitio est demonstratio positione difference; quia in hoc solo differt a demonstratione, quia non est ordinata in modo et figura."

(11) In II Phys., lec. 15, n. 5:

"...finis in iis quae fiunt propter finem, tenet locum principii quod est in demonstrativis."

- (12) *Ibid.*, n. 6:
 "Si enim aliquid velit definire opus serrae, quoniam est talis
 divisio quae quidem non erit nisi habent dentes, qui non erant
 apti ad dividendum nisi sint ferrei: oportebit in definitione
 serrae ponere ferrum."
- (13) *Ibid.*:
 "Nihil enim prohibet in definitione poni quaedam partes mater-
 iae, non quidem partes individuales, ut haec carnes et haec ossa;
 sed partes communes, ut carnes et ossa; et hoc necessarium est
 in definitione eorum rerum naturalium."
- (14) *Ibid.*:
 "Sicut igitur definitio quae colligit in se principium demons-
 trationis et conclusionem est tota demonstratio; ita definitio
 colligens finem et formam et materiam, comprehendit totum pro-
 cessum generationis naturalis."
- (15) De Partibus Animalium, Book I, ch. 1, 642a-642b
- (16) In II Phys., lec. 12, n. 5:
 "Nam Pluvia licet habeat necessarium causam ex parte materiae,
 tamen ordinatur ad finem aliquem, scilicet ad conservationem
 rerum generabilium et corruptibilium. Propter hoc enim est
 generatio et corruptio mutua in istis inferioribus, ut con-
 servetur perpetuum esse in eis."
- (17) De Generatione Animalium, Book 5, ch. 8, 789b3-7
- (18) *Ibid.*, 12-15
- (19) De Generatione Et Corruptione, Book 2, ch. 9, 336a7-12

Chapter Seven:

- (1) De Generatione Animalium, Book 5, ch. 1, 778a17-23
- (2) *Ibid.*, 778a-778b
- (3) *Ibid.*, 778b2-6:
 "For, as was said originally in the outset of our discussion, when
 we are dealing with definite and ordered products of nature, we
 must not say that each 'is' of a certain quality because it 'becomes'
 so, but rather that they 'become' so and so because they 'are' so,
 for the process of Becoming or development attends upon Being and is
 for the sake of Being, not 'vice versa'."
- (4) S.D. De Male, Q. 5, a. 5, in 1:
 "Corpus enim hominis componitur ex contrariis. Sed omne compositum ex

contrariis est naturaliter corruptibile. Ergo homo naturaliter est mortalis, et per consequens ceteris defectibus subiectus."

(5) Ibid., corpus:

"Dicendum, quod secundum Philosophum in II Physic. naturale dicitur dupliciter: vel id quod habet naturam, sicut dicimus corpora naturalia; vel illud quod consequitur naturam secundum naturam existens, sicut dicimus quod ferri sursum, est naturale igni; et sic loquimur nunc de naturali, quod est secundum naturam. Unde cum natura dicatur dupliciter, scilicet forma et materia, dupliciter dicitur aliquid naturale: vel secundum formam, vel secundum materiam. Secundum formam quidem, sicut naturale est igni quod calefacit, nam actio consequitur formam; secundum materiam autem, sicut aqua est naturale quod ab igne calefieri possit. Cumque forma sit magis natura quam materia, naturalis est quod est naturale secundum formam quam quod est naturale secundum materiam."

(6) Ibid.,

"Sed id quod consequitur materiam, dupliciter accipi potest: uno modo secundum quod congruit formae; et hoc est quod agens eligit in materia, alio modo non secundum quod congruit formae, immo forte repugnant etiam formae et fini, sed est ex necessitate materiae; et talis conditio non est electa vel intenta ab agente; sicut artifex qui facit serram ad secundum, quaerit ferrum, quia est materia apta ad formam serrae et ad finem eius propter suam dicitatem. Invenitur tamen in ferro aliqua conditio secundum quam ferrum non habet aptitudinem nec ad formam nec ad finem, sicut quod est frangibile vel contrahens rubiginem vel aliquid huiusmodi, quae sunt impeditiva finis; unde non sunt electae ab agente, sed magis repudiarentur, si esset possibile."

(7) Ibid.,

"Cum enim anima humana sit intellectiva in potentia, unitur corpori ut per sensus accipiat species intelligibiles, quibus fit intelligens actu. Non enim unio animae ad corpus est propter corpus, sed propter animam; non enim forma est propter materiam, sed materia propter formam. Prius autem sensum est tactus, qui quodammodo est fundamentum aliorum; organum autem tactus oportet esse medium inter contraria, ut probetur in II de Anima. Unde corpus congruens tali animae fuit corpus ex contrariis compositum."

(8) Ibid.,

"Et quidem omnis corruptio cuiuscunque rei naturalis, non est secundum convenientiam ad formam; nam cum forma sit principium essendi, corruptio, quae est via ad non esse, opponitur ei; unde Philosophus dicit in II de Cael. et Mundo, quod corruptio seminum et omnia defectus sunt contra naturam particulares huius rei determinatae per formam... sed speciali modo corruptio proveniens ex necessitate na-

teriae est praeter convenientiam huius formae quae est anima intellectiva. Nam aliae formae sunt corruptibiles saltem per accidens; sed anima intellectiva non est corruptibilis nec per se nec per accidens."

(9) Ibid.:

"Unde si in natura inveniri potuisset aliquod corpus ex elementis compositum quod esset incorruptibile, procul dubio tale corpus esset conveniens animae secundum naturam... quia natura non potest invenire corpus ex elementis compositum quod secundum naturam materiae sit incorruptibile, aptatur naturaliter animae incorruptibile corpus organicum licet corruptibile."

(10) Op. cit.

(11) Op. cit.:

"Unde etiam Philosophus dicit in XIX de Animalibus, quod in accidentibus individui non est querenda causa finalis sed solum causa materialis: proveniunt enim ex dispositione materiae, non ex intentione agentis."

(12) In III De Anima, lec. 17, n. 851:

"Sed ex hoc quod membra sunt talis dispositionis, sequitur quod habeant aliqua accidentia, sicut quod habeant pilositates quasdam, vel colorem, vel corruptiones, quae non sunt propter finem, sed magis proveniunt ex necessitate materiae."

Chapter Eight:

(1) Op. cit., p. 466.

(2) Op. cit.

(3) Op. cit.

(4) "Le Hasard", p. 306.

(5) Ibid.

(6) Summa Contra Gentiles, Book II, ch. 30:

"In quibus vero forma non complet totam potentiam materiae, remanet adhuc in materia potentia ad aliam formam. Et ideo non est in eis necessitas essendi, sed virtus essendiconsequitur in eis victoriam formae super materiam..."

(7) De Generatione Animalium, Book 4, ch. 4, 770b17

(8) Philosophy of Science

(9) Ibid.

(10) Ibid.

(11) Ibid.

(12) Ibid.

(13) Ibid.

PROPOSITIONS

In creatures, there is a real distinction between the essence and the supposite.

The signification of a term is different from its supposition.

In substantial generation, there is a resolution of all forms to prime matter.

No common good is subordinated to a private good as such.

In Marxist theory and terminology, the expression "Socialist State" is a contradiction in terms.