

*Avicenna's Scientific
Method in Ben Jonson's
The Alchemist*

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Abstract

During the twelfth and the thirteenth centuries, known as the great age of translation, Arabic scientific and philosophical literature was transmitted to Europe through centers of translation in Spain. Alchemy, the art of transmuting base metals into gold revived from ancient Egyptian and Greek culture by Arab scholars, was one of the transmitted Arabic cultural products which had a great appeal in Europe. Avicenna, whose scientific method depends on observation and experimentation, rejects alchemy because it is experimentally impossible to transmute base metals into gold. He considers alchemists cheaters who exploit people's lust for money. Translated into Latin, Avicenna's philosophical and medical writings became an integral part of European cultural legacy that the Renaissance inherited. This paper assumes that Ben Jonson was affected by Avicenna's legacy and traces the influence of Avicenna's scientific method and stance on alchemy on Jonson's play *The Alchemist* in terms of plot, theme, characterization, and dialogue. Satirically, Jonson dramatizes themes of greed, deception, and fraud through the careers of two conmen who set up a fake alchemy laboratory in order to swindle wealthy clients. What Avicenna proposes about alchemy has close affinity to what Jonson proposes in his play.

Key words

Alchemy – Ben Jonson – Avicenna – scientific method – *The Alchemist* – Medieval – Elizabethan culture.

In the twelfth and the thirteenth centuries, Arabic-European cultural contact flourished. During this period, known as the great age of translation, Arabs' science and philosophy were transmitted to Europe through centers of translation in Spain which was then under the Arabs' rule (Watt 60). Avicenna's scientific and philosophical legacy was translated into Latin and affected European Medieval and Renaissance culture. This paper aims at tracing the impact of Avicenna's scientific method on Ben Jonson's play The Alchemist.

Investigating the origin of the scientific method F.Betz writes, "The origin of modern scientific method occurred in Europe in the 1600s: involving a chain of research events from Copernicus to Newton" (21). Betz dates the origin of the scientific method to times after Avicenna's (980 – 1037) and attributes it exclusively to European scientists. Therefore, before going deep in discussing Avicenna's scientific method and whether it has a relation to Ben Jonson's The Alchemist or not, the validity of the title of this paper itself requires to be examined. Whether Avicenna has or follows a scientific method or not has to be investigated.

In Stedman's Medical Dictionary it is defined as:

The principles and empirical processes of discovery and demonstration considered characteristic of or necessary for scientific investigation, generally involving the observation of phenomena, the formulation of a hypothesis concerning the phenomena, experimentation to demonstrate the truth or falseness of the hypothesis, and a conclusion that validates or modifies the hypothesis. ("Scientific")

According to this definition, some of Avicenna's heritage is to be examined in order to decide if he follows a scientific method

or not. In *De Mineralibus*, part 2 section 5 of Avicenna's famous encyclopedia of philosophy and natural sciences *Sufficiencia* (1014-1020) (Kitab Al-Shifa or The Book of Healing), he discusses the formation of rocks, mountains, and fossils. Concerning rocks and mountains, he proposes that the earth raised from the sea floor would be transformed into rock "partly by the hardening of clay in the sun and partly by the congelation of water" (Sezgin 48: 149). He observes:

Stone has been formed from flowing water in two ways: (a) by the congelation of water as it falls drop by drop or as a whole during its flow, and, (b) by the deposition from it, in its course, of something which adheres to the surface of its bed, and then petrifies. Running water has been observed, part of which, dripping upon a certain spot, solidifies into stone or pebbles of various colours, and dripping water has been seen which, though not congealing normally, yet immediately petrifies when it falls upon stony ground near its channel. We know therefore that in that ground there must be a congealing petrifying virtue which converts the liquid to the solid. (Al-Rawi 4)

He accounts for the formation of fossils as follows: "The cause of this phenomenon is a powerful mineralizing and petrifying virtue which arises in certain stony spots, or emanates suddenly from the earth during earthquakes, and petrifies whatever comes in contact with it (qtd in Sezgin 48:150). He supports this hypothesis by observation:

I myself have seen a loaf of bread in the shape of a round, flat-cake baked, thin in the middle, and showing the marks of teeth – which had petrified but still retained its original colour, and on one of its sides was the impression of the lines of the oven. I

found it thrown away on a mountain near Jajarm, a town of Khurasan (qtd in Sezgin 48: 150).

These extracts clearly tell that Avicenna depends on accurate constant observation of nature in formulating his theories on geology. This scientific attitude also appears in his writings on astronomy. Although the part devoted to Astronomy in *Sufficiencia* is mainly based on Ptolemy's Almagest, notably summarizes it, Avicenna contradicts Ptolemy in some points because of the results of observation. He examines the validity of the Almagest statements according to observational results either reached by other astronomers or by himself. George Saliba writes:

He takes the parameter for the inclination of the obliquity, determined by Ptolemy to have been 23;51 degrees, and reports the results reached by the astronomers working during the reign of the caliph al-Mamun as being 23;35. He then claims that it had decreased after that by some one minute, and that he himself had observed the inclination and found it in his own days to be less than that by another amount equal to half a minute approximately. (1:90)

In a section of his medical encyclopedia Canon of Medicine Avicenna studies the effects of drugs administered to cure diseases in man and the causes of these effects. He proposes that the way of such investigation should be experimentation (Al-Fahaam, Anawati and Bayoumi 55). He puts seven conditions for a reliable experimental investigation. A.C. Crombie summarizes them as follows:

- 1 - The drug must be free from any extraneous, accidental .
- 2 - The experimentation must be done with a simple and not a composite disease.
- 3 - The drug must be tested with two contrary types of disease by its essential qualities and another by its

accidental ones 4 - The quality of the drug must correspond to the strength of the disease. 5 - The time of action must be observed, so that essence and accident are not confused. 6 - The effect of the drug must be seen to occur constantly or in many cases, for if this did not happen it was an accidental effect. 7- The experimentation must be done with the human body. (Sezgin 48:141)

Repeated observation of the results of accurately conditioned experiments allows the formation of a conclusion about the efficacy of a drug through syllogism. In *Sufficiencia* Avicenna says, "Testing and experiments do not provide knowledge on account of the many observations of that fact only, but on account of the syllogism that is associated with it" (qtd in Gutas 400). He explains how syllogism should work to reach true conclusions out of repeated observation.

The procedures that Avicenna follows make it quite clear that he has the basics of the scientific method in its modern sense. Here Avicenna provides a typical model of scientific investigation where experiments are to be accurately conditioned and controlled, constantly repeated and observed, and hypotheses are to be tested and modified according to the results of experimental observation and syllogism.

