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THE POEM OF THE PHILOSOPHER THEOPHRASTOS UPON THE SACRED ART: A METRICAL TRANSLATION WITH COMMENTS UPON THE HISTORY OF ALCHEMY

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AMONG the remains of Greek literature that have come down from the Byzantine period are four poems in iambic verse upon the divine or sacred art. These poems, in the fifteen or more manuscripts which are preserved in different libraries of Europe, form part of a large collection of works upon alchemy. Most of the prose manuscripts of this collection were edited and translated by the French chemist Berthelot in 1888. The four poems, although a part of Berthelot's original plan, were not included in his edition of the Greek alchemists and, except for a meager summary of their contents by Reinesius in 1634 and a few brief extracts by Hoefer in his "Histoire de la Chimie" in 1866, no efforts have been made to give a rendering of their contents in any modern language. A study of these poems has recently been made by the writer and as they throw considerable light upon the history of Greek science in its later days, the following commentary and translation of the poem of Theophrastos are given.

The four poems, which appear in the different collections under the names of Heliodoros, Theophrastos, Hierotheos and Archelaos, usually in the order given, resemble one another so much in peculiarities of language and meter that they were undoubtedly composed under similar influences. The resemblances are so striking that Reinesius regarded the poems as the work of a single author and as nothing more than versification of different parts of the long prose work of Stephanos, who wrote in the reign of Emperor Heraclius (610 to 641 A.D.). The imitations of Stephanos in style and language are unmis-

takable and the poems must have been composed after his time. The earliest collection of the poems, the Codex 299, in the library of St. Mark at Venice, is written in a hand of the eleventh century. This codex refers again to a still earlier collection that is lost. Without discussing further the interesting questions of authorship, we are probably safe in saying that the poem of Theophrastos was composed by a Byzantine sophist or schoolman some time between the years 700 and 900 A.D. All four poems, in fact, celebrate the importance and learning of these sophists, which term in the days of the Greek Empire was one of honor and not of reproach. Theophrastos¹ begins his poem with the following eulogy:

We sophists, and the rhetoricians too,
 Are fortunate and lead a life most wise;
 We know the nature of created things,
 The kinds of elements, and understand
 How, by close union each to each, they tend
 To one new form, most fair and wholly strange,
 With brilliant splendor filled, its make-up such
 That it bestoweth wealth and great reward.

The union of the elements into a new wealth-bringing combination has always been the one great aim of alchemy. Theophrastos, however, in order to dispel the belief that he and his fellow sophists were only worshipers of mammon, hastens to add that their chief object in life was to train new converts in the path of wisdom.

But most of all we wish with one accord
 All mortals to be taught and disciplined
 And trained in wisdom of the sophist school,
 That they may shape themselves to perfect men,
 That they may know the bounds of Nature's realm,
 (How all things thrive and mix and interweave)
 And last that they may nothing speak except
 What words the wise old masters used to say.
 Those masters urge all mortals who are wise
 To be instructed in the mystic lore
 Of sacred rites, whose meaning they proclaim
 By actions rather than by words of mouth.

His introduction finished, Theophrastos proceeds to give a brief account of the skill of the sophists in the different sciences. He begins most naturally with astrology, for the teachers of that time were firm believers in the power of starry influences.

We, who foretell just where the stars shall be,
 Who know their natures, heights and intervals,
 Their occultations, when they rise and set,

¹ The Greek text, upon which the translations of Theophrastos and other Byzantine alchemists in this paper are based, is that given in Ideler's "Physici et Medici Græci minores," Berlin, 1841.

Their measured bounds and what their orbs portend,
 Do not misread their signs, though far away,
 For when assisted by a knowing mind
 Our sense of vision sees them as they are.
 We know the truth of what is in the sky
 Above and are not ignorant of what
 Is there performed, for we perceive it all
 And make it evident to mortal minds,
 As their experience can testify.

Next in importance after astrology Theophrastos places medicine. In the decadence of Greek science, astrology and medicine were always linked together. The Perignostics of Hermes Trismegistos give in great detail the influence of the planets upon the courses of disease.

The most important branch of Byzantine medicine was prognosis, which was elaborated to such a degree that physicians professed to indicate sickness long before the patient felt any of its symptoms. Copious treatises upon diagnosis have come down from Byzantine writers, who describe with great minuteness methods for examining the urine and feces, or for determining the patient's condition from the beatings of his pulse. In the treatment of disease the regulation of diet played a most important part and elaborate regimens were prescribed for the sick for each season and month of the year.

Yet more than this, the causes we reveal
 Of each affliction in the body's frame;
 Experimentally our school explores
 The science, art and ends of medicine,
 With such success that our prognosis shows
 What sicknesses are destined to appear
 And what is best to cure or ward them off;
 Its findings also lead us to foretell
 An end of life from sickness far from home.

Leaving medicine Theophrastos next briefly relates the investigations of the sophists in the vegetable, mineral and animal kingdoms.

Not only has our wisdom known the ways
 By which to check each illness and disease,
 —Prodigious wonders even though they be—
 But with exactness we describe the flowers,
 (Their qualities, their mixtures and their kinds),
 And taste of juice and substances of plants.
 Each class of growing herbs has been portrayed
 For our prognosis and with words exact,

We also know the hues and kinds of stones,
 The places where the metals are produced
 And all their properties both good and bad.
 The many kinds of creatures in the sea
 Are known to us and all their many forms;
 We teach mankind their natures, good and bad,

How some to use and others to avoid.
 Nor do we slight the race of gay-hued birds,
 Those strange in form and those who kill their kind,
 Those who by nature are of use to man,
 And so contribute to the joy of life.
 Each class and race of reptiles we describe,
 And so all living things find place within
 Our catalogue. Nor have we falsified
 In anything, for every word is true.
 All we have said or shown to mortal men
 Is for their use and happiness in life.

