ST. ALBERT THE GREAT AND ST. THOMAS AQUINAS ON THE PRESENCE OF ELEMENTS IN COMPOUNDS[1]

If the philosophy of St. Thomas Aquinas is truly a perennial philosophy, which is essentially as sound today as it was seven hundred years ago, then the doctrine of hylomorphism must still be true, for hylomorphism is the very foundation of Thomism. According to the hylomorphic doctrine of Thomas, the world we know immediately is a world filled with natural material units called substances. Substances are composed of two fundamental principles, form and matter. Substances, however, are not the only realities in the material world, for there are other realities, called accidents, which inhere in substances. Accidents by nature inhere in a subject; substances do not inhere in something else as in a subject. Both accidents and substances are understood in terms of form and matter. Substances are composed of prime matter and substantial form; accidents are accidental forms, which inhere in the matter of the substance, called secondary matter.

At least one important critic has thought that the doctrine of hylomorphism is flawed because of the problem of elements[2]. According to hylomorphism, a substance is composed of its substantial principles (substantial form and prime matter), and in addition there are accidents which inhere in the substance. Elements,

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[1] A version of this article, entitled «Matter, Prime Matter, and Elements», was read at the Thomistic Institute, Jacques Maritain Center, University of Notre Dame, 24 July 1998. Let me express my gratitude to Prof. Ralph McInerny, who organized the Institute, and to the participants who helped me to improve the paper with their excellent comments. References to Thomas Aquinas are taken from the following works: *Scriptum super libros Sententiarum Petri Lombardi*, Eds. P. Mandonnet and M. F. Moos, 4 vols., Paris: Lethielleux, 1929-1947. All references in this article are to the second volume, edited by Mandonnet, 1929. *In librum Boethii de Trinitate expositio*, in *Opuscula theologica*, vol 2., ed. R. M. Spiazzi, Rome: Marietti, 1954. *De mixtione elementorum ad Magistrum Philippum de Castro Caeli*, in *Sancti Thomae de Aquino opera omnia*, vol. 43, Leonine Edition, Rome: Editori di San Tommaso, 1976, pp. 155-157. References to Albert's *De caelo et mundo* are made to *Alberti magni opera omnia*, vol. 5, part 1, ed. Paul Hossfeld, Cologne: Aschendorff, 1971. References to Thomas' *De mixtione elementorum* and to Albert's *De caelo et mundo* will include, in brackets, page numbers followed by line numbers, with the page and line numbers separated by a colon.

[2] Anneliese MAIER has argued that the collapse of scholastic philosophy was brought about, in part, by the inability of hylomorphic doctrine to account for the real presence of elements in compounds. «Die Struktur der materiellen Substanz», in *An der Grenz von Scholastik und Naturphilosophie*, 2nd ed. (Rome: Edizioni di Storia et Letteratura, 1952), pp. 3-140.

however, are real and must be explained in some way. In themselves, elements are substances, but elements are also said to be parts of compounds, in which they are present. But just how are they present in compounds? Are they merely accidents? If so, then they are not present in compounds *as elements*, for elements are themselves substantial units. On the other hand, if we insist that elements are substances, then we cannot say that they are present in substances, for if they are substantially present in compounds, the compound will in reality be not one substance but several.

Crucial, then, to Thomistic philosophy is the explanation of how it is that elements are present in compounds. Thomas' explanation of this, in fact, changed over time, and changed because of the influence of his teacher, Albert the Great. In what follows, we shall see how it was that Thomas accepted, early in his career, the teaching of Albert and why Thomas in his mature teaching came to reject this same teaching[3]. This short history is instructive, both to help us understand hylomorphic doctrine and to help us understand better the relation of Thomas to his teacher. We shall consider first the common, Aristotelian understanding of elements, then Albert's teaching, and finally the doctrine of Thomas.

ARISTOTELIAN CONCEPT OF ELEMENTS

Aristotle provides the classic definition of the element: an element is «that from which a thing is composed primarily, remains in it, and is indivisible in species»[4]. In the definition, the words, «that from which», indicate the genus of that which is being defined. An element is «that from which», that is, an element is a kind of material cause. Just what kind of material cause is made clear by the three terms used in the definition.

The term «primarily» means, as Thomas explains, that the elements are that out of which a thing is composed *first*. In order to understand a thing, we *analyze* it, that is, we break it down into ever smaller parts. When such analysis is complete, the last things that we identify are elementally first, for what is last in analysis or resolution is first in composition. Thus, an automobile is made up of various parts that are systems —electrical system, engine and drive train, suspension, breaking system, and so forth. Each of these systems, however, is made up of something that is primary: nuts, bolts, casings, wires, cables, and so forth. These primary elements are what is really first, for the first things that are assembled in construction are the last things revealed in deconstruction. Similarly, the living organism is composed of various systems: a nervous system, a respiratory system, a digestive system, and so forth. These systems, in turn, are made up of organs, the organs of cells, and the cells of chemical constituents. To the biologist, the chemicals of organic chemistry are

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[3] On this history, I am indebted to the fine doctoral thesis of Laura LANDEN, *Thomas Aquinas and the Dynamism of Natural Substances* (Washington, DC: The Catholic University of America, 1985).

[4] *Metaphysics* 5.3 (1014a27). See also Aristotle's more extensive discussion of elements: *De generatione et corruptione* 2.1-8 (328b26-335a23); *De caelo* 3.3-8 (302a10-313b24). I am guided by two texts of Thomas to explicate this definition: an early work, *De principiis naturae* (1252-1256), and the *Commentary* on the *Metaphysics* (1269-1272).

elemental. The chemist, on the other hand, analyzes chemical compounds and elements in terms of the atomic constituents, and the physicist pushes the analysis of matter further to the level of the sub-atomic. What is primary or elemental, then, is relative to the level of analysis: it means something different for the mechanic, for the biologist, for the chemist, and for the physicist[5]. For each, however, the elemental is analogously the same: that which is last in the analysis of a whole is first in the composition of that whole.

The second differentia in the definition is the term «remains in». The element remains in the compound or in that of which it is an element. Just how it is that elements do remain in compounds is, as I have already said, our principal task in this essay, but *that* elements must remain *in some way* is clearly the meaning of Thomas and Aristotle[6]. If I eat some bread, for example, it is not true that the bread as bread remains in me, after I have eaten and digested the bread. What does remain in me are the nutrients that come from bread: carbohydrates, glucose, vitamins, and so forth. So the bread is not an element, but the nutrients that come from bread are elements.