According to this scientific procedure, Avicenna tests theories that are held to be true against experimental results. One of the most famous tested theories is that of alchemy; the possibility of transmuting base metals into gold. According to The Dictionary of Alchemy, the word 'alchemy' is directly derived from the Arabic *al kimiya*, used in the Arab world to denote the art of producing the elixir or the philosopher's stone and the process of transmutation (Haeffner 38). "*al*" is the Arabic for "the" and *kimiya* is traced back

to the Greek word *Χημεία* (*khêmeia*); the Egyptian art of transmutation (preparation of silver and gold) which may be derived from *khem* (an ancient name for Egypt) (Huges 20). The etymology of the word indicates the evolution, development, and transmission of the art. The roots of alchemy were in Egypt; the *Corpus Hermeticum*, works attributed to Herms, formed the basis of alchemy (Khan 1:134). Egyptian and Hellenistic alchemical texts dated from the first millennium B.C. (Raff xii). In the eighth century and the ninth century -the era of rapid increase of translation into Arabic (The Abbāsīd era)- these ancient alchemical texts were translated and alchemy was studied systematically (Carusi 1:52). Arab scholars began to practice alchemy and write their own treatises. Jabir ibn Hayyan, Abu Bakr Al-Razi, and Muhammad Ibn Umayl are famous examples (Moureau1:56). Alchemy became a cultural trend thereby.

In the fifth section of the first book of *De Mineralibus* of *Sufficiencia*, while the belief in it was extremely widespread, Avicenna rejects alchemy. He confirms that each substance has a "specific difference"; a factor that determines its identity and it is experimentally impossible to change it in order to obtain another substance with another specific difference. And what can happen is a change in the appearance of the substance by exposing it to certain conditions:

As to the claims of the alchemists, it must be understood that it is not in their power to bring about any true change of species. They can, however, produce imitations that are perceived by the senses, dyeing the red [metal] white so that it closely resembles silver, or dyeing it yellow so that it closely resembles gold. They can, too, dye the white [metal] with any colour they desire, until it bears a close resemblance to gold or copper; and they can free the leads from most of their defects and impurities. Yet

in these [dyed metals] the essential nature remains unchanged; they are merely so dominated by induced qualities that errors may be made concerning them, just as it happens that men are deceived by salt, *qalqand*, sal-ammoniac, etc... As for the removal or imparting of dyes [to metals to make them look like each other], or such accidental properties as odors and densities these are things which one ought not to persist in denying merely because of lack of knowledge concerning them, for there is no demonstration whatever of their impossibility. (qtd in Sezgin 48:148, Gutas 422)

Avicenna adds that the change in appearance can deceive some people and make them believe that the substance is converted into gold or silver:

I do not deny such a degree of accuracy may be reached as to deceive even the shrewdest, but the possibility of eliminating or imparting the specific difference has never been clear to me. On the contrary, I regard it as impossible, since there is no way of splitting up one combination into another. Those properties which are perceived by the senses are probably not the differences which separate metals into species, but rather accidents or consequences, the specific differences are being unknown. And if a thing is unknown, how is it possible for anyone to endeavor to produce it or to destroy it? (qtd in Sezgin 48:148)

Avicenna concludes with the general statement of the theory on the basis of which the invalidity of alchemy is established:

It is likely that the proportion of the elements which enter into the composition of the essential substance

of each of the metals enumerated is different from that of any other. If this is so, one metal cannot be converted into another unless the compound is broken up and converted into the composition of that into which its transformation is desired. This, however, cannot be affected by fusion, which maintains the union and merely causes the introduction of some foreign substance or power. (qtd in Sezgin 48:148-9)

In his introduction to *Sufficiencia* he declares that "those who have most merits and science contradict the followers of transmutation and reject their opinion as false" (qtd in Rashid 3: 879). In a treatise on astrology "Resala fi Ahkam Al-nujuum", Avicenna gives some thoughts about the motives that pushed people to be interested in alchemy and to devote huge literature to it:

The preference of man for rest and easy life made him believe that the acquisition of these goods is only possible through wealth and that this can only be acquired, except for rare cases of inheritance or an extraordinary windfall, by a lot of pain and work; consequently some have imagined a way of finding this wealth without effort and without pain and invented alchemy as a method and the most sure science to change all vile metals into silver and silver into gold. They have left numerous books on this subject, for instance Jabir's writings, and those of Ibn Zakariyya al- Razi. (qtd in Rashid 3:877)

Thus Avicenna's heritage clearly indicates that he depends on observation, hypotheses formulation, and experimentation which are the principles of the scientific method. Whether this heritage

was transmitted to Europe and what effects it had on European culture are to be investigated.

In his brief history of philosophy included in *Opus Maius* (1266-7) Roger Bacon writes, "Avicenna in particular, the imitator and expositor of Aristotle, and the man who competed philosophy as far as it was possible for him to do so, composed a threefold volume in philosophy....The Latins have the first in certain parts...., that is the book of Sufficiency" (qtd in Sezgin 48:136). In his *Inferno* Dante Alighieri (1265 – 1321) places Avicenna in Limbo along with other great non- Christian scholars (Dehsen19). This is enough to prove that Avicenna's works were transmitted to Europe through translation and had a remarkable effect on European culture. However, some details about this transmission and its effects are worth mentioning.

Of Avicenna's encyclopedic work *Sufficiencia*, consisting of four parts (Logic, Physics, Mathematics, and Metaphysics) nearly three were translated during the Middle Ages (Reit 1: 104 –5). These translations are quoted, paraphrased, or referred to in many Medieval European writings. Reit mentions the following examples:

Dominc Gundisalvi compiled several treatises containing quotations and paraphrases from works by Avicenna. ...Several writers active about 1240, such as Guillaume of Auvergne, Alexandre of Hales, Jean of La Rochelle show in their comments or censures that they had precise knowledge of Avicenna's *De Anima*....Various works of Avicenna enter prominently into the philosophical- scientific encyclopedia of Albert Magnus who started to work in it in the middle of the thirteenth century. ...Thomas Aquinas's writings contain more than 400

explicit quotations of Avicenna drawn mainly from *DeAnima* and the *Metaphesica*. (1:105- 6)

Avicenna's work was studied in many European universities. Remarkable European scholars considered Avicenna's *Philosophia Prima* the privileged way of access to Aristotle's Metaphysics and its main tool of interpretation (Hasse, Nicholas, and Bertolacci 302). Traces of this tendency can be found in Robert Grosseteste in Oxford; its full development occurs, however, Paris by masters of arts such as John Blund, and professors of theology such as Ronald of Cremona and Roger Bacon. The university of Paris documents a progressive acceptance of Avicenna's work as John Blund witnesses (Hasse, Nicholas, and Bertolacci 302).

Three medical works by Avicenna were available in Latin versions in the later Middle Ages: al-Qanun fi 'l-tebb [Canon of Medicine], al-Adwia al-qalbiya, and al-Orjuza fi 'l-tebb (Parsa 1:107).