But the sophist's career, which Theophrastos has thus far painted in brightest color, was not one of unalloyed happiness. Many of the prose writers among the Greek alchemists dwell upon the opposition which was provoked by their ideas regarding the transmutation of metals, but few of them are as bitter in the denunciation of their critics as the poets. No better example can be found than Theophrastos of that proverbial sensitiveness which Horace states has always characterized the fretful tribe of poets.

How then can those vile critics censure us,
 They who in secret learning are inept,
 And who in sophic wisdom have no share?
 How can they say we sophists speak untruths
 With their own minds so pitifully maimed
 They give no thought or care to things divine?
 They ask how gold is ever to be made,
 How that can change which has a nature fixed,
 Placed there of old by God the demiurge,
 Who formed its substance never to be moved
 From that position which from early time
 Was its abode and destined resting place;
 They say gold thus abides, nor suffers change,
 For naught can be transmuted from the class
 Or species where its origin took place.
 They who speak thus but trifle with their minds
 And nothing say that bears the stamp of truth.

The quarrel between the alchemists and their critics involved the old question of the fixity or transmutability of genera and species. It dated back to the time of Aristotle, who was the first to make the distinction between a material cause and a formal cause. The critics of alchemy insisted that matter was unchangeable, that lead always remained lead as gold always remained gold and that the gulf between these two metals was an impassable one.

To the argument for the unchangeableness of matter the alchemists gave complete assent. They replied to their critics:

We agree with you that matter is unchangeable, but you forget that it is not matter which we seek to change but only the form in which this matter is cast. The material substance or stock (*φύτη*) of lead, gold and

other things is one and unchangeable, and the object of our endeavor is simply to pour the matter from the form of lead into the form which our human perceptions recognize as gold. Just as an artist can take the bronze of an ugly vessel and recast it into a beautiful vase. But if the idea of transmutation seems so irrational, take the case of the sun. He is always the same, yet by his movements along the ecliptic he produces the change of seasons which pass from extreme cold to extreme heat and from extreme moisture to extreme dryness.

The comparison of transmutation with the change of seasons was a favorite one with the Greek alchemists, for it rested upon one of those etymological subtillies which always appealed to the Hellenic mind, the word *τρόπη* meaning both alteration and season (originally solstice). This play upon words is followed by Theophrastos.

But we will show the end of this our art,
 An end most useful and most quickly learned,
 For nothing strange it needs save that one stock
 From which all things by Nature are produced.
 From Time's four transformations learn the way
 By which the work most skilfully completes
 The transformations of sophistic art.
 The winter, cold and moist, controls the frost;
 By him the fleeting clouds are borne on high
 To drench the earth and quicken seeds to life;
 Three months elapse before his time expires.
 Next Spring, a season moist and warm comes in;
 By her the earth is made to bloom with flowers
 Of every kind; her course is also run
 When three more months their transformation bring.
 Next Summer, warm and very dry, appears;
 By her Earth's bosom is released from damp
 And, warmed from chilliness, is made to bear;
 Her period in three more months is run.
 The Autumn quickly comes upon his way,
 A season dry and cold in which alas
 The beauty of the flowers is all destroyed;
 His rapid course in three more months is passed.
 Through these four transformations runs the sun;
 He makes his circuit in the dozen months
 Which form the year and sheds his light on all
 Beneath the sky. The splendor of his beams
 Fills all the earth with mild increasing warmth;
 With rapid course he summons things to life
 And makes with gentle heat all trees to bud.
 From him the moon receives her gleaming light
 And all the wandering stars, the planets seven,
 And likewise those whose shining orbs are fixed.

The argument of Theophrastos about the seasons is a brief summary of that given in the fifth praxis of Stephanos, who states that the four elements, earth, water, air, fire, in their cycle of the year form twelve combinations of triads in four

sets. There is thus one triad of elements for each month and a set of three triads of similar elements for each season. The arrangement of this cycle of elements is illustrated by the following diagram.

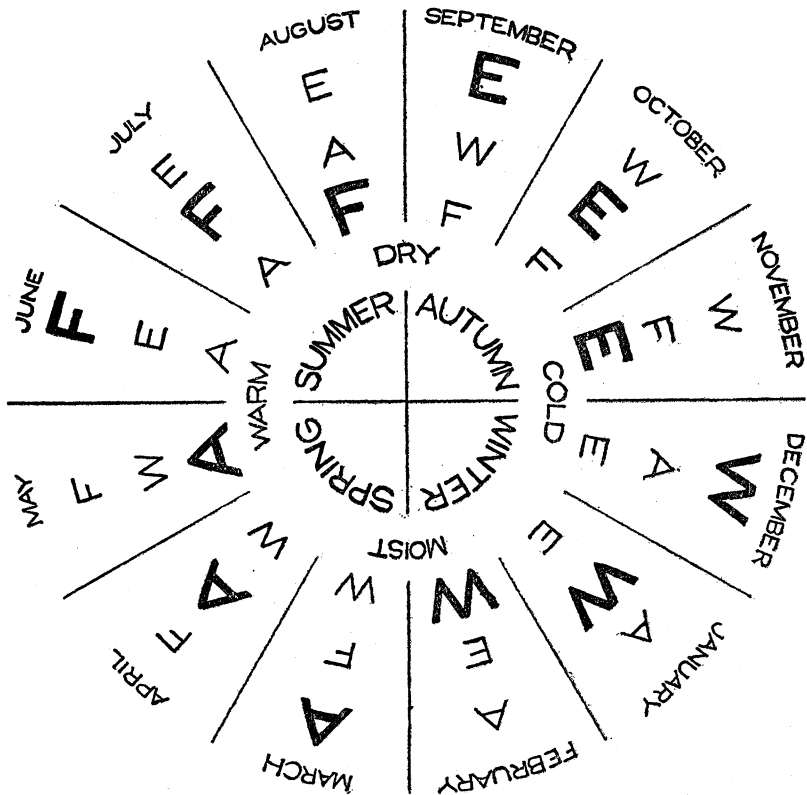


DIAGRAM OF THE YEAR'S CYCLE OF ELEMENTS (constructed from Stephanos).