Third, an element is «indivisible in species». An amount of an element might or might not be divisible quantitatively, but if it is divisible quantitatively, such division could never result in something that is different in species. To consider the ancient theory of the four elements, if we divide the element water into smaller and smaller amounts, we never can divide water into something that is not water. An element can be changed into something else, into another element, for example, or into a

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[5] William WALLACE has made this point, see *From a Realist Point of View: Essays on the Philosophy of Science*, 2nd ed. (Lanham, MD: University Press of America, 1983), pp. 175-177, p. 211, n. 58.

[6] There is, in fact, a controversy among interpreters of Aristotle's saying that the elements «remain in» the compound. Alan CODE argues that Aristotle holds that the elements are simply present as substances in the compound and that, since the elements are so present, Aristotle cannot distinguish between a true compound of elements and a mere aggregate of elements. «Potentiality in Aristotle's Science and Metaphysics»: *Pacific Philosophical Quarterly* LXXVI (1995) 405-418. Similarily, Richard SHARVY holds that Aristotle's doctrine of elements requires that elements have the same determinate quantity of matter before and after composition in compounds. Such a requirement makes it impossible for Aristotle to talk of the elements existing in some potential state in the compound. «Aristotle on Mixtures»: *The Journal of Philosophy* LXXX (1983) 439-457. Mary Louise GILL has Aristotle holding that the elements are not present in the compound but that the elemental powers are actually present, a doctrine which renders the compound substance an unstable forum of contradictory qualities. *Aristotle on Substance: The Paradox of Unity* (Princeton: Princeton University Press, 1989). Kit FINE gives what I would call an Averrostic interpretation to Aristotle: the elements actually do remain in compounds, but the elements in compounds are neither true substances nor merely the powers or capacities of the compound. They are a third kind of form in between the substantial and the accidental (although Fine does not use the language of substantial and accidental form). «The Problem of Mixture»: *Pacific Philosophical Quarterly* LXXVI (1995) 266-369. James BOGEN comes closest to what I take to be the true Aristotelian and Thomistic position, which is that the elements undergo a genuine substantial change when they are made into a compound such that the elements before the compound's coming into being are not numerically identical with the elements after the distruction of the compound. In the compound, the elements are not actually present, nor are the elemental qualities actually present, but the qualities are present in some remiss way insofar as the compound has a new quality that is a blend of qualities of the elements out of which it has been made. «Fire in the Belly: Aristotelian elements, Organisms, and Chemical Compounds»: *Pacific Philosophical Quarterly* LXXVI (1995) 570-404.

compound, but it cannot be found, upon being divided, to be composed of something more basic than itself[7].

From a consideration of these three points (that the element is primary in the composition of a compound, that the element remains in the compound, and that there is nothing more basic than the element), it should be clear that the elements as material cause are quite distinct from matter in its primary sense, prime matter. Matter in its primary sense is an opposite to form, for it is the principle of potentiality as against form, which is the principle of actuality. Prime matter is the potency that material things have for the most radical sorts of change. Ultimately, any material thing has the potency to become any other material thing. This omni-potentiality of matter cannot be restricted or determined in any way, and hence prime matter cannot have form. What does not have form, of course, cannot be strictly known or defined, and hence prime matter cannot be known or defined. That it is real is known by argument and by comparison with other things. Elements, on the other hand, are material causes, but they are not matter in this primary sense, because elements have definite, knowable natures and, hence, have form. We recognize certain tendencies, activities, and characteristics that belong to the elements, and we know that such tendencies, activities, or characteristics must flow from an actuality, that is, from form. On the ancient theory, earth has the tendency of downward motion, to congealing coldness, and to dryness; air has all of the opposite tendencies, and so forth.

An element is a primary material cause (but not prime matter), it is indivisible in species, and it remains in some way in the compound. The problem now is to explain in just what way it does remain in the compound. First we consider the teaching of Albert on this, then that of Thomas.

ALBERT ON THE PRESENCE OF ELEMENTS IN COMPOUNDS

In two Aristotelian paraphrases, *De generatione et corruptione* and *De caelo et mundo*, both written in the early 1250s[8], Albert explains what Aristotle had meant

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[7] Unless, that is, we analyze the thing to a lower, more basic level of reality. The ancients and mediaevals, of course, thought that water was one of the most basic elements, but we think that there is something more elemental than water. For us, hydrogen and oxygen are the elements of water. Hydrogen and oxygen are indivisible in species, and yet we know that even they, at a more profound level, can be divided. Again, the idea of element is a relative or analogous one. One might say that, in the final analysis, only the elements of physics (quarks, or whatever) are really elements, for all other elements turn out to be compounds of elements. This is true, but the concept of element remains a valuable one for other levels of analysis, because a chemist, for example, wishes to analyze his compounds no further than to the level of the chemical elements. For him and for his methods of analysis the chemical elements really are elemental, even though there is a more fundamental level of material reality.

[8] For dating of Albert's texts in natural philosophy, see James A. WEISHEIPL, «Albert's Works on Natural Science (*Libri naturales*) in Probable Chronological Order», in *Albertus Magnus and the Sciences: Commemorative Essays 1980*, ed. J. A. Weisheipl (Toronto: Pontifical Institute of Mediaeval Studies, 1980), pp. 565-577.

when he said that elements do not remain as «body» and «white» remain in a material thing, nor are they simply destroyed, but that the power (δύναμις) of the elements remains in the compound[9]. The question is whether the substantial forms of the elements do or do not remain in the compounds. If we say that the substantial forms do remain in the compounds, then it seems that we are forced to say that there are several substantial forms in the compound, but Albert, like Thomas, always rejects the doctrine of a plurality of substantial forms, for no thing, not even a compound, can have more than one substantial form[10]. If a thing has more than one substantial form, then it would be simultaneously in more than one species, which, of course, is absurd. Furthermore, a plurality of substantial forms would result in the thing's being not a unified, single substance but a heap or a collection of substances. On the other hand, if the substantial forms of the elements do not remain in the compound, then the matter of the compound should be absolutely simple, but this would mean that the elements would be indistinguishable from prime matter[11]. Furthermore, if the elements do not remain in the compound, then, as prime matter will be indistinguishable from the matter of a compound, what is true of prime mater must also be true of the matter of a compound. It is true of prime matter, however, that it can receive the form of an element. It would then have to be true that the matter of a compound could receive the form of an element. A compound like flesh, for example, could receive the form of earth. Such, however, is clearly absurd. Another way to express this is to note that the matter of a compound is specific or proper to the compound, for a compound will decompose into not just any elements but only into certain ones. The fact that salt decomposes into sodium and chlorine, and never into anything else, is an indication that sodium and chlorine are really present in some way in the salt. The matter of salt is specifically different from the matter of sugar, a fact which is accounted for by the real presence of elements in the compound beyond the prime matter of all things, which just as prime matter is common.