The Canon, in its Latin version, came into use among medical scholars as well as in university courses in Europe during the Middle Ages:

The earliest testimony is a syllabus for mastership candidates at the University of Montpellier included in a papal bull of 1309. The Canon is recommended in this document as one of a number of optional textbooks. By 1340, however, it had been firmly established in various course programs At Paris the Canon is first mentioned as lecture material in 1330, and it also appears in the library catalogue of the medical faculty made in 1395. Following the example of Paris, German universities founded in the fourteenth and the fifteenth centuries also admitted the canon to their programs of study.(Parsa 1:107)

Thus Avicenna's philosophical and medical writings became an integral part of European cultural legacy that the Renaissance inherited. This paper assumes that Ben Jonson was affected by Avicenna's legacy, notably concerning his scientific method and this effect appeared in The Alchemist. No historical evidence can be provided about whether Jonson read Avicenna's Latin translations or not. However, evidence can be provided about Jonson's familiarity with Avicenna. Jonson mentioned Avicenna in The Magnetic Lady: "Galen or Rasis, Avicen, Averroes" (3.3.19). Jonson's familiarity with Avicenna may have been through second-hand readings.

Actually, Avicenna had a great impact on European culture, however, regarding alchemy, exponents had a greater impact. Latin translations of Arabic alchemical authorities were greatly appealed in Medieval and Renaissance Europe. A large corpus of Latin alchemical literature had been built up. Editions found their way in large numbers into English libraries, both private and institutional, a handful of alchemical works were published in vernacular, and many circulated in manuscript forms (Webster 308,9).

The cultural milieu within which The Alchemist was written was a heyday of alchemy. Jonson came through several alchemical writings as M.B. Butler describes Jonson's experience of alchemical writings, as appeared in The Alchemist and Mercury Vindicated from the Alchemists at Court (1615) as "genuine, and he drew on many authorities: Arnold of Villanova, Geber, Paracelsus, Robertus Vallensis, Sendivoguis, and Martin del Rio, besides a German collection of treatises *De Alchemia*, and English writings by George Ripley and Roger Bacon" (qtd in Nunez 257). The result of this experience was an opponent stance. The Dictionary of Literary Terms and Literary Theory includes The Alchemist in the definition of satirical comedy: "A form of comedy, usually dramatic, whose purpose is to expose, censure,

and ridicule the follies, vices, and shortcomings of society and individuals who represent that society....In English literature, classic examples of the genre are Ben Jonson's Valpone (1606) and The Alchemist (1610)..." (Cuddon 634).

This satirical stance on alchemy reinforces the hypothesis that Avicenna's scientific method, notably his view of alchemy, had an influence on Jonson. However, it can be argued that Jonson was affected by Francis Bacon (1561-1626), who "attempted to apply the inductive method of modern science and urged full investigation in all matters"(Brock 17). Actually, Jonson had great respect for Bacon and seemed to know a great deal about him. He lauded Bacon highly in Timber (2.938-47) and in Und. LI praised him on his sixtieth birthday, he had a copy of the *Novum Organum* in his personal library, and in Timber (2.2090-2124) he paraphrased a long passage from The Advancement of Learning (Bk.1 Ch4) on the distemper of learning (Brock 17). However, even Bacon, showed an ambiguous and/or an ambivalent attitude towards alchemy.

Sometimes Bacon attacks alchemy and alchemists for lack of experimentation. In his *Novum Organum* (1620) he writes: "Alchemists out of a few experiments of the furnace have built up a philosophy framed with reference to a few things. Those who accepted such experimental results has been infected by their imagination" (qtd in Janacek 75). Immediately after criticizing alchemists in the passage quoted above, he writes," Not but that Alchemists have made a good many discoveries, and presented men with useful inventions ...The study of nature is engaged in by the mechanic, the mathematician, the physician, the alchemist,..." (qtd in Janacek 77) Although he was clearly criticizing alchemists, he grouped them with practioners of substantial disciplines.

In "Experiment Solitary Touching the Making of Gold", a section of *Sylva Sylvarum* or A Naturall Historie in Ten Centuries (1627), Bacon begins by stating that gold can be made artificially, but the remarks that follow indicate why experiments fail. "The world hath been much abused by the opinion of making gold. The work itself I judge to be possible; but the means to effect it are in the practice full of error and imposture, and in the theory full of unsound imagination" (qtd in Linden 115).

Bacon's ambivalence towards alchemy refutes the assumption that Jonson's view of alchemy was affected by Bacon's and at the same time supports the hypothesis that it was affected by Avicenna's. Going deep into The Alchemist can confirm this hypothesis.

From the very beginning of the play, Jonson announces his stance on alchemy and what kind of play about alchemists he presents. In the argument, he tells about three characters: a corrupted servant, a cheater, and a whore and indicates that they manage their frauds on the basis of alchemical processes which are proved to be in vain.

*Much company they draw, and much abuse,
In casting figures, telling fortunes, newes,
Selling of flies, flat bawdry, with the stone:
T'll it, and they, and all in fume are gone* (Argument 9-12)

The play opens at Subtle – Face quarrel which reveals that alchemy is a mere fraud they practice for the sake of money. Each of them tells about each other's humble past and how the alleged alchemical practice is supposed to promote them. Jonson makes fakeness of their practice clear throughout the scene. Dol's enthusiastic attempts to stop the quarrel which threatens the success of their fraud is a reminder that what is to follow is an intrigue "Will you have / The neighbours heare you? Will you

betray all? (1.1. 8-9). Face overtly describes Subtle's skills as "Your alchemy and your Algebra, / Your mineralls, vegetalls, and animalls, / Your conjuring, cosning, and your dozen of trades" (1.1.38-40). The scene ends with the three cheats preparing themselves to welcome a victim. "Get you / Your robes on. I will meet him, as going out." (1.1. 196-7).

Within this fraudulent atmosphere Jonson begins to create a lifelike alchemical world in Lovewit's house. One of Jonson's significant tools of building this world is references to Subtle's alchemical laboratory. The early seventeenth century audience was familiar with laboratories. Christopher Hill indicates that "laboratory [. . .] was in the workshops of metal- workers, glass-makers, paper-makers, dyers, brewers, sugar-refiners- new industries or industries in which new processes had been introduced" (qtd in Shanahan 45). Jonson seeks to show his audience how the alchemical laboratory which they are familiar with and believing in is a part of making the fraud more credible. Face refers to the laboratory equipment: " ...credit for your coales, / Your stills, your glasses, your materialls, / Built you a fornace,..." (1.1.43-5). Another significant tool is references to recent or contemporary alchemical authorities: "The spirits of dead HOLLAND, and living ISAAC" (1.2.109). These names recall the audience's deeply rooted alchemical beliefs and associate them with what is going on in Lovewit's house. Thereby, Jonson uses his deep knowledge of alchemy as a "potential source of illumination and as well as a vehicle for satiric attack" (Linden 120). He means to uncover for his audience how alchemical frauds are carefully built.