The Elements Earth, Water, Air, Fire are represented by their initials E, W, A, F; the governing element of each season and month is in large letter. Fire is absent in winter, Earth in spring, Water in summer, Air in autumn. Commencing on the middle circle in Dec. Air goes to the outer circle for Jan., Feb., Mar., crosses in April to the inner circle for May, June, and July and finishes again on the middle circle in August. Then Water follows a similar path, to be succeeded by Earth, the final interweaving circuit of the three rings being completed by Fire.

The quality Moist is common to winter and spring, Warm to spring and summer, Dry to summer and autumn, Cold to autumn and winter.

Theophrastos, in the last line, expresses the belief, common in ancient times, that the fixed stars, as well as the moon and planets, received their light from the sun. As the production of metals, precious stones, etc., within the earth was believed by the ancient alchemists to be due to emanations from the heavenly bodies and, as the light of the moon and planets was received from the sun, the generation of the metals and precious stones could thus be referred to a single influence.

So understand the work, how to refer
The four mutations to one simple form
And from the four to make the work complete,
Seven colored, even as the planets seven,
Whence Nature gets her species, kinds and forms,
Whence Luna's metal takes a whitened hue
And whence proceeds the yellow principle
(That gives a second splendid purple tint)
Which brightening all bodies tinges them
The brilliant golden color of the sun.

Theophrastos having outlined the theory of his art, next takes up its practical execution. His description of the process of gold-making, however, is so obscured by allegory that it is a hopeless task to follow him without referring to the older works.

Transmutation, although described by the Greek alchemists as a conversion of base metals into silver and gold, is everywhere designated as a process of coloring or tingeing. Several methods of tingeing the base metals were employed, but only two of these will be described.

The first method consisted in giving the metal a wash with an amalgam of silver or gold. Upon heating the coated metal the mercury was expelled and a thin film of silver or gold remained. This receipt for silvering, or gilding, metallic objects was an old one. It was a favorite with counterfeiters and was one of the methods resorted to by the Roman Emperors when they wished to debase the coinage. In the practical receipts we find no suggestion of transmutation when this method was used. It is only with the alchemists that the process acquired an additional mystical interpretation. Mercury, which was volatile, was a spiritualizing agent and the leaven, or seed, of precious metal when placed therein had the power of transmuting the baser metal into its own nature. This was illustrated by the sayings.

Just as the yeast of bread can leaven a large mass of dough, so does a little silver or gold act. He who sows wheat produces wheat and harvests it, in the same way gold produces gold and silver produces silver.

In the first method of tingeing metals the coloration took place only upon the surface. In the second, and to the alchemists the most important, method of tingeing the change in color was effected throughout the whole body of metal. The earliest writers drew a clear distinction between these two methods, the Pseudo-Democritus being among the first to condemn those who supposed that mercury should act only upon the surface. The means by which the Greek alchemists claimed to transmute the entire body of base metal into gold can only be understood by going back to the oldest receipts.

When the Greeks under Ptolemy took possession of Egypt they found in the temples a vast collection of practical receipts which were jealously guarded by the Egyptian priests. These ancient books, which formed a large collection of works upon pharmacy, metallurgy and other arts, were ascribed by the Egyptians to Thoth whom the Greeks identified with their god Hermes. These books have all been lost with the exception of one manuscript upon medicine, the so-called Ebers papyrus written about 1500 B.C., which contains various pharmaceutical and magical prescriptions for treating diseases. The mention in this manuscript of such substances as copper, lead, iron, stibium, asem (a gold-silver alloy), sulphur and soda and the reference to such operations as roasting, cooking, melting, extracting and filtering shows that the early Egyptians were familiar with the products and processes of practical chemistry. It is unfortunate that none of the Hermetic books upon metallurgy have survived. Allusions to these books by Olympiodoros and other Greek writers show, however, that the Egyptian priests possessed a vast amount of information upon the smelting, alloying and coloring of metals. Translations of some of these Hermetic receipts have no doubt been incorporated into the collections of the Greek alchemists.

Although the ability to transform the base metals into silver and gold was attributed to the Egyptians by the Greek alchemists, we find no historical mention of this until about 290 A.D. when the Roman Emperor Diocletian destroyed the books of the Egyptians upon the chemistry of gold and silver. The incident is thus commented upon by the historian Gibbon:

At the same time that Diocletian chastised the past crimes of the Egyptians, he provided for their future safety and happiness by many wise regulations, which were confirmed and enforced under the succeeding reigns. One very remarkable edict which he published, instead of being condemned as the effect of jealous tyranny, deserves to be applauded as an act of prudence and humanity. He caused a diligent inquiry to be made "for all the ancient books which treated of the admirable art of making gold and silver, and without pity committed them to the flames; apprehensive, as we are assured, lest the opulence of the Egyptians should inspire them with confidence to rebel against the empire." But if Diocletian had been convinced of the reality of that valuable art, far from extinguishing the memory, he would have converted the operation of it to the benefit of the public revenue. It is much more likely that his good sense discovered to him the folly of such magnificent pretensions, and that he was desirous of preserving the reason and fortunes of his subjects from the mischievous pursuit. It may be remarked that these ancient books, so liberally ascribed to Pythagoras, to Solomon, or to Hermes, were the pious frauds of more recent adepts. The Greeks were inattentive either to the use or to the abuse of chemistry. In that immense register, where Pliny has deposited the discoveries, the arts, and the errors of mankind,

there is not the least mention of the transmutation of metals; and the persecution of Diocletian is the first authentic event in the history of alchemy.