Now it seems clear to Albert that if it is true that the properties of elements are present in compounds, then the proper source of those properties, which is the substantial form of the elements, must also be present in the compound[12]. One attempt to explain the presence of the substantial forms in compounds is to say that

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[9] *De generatione et corruptione* 1.10 (327b29-32).

[10] «Adhuc autem, videbitur forte alicui quaerendum de formis substantialibus elementorum, utrum maneant in commixto ex elementis vel non. Si enim manere dicantur, tunc videbitur consequi necessario, quod compositum plures habeat formas substantiales, et ad hoc multa sequuntur inconvenientia, quorum unum et primus est, quia nihil simul suscipit multas formas substantiales, ergo nec compositum; adhuc autem, quia per multas formas substantiales poneretur in diversis speciebus; adhuc autem, quia non esset vere unum, sed potius esset contiguum vel per accidents unum, quae omnia absurda sunt» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [240:56-68]).

[11] «Si autem [formae substantiales elementorum] non manent, tunc videtur, quod cum materia mixti nullam habeat actu formam, nec simplicis videlicet neque compositi, quod privatio ipsius est adeo generalis sicut privatio materiae primae; sed prima materia est simplex, ergo et materia compositi, quod omnino est absurdum; adhuc autem secundum hoc materia communis et prima per nihil efficeretur propria huius vel illius materia» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [240:68-75]).

[12] «Cum igitur sciamus proprietatem nusquam esse sine proprio subiecto, oportebit, quod secundum aliquem modum elementum infit composito secundum formam substantialem» (*De caelo et mundo* lib. 3, tract. 2, cap. 8 [240:93-96]).

the elemental substantial forms can admit of more or less, that there can be a diminished version of an elemental form in the compound. But this view runs into the objection that substantial forms are an «all or nothing»: a thing either is or is not a substance. As Albert says, there is a difficulty on every side of this question[13].

The solution to this problem can be found, says Albert, by distinguishing between the first and second being of the elements[14]. The first being of the element is that which is associated with or identified with the form of the element. This first being remains in the compound in which the element is found, but it remains in the compound in a confused or indistinct way. Hence, the form of the element is present in the compound, but the existence or being that this elemental form has is not the distinct or determinate existence that substantial forms have in the natural substances of ordinary experience. The secondary being, however, is the being associated with or identified with the proper accidents of the element, that is, the various powers or tendencies that the element naturally has. This second being should be understood as the *exact* degree or intensity of the elemental powers. Fire, for example, on the ancient theory has the tendency to be hot, and fire in its pure state has an exact degree or intensity of heat. In a compound such as an animal, there is also heat, and hence fire. But there is not in the animal the exact intensity of heat that is found in fire, for the animal is not as hot as pure fire. Hence, Albert means that the secondary being of fire is not present in the animal, even though the first being of fire is present. Rather, the secondary being of the animal's form is specifically and precisely present. Albert's position, then, is that the first being of elements (their forms) are present in compounds but that the secondary being of elements (their precise powers) are not.

This position, Albert reports, is also the position of both Avicenna and Averroes, who, in spite of some verbal differences, agree that the substantial forms of the elements are actually present in compounds[15]. They both affirm that the substantial

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[13] «Si autem haec omnia forte aliquis vellet solvere dicens, quod elementa manent secundum medietates suarum formarum et secundum medietates alterantur ad invicem, sicut videtur dicere Aristoteles in fine primi *Peri Geneseos*, videtur hoc esse inconveniens, eo quod formae substantiales non recipiunt intensionem et remissionem, et sic non possunt intendi et remitti» (*De caelo et mundo* lib 3, tract. 2, cap. 8 [241:5-12]).

[14] «Ad omnia autem haec dicendum, quod est primum esse et secundum esse elementorum. Est autem primum esse, quod habent ex formis suis substantialibus, secundum autem est, quod habent coniuncta cum accidentalibus naturalibus, quae sunt potentiae suae naturales. Et quantum ad hoc secundum esse corrumpuntur excellentiae ipsorum unoquoque secundum medietatem corrumptente alterum, et ex his omnibus provenit qualitas, quae est actus mixti. Quantum autem ad primum esse miscentur quidem substantiae ipsorum, et unaquaeque secundum aliquid corrumpitur ad alteram et secundum aliquid manet, et manet meo iudicio in confuso esse et non distincto» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [241:27-39]).

[15] «[...] et hoc vocat Avicenna manere secundum actum diminutum et non perfectum, non manet autem secundum actum distinctum et esse distinctum et perfectum. Et ideo dicit Averroes, quod [formae substantiales elementorum] non manent nisi secundum potentiam, et non est secundum rem contradictio aliqua inter istos duos viros, nullo tamen modo manent secundum figuras. Forma autem mixti compositi et actus eius est fluens ex mixtione tali elementorum, sicut distinctum a confuso et determinatum a generali et sicut, breviter loquendo, actus de potentia formali non naturali omnino; et est actus ille secundum esse simplex, sed tamen in se habet virtutes mixtorum, a quorum virtutibus causatur et educitur. Nihil enim prohibet unum simplex esse multarum virtutum, sicut in scientia *Primae philosophiae* habet ostendi. Sic enim omnis forma secunda se habet ad priores, ex quibus fluit

form of the compound is the result of the mixing of the elements out of which the compound is made. This mixing results in a new form which is something distinct, but its components really do remain, although they remain as indistinct formal realities. The compound that is the result of the mixing is a simple and single substance, even though the composing elements are multiple and complex.

What makes this possible is Albert's conviction that the form of the element is not a substantial form in the sense in which something perfect and complete in nature has a substantial form[16]. A substantial form that is the form of something perfect in nature, like the form of a living organism, cannot be intensified or diminished, for there cannot be more or less of such a form. The form of an element, however, is the form of something that is incomplete and imperfect. The element, says Albert, is not really a substantial thing in its own right, for it is fundamentally a *via ad aliud*[17]. It is a constituent that accounts for the reality of other substances, but it is not really a substance all on its own. And yet, elements in themselves are substances, not accidents. Albert recognizes the fact that, on the mediaeval account, the elements seldom or never existed on their own in their pure state. The earth we walk on, the water we drink, the air we breathe, and the fire we burn are all already compounds. Each is predominantly composed of its most obvious element, but each one is also composed of the other elements[18]. Albert, therefore, is driven to the conclusion that

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sicut ex causis primariis. Vivere enim sic se habet ad esse, et sentire sic se habet ad vivere et esse, et per istud iam fere elucescit totius istius quaestionis solutio» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [241:39-59]).