The rest of Act I shows two of the alchemist's clients. The three deceiving partners aim at making easy earnings. Their clients resort to alchemy because they have the same aim. This is exactly what Avicenna considers the motive that makes alchemists and

their clients devoted to alchemy. Dapper, the first client, is a typical example. He is a gambler who comes to the alchemist to provide him with an attendant spirit that enables him to win at all kinds of gambling; horse races, dice, and cards: "*Yes, Captayne, I would have it for all games*" (1.2.85) . Drugger, the second client, wants the alchemist to help him in attracting more customers to his newly established business. Jonson involves long dialogues between Face and the pathetic clients about the fees which they should pay. This draws his audience's attention to the clients' folly as they pay for Subtle's promises.

Through Subtle's dialogues with the two clients, Jonson associates alchemy with superstition and witchcraft. This association serves a double function. It creates an actual alchemical situation as those with which Jonson's audience is familiar. This allows more audience involvement and makes the results of this situation at the end of the play more impressive and illuminating. The association also juxtaposes practical alchemy with alchemical writings assumptions. It is too far from being the alleged philosophical science.

For Dapper, he is promised to have a spirit that will enable him to win in all games. Moreover, Subtle and Face convince him that the Queen of Fairies is his aunt and she will give him a huge wealth.

FACE. The doctor

Swears you are-

SUBTLE. Nay, captaine, yo 'll tell all now.

FACE. Allyed to the queene of faerie.

DAPPER Who? That I am?

Beleeve it, no such matter-

.....
FACE. But say to me, Captayne, I'll see her Grace

DAPPER. I'll see her Grace. (1.2. 124-6, 161-2)

For Drugger, he asks Subtle to use his magical skills to guide him where to put the door and the shelves: "*And I would know, by art, sir, of your worship, / Which way I should make my dore, by necromancie*" (1.3.10-11).

Sir Mammon Epicure, the third client, is the strikingly obsessed by alchemy. He is eagerly waiting for Subtle's researches to be finished in order to obtain the philosopher's stone and become an alchemist himself. As Subtle says, he dreams of using the elixir in curing plague and venereal diseases, restoring old women's youth, and making beggars rich. He thinks that he will benefit mankind to the degree that makes Nature feel ashamed of her passivity. Subtle himself mocks at his deep belief in alchemy:

SUBTLE. With the sunnes rising: ' Marvaile, he could sleepe!

This is the day, I am to perfect for him

The magisterium, our great worke, the stone

.....
If his dream last, hee'llturne the age, to gold. (1.4. 13-5, 39)

When Mammon appears, he keeps stating the magnificent powers of the philosopher's stone to the skeptic Surly who scoffs at them. Through this argument, Jonson provides the criteria according to which he, as Avicenna does, attacks alchemy and alchemists i.e. experimentation. As Mammon speaks of how the philosopher's stone will enable him to change everything to gold, to combat all diseases, and to give youthful strength to the old, Surly puts it short and to the point: he will never believe unless he experiences with his own eyes the effects of the philosopher's stone.

MAMMON. Yes, and I'll purchase Devonshire, and Cornwaile,

And make them perfect Indies! You admire now?

SURLY. No faith

MAMMON.. *But when you see th' effects of the great med'cine!*

*Of which one part projected on a hundred
Of Mercurie, or Venus, or the Moone
Shall turne it, to asmany of the Sunne;
Nay, to a thousand,so ad infinitum:
You will believe me.*

SURLY. *Yes, when I see't, I will.*(2.1.35-42)

Jonson employs Mammon-Surely dialogue to start his direct satire on alchemy. He incorporates in Mammon's speech references to alchemical authorities and believed legends and makes Surly logically criticize them. At the same time Jonson highlights how Mammon's obsession with alchemy blocks his mind as he goes on defending alchemy and trying to convince Surly with more legends. For example, Mammon tells Surly that Adam, Moses, and Solomon were alchemists and wrote texts on the powers of philosopher' stone. When Surly exclaims if Adam could write, Mammon answers that he could write in German. As Surly wonders if Adam spoke German, Mammon confirms that German is the first spoken language.

MAMMON. *Will you believe antiquitie? recordes?
I'll shew you a booke, where MOSES, and his sister,
And SALOMON have written, of the art;
I, and a treatise penn'd by ADAM.*

SURLY. *How!*

MAMMON. *O'the philosophers stone, and in high-Dutch.*

SURLY. *Did ADAM write, sir, in high-Dutch?*

MAMMON. *He did*

Which proves it was the primitive tongue. (2.1.80-6)

Then he proceeds on telling legends about the philosopher's stone. He presents alchemical interpretations of well-known myths (2.1.89-104). Jonson, thereby, effectively recapitulates a familiar

feature of Renaissance alchemical writings (Linden127). However, with Mammon's extravagancy, especially when the aim is to convince the skeptic Surly, Jonson elicits his audience's ridiculous laughter.

In the next scene, Jonson goes on clarifying how the illusion of alchemy is created and marketed and what kind of people the clients of alchemists are. Face tells Mammon that the philosopher stone is about to be ready, and he kept blowing the coal in the furnace to allow the process to be completed. Face describes to Mammon the colors that mark the stages in the alchemical process: "*Have wak'd, to reade your severall colours, sir, / Of the pale citron, the greene lyon, the crow, / The peacocks taile, the plumed swan*" (2.2.25-7). Mammon shows deep belief and anxious waiting for the production of the philosopher's stone and keeps dreaming of the money and sensual delights that will be available by the stone's power. The process of color transformation is actually what Avicenna refers to as a method by which some people can be convinced that a base metal can be changed into gold. However, Jonson involves it in an earlier alchemical stage i.e., producing the philosopher's stone.

In the following scene Jonson uses his knowledge of alchemy to get his audience experience a neatly designed alchemical intrigue. He creates a situation where a phase of an alchemical fraud is professionally carried out by Subtle and Face on the obsessed Mammon and juxtaposes Mammon's deep belief to Surly's satirical skepticism. Whereas Mammon is totally convinced that he will get the philosopher's stone which Subtle is producing, Surely shows total disbelief: "*Indeed, sir, somewhat causative of believe / Toward your stone: would not be gull'd*" (2.3.2607). In Surly's reaction, Jonson seems to involve his own point of view whose impression on the audience is enhanced by the lifelike alchemical setting. Jonson makes Subtle's and Face's language and

theoretical references typical to those used in authentic alchemical writings and makes Surly's reaction increasingly satirical. Whereas Subtle and Face use alchemical terms and refer to laboratory apparatuses and alchemical materials, Surly mocks their language and finds it a means to cheating fools.

*SUBTLE. Looke well to the register,
And let your heat, still, lessen by degrees,
To the Aludels.*

FACE. Yes, sir.