The question "if the Egyptians could make gold why did Diocletian not avail himself of the knowledge?" has puzzled many a writer. We know that the financial condition of the Roman Empire at this time was a desperate one. The argenteus, of which sixty were originally coined from a pound of silver, had, under succeeding Emperors, been continually debased. In the reign of Gallienus the argenteus consisted only of base metal plated with silver. The final limit was reached when it was made of copper and counterfeited to resemble silver by a wash of tin.

Diocletian adopted heroic remedies to relieve the financial condition of his empire by regulation of taxes, fixation of prices and restoration of the silver coinage. From the information contained in papyri, that have recently been published, we now know that Diocletian's destruction of the chemical treatises of the Egyptians was directly in line with these reforms. Counterfeiting had reached a higher state of perfection in Egypt than in any other part of the Roman Empire and when the practical-minded Emperor discovered that the chemical books of the Egyptians gave detailed information for imitating silver and gold he very properly burned these treatises as one of the causes of the Empire's financial troubles. Stringent measures were taken to enforce these regulations and the counterfeiters, who previously worked in the open, were now compelled to labor in secret. Their practical knowledge of the art was rewritten in an obscure enigmatic language which if discovered would deceive the military inspectors. This obscurity was still further enhanced by the decline of the metallurgic arts and the influence of Greek, Jewish and Gnostic mysticism, until what in the older days was bluntly admitted by the practitioners to be a fraud was now acclaimed by the speculative mystics to be a transmutation.

This view of the origin of alchemy which was advanced by Berthelot¹ has been amply confirmed by the publication in re-

¹ "It was thus that the workmen, accustomed to compound alloys resembling gold and silver with such perfection that at times they deceived even themselves, ended by believing in the possibility of an actual creation of these metals." (Berthelot, *Alchemistes Grecs*, *Introd.*, p. 73.) The Upsala papyrus was not published until 1913 (*Papyrus Græcus Holmiensis*, Upsala A. B. Akademiska Bokhandeln). Could Berthelot, who saw the great importance of the Leyden papyrus, have only lived to read the Upsala papyrus, he would have seen the most complete verification of his views. Lagercrantz, in his scholarly edition of the Upsala papyrus, discusses the whole question exhaustively and adopts the same view of the

cent years of two Greek papyri belonging to libraries in Leyden and Upsala. These papyri, which have been described as twin-brothers, were discovered in Egypt nearly a century ago by natives, while engaged in the plunder of tombs, but it is only lately that their contents have been made known. The two documents consist of over 250 receipts for purifying and treating metals, for preparing alloys, for counterfeiting gold and silver, for imitating pearls, emeralds, sapphires and other precious stones and for preparing colors and dyes. Only a few of the receipts for counterfeiting gold and silver will be quoted.

To adulterate gold (χρυσού δόλος). An equal part of misy and Sinopic rouge to an equal part of gold. Put the gold in a furnace and when it is bright add each of the other ingredients. Take out and let cool when the quantity of gold is doubled. (Leyden papyrus, Rec. 17.)

To make silver (ἀργύρου ποιησις). Clean white soft tin four times, melt six parts of the same with one mina of white Galatian copper. It becomes prime silver that will deceive even skilled workmen who will not suppose it to be made by such a treatment. (Upsala papyrus, Rec. 3.)

Another receipt. Add six parts of purified tin and seven parts of Galatian copper to four parts of silver and the resulting product will pass unnoticed for silver bullion. (Upsala papyrus, Rec. 4.)

The receipts just quoted are all manifestly fraudulent as they are stated to be in the directions. One other receipt for making silver has an interesting significance, as it makes use of mercury, the spiritualizing medium of the later alchemists.

To make silver. Purchase coals such as the coppersmiths use and steep them in vinegar for one day. Then take one ounce of copper, fix it well with alum and melt in this condition. Then take eight ounces of mercury and empty the same into poppy extract. Take also one ounce of silver and, having incorporated these ingredients together, melt. (Upsala papyrus, Rec. 8.)

The Leyden and Upsala papyri were written apparently towards the close of the third century and are to be regarded as prototypes of the later alchemical receipts, the earliest manuscript of which dates back to the eleventh century. The connection of the two classes of documents with one another is unmistakable. The papyri refer to Democritus and Aphrikanos, who are mentioned repeatedly by the alchemists. Many fraudulent origins of alchemy. "The Egyptian priests are therefore to be regarded as the oldest representatives of the art of adulterating gold, silver, precious stones and purple. Since the preservation of receipt books in the temples is expressly mentioned, then in all probability we should regard these places also as workshops for counterfeiting. If any one should think such a calling not to conform exactly with the virtues of priesthood, we would reply by saying that we should not entertain too exaggerated ideas of the morality of this profession. Moreover an outward show of uprightness could easily be given to operations from which the public at large was naturally excluded."

of the receipts in the two collections are identical and the occurrence of the term an inexhaustible cake (*ἀνέκλειπτος μᾶζα*) of metal in both the papyri and the alchemists shows a certain community of origin.

The two papyri no doubt belong to the class of chemical books which Diocletian destroyed, the accident of burial, or concealment, having secured their preservation. They offer a good illustration of the practical receipts of the Egyptians before they were obscured by the allegorical interpretations of later mystics.

Under Christian influences this allegorizing tendency was further accentuated. The technical term for coloring is *βάπτειν*, to dip, and the close resemblance of this word to its cognate, *βαπτίζειν*, to baptize, conveyed a spirit meaning of the process to the Christian alchemists of the Byzantine era. Allusions to the New Testament became frequent. Chemical processes are represented under such terms as baptism, bodily death and resurrection, while the whole language is permeated with mystical expressions. Each metal, the same as man, becomes endowed with the triple hypostacy of body, soul and spirit. "The aim of our philosophy," writes Stephanos, "is the separation of soul and body." Divest lead or copper of its soul and spirit, endow the resulting body with a soul and spirit of a higher type and the result is gold. The change from the black of lead or the red of copper to the yellow of gold could not, however, be accomplished directly. The base metal must first be brought to the whiteness of silver before projection of the stone can produce gold. This is indicated in the lines of Theophrastos:

The white, augmented thrice within a fire,
In three day's time is altogether changed
To lasting yellow and this yellow then
Will give its hue to every whitened form.
This power to tinge and shape produces gold
And thus a wondrous marvel is revealed.