[16] «Iam enim patet, qualiter materia compositi differt a materia prima, et qualiter unius et eiusdem non sunt plures formae, prout forma est finis et perfectio ultima, distincta secundum esse. Hoc enim solo modo intelligitur, quod unius et eiusdem non sunt formae multae, quia formae confusae et indistinctae sunt in materia, sicut potentia propria ad formam ultimam. Hoc autem quod dicitur, quod formae substantiales non intenduntur er remittuntur, est aliquo modo verum et aliquo modo falsum. Formae enim, quae sunt sicut perfectiones ultimae in natura, non intenduntur neque remittuntur et ideo etiam non commiscentur. Talem autem formam non habet elementum, secundum quod est elementum, cum elementum diffiniatur ad compositionem, sicut patet ex praedictis, sed potius nominat formam materialem et imperfectam, et ideo est remissibilis et commiscibilis forma sua. Et haec est etiam causa, quare ea retenta secundum aliquem modum susciptibile est elementum adhuc alterius formae, quia non retinet eam, nisi prout efficitur habitus confusus cum aliis formis elementorum» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [241:59-80]).

[17] *De caelo et mundo*, lib 3, tract. 2, cap. 1 (221:6-13).

[18] There are other indications that elements are incomplete substances. For example, the form of any element does not specify any natural shape, but any thing that is complete in species does have its own natural shape specified by its substantial form. «Quod autem dicitur, quod hoc modo [elementa] deberent etiam retinere figuras, non sequitur, quia, sicut diximus, elementa propter hoc quod sunt elementa, non habent figuras determinatas, quia figura est concomitans formam substantialem perfectam, et ideo non est vere figura nisi in corporibus animatis. In lapidibus autem est secundum minus, et ideo salvatur esse lapidum etiam fracta figura generationis eorum, quod non contingit in animatis. In elementis autem nulla est, quia elementum est ordinatum ad susceptionem omnis figurae, et ideo si haberet et retineret figuram, haberet elementum formam substantialem manentem et nullo modo commiscibilem, et corrupta figura elementi non maneret elementum [...]» (*De caelo et mundo*, lib 3, tract. 2, cap. 8 [241:80-93]). Elements do, however, have a sort of shape that is consequent upon the natural motions of the elements. «[...] numquam probavimus, quod elementum haberet figuram naturalem, sicut figura est consquens formam perfectionis ultimae, sed talem habet figuram, quae est naturalis ex motu suo et loco suo. Et haec figura est, quae non accidit ei, inquantum est elementum, sed potius secundum quod

the form of the element is a sort of intermediate form. It is not an accidental form or a substantial form; it is not completely indeterminate like prime matter, but it is not completely determinate like a real substantial form. Hence, between accident and substance, between prime matter and substantial form, there is a kind of intermediate form, the form of an element. Notice that Albert is attempting to fit his principles carefully to the empirical evidence as he sees it. Since elements are substantial but not normally existent as independent substances, a different sort of form to account for this different sort of reality should be posited.

THOMAS ON THE PRESENCE OF ELEMENTS IN COMPOUNDS

Early in his academic career, in 1253-54, when composing the second book of his *Writings* on the *Sentences* of Peter Lombard, Thomas had to explain what was meant by the Genesis account of creation, when it was said that before the formation of the heavens and the earth the world was «formless». If one takes the view that the world was created not all at once but over a period of time and that the matter which was initially «formless» was the matter out of which all natural substances were eventually made, then it seems that the initial «formless» matter is prime matter. Prime matter cannot exist just as prime matter with no form, but in some sense prime matter is said to be existent and unformed.

We are not concerned with Thomas' own interpretation of the Six Days of Genesis, but we are concerned to see Thomas' explanation, given merely for the sake of the argument, of how it is that there could be some existent matter which is unformed in the sense that it is a kind of stuff that contains all of the elements. This, for the sake of the argument, is what Thomas takes the unformed matter of Genesis to be: a substance which is different from any of the substances known in our world (after the Six Days), which is made up of all of the four elements, but which does not possess the specific active and passive qualities of any of the four elements[19]. How could this primal stuff be the stuff out of which all later substances were made? Thomas' answer is that, although no one thing can have a plurality of substantial forms, nevertheless it would be possible for prime matter to possess simultaneously the forms of all of the elements. This could happen, says Thomas, if we accept Avicenna's doctrine of how it is that elements exist in a compound[20]. According to

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est mobile ad locum ex gravitate vel levitate [...]» (*De caelo et mundo*, lib. 3, tract. 2, cap. 8 [242:2-8]).

[19] «Et ideo, tenendo viam aliorum sanctorum, qui ponunt successionem in operibus sex dierum, videtur mihi dicendum quod prima materia fuit creata sub pluribus formis substantialbus, et quod omnes formae substantales partium essentialium mundi in principio creationis productae sunt: et hoc sacra Scriptura ostendit, quae caelum et terram et aquam in principio commemorat: et hoc etiam Magister dicere videtur, ponens in illa informi materia hoc terreum elementum in medio consistere, et aquas rariores fuisse, in modum nebulae supra extensas. Sed dico quod virtutes activae et passivae nondum in principio partibus mundi collatae fuerant, secundum quas postmodum distingui et ordinare dicuntur» (*Scriptum super libros Sententiarum*, lib. 2, d. 12, q. 1, a. 4, sol. [p. 315]).

[20] «Et hoc esse possibile patet, si sustinere volumus opinionem Avicennae, qui, *Metaph.* suae tract. II, c. XI, ponit elementa in mixto remanere secundum formas substantiales quantum ad primum esse, transmutari autem quantum ad secundum, scilicet quantum ad qualitates activas et passivas: est enim mixtio miscibilium alteratorum unio. Unde possibile est materiam esse sub forma substantiali sine hoc quod

Avicenna, elements exist in a compound, not according to their secondary being, but according to their primary being. The active and passive qualities of the elements would not exist as such in what we might call «the primal prime matter», but the substantial forms of the elements would exist there. This would allow for the elements to manifest themselves in their prime state at some time after the creation of matter on the first day. Thomas states that he is not taking an Anaxagorean position that all substantial forms exist actually in the primal «soup» of substances; nor is he taking a developmental or embryonic view, such that the primal substance would be a form that is mid-way between prime matter and the elemental form; nor is he adopting the view that there can be a plurality of substantial forms[21]. Rather, Thomas is adopting, in the very same language, the position of his teacher, St. Albert: one can say that the primary being of the elements exists in a compound without denying that the compound is a unified being. It is not clear, however, whether Thomas at this time also adopts Albert's view that the form of the element is a sort of hybrid form.