SUBTLE. O'the Bolts-head yet?

FACE. Which, on D. sir?

SUBTLE. I. What's the complexion?

FACE. Whitish.

*SUBTLE. Infuse vinegar,
To draw his volatile substance, and his tincture:
And let the water in Glasse E. be feltred,
And put into the Gripes egge. Lute him well;
And leave him clos'd in balneo.*

FACE. I will, sir.

SURLY. What a brave language here is? next to canting?

(2.3.34-42)

In Subtle's attempts to convince Surly, Jonson includes several references to the alchemically accredited theory i.e. the mercury- sulfur theory. The widespread theory states that "all metals are a synthesis of mercury and sulfur, whose union might achieve varying degrees of harmony. A perfectly harmonious "marriage of mother and father of metals produces gold" (Haeffner 176).

*SUBTLE. Do e make theelementarie matter of gold:
Which is not, yet, propria material,*

.....

Where it turnes to sulphur, or to quick-silver:

Who are the parents of all other mettalls. (2.3. 147-154)

On this theory, the possibility of transmutation is based. Alchemists allege that they can provide the suitable catalyst for this "marriage" through complex alchemical processes, so that they can produce gold in a less time than Nature needs: "*And that / Our art doth furder*" (2.3.137).

This argument dramatizes how alchemists' defenses of the theory can be logically refuted. Subtle argues that if Surly believes that eggs can be hatched by putting them in a heap of dung, he must believe that base metals can be changed into gold for it is a greater miracle to convert an egg into chicken. Surly indicates that conversion to gold is practically impossible for base metals are different by nature from gold, whereas an egg contains the embryo which is potentially a chicken.

SUBTLE. Sir, doe you

Beleeve that eggs are hatch'd so?

SURLY. If I should?

SUBTLE. Why, I thinke that the greater miracle.

No egge, but differs from a chicken, more,

Then metals in themselves.

SURLY. That cannot be.

The egg's ordain'd by nature, to that end:

And is a chicken potentia.(2.3.130-5)

The audience's awareness that Subtle actually fails to produce the philosopher's stone that he promises and therefore asks Mammon to give him more time to handle a problem in the laboratory enhances the validity of Surly's rationale. "*That Alchemie is a pretty kind of game /Somewhat like tricks o'the cards, to cheat a man / With charming*" seems to be a reasonable conclusion (2.3.179-181). Jonson includes in Surely's speech many

of the odd alchemical terms and various ingredients that are used to perplex people and cheat them.

*SURLY. Of your elixir, your lac viriginis,
Your stone, your med'cine, and your chrysosperme,
Your sal, your sulphur, and your mercurie,
your oyle of height, your tree of life, your bloud,*(2.3.182-185)

Jonson proves what Surly thinks to be quite accurate. In scene 2.5, Jonson employs alchemical terms to highlight how alchemists use a sophisticated cant to deceive more victims. In their meeting with Ananias who, Subtle and Face use a bulk of technical terms such as "*Putrefication, / Solution, Ablution, Sublimation, / Cohobation, Calcination, Ceration and / Fixation*" (2.5.21-3) in order to convince Ananias that Subtle is a real philosopher not a heathen as he thinks. Jonson seems to warn his audience not to allow alchemists fool them by using the huge bulk of technical terms. Ananias afterwards confirms: "*And, with phiosophie, blinds the eyes of man*" (3.1.10).

At the end of the act he uses Drugger's reappearance to remind the audience that alchemy is a superstitious illusion as Drugger comes to Subtle to get a sign that can bring him good luck. Jonson humorously shows how Drugger is being fooled.

*SUBTLE. He first shall have a bell, hat's Abel
And, by it, standing one, whose name is Dee
In a rug gowne; there's D. and Rug, that's Drug:
And, right anesthim, a Dog snarlingEr;
There's DRUGGER, ABEL DRUGGER. That's his signe.
And here's now mysterie, and hieroglyphick!
Face. ABEL, thou art made.
DRUGGER. Sir, I doe thanke his worship.*(2.6. 19-25)

The one "whose name is DEE" is John Dee. This is a satirical reference to the most famous and influential Elizabethan alchemist. King James I had cleared him out of the court before the play was written (Yates 161). Jonson involves his name in a typically superstitious fraudulent practice. This reference makes Jonson's satire more relevant to his audience's real life and, therefore, more impressive.

With Ananias's return with Tribulation to give Subtle the extra money required for the production of the philosopher's stone, Jonson makes clear that Ananias's previous angry exit was not due to disbelief in alchemy. Ananias rejects the way Subtle speaks, hates his appearance, and thinks that his alchemical practices are immoral and therefore should not be used for moral goals: "*The sanctified cause / Should have a sanctified course*" (3.1.13-4). The dialogue between Ananias and Tribulation indicated no signs of doubting the possibility of transmuting base metals to gold. Thereby, Jonson introduces a further type of clients of alchemists; those who show disapproval of alchemy for religious and moral reasons but want to make use of its outcomes.

ANANIAS. I doe not like the man: He is a heathen.

And speaks the language of Canaan, truly.

TRIBULATION. I thinke him a prophane person, indeed.

ANANIAS. The visible marke of the Beast, in his fore-head.

And for his Stone, it is a worke of darknesse. (3.1. 5- 9)

This type of clients is also easily fooled by alchemists. Jonson humorously dramatizes how Subtle fools both Ananias and Tribulation. Subtle keeps telling them about his complex experiments, the several materials he uses, and the great privileges of obtaining the philosopher's stone: "*O, but the stone, all's idle to it! Nothing! / The art of angels, nature's miracle,*"(3.2.102-3). Then he convinces them to buy many metallic objects lying inside as a matter of charity for the benefit of orphans. These objects are the

articles brought by Mammon for being converted into gold. Increasing the sense of humor and emphasizing the fraudulent practices of Subtle and Face, Jonson, shortly afterwards, shows them planning for selling the same articles to Dapper.

SUBTLE. Another chapman, now, would buy 'hem outright"

FACE. ' Slid, NAB shall doo't, against he ha' that widow,
(3.3.57-8)

For more shocking satire, Jonson ironically juxtaposes what alchemists allege and what their clients, both the play's characters and audience, think of the alchemist's house and laboratory with what actually happens in Lovewit's house under Subtle's supervision. Clients think that alchemists' houses are places where science, philosophy, and creativity are always there. Jonson makes Lovewit's house a brothel. In 3.3 Subtle and Face manage to host a rich Spanish count in order to do sex with Dol for a huge sum of money. The Spanish count is the disguised Surly who wants to make sure that Subtle and Face are pimps as he has expected.

FACE. Shee must prepare perfumes, delicate linen,

The bath in chiefe, a banquet, and her wit,

For shee must milke his Epididimis.