The great agent of transmutation was the stone. "It is found," said Avicenna, "in the dirt of streets and is trodden under foot by men." The Greek alchemists were no less explicit. "It can not be bought with gold," said an unknown prose writer, "yet God has given it freely to beggars." Zosimos, a Greek of Panopolis, described it as "a stone yet not a stone, a thing despised yet full of honor, of many forms yet shapeless, a thing unknown yet familiar to all, of many names yet nameless." The description of Theophrastos is equally obscure.

Though not a stone, it yet is made a stone
 From metal, having three hypostases,
 For which the stone is prized and widely known;
 Yet all the ignorant search everywhere
 As though the prize were not close by at hand.
 Deprived of honor yet the stone is found
 To have within a sacred mystery,
 A treasure hidden and yet free to all.

The symbol of chemical change from the earliest days of alchemy has been the fiery dragon or salamander. In the form of a dragon devouring its tail and bearing the mystical motto of three words and seven letters, *ἐν τὸ πᾶν*, "The All is One," it was used by the Greek alchemists to typify the unity of matter. It was the symbol of the never-ending cycle of the elements; the appearance of matter is always changing, yet its substance is eternally one and the same.

The first step in the process of transmutation, the process of albifaction (*λευκωσις*) or conversion of the base metal into silver, is thus described by Theophrastos under the symbol of the dragon.

A dragon springs therefrom which, when exposed
 In horse's excrement for twenty days,
 Devours his tail till naught thereof remains.
 This dragon, whom they Ouroboros call,
 Is white in looks and spotted in his skin,
 And has a form and shape most strange to see.
 When he was born he sprang from out the warm
 And humid substance of united things.
 The close embrace of male and female kind,
 —A union which occurred within the sea—
 Brought forth this dragon, as already said;
 A monster scorching all the earth with fire,
 With all his might and panoply displayed,
 He swims and comes unto a place within
 The currents of the Nile; his gleaming skin
 And all the bands which girdle him around
 Are bright as gold and shine with points of light,
 This dragon seize and slay with skillful art
 Within the sea, and wield with speed thy knife
 With double edges hot and moist, and then,
 His carcass having cleft in twain, lift out
 The gall and bear away its blackened form,
 All heavy with the weight of earthy bile;
 Great clouds of steaming mist ascend therefrom
 And these become on rising dense enough
 To bear away the dragon from the sea
 And lift him upward to a station warm,
 The moisture of the air his lightened shape
 And form sustaining; be most careful then
 All burning of his substance to avoid
 And change its nature to a stream divine

With quenching draughts; then pour the mercury
 Into a gaping urn and when its stream
 Of sacred fluid stops to flow, then wash
 Away with care the blackened dross of earth.
 Thus having brightened what the darkness hid
 Within the dragon's entrails thou wilt bring
 A mystery unspeakable to light;
 For it will shine exceeding bright and clear,
 And, being tinged a perfect white throughout,
 Will be revealed with wondrous brilliancy,
 Its blackness having all been changed to white;
 For when the cloud-sent water flows thereon
 It cleanses every dark and earthy stain.

Thus he doth easily release himself
 By drinking nectar, though completely dead;
 He poureth out to mortals all his wealth
 And by his help the Earth-born are sustained
 Abundantly in life, when they have found
 The wondrous mystery, which, being fixed
 Will turn to silver, dazzling bright in kind,
 A metal having naught of earthy taint,
 So brilliant, clear and wonderfully white.

With the help of the practical receipts and early prose treatises upon alchemy we are able to form some idea of the operations thus described.

It was recognized by the very earliest writers upon alchemy that the two important conditions necessary for promoting material change were heat and liquidity. Solution of the interacting substances was first necessary and to effect this solution heat and a liquid solvent were required. "Corpora non agunt nisi soluta" was a tenet of the medieval alchemists, an expression which was simply borrowed from the *ἀναλυόμενα πάντα ἐργάζεται* of the Greeks. When Theophrastos states, therefore, that the dragon is born from "warm and humid substance" and is to be slain in turn by a "knife with double edges hot and moist," we are simply to infer that the ingredients of his preparation are to be acted upon by some liquid through the agency of heat. The ingredients in this case, as in receipt No. 8 of the Upsala papyrus, are copper and silver and the acting liquid, as in the same receipt, is mercury.

Theophrastos describes his ingredients as male and female, a method of appellation common to the alchemists, who classified nearly all their substances under the one or the other of these terms. One very important male ingredient, used for the white coloration of copper, was arsenic, the word *ἀρσενικόν* in Greek meaning either arsenic or masculine. The connection of gender, however, is not always so apparent as this. Another means of differentiation was based upon the gender of

the word, planet or deity representing the substance. Thus lead and gold are always masculine whether represented under the common names *μόλυβδος* and *χρυσός* or under the planetary names *Κρόνος* and *Ἥλιος*. Copper and silver, on the other hand, are masculine under the common names *χαλκός* and *ἄργυρος*, feminine under the planetary names *Ἀφροδίτη* and *Σελήνη*. Copper, however, is stated by nearly all the alchemists to be a man, while silver is constantly referred to as copper's bride, the union of the two being symbolized as a marriage.

The mystical marriage of copper to silver was not accomplished, however, by melting. The fusing together of copper and silver into the alloy was recognized by the alchemists as a blending (*κράσις*) and not as a uniting (*ἔνωσις*). For the actual union of two opposites Greek philosophic ideas required the action of an intermediary which shared the qualities of the two elements or substances. The old alchemists dwell constantly upon the necessity of this. Fire, for example, is warm and dry, while water is moist and cold. These two opposites are joined by the intermediary action of air which is warm and moist.