Some five years later, however, in 1258-59, Thomas' position begins to depart from that of Albert. In his *Commentary* on the *De Trinitate* of Boethius, Thomas takes up the problem of whether two bodies can be simultaneously in the same place. They cannot, according to Thomas, and one of the objections has to do with our problem. The objection is that since more than one element can be in one compound, it follows that more than one body can be simultaneously in one place, because elements are each distinct bodily substances.

To this objection, Thomas takes up two lines of response. First, he gives the Avicennian, or Albertinian, view that the substantial forms of the elements remain in the compound[22]. On this view, says Thomas, the compound, which is made up of elements, is not several bodies but is only one body. Thomas does not explain how this can be so, but perhaps he still accepts Albert's reasoning that a plurality in elemental primary being is compatible with a unity in the substantial form of the compound.

Against this Avicennian view is the view of Averroes, which Thomas develops as a second line of response. Averroes held what Thomas calls the more probable view that elemental forms do not simply remain in the compound but do not simply corrupt, either. Rather, the elemental forms which exist in compounds are a sort of intermediate form, in between the substantial and accidental forms[23].

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habeat qualitates activas et passivas in sui complemento: et sic cum esse primum naturaliter praecedat esse secundum, expressus est ordo naturae in successione temporis, dum res prius fiunt in esse primo quam perficiantur in esse secundo» (*Scriptum super libros Sententiarum*, lib. 2, d. 12, q. 1, a. 4, sol. [p. 315]).

[21] The Anaxagorean position has been disproven by Aristotle. The embryonic view is wrong because there is no form between prime matter and the elements, as there are intermediate forms (in Aristotelian embryology) between the conceptus and the full-term mammal at birth. The position that there is a plurality of substantial forms in one substance, as found in the *Fons vitae* of Avicebron, has been disproven by Avicenna. *Scriptum super libros Sententiarum*, lib. 2, d. 12, a. 4, sol. (p. 314).

[22] «Ad sextum dicendum, quod etsi ponantur elementa in corpore mixto remanere secundum suas formas substantiales, non tamen ponentur esse plura corpora in actu, alias nullum corpus mixtum esse vere unum, sed est plura potentia, et unum actu» (*In Boethii De Trinitate*, q. 2, a. 3, ad 6 [p. 358]).

[23] «Probabilior tamen videtur opinio Commentatoris, III *de Caelo et Mundo*, qui hanc opinionem Avicennae improbans, ait, elementorum formas in mixto non remanere, nec totaliter corrumpi, sed fieri ex

Thomas cautions us, however, that this position of Averroes must be understood in the right way. Really, substantial forms cannot be «more» or «less», because something either is or is not a substance. Therefore, to talk of an intermediate form that is «more» or «less» is really to talk, not about the substantial form, but about the elemental qualities which remain virtually within the compound. The substantial forms of the elements, says Thomas, «do not remain themselves in the compound but they remain only virtually in their qualities, out of which an intermediate quality is formed»[24].

In this text, Thomas distances himself from the position of Avicenna, but he does not reject the Avicennian position as though it were an impossible position. He merely prefers another position, that of Averroes, as more probable. The position of Averroes, however, at Thomas' hands, is interpreted into something rather different from what Thomas himself will later identify as the true position of Averroes. In fact, Thomas now reads Averroes as expressing just about what Thomas himself will express when he gives his own mature position somewhat later. Note, further, that the position of Albert, which can be found in the words of both Avicenna and of Averroes, is not quite rejected by Thomas but is, we might say, set aside in favor of a properly interpreted Averroes.

Ten years after this, in the late 1260s and early 1270s, Thomas states his mature position in several works, including the *Summa theologiae*, the *Quaestiones disputatae de anima*, a quodlibetal question, and the short treatise, *De mixtione elementorum*[25]. Here Thomas no longer tries to accommodate the positions of Avicenna and of Averroes. He calls the position of Avicenna «impossible» and the position of Averroes «more impossible» and even «ridiculous». These «impossible» and «ridiculous» positions, however, are versions of Albert's position, which makes us wonder what Thomas' reasons are for rejecting them so stoutly.

The Avicennian position, as Thomas states it, is that the substantial forms of the elements remain actually in the compound. Against this Thomas advances two arguments. First, any one substantial form can exist only in one determinate quantity of matter, for what constitutes a natural body is a determinate quantity of matter with the appropriate substantial form[26]. If a compound had several elemental substantial

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eis unam mediam formam, inquamtum suscipiunt magis et minus» (*In Boethii De Trinitate*, q. 2, a. 4, ad 6 [pp. 358-359]).

[24] «Sed cum formae substantiali suscipere magis et minus sit absonum, videtur eius dictum intelligendum hoc modo, quod formae elementorum suscipiunt magis et minus, non secundum se, sed secundum quod manent virtute in qualitatibus elementaribus quasi in propriis instrumentis; ut sic dicatur: Formae secundum se non remanent, sed solum prout sunt virtute in suis qualitatibus, ex quibus fit una media qualitas» (*In Boethii De Trinitate*, q. 2, a. 4 [Marietti, p. 359]).

[25] *Summa theologiae* I, q. 16, a. 4, ad 4 (1269); *Quaestiones disputatae de anima*, q. 9, ad 10m (1269); *Quaestiones quodlibetales*, q. 1, a. 6, ad 3 (quodlibetum primum, quaestio quarta, articulus primus), (1269, Easter); *De mixtione elementorum* (1270-1271).

[26] «Impossibile est enim materiam secundum idem diuersas formas elementorum suscipere; si igitur in corpore mixto forme substantiales elementorum saluentur, oportebit diuersis partibus materie eas inesse. Materie autem diversas partes accipere est impossibile nisi preintellecta quantitate in materia, sublata enim quantitate substantia indiuisibilis permanet, ut patet in I Phisicorum; ex materia autem sub quantitate existente et forma substantiali aduenient corpus phisicum constituitur: diuerse igitur partes materie formis elementorum subsistentes plurium corporum rationem suscipiunt. Multa autem corpora

forms, this could only mean that the various substantial forms occupied different places within the compound. But if this were so, then the compound would not be a true compound; it would be what Aristotle had called a *mixtio ad sensum* (μίξις πρὸς τὴν αἴσφησιν). That is, the supposed compound would not be one substance but a heap or a collection of many substances, even though the many substances might be very finely divided and distributed throughout the whole heap. If, therefore, the compound is to be one substance and not many, then the substantial forms of the constituent elements of the compound cannot be present in the compound.