Where is the Doxie? (3.3.20-3)

Jonson reveals how alchemists make use of their clients' greed and foolishness to make more money. For each client, they use a plan suitable for his character and beliefs. When Druggier and Kastril arrive, Face convinces Kastril that Subtle is highly experienced in the art of quarrelling which he wants to learn and that he has invented a device that can indicate to a quarrelling person the degree of safety or danger during fighting.

FACE. An instrument he has, of his owne making,

Where-with, no sooner shall you make report

Of any quarrel, but he will take the height on't,

Most instantly; and tell in what degree,

Of saftey it lies in, or mortalitie. (3.4.27-31)

He also convinces Kastril to bring his sister, whom he wants to marry, for Subtle is very successful in matrimonial matches for young widows: " *And then for making matches for rich widows*" (3.4.101).

When Dapper comes again after carrying out the instructions that Subtle gave him in order to receive the favours granted by the Queen of Fairies, Subtle and Face manage an intrigue based on Dapper's deep faith in her. Subtle, "*disguised like a Priest of Faery*", tells him that the Queen of Fairies has sent him to give her nephew this piece of her garment to cover his eyes with. Then, Subtle and Face blindfold him and ask him to throw away everything he has. He throws away his purse, his handkerchiefs, every bit of money in his pocket, and the silver seal he wears at his wrist. Here, Jonson uses blindfolding, physical blindness to symbolize mental blindness. Jonson makes the symbol more ironic as the disguised Subtle starts his speech to Dapper by telling him that the Queen of Fairies wants her nephew to sharpen his senses by using drops of vinegar: " *Hoping, that he hath vinegard his senses, / As he was bid, the Faery Queene dispenses,*" (3.5.5-6). After being blindfolded, Dapper shows absolute obedience to Subtle's and Face's instructions. This is the same with all alchemists' clients who blindly obey alchemists and put themselves and their possessions under the alchemists' control.

*FACE. Shee need not doubt him, sir. Alas, he has noting,
But what he will part withal, as willingly,
Upon her Graces word (throw away your purse)
As shee would aske it: (hand-kerchiefs, and all)
Shee can't bid that thing, but hee'll obey.
(If you have a ring, about you, cast it off,
Or a silver seale, at your wrist, her grace will send
Her faeries here to search you, therefore deale*

*Directly with her Highnesse.
He throws away, as they bid him.
If they find
That you conceale a mite, you are un-done.)
DAPPER. Truly, there's all.(3.5.19-29)*

When Mammon arrives, Face tells him that the final stage of the alchemical process (projection) is to be finished and that all the metallic stuff that he brought is to be changed into gold and silver. Simultaneously, Face tells Mammon that Dol is ready to meet him. Jonson makes the alleged development of the alchemical process parallel to the development of Mammon- Dol's relationship and ironically shows Face's double function as the alchemist's assistant and as a pimp. This conveys that alchemy is, as prostitution is, a vulgar, low-level transaction. Irony increases with Face's confirmation that Subtle must not know about Mammon-Dol's relationship for he is a serious scholar and this house is a place of virtue and honour. Face assures that "*The very house, sir, would runne mad. You know it / How scrupulous he is, and violent, / 'Gainst the least act of sinne*" and Mammon believes that "*H'is a divine instructor*" (4.1.13-5, 85). After Mammon gives Dol a diamond, Jonson ends the scene with both going upstairs together on Face's demand because their loud voices can be heard in the laboratory. This highlights to the audience that the alchemical language, laboratories, tools, and materials they believe in are used to create a fake setting of scholarship in order to veil dirty deals. With "*A man the emperor / Has courted above Kelley*" (4.1.89-90), Jonson associates the going-on incidents with the audience's real alchemical experiences and beliefs as he refers to the famous Elizabethan alchemist Edward Kelley.

Dirty intrigues proceed as Surly, disguised as a Spanish Count, arrives. As promised the Spanish Count asks for a lady to sleep with. As Dol is busy with Mammon, Subtle and Face plan to

offer him Dame Pliant, Kastril's widowed sister who has just arrived. Subtle-Face conversation in front of Surely who pretends that he is unable to understand English is dramatically significant. Jonson incarnates how Subtle and Face exploit their clients' ignorance and plan to rob them as they speak freely in Surly's presence. This can push Jonson's audience to think of what can be planned in alchemists' houses to rob ignorant people.

FACE. ' Slid, SUBTLE, how shall we doe?

SUBTLE. For what?

FACE. Why, DOL's employ'd, you know.

SUBTLE. That's true!

' Fore heaven I know not: He must stay, that's all.

FACE . Stay? That he must not by no meanes.

SUBTLE. NO, why?

FACE. Unlesse you'll marre all. Slight, hee'll suspect it.

And then he will not pay, not halfe so well.(4.3.50-5)

As Subtle and Face proceed in deceiving Mammon, Dol, according to Subtle's order, keeps speaking nonsense to convince Mammon that she has gone mad. When Subtle appears on the scene and finds Mammon in Dol's company, he keeps blaming Mammon for his sinful deed; making love to a woman in the holy precincts of the laboratory where the holy alchemical process is going on : "*Error? / Guilt, guilt my sonne! Give it the right name*" (4.5.38-9). This sin is expected to delay the production of the philosopher's stone which was about to be completed as the alchemical process "*stood still this half an hour*" (4.5.43). In Subtle's severe blame, Jonson makes a humorous irony for the audience knows his real intention. In making Subtle speak of the sanctity of the alchemical process violated by Mammon's lustful deed, Jonson typically means the opposite.

In Face's reappearance, he tells both Subtle and Mammon that an explosion has occurred and destroyed the whole alchemical process. Mammon again is considered the cause of this destruction.

*FACE. O' sir, we are defeated! All the workes
Are flowne in fumo: every glass is burst.
Fornace, and all rent downe! As if a bolt
Of thunder had been driven through the house.
Retorts, receivers, Pellicanes, Bolt-heads,
All stroke in shivers! (4.5.57-63)*

With Face's detailed description of the tools and equipment, Jonson refreshes an imagery vision of the alchemical laboratory in the audience's minds. Throughout the play, Jonson shows no experimental equipment and the alchemical laboratory behind a back door on stage is entered and exited only by the conmen Subtle and Face. From the perspective of the audience, Subtle's "laboratory" is no more than the words used to evoke it (Shanhan 36). With the destruction that Face tells about, Jonson destroys in the audience's minds any possibility of the alleged alchemical process. This summarizes Jonson's view of alchemical transmutation i.e. it is experimentally impossible. Therefore, Subtle has no other means to get rid of his promise to Mammon but to tell him that the whole experiment is destroyed because of his sin.

Subtle exploits Mammon's interest in repairing the destroyed experiment to get more money. Being totally convinced that this destruction is "*the curst fruit of vice, and lust!*"(4.5.72), Mammon willingly promises to pay a hundred pounds as a donation to a mental hospital to make up for the sin he has committed.