The intermediary agent employed in the union of copper to silver was mercury, which in some of its attributes shared the qualities of both these metals. For example, mercury in color resembled silver, while its oxide in color resembled copper. But the point upon which the alchemists placed most stress was the intermediary influence of gender, mercury being both male and female. In the Upsala papyrus we find the masculine form *ὁ ὑδράργυρος* in the eighth receipt and the feminine form *ἡ ὑδράργυρος* in the seventeenth. The same difference in gender is also observed in other technical treatises. The classic Greek writers used the masculine form, but most of the alchemists employed the feminine, although recognizing the distinction of double gender. Zosimos, for example, in one of his allusions to mercury says "it is the silvery water, the masculine-feminine (*τὸ ἀρσενόθηλυ*), that which is always running away and yet hastening unto its own."

The union of copper and silver is referred to by Theophrastos as taking place within the sea, the latter being a common term for the liquid metal mercury. The amalgamation is hastened by warming the vessel containing the ingredients in fermenting horse dung for twenty days. At the end of this time all traces of metal have been dissolved by the mercury, or as Theophrastos says the dragon "devours his tail till naught thereof remains."

The mixed amalgam of copper and silver, which according to Theophrastos was a speckled white, was next transferred to some form of Egyptian alembic, such as were made at Alexandria, an operation alluded to by saying that the dragon "comes unto a place within the currents of the Nile." The mixture is then heated over a gentle fire until the mercury is distilled away, this part of the operation being indicated by such terms as slaying the dragon "with skillful art within the sea," "Clouds of steaming mist ascend therefrom and these become on rising dense enough to bear away the dragon from the sea," etc. The vapors are condensed in the head of the alembic, "its nature changed into a stream divine," after which the liquid mercury is poured out into a recipient. Theophrastos here for the first time banishes allegory and calls mercury by its actual name, the sign of the waxing crescent being affixed to remove all doubt of his meaning.

During the distillation of the mercury a dross of black oxide gathered on the surface of the melted contents of the alembic, a phenomenon alluded to as the lifting out of the gall, and the removal of "its blackened form all heavy with the weight of earthy bile." The final flashing of the melted metal under the scum of oxide, which Theophrastos mentions under such terms as brightening "what the darkness hid within the dragon's entrails," is, according to Hoefer, exactly what the metallurgist to-day observes in the cupellation of silver.

The mass of metal in the alembic is then cooled and scrubbed with running water which "cleanses every dark and earthy stain." The silver-copper alloy thus obtained is described by Theophrastos as "silver dazzling bright in kind, a metal having naught of earthy taint."

The transmutation of copper to silver by the above process is described by many of the Greek alchemists as a combat or battle in which the male contestant copper is completely vanquished by the female victor silver.

Stephanos in his fourth praxis exclaims:

Fight copper! Fight silver! Join male and female! The copper in his contest with silver is destroyed; the silver by her combination with copper is fixed. Destroy the body of copper and make it incorporeal by means of silver.

So also Archelaos in his poem causes the soul of copper to address its lifeless body:

Thou dost not wait the female joined to thee
 In wedlock as desired. Thou dost not check
 The clash of female conflict but decay
 Awaits thy bloom from her.

It is seen from this that Mr. Kipling was not the first poet to declare, "The female of the species is more deadly than the male."

The first step of transmutation, the albifaction or *λείκωσις* having been accomplished, there only remains the final step, the yellowing or *ξάνθωσις*, by means of which the silver is transformed to gold. This part of the process is described by Theophrastos as the second slaying of the dragon.

Then seize again this dragon changed to white
 (A change divinely wrought, as I have said,
 By means of albifaction twice performed)
 And slaying him again with knife of fire
 Draw all his blood which gushes blazing hot
 And red as shining flame when it ignites.
 Then dip the dragon's skin into the blood
 Which issued from his belly's gory wound
 (As thou wouldst dip a whitened robe in dye
 Of murex purple); so wilt thou obtain
 A brilliant glory, shining as the sun,
 Of goodly form and gladdening the heart
 Of mortals who behold its excellence.

This second slaying of the dragon is accomplished by heat alone, the agency of liquid mercury not being required. The weapon this time is "a hot knife of fire" in place of the "knife with double edges hot and moist" previously employed. The metal from the first transmutation is accordingly re-melted over a hot fire preparatory to the addition of the stone, or powder of projection, by means of which the conversion of the silver to gold is to be accomplished. This is done by drawing off the melted metal, which Theophrastos calls the blood of the dragon, and stirring into it the powder of projection, an operation which is poetically described as dipping "the dragon's skin into the blood."

The composition of this "dragon's skin," or stone, or powder of projection, was the chief subject of investigation by the medieval alchemists, who wrote countless treatises upon the subject. Without discussing any of the medieval receipts it may be said that reference to the oldest writings indicates that the so-called stone was originally a yellow powder composed of such ingredients as copper, cuprous oxide, cinnabar, litharge, yellow arsenic or orpiment, misy (a copper-containing pyrites), sory (basic sulphate of iron), sulphur, and other substances whose yellow color might be a recommendation. A certain amount of gold was also probably included to act as a seed or leaven.

In a receipt, previously quoted from the Leyden papyrus for adulterating gold, misy and Sinopic rouge are mentioned as

ingredients to be added to the gold and we have here probably a germ of the later powders of projection.

A somewhat fuller receipt is given in the Pseudo-Democritus :

Lighten the color of cinnabar by means of oil, vinegar, honey, brine or alum; then make it yellow by means of misy, sory, flower of copper, nature sulphur, or in any way desired. Project this upon silver and it will be gold.

A considerable latitude is given in these directions, as is indicated by the expression, "or in any way desired." The rigid exactness of the mediæval alchemists, who permitted not the slightest deviation in character or quantity of the ingredients, is not as yet apparent.