A second argument against the Avicennian position is based upon the premise that every substantial form is the source of its own proper dispositions: active or passive qualities, tendencies, and activities[27]. The substantial form, for example of fire is the source of the qualities of heat and dryness and the tendency of upward motion; the substantial form of water has the opposite qualities, coldness and wetness, and a tendency downwards. To say, however, that one compound is composed of both the substantial form of fire and the substantial form of water is to say that one and the same substance has simultaneously contradictory dispositions. Either the result will be, again, a mere *mixtio ad sensum*, and not a true compound, or one is affirming an impossibility, for the same substance cannot have both the dispositions of fire and the dispositions of water. So much for the position of Avicenna.

The position of Averroes attempts to avoid having to posit a mere *mixtio ad sensum*, but it does so at the cost of advancing what Thomas calls a ridiculous position. Averroes holds that the forms of the elements are neither true substantial forms nor true accidental forms but that, being close to prime matter, they are an imperfect sort of form[28]. They bear a resemblance to the accidental form precisely in this, that they can be «more» or «less». That the forms of the elements can be more or

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impossibile est esse simul; non igitur in qualibet parte corporis mixti erunt quatuor elementa: et sic non erit uera mixtio sed secundum sensum, sicut accidit in aggregatione corporum insensibilium propter paruitatem» (*De mixtione elementorum* [155:18-35]).

[27] «Amplius, omnis forma substantialis propriam dispositionem in materia requirit, sine qua esse non potest: unde alteratio est uia ad generationem et corruptionem. Impossibile est autem in idem conuenire propriam dispositionem que requiritur ad formam ignis, et propriam dispositionem que requiritur ad formam aque, quia secundum huiusmodi dispositiones ignis et aqua sunt contraria; contraria autem impossibile est esse in eodem: impossibile est igitur quod in eadem parte mixti sint forme substantiales ignis et aque. Si igitur mixtum fiat remanentibus formis substantialibus simplicium corporum, sequitur quod non sit uera mixtio sed solum ad sensum, quasi iuxta se positis partibus insensibilibus propter paruitatem» (*De mixtione elementorum* [155:37-52]).

[28] «Quidam autem utrasque rationes vitare uolentes, in maius inconueniens inciderunt: ut enim mixtionem ab elementorum corruptione distinguerent, dixerunt formas substantiales elementorum aliqualiter remanere in mixto. Sed rursus, ne cogerentur dicere esse mixtionem ad sensum et non secundum ueritatem, posuerunt quod forme elementorum non manent in mixto secundum suum complementum sed in quoddam medium reducuntur; dicunt enim quod forme elementorum suscipiunt magis et minus et habent contrarietatem ad invicem. Sed quia hoc manifeste repugnat communi opinioni, et dictis Aristotilis dicentis in Predicamentis, quod substantie nichil est contrarium et quod non recipit mgis et minus, ulterius procedunt, dicentes quod forme elementorum sunt imperfectissime, utpote materie prime propinquiores, unde sunt medie inter formas substantiales et accidentales, et sic, in quantum accedunt ad naturam formarum accidentalium, magis et minus suscipere possunt» (*De mixtione elementorum* [155-156: 53-73]).

less means that they can be mixed together in a compound without compromising the substantial unity that comes from the substantial form. They are, so to speak, substantial forms that behave like accidental forms when they are in a compound.

According to Thomas, however, it is impossible that there be some sort of form that is in between the substantial and the accidental form, just as it is impossible that there be something in between an affirmation and its denial[29]. A substance is defined as that which does not inhere in another as in a subject, whereas an accident is defined as that which does inhere in another as in a subject. A subject in this context means a *hoc aliquid*, or a substance. Either something does inhere in a substance, and if so it is an accident, or it does not inhere in a substance, in which case it is a substance. There is no third possibility, nor can there be. The predicate «inheres in a subject» and its contradictory «does not inhere in a subject» leave no room for some third possibility.

This is Thomas' fundamental argument against the position of Averroes. What strikes Thomas as so wrong about this position is that it manifests a basic misunderstanding of the division between substance and accident. Given what these concepts mean and given the central importance of them, the position advocated by Averroes is ridiculous.

There are, however, other arguments against the position of Averroes. One is that, if the elemental forms are susceptible of more or less, then these forms must be liable to some continuous motion[30]. That is to say, these forms would not be truly generated, as a substance is generated; they would, rather, be like the realities brought about through local motion, increase and decrease, or alteration. Put differently, substantial change is not reducible to one of the accidental changes that involve continuous motion. But such a reduction would have to be the case, if a substantial form were susceptible of more and less.

Finally, Thomas argues that any variation in a substantial form results in a specifically different form[31]. A specific form is what it is, *specifically*. Individuals dif-

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[29] «Hec autem positio multiplicitur improbabilis est. Primo quidem quia esse aliquid medium inter substantiam et accidens est omnino impossibile: esset enim aliquid medium inter affirmationem et negationem. Proprium enim accidentis est in subiecto esse, substantie uero in subiecto non esse; forme autem substantiales sunt quidem in materia, non autem in subiecto: nam subiectum est hoc aliquid, forma autem substantialis est que facit hoc aliquid, non autem presupponit ipsum» (*De mixtione elementorum* [156:74-84]).

[30] «Deinde, impossibile est formas substantiales elementorum suscipere magis et minus. Omnis enim forma suscipiens magis et minus est diuisibilis per accidens, in quantum scilicet subiectum eam potest participare uel magis uel minus. Secundum autem id quod est diuisibile per se uel per accidens, contingit esse motum continuum, ut patet in VI Phisicorum: est enim loci mutatio et augmentum et decrementum secundum quantitatem et locum, que sunt per se diuisibilia; alteratio autem secundum qualites, que suscipiunt magis et minus, ut calidum et album. Si igitur forme elementorum suscipiunt magis et minus, tam generatio quam corruptio elementorum erit motus continuus: quod est impossibile, nam motus continuus non est nisi in tribus generibus, scilicet, in quantitate et qualitate et ubi, ut probatur in V Phisicorum» (*De mixtione elementorum* [156:90-107]).