Jonson seems to make the point of explosion a climatic point. As the possibility of transmutation diminishes, all the tricks and intrigues based on this possibility begin to collapse successively.

When Subtle comes to make the Spanish Count's pockets "lighter", Surly strikes him down and reveals that he knows all of the fraudulent practices occurring in this house and he will report them to the authorities. In the Elizabethan/Jacobean context, reporting authorities about a house where alchemy is practiced can drive practitioners to jail. This, of course, is not because monarchs rejected the possibility of transmutation. It is rather because

alchemists were invited or conveyed by force to their castles and were promised fine rewards if they produced gold. However, the outcome of their efforts was invariably poor; some even had to pay with their lives for their failure. This, of course, made many alchemists decline the honour of working with the prince, preferring to be their own masters. (Johansson 203)

In Surly's speech about how Subtle and Face cheat people, Jonson seems to warn his audience of further alchemical tricks. Surly says that Face covers his boots with sulfur and gets clients' gold in touch with it. When its colour is changed, he tells them that their gold is not genuine and keeps it for himself: " 'T was here, you learn'd t' anoint your boot with brimstone, / Then rub men's gold on it, for a kind of touch, / And say t'was naught, when you had chang'd the colour" (4.6.37-9). About Subtle's tricks, Surly says that he pretends to put the clients' gold into a flask which actually contains mercury, and when the flask explodes, he says that gold is lost in smoke: "*With sublim'd Mercury that shall burst I' the heat, / And fly out all in fumo!*" (4.6.44-5). The tricks that Surly tells about neither occur nor referred to throughout the incidents of the play. Jonson implies them to draw his audience's attention to the outer world alchemists' tricks and indicates that the tricks included in the play are only a part of what alchemists do to cheat their clients.

Subtle and Face realize how dangerous Surly is. They bring Kastril to test his skill in quarrelling and encourage him by telling that Surly comes to seduce his sister and cheat everybody in the house. When Drugger comes they ask him to fight Surly for he wants to marry the rich widow whom he wants to marry. At a moment Surely is attacked by all, the alchemist, his assistant, and his clients; Kastril, and Drugger. Therby, Jonson satirically dramatizes how the majority of the society is exponents of alchemy.

With Lovewit's unexpected arrival and Surly's, Mammon's and Kastril's return, Jonson increases the three frauds' crisis. Positions this time are altered. Surly, who was attacked by the alchemist and his defenders, explained the reality of Subtle and Face to Mammon and Kastril and the three come to confront the rogues. By this speedy change in positions, Jonson tells his audience that getting rid of belief in alchemists can be done instantly, just as what occurs with Mammon and Kastril when the reality of the alchemist and his assistant revealed. The audience watches the obsessed Mammon shouting " *Rogues, / Cozeners, imposters, bawds*" (5.3.8-9)and the believing Kastril cries " *What rouges, bawds, slaves, you'll open the dore anone*" (5.3.33) The audience also have realities about alchemists and their tricks revealed through the play, so they can withdraw their beliefs in alchemy.

Jonson ironically juxtaposes Dapper to Mammon and Kastril. Keeping Dapper's eyes bandaged, he symbolizes continuity of belief in alchemy and possibility of being fooled by the alchemist. As Dol enters in the dress of the queen of fairies, Dapper is made to kneel before her and to seek her blessings: "*And my most gracious aunt, god save your Grace*" (5.4.24). Jonson, thereby, opens the two choices for his audience; either to give up belief in

alchemy like Mammon and Kastril or to remain obsessed and consequently fooled by alchemists like Dapper.

Having their reality discovered, Subtle and Dol escape to save themselves from being taken into custody. Face gets his master's forgiveness and afterwards admiration because he manages a plan that enables him to marry Dame Pliant. The alchemist's clients, who now realize his fraudulent practices, come to restore their possessions and money and want to have the cheaters punished. Mammon, arrives with an officer, wants to take his metallic goods sent to the alchemist for conversion into gold. However, Lovewit denies that there were anybody in his house does not allow Mammon to take them unless he brings an order from a court of law.

*LOVEWIT. The house is mine here, and the dores are open:
there be any such persons, as you seeke for,
Use your authoritie, search on o'gods name.
I am but newly come to towne, and finding
This tumult' bout y dore (to tell you true) (5.5.26-30)*

The Anabaptists, Ananias and Tribulation, come to take the goods for which they paid a hundred marks to Subtle, but Lovewit refuses and tells them that these goods are claimed by Sir Mammon and he cannot allow them to remove any piece of them from his house. Drugger comes to marry Dame Pliant, but she has already married to Lovewit and thereby he loses the opportunity to marry the rich widow. Kastril comes angrily as he knows that his sister is not married to the Spanish Count, but Lovewit intervenes and tames him. On the one hand, the three conspirators are left unpunished; Subtle and Dol escape and Face, being forgiven by Lovewit, restores his position as a butler. On the other hand, all the clients are losers. With this ending, Jonson seems to be less sympathetic with the deceived than the deceivers for the deceived foolishly enables the deceivers to go on their dirty work. Jonson

summarizes the result of believing in alchemy and believing alchemists in Lovewit's statement to Mammon: "*What a great losse in hope have you sustain'd*" (5.5. 75).

Even Surly, although he does not believe in alchemy, loses at the end. When he returns to marry Dame Pliant, he finds her married to Lovewit.

*LOVEWIT. And should ha' marryed a Spanish Count, but he,
When he came to't, neglected her so grosly,
That I, a widower, am gone through with her.
SURLY. How! Have I lost her then? (5.5.46-9)*

With Surly's final statements Jonson seems to put moral responsibility on his audience's shoulders. Surly, who was skeptic about alchemy from the very beginning, who keeps advising his friend Mammon not to believe Subtle and Face, and who refuses to have sex with Dame Pliant also loses. This is a warning that when the majority follows lies and illusions, the rational minority cannot solely cause change. On the contrary, liars and cheaters survive while the rational minority is defeated. Jonson makes Surly unable to recognize Face who appears this time as Jeremy, the butler. Whereas as Face is standing in front of Surly, he says, "*Come let us goe, and harken out rogues. / that FACE I'll marke for mine, if ere I meet him*" (5.5.85-6). Jonson adds a touch of pathos when Surely speaks miserably about the outcomes of being honest. He finds out that his honesty does not make sense and he should stop being honest: "*Must I needs cheat my selfe, / With that same foolish vice of honestie!*" (5.5.83-4).

With Lovewit's "*I will be ruled by thee in anything, Jermie*" (5.5.143) and with his final speech of gratitude to Face, Jonson opens a possibility of Lovewit's future acceptance of allowing Face to resume his career in the house. The possible continuity of the alchemical fraudulent practices is reinforced in Face's final speech.