Two very important substances, used by the Greek alchemists in projections, were the so-called molybdochalc (*μολυβδόχαλκος*) and aphroselen (*ἀφροσέληνον*). Owing to the very inexact nomenclature of the times, these words were given to a variety of products, although the terms seem most generally applied to the oxidation products obtained in refining lead-copper and copper-silver ores. The waste dust of the lead, copper and silver smelting works was especially prized by the old alchemists. This dust, described under such names as cadmia, tutia, magnesia, tephra, pompholyx, little scorïæ, etc., fulfilled the mystical requirements of the stone, "being a product of many names, of no value, found in the dust of streets and trodden under foot by men." The incorporation of metallic oxides into the tinctorial powder or stone is alluded to by Theophrastus where he says "though not a stone, it yet is made a stone from metal."

The substances entering into the tinctorial powder were obtained in many cases by subjecting the metals themselves to a process of corrosion (*ἴωσις*). The directions for preparing molybdochalc according to a receipt of the Pseudo-Democritus were to heat white lead, or litharge, with flower of copper, or roasted copper, or treated copper-rust until the mixture became yellow. The manufacture of some of these ingredients, according to accounts given in Dioscorides and Pliny, will be briefly described.

White Lead (Greek, *ψιμίθιον*; Latin, *cerussa*) was made as follows: plates of lead were put into jars containing vinegar and kept closed for ten days. The corrosion that formed upon the surface of the metal was then scraped off and the lead put into the vinegar again. The process of corroding and scraping was continued until the whole of the lead was consumed. The scrapings were powdered, sifted, and dried in the sun. The method thus described is about the same as the modern

Dutch process for making white lead. The white lead obtained was used as such, or else was heated in shallow pans until it was converted into the yellow or red oxides. These changes of color from the black of lead to the white of the basic carbonate and to the yellow of the oxides were of especial significance to the alchemists, for they followed the traditional order which base metals should follow in their conversion to silver and gold.

Flower of Copper (Greek, χαλκοῦ ἄνθος; Latin, æris flos) was made in several ways. In one method the fused metal was exposed to a blast of air which caused the surface to peel off in small scales. In another method the scales were formed by drenching the hot metal with water. The scales, after being powdered, had a reddish-yellow color and consisted of a mixture of metallic copper and cuprous oxide.

Roasted copper (Greek, χαλκὸς κεκαυμένος; Latin, æs ustum) was made by heating copper in closed vessels with various substances, such as sulphur, salt, alum, and vinegar. The calcined residue was then powdered in a mortar, washed and sifted. It consisted of a reddish-yellow powder and had a composition resembling that of flower of copper.

Copper rust (Greek, ῥος; Latin, ærugo) or verdigris was made by sprinkling vinegar upon copper filings or by putting plates of copper into earthen pots containing vinegar and scraping them every ten days. The scraped rust referred to in the receipt of Pseudo-Democritus was not used directly in making the powder of projection, but was treated, a process which, from a description of Dioscorides, probably consisted in heating the verdigris in a closed vessel until the basic acetate was changed into a red suboxide of copper.

The scraping of the corrosion or oxide from the metal plates, mentioned in these processes, is the operation described by Theophrastos and other alchemists as "skimming the dragon," the figurative skin, which was removed, forming the basis of the older powders of projection.

The action of the "dragon's skin," or stone or powder of projection, upon the silver-copper alloy of the first treatment would simply be to increase the copper content of this alloy and give it a golden color. The seed of gold and unchanged copper in the preparation would of course be readily taken up. The suboxide of copper has also a certain solubility in melted alloys of this kind and would help to impart a red or yellowish tint to the resultant mass of metal. Any unabsorbed ingredients, such as sulphur, orpiment, cinnabar, litharge, etc., would be either colatitized or thrown out as dross. The fused alloy after drawing off and casting probably had a yellow color

much like that of gold. It might possibly "escape detection by skillmen workmen," to use the unsophisticated language of the old receipts, and to the credulous-minded alchemists, who had forgotten the old Archimedean method for determining the purity of metals, might easily pass for gold so pure that even "the treasuries of kings did not possess the like."

A final question, which remains to be considered, is the quantity of tinctorial powder that was used for projection. In the Leyden papyrus the receipt for adulterating gold prescribed "an equal part of misy and Sinopic rouge," and we can infer from other practical receipts that the amount of material used in the early days for tingeing metals the color of gold was considerable. In one Greek manuscript the directions state: "As to the weight of the projection, in the first operation one weight is projected into one weight; in the second one weight into a thousand weights; in the third one weight into a million weights." We know from the old writings that the process of projection was frequently repeated and with each repetition of the process the quantity of powder was diminished.

When the old practical receipts became permeated with mysticism, the idea of a seed or leaven, which could transform an almost unlimited amount of base metal, got the upper hand. The quantity of powder was reduced until in the middle ages it was held that one grain of powder could transmute whole oceans of base metal into gold. By thus diminishing the quantity of powder the coloration produced by the older methods of projection was no longer obtained and the composition of the powder was held to be lost.

The subject of alchemy offered the Byzantine schoolmen a convenient theme for the exercise of rhetorical flourishes and Theophrastos next proceeds in a kind of litany to tell how the fortunate ones, who have been enriched by alchemy, express their appreciation.

They praise the gift with wise and joyous words
 As one divinely sent and great in worth;
 And thus they speak and voice their thankfulness.
 O work divine, well-pleasing and concise!
 O beauty brilliant with an aspect clear!
 O marriage and conjunction most renowned!
 O husband in a single union joined!
 O wife united by affection deep!
 O offspring famous and with glory filled!
 O progeny of splendor, light and worth!
 O robe with gold and silver overlaid!
 O double-folded mantle bright as snow!
 O metal which with gleaming silver teems!
 O clear refreshing river of the sea!