[31] «Amplius, omnis differentia secundum formam substantialem uariat speciem; quod autem recipit magis et minus, differt quod est magis ab eo quod est minus et quodammodo est ei contrarium, ut magis albus et minus album. Si igitur forma ignis suscipiat magis et minus, magis facta uel minus facta speciem uariabit, et non erit eadem forma sed alia. Et hinc est quod Philosophus dicit in VIII Metaphisice, quod sicut in numeris uariatur species per additionem et subtractionem, ita in substantiis» (*De mixtione ele-*

fer within a species accidentally, but they must all be identical specifically, or else they are really members of different species. One can talk of more or less matter quantitatively —a bigger or a smaller man— but one cannot talk of more or less humanity.

Thomas' own solution to the problem is to say that the elements remain in a compound, not insofar as the substantial forms of the elements remain, but only insofar as the active and passive qualities of the elements remain[32]. These active and passive qualities remain in states that are more or less; that is, the precise amount of the qualities that are in the compound will be different from the amount of the quality that can be found in the pure element or that can be found in another compound. The warmth that is in mammals is from the element fire, for example, but the precise amount of warmth that is appropriate to a mammal is different from the amount of heat that there is in pure fire and different again from the amount of warmth in a plant. *That* there is warmth in the mammal is caused by the presence of the element fire; that it is *just the right amount* is caused by the substantial form of the mammal. The elemental powers thus remain in the compounds and become the powers of the compound. The elements, says Thomas, are present in the compounds *in virtute*, which means that the substantial forms of the elements are not present but that the elemental qualities are present, but present precisely as determined by the substantial form of the compound[33].

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mentorum [156:108-118]).

[32] «Oportet igitur alium modum inuenire, quo et ueritas mixtionis saluetur, et tamen elementa non totaliter corrumpantur, sed aliqualiter in mixto remaneant».

«Considerandum est igitur quod qualitates actiue et passiue elementorum contrarie sunt ad inuicem, et magis et minus recipiunt. Ex contrariis autem qualitatibus que recipiunt magis et minus, constitui potest media qualitas que sapiat utriusque extremi naturam, sicut pallidum inter album et nigrum, et tepidum inter calidum et frigidum. Sic igitur remissis excellentiis qualitatum elementarium, constituitur ex hiis quedam qualitas media que est propria qualitas corporis mixti, differens tamen in diuersis secundum diuersam mixtionis proportionem; et hec quidem qualitas est propria dispositio ad formam corporis mixti, sicut qualitas simplex ad formam corporis simplicis. Sicut igitur exrema inueniuntur in medio quod participat naturam utriusque, sic qualitates simplicium corporum inueniuntur in propria qualitate corporis mixti. Qualitas autem simplicis corporis est quidem aliud a forma substantiali ipsius, agit tamen in uirtute forme substantialis; alioquin calor calefaceret tantum, non autem per eius actionem forma substantialis educeretur in actu, cum nichil agat ultra suam speciem. Sic igitur uirtutes formarum substantialium simplicium corporum in corporibus mixtis salvantur».

«Sunt igitur forme elementorum in corporibus mixtis, non quidem actu sed uirtute. Et hoc est quod Aristotiles dicit in I De generatione: "Non manent igitur — elementa scilicet in mixto— actu ut corpus et album, nec corrumpuntur nec alterum nec ambo: saluatur enim uirtus eorum» (*De mixtione elementorum* [156-157:119-153]).

[33] Mario Enrique SACCHI makes the point that the elemental qualities, which are accidental forms, cannot be present *in actu* in the chemical compound, for if they were then the natural contrariety of the elemental qualities would destroy the compound. If, for example, the quality of heat (from fire) were simply and actually present in the compound in which the quality cold (from earth) were also simply and actually present, the result would be an impossibility, for the same substance cannot be simultaneously hot and cold. What was true for Thomistic chemistry is also true in today's terms. The electrical equilibrium of the atom, for example, requires that the negative charge of the electron be balanced by the positive charge of the proton. This balance or equilibrium, however, cannot be a balance in which the atom is actually negatively charged and also actually positively charged, for the same atom cannot be simultaneously negative and positive. Yet it would be wrong to say that the negative and positive charges of the electron and proton were simply non-existent. Hence, we must say of the electrical

Here I should explain that, when Thomas says that the elements are present in a compound *virtualiter,* he means that the compound is made out of the elements but that the elements in the compound are not numerically identical with the elements before they are in the compound. Thus, the elements undergo a genuine substantial change, the result of which is that they are not substantially present in the compound. The compound is what it is, in part, because it has been made out of certain elements. This fact means that the powers of the compound are what they are because of what the compound has been made out of. An animal is warm because it was made out of the element fire, but fire does not exist in the animal.

In the teaching of Thomas Aquinas, a *virtus* or power can be present in a thing even though that to which the power properly belongs is not in the thing. Thus, for example, Thomas claims that the male semen before conception has the power (*virtus*) of a human soul but does not actually have a human soul[34]. This power in the semen acts to dispose the menstrual matter in order that the matter may receive the form which is the human soul, and the semen does this even though it is not itself ensouled but only empowered by one of the soul's powers. Similarly, Thomas teaches that an instrumental cause may possess the power of the primary efficient cause, even though such power is not proper to or permanent in the instrument[35]. A knife, for example, may be said to have the power of the art of sculpting, insofar as the sculptor may use the knife for sculpting. It would make no sense at all to say that the sculptor himself is in the knife, either potentially or actually, although we might speak metaphorically in this way. The sculptor does, however, really move the knife and move it in the precise ways to sculpt some wood, and this sculpting motion is genuinely, although instrumentally, in the knife. In this sense, the power of the sculptor is in the knife, even though the sculptor is not. For a different example, Thomas will say that God's power is in the whole of creation, but he would not say that God is substantially in the creatures[36]. There is, therefore, a linguistic and conceptual basis for Thomas' way of talking when he says that the elements remain in compounds, not according to their substantial forms, but according to their powers.

ALBERT AND THOMAS

Let me now compare the positions of Albert and of Thomas. The position of Albert on the presence of elements in compounds is guided by two principles. First, there cannot be a plurality of substantial forms in any one substance. Second, whenever the properties of some substantial form, nature, or essence are present, then the substantial form, nature, or essence which is the cause of these properties must be actually present. Making use of these two principles, Albert sought to give an account of three empirical facts. First, when a compound is destroyed, it gives rise

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charges what Thomas says of the elemental presence: they are present not actually but *virtualiter. Contrariedad y equilibrio en la naturaleza de las substancias materiales* (Buenos Aires: Basileia, 1997), 99-106.

[34] *Quaestiones disputatae de potentia Dei*, q. 3, a. 9, ad 9.