FACE. So I will, sir. Gentlemen,

.....
*Got off, from SUBTLE, SURLY, MAMMON, DOL,
Hot ANANIAS, DAPPER, DRUGGER, all
With whom I traded; yet I put my selfe,
On you, that are my countrey: and this pelfe,
Which I have got, if you doe quit me, rests
To feast you often, and invite new ghests(5.5 .157-165)*

Jonson includes significant ambiguity in Face's last line. It can be understood as Face the actor addressing his audience promises to entertain them again in coming shows and to invite new audience in the future. However, it can be interpreted as Face, the character intends to have them together with new guests as clients of alchemy. Thereby, Jonson makes the audience a partner of Face in his future fraudulent activities. The audience is invited to think of and judge the whole matter; whether to tolerate the alchemist's practices and have themselves and other people cheated or to withdraw them. This increases the intellectual and moral responsibility of the audience.

To conclude, Jonson's view of alchemy as a pseudoscience and of alchemists as frauds is the pivot of the play. Plot, theme, characterization, and dialogue convey his rejection of alchemy in a society obsessed with it. This is evidently refers to Avicenna's scientific method and its influence on The Alchemist.

Notes

1-This paper is based on two chapters of the author's PH.D. dissertation entitled "The Concept of Acculturation in Edward Said's Writings and its Application to Elizabethan Drama" that was supervised by Prof. Mona Abousenna & Dr. Ghada Gamal, examined by Prof. Mohamad Enani, and approved with a recommendation of exchange with universities and research centers in 2016 by English Dept. Faculty of Education, Ain Shams University.

Bibliography

- Al-Fahaam, Shaker, George Anawati, and Ibrahim Bayoumi. Al-Shekh Al-Raees Abu Ali Al-Hussein Ibn Abdallah Ibn Sina (Avicenna). Damascus: Higher Council of Sciences. 1981.
- Al-Rawi, Munim. "The Contribution of Ibn Sina to the Development of earth Sciences". Muslim Heritage.com. Ed. Salah Zaimeche. FSTC Limited. 2002.<<http://www.muslimheritage.com/uploads/ibnsina.pdf> >
- Betz, F. Managing Science: Methodology and Organization of Research. Innovation, Technology, and Knowledge Management 9. New York: Springer, 2011.
- Brock, D. Heyward. A Ben Jonson Companion. Indiana:Indiana University Press, 1983.
- C.Si. " Science". Encyclopedia Britannica. 17th ed.1965.
- Carusi, Paola. "Alchemy in the Arab World". Encyclopedia of Medieval Philosophy: Philosophy between 500 and 1500. 1st ed. New York: Springer, 2011.
- Cuddon, J.A and M.A.R Habib. The Dictionary of Literary Terms and Literary Theory. Oxford:Blackwell Publishing Ltd.,2013.
- Dehsen, Christian D. Von. Lives and Legacies: An Encyclopedia of People Who Changed the World Philosophers and Religious Leaders. New York: Routledge, 2013.
- Gutas, Dimitri. " Empiricism of Avicenna". Oriens. 40(2012)391-436.

Avicenna's Scientific Method in Ben Jonson's The Alchemist

Dr/ Iman Magdy Talaat

- Haeffner, Mark. Introduction. The Dictionary of Alchemy. London: Aquarian Press, 1991.
- Hasse, Dag Nicholas and Amos Bertolacci, ed. The Arabic, Hebrew, and Latin Reception of Avicenna's Metaphysics. Berlin: Walter de GruyterGumbh&Co.,2012.
- Huges, Jonathan. The Rise of Alchemy in Fourteenth-Century England: Plantagenet Kings and the Search for the Philosopher's Stone. London: Continium International Publishing Group, 2012.
- Khan, Muhammad Abdul Mujeeb. "Chemistry and Alchemy". The Oxford Encyclopedia of Philosophy, Science, and Technology in Islam. 1st ed. New York: Oxford University Press, 2014.
- Janacek, Bruce. Alchemical Belief: Occultism in the Religious Culture of Early Modern England. Pennsylvania: Pennsylvania State University, 2011.
- Johansson, Bertil. Religion and Superstition in the Plays of Ben Jonson and Thomas Middleton. New York: Haskell House, 1966.
- Jonson, Ben. The Magnetic Lady. Ed. Peter Happe. Manchester: Manchester University Press, 2000.
- _____. The Alchemist. Ed. F.H.Mares. Manchester: Manchester University Press, 1979.
- Linden, Stanton J. Darke Hieroglyphicks: Alchemy in English Literature from Chaucer to Restoration. Kentucky: The University Press of Kentucky, 1996.

Avicenna's Scientific Method in Ben Jonson's The Alchemist

Dr/ Iman Magdy Talaat

- Nasr, Seyyed. Science and Civilization in Islam. Harvard University Press, 1968.
- Nunez, Rafael Vellez. " Beyond the Emblem: Alchemical Albedo in Ben Jonson's The Masque of Blackness" Sederi VIII (1997)257-263.
- Parsa. R.A. " Avicenna: The influence of Avicenna on the Medical Studies in the West". Encyclopedia Iranica. 1st ed. London: Routledge & Kegan Paul,1982.
- Raff, Jeffrey. Introduction. Jung and the Alchemical Imagination. York Beach: Nicholas Hays Inc., 2000.
- Rashid, Roshdi, ed. Encyclopedia of the History of Arabic Science: Technology, Alchemy, and Life Sciences. London: Routledge,1996.
- Reit, Van, A. " Avicenna: The Impact of Avicenna Philosophical Work in the West". Encyclopedia Iranica. 1st ed. London: London: Routledge & Kegan Paul,1982.
- Saliba, George. " Avicenna: Mathematics and Physical Sciences". Encyclopedia Iranica. 1st ed. London: Routledge & Kegan Paul,1982
- "Scientific Method". Dictionary.com. Stedman's Medical Dictionary. Houghton Mufflin Company.2002. <<http://dictionary.reference.com/browse/scientific.method> >
- Sezgin, Faut, ed. Ibn Sina in the Western Tradition. Islamic Philosophy 48. Frankfurt: Institute for the History of Arabic – Islamic Sciences, 1999.

Avicenna's Scientific Method in Ben Jonson's The Alchemist

Dr/ Iman Magdy Talaat

Shanahan, John. "Ben Jonson's 'Alchemist' and Early Modern Laboratory Space". Journal for Early Modern Cultural Studies. 8 (2008) 35-66.

Tillyard. E.M.W. .The Elizabethan World Picture. London: Chatto & Windus, 1958.

Watt, Montgomery W. The Influence of Islam on Medieval Europe. Edinburgh: Edinburgh University Press,1972.

Webster, Charles, ed. Health, Medicine, and Morality in the Sixteenth Century. Cambridge: Cambridge University Press, 1979.

Yates, Frances A. The Occult Philosophy in the Elizabethan Age. New York: Routledge, 1979.