O water than the loosened earth more free!
 O ether rising far above the earth!
 O clouds transformed from blackness into white!
 O brilliant colored glory of the heaven!
 O light which shines to all beneath the sky!
 O system and bright circuit of the stars!
 O lunar light reflected from the sun!
 O sun whose darting beams engender gold!
 From these the work of every sage begins
 To reap in practise some deserving end;
 In thee appears the object of our search;
 Thou shinest scattering thy wondrous light,
 A treasure most desired, all filled with pearls;
 And bringing gain and wealth to mortal men.

This rhapsody, which repeats in gorgeous rhetoric the various steps of transmutation, seems somewhat overdrawn, yet Theophrastos in the use of exclamation is mild when compared with Stephanos, who in page after page of his prose treatise upon the sacred art lets flow a muddy stream of bombastic Greek. The science of the early Alexandrians had so far degenerated in the days of the Byzantines that it was made a theme for rhetoricians while the ancient clarity and conciseness, which made the scientific writings of Hippocrates and Archimedes models of expression, had now given way to deliberate obscurity of thought and to the empty jingling of an inflated style.

The alchemical poets conclude their verses with reflections of a moral and religious nature. This also was in general keeping with the custom of Stephanos and other Byzantine writers whose treatises usually began and ended with a prayer. Theophrastos simply followed the usage of his time and concluded his poem as follows:

Who, then, beholding the great universe
 Which Thou hast wisely wrought,—a well-designed
 Production, made with singleness of art,
 And faith inspiring in its glorious works—
 Entranced with wonder would not be amazed?
 He would extoll the boundless providence
 Of reason's God and praise the sympathy
 Which He, in ways both wise and manifold,
 To us declares. As Lord beneficent
 He wishes all mankind a happy life
 And wealth by their activities to gain.

Then let us shape life's course with reverence
 And cherish piety's clear beacon light,
 Our pathways brightening with godly deeds,
 Our neighbor loving and the foreign guest;
 And day and night with supplicating prayers
 Our adoration pay, as servants wise,
 To God the Lord, all-seeing King of all,

Forgiveness asking for our trespasses
And that all kin from danger may be spared
And from temptations freed, as they arise;
And let us never undertake a work
Unless we give the praise therefor to God,
The Father, who begot the only Son,
The Son, the holy Word from God produced,
The Holy Ghost, proceeding too from Him,
Both now and always evermore. Amen.

This ending in orthodox Greek fashion is typical and reflects in a measure the ecclesiastical mania of the times, which found its expression in liturgies, ceremonies and the other accompaniments of an extravagant ritual. The doctrine of the Procession of the Holy Ghost from the first person of the Trinity, contained in the next to the last line, shows that the poem was composed after the Council of Chalkedon in 451, and so could not have been written before this date as some have supposed. The same doctrine is promulgated in Stephanos to the disgust of Reinesius who, however much he admired the opinions of this writer on the subject of transmutation, could not uphold him in this.

The moral admonitions contained in Theophrastos and the other Greek alchemists were not, however, entirely the result of ecclesiastical influences. As the mystical doctrines of the alchemists gained ground the transmutation of the base metals into gold began to be regarded as a symbol of the transformation of man's own lower nature into something nobler and higher. The comparison of the nature of man with that of the metals was used, in fact, by Greek writers of the earlier Alexandrian period. Plotinos writes: "As gold is contaminated by the adherence of earthy dross, so is the soul corrupted by its union with the body." Hierocles makes a similar comparison in his commentary upon the Golden Verses of Pythagoras, where he says, "Gold is symbolic of virtue because it never corrodes while the baser metals gather rust which is typical of the vice that arises from material contaminations."

An example of the extension of this comparison, after the belief in transmutation had gained currency, is found in a fragment of so-called political verse, attributed to John of Damascus, who lived between 700 and 754. The poem, in which the lines occur, was called the Dioptra and gives a dialogue between the soul and body. The body mentions the unapproachableness of the state of man to that of God, but the soul in reply expresses the possibility of transforming man's condition by the following comparison:

It is as if when lead and gold are banished far asunder
 A distance from each other's home, a distance wide are parted,
 A certain craftsman then should come, who wished to show his cunning,
 The operation of his art and scientific knowledge,
 Should take this lead and melting it within his blazing furnace
 Should show the same transformed to gold of quality the finest.
 And this is surely wonderful and strange beyond believing
 That what was never gold before, now gold becomes at present,
 What was not gold has gold become, though not so at commencing.
 O great display of excellence! O great display of reason!

The alchemists, who were always immoderate in their use of symbols, finally carried this comparison to its ultimate extreme with the result that the symbol became of paramount importance, while the act of material transmutation sank into insignificance. Stephanos, the chief Byzantine writer upon the sacred art, makes the following digression towards the close of his eighth praxis:—

From the objects of sense perception pass over now to those sights which are perceived by the mind. Behold the great order and immaterial splendor of the heavenly bodies. When thou hast seen the beauty of these, lift up thy mind beyond and noting the resplendent glory and great joy of the angels do not hereafter be led astray with respect to the material transformation of this earthy substance, of that which is sought after by the hand and revealed by the philosophy of gold-making.

It is not surprising, therefore, that certain writers upon the subject should hold that all the old treatises upon alchemy are simply moral and religious allegories and that the gold, "such as was not found in the treasuries of kings," was of a heavenly, and not of an earthy, kind. An American writer, Ethan A. Hitchcock, was the first to advance this view in 1857 in an anonymous book of some three hundred pages. The same opinion in a modified form is also held by the well-known English writer, A. E. Waite, best known for his scholarly edition of Paracelsus.

The theory, however, that ancient alchemy was a moral allegory and nothing more carries with it its own refutation, for if we accept it as true we must also admit that there was a strong contemporary belief in the actuality of transmutation, otherwise the symbol and allegory would have had no meaning.

It was a strange reversal of ideas that the so-called sacred art, which originated in the fraudulent practises of Egyptian counterfeiters, should have afterwards developed into a means for the inculcation of virtue and religion.