[35] *Quaestiones disputatae de potentia Dei*, q. 3, a. 7, ad 7.

[36] *Scriptum super libros Sententiarum.*, lib. 2, d. 1, q. 1, a. 4, sol.

to not just any natural successor but only to certain successors. That is, at the death of an animal, the decomposition of the corpse yields very definite and predictable results. The predictable results are that certain combinations of the elements emerge and no other combinations. This fact is taken by Albert as an indication that the elements are substantially present, or that the substantial forms are present in the compound. Second, the active and passive qualities of the elements are present in the compounds —indicating that the elements are substantially present— but these qualities are always present in the compounds in a mixed way, in a different way, and in a different quantity from the way in which they would normally be present in the pure elements. This is an indication to Albert that the secondary being of the element has been lost in the compound. Third, the elements seldom or never exist in their pure state. Normally we encounter compounds of one sort or another. The elements themselves are fundamentally suited to being in another substance. As Albert says, the form of the element is a *via ad aliud.*

Taking account of all of this, not wishing to affirm a plurality of substantial forms, and seeing no significant differences in the positions of Avicenna, Averroes, and Aristotle, Albert holds that elements are a metaphysical oddity: not quite a substance or an accident, but a hybrid between the two.

Thomas, on the other hand, agrees completely with the metaphysical principle that there cannot be a plurality of substantial forms, but he does not accept Albert's second principle that the presence of proper qualities indicates the presence of the proper substantial form as the cause of those qualities. Thomas does not think, for example, that the presence of heat and moisture in an animal indicates the presence of the substantial forms of fire and of water in the animal. The presence of heat and moisture in the animal *does* indicate that the animal was made of the elements fire and water and that the powers of these elements remain in the animal, but it does not indicate the presence of the substantial forms of the elements in the animal.

On the empirical evidence that Albert had considered, Thomas would agree with most of the empirical facts but would disagree with some of the interpretations. Thomas, for example, agrees that compounds decompose in regular patterns, but he takes this to mean not, as Albert did, that the elements are substantially present in compounds, but that the elements give rise to the specific secondary matter of the compounds. Water comes out of the decomposing animal, not because the substantial form of water is in the animal but because the secondary matter of the animal is moist. Furthermore, the fact that the active and passive qualities of the elements are different in the compound from what they are in the pure element is an indication to Thomas, not that the elemental qualities are destroyed, as Albert said, but that the elemental qualities remain, although in the compound these qualities are different in degree, for they are now qualities of the substantial form of the compound, not of the element.

On the third point, Thomas seems to differ from Albert on what the empirical evidence is. Albert thought that the elements seldom or never exist on their own in their pure state. Thomas, on the other hand, seems to regard the elements as first and foremost substances that do or can exist on their own. Thomas thinks of the elements as substances, and hence what is true of any substance is true of the elements. Albert, by contrast, thinks of the elements as quasi-substances that always or almost always exist in compounds.

Thomas, the more rigorous metaphysician, insists that the element just cannot be the sort of hybrid entity that Albert supposes it to be. Albert tries to be as faithful as he can be to the empirical evidence, and in so doing finds a need to be metaphysically creative.

CONCLUDING SUGGESTION

The term «element» or the concept of elementarity is, as I have indicated, a relative or analogous term. The term «element» is used differently when it is used of artifacts, of living organisms, of chemical compounds, and of atoms. The differences that we have just seen between Albert and Thomas are interesting enough historically, but I wonder whether they might also shed some light on our current understanding of elementarity and of matter. As I understand things, there is a very big difference between the sort of elementarity one might talk about in regard to the elementary particles such as protons, electrons, or quarks, on the one hand, and chemical elements such as sodium or chlorine, on the other. The difference is a rather striking one. Whereas it is clear to everyone that sodium and chlorine are substances, it is not so clear that quarks, electrons, and protons are substances. Some, in fact, even doubt that the subatomic particles are real, but I shall leave that problem aside, for I think it is safe to say that in the broad philosophical tradition of Aristotelian realism the subatomic particles must be real in some way. The question is, in what way? The problem is that, whereas the elements on the periodic table can usually be known perceptually and immediately to be substances, the subatomic particles can only be made to reveal traces of themselves in highly artificial conditions and for extremely short periods of time. It is as though the subatomic particles naturally resist the state of not inhering in another as in a subject but the chemical elements do naturally not inhere in another as in a subject.

One suggestion which I am tempted to make is the following. Perhaps something like Albert's view of elements is appropriate to understand the subatomic particles but Thomas' view is more appropriate to understanding elements at the levels of more complex matter, say, from the molecular level on up. What is tempting about this suggestion is the peculiarity of the way in which subatomic particles exist as substances. Just as Albert thought of the four elements as having a substantial existence that was not independent subsistence but rather a *via ad aliud*, so today we might think of the subatomic particles as resisting independent subsistence and of having the sort of reality that supports larger atomic, molecular, and chemical realities. On the other hand, the elements on the periodic table are clearly substances in the sense that they obviously, in themselves, do not inhere in another as in a subject. These chemical substances can become the material out of which a compound is formed, but when this happens it is fair to say that the chemicals exist not substantially in the compound but only insofar as some powers of the elements can be found in compounds. On this interpretation the form of the subatomic particle would be a sort of hybrid: a substantial form, the tendency of which is precisely to inhere in another as in a subject. It would be a substantial form that behaves usually like an accidental form.

Against this, however, a Thomist of the strict observance might say that the argument which I have called the fundamental argument against Averroes is an argument that has lost none of its force, in spite of the oddness of subatomic particles. Either something does inhere in another as in a subject (in which case it is an accident) or it does not (in which case it is a substance). This disjunction is a contradictory and admits of no third or middle possibility. There can, thus, be no hybrid form between the substantial and the accidental. Since there can be no hybrid form, then we must say that the subatomic particle when part of an atom, molecule, or chemical element, is *virtually*, not substantially, present. One of the features of this virtual presence is that, when bombarded with high energy particles, it can be made to give rise to the very brief substantial existence of a subatomic particle. For a very brief time a substance called a quark, electron, or proton does exist as a substance and not merely as a virtual presence in some other substance. This, the Thomist would say, is odd but metaphysically consistent with philosophical principles we know to be true. And so in the end, the Thomist would want to say that the notion of elementarity and of substance and accident remains analogously in tact. There is no need to suppose a new sort of hybrid form.

I must say that this sort of Thomistic economy wins the day, as far as I am concerned, although I think that we, like Thomas, owe a debt to Albert for having shown so well what the real problem is in explaining the difficult concept of elementarity.

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