THEORIES OF CATEGORIES IN EARLY MEDIAEVAL CHINESE ALCHEMY

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I

Introduction

The study of the concepts and practices of the Chinese alchemists presents a field of investigation most necessary for the comparative history of thought and science. We do not refer primarily here to the current of mystical and introspective alchemy (*nei tan*[1]) which was as powerful no doubt as that of the West, but to the practical preparation of elixirs and the attempts to obtain the transmutation of the metals (*wai tan*[2]). It is this tradition which naturally most interests the historian of science, and the more one studies it the more one comes to feel that in spite of the usual bewildering terminology it was on the whole less systematically allegorical and more practically empirical than its counterpart in Europe.

This does not mean, however, that it had no theories. It has often been thought that the mediaeval Chinese alchemists worked in a wholly empirical manner. If some of us have suspected that they must have formulated hypotheses to guide their experimentation, very few texts so far studied and translated have thrown any light on the origins and nature of this body of theory. We wish here to present a Thang text with a Sung commentary which strongly indicates a derivation from the philosophical ideas of a famous Han scholar and thinker, Tung Chung-Shu[3] (179 to 104 B.C.). This is the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*[4] (Arcane Essentials of the Similarities of the Five [Substances] in the *Kinship of the Three*).

II

Sources

In the course of our argument we shall have occasion to mention other alchemical texts in the Taoist Patrology (*Tao Tsang*[5]) and other mediaeval Chinese writings; a list of these follows.

(a) Taoist Patrology:

Chou I Tshan Thung Chhi[6] (The Kinship of the Three; or the Accordance of the *Book of Changes* with the Phenomena of Composite Things) by Wei Po-Yang[7] in 142 A.D. and with a Commentary attributed to Yin Chhang-Sêng[8] (A.D. 142 to 220); W/990 (number in Wieger's (27) Catalogue).

Kêng Tao Chi[9] (Collection of Procedures of the Golden Art [Alchemy]), author unknown, written after A.D. 1144, W/946.

N.B.—Superior numerals in italics refer to the corresponding Chinese characters, pp. 203 to 207; figures in brackets after names of authors refer to the bibliography on pp. 207 to 209.

The method of romanization of Chinese names and words here used is that modification of the standard Wade-Giles system which substitutes the letter *h* for the aspirate sign (see Needham (18), I, pp. 23 ff.).

Lung Hu Huan Tan Chüeh[10] (Explanation of the Dragon and Tiger Cyclically Transformed Elixir), by Chin-Ling-Tzu[11] (the Golden Tomb Master), exact date unknown but probably of the Sung dynasty (A.D. 960 to 1279), W/902.

Shang-Yang-Tzu Chin Tan Ta Yao Thu[12] (Shang-Yang-Tzu's Illustrations for the Treatise on the Main Essentials of Gold Elixirs), by Chhen Chih-Hsü[13] in A.D. 1331, W/1054.

Shih Yao Erh Ya[14] (Synonymic Dictionary of Minerals and Drugs) by Mei Piao[15] in A.D. 806, W/897.

Tan Fang Chien Yuan[16] (Descriptive Catalogue of Alchemical Reagents) by Tuku Thao[17], in A.D. 938, W/918.

Thai-Chhing Shih Pi Chi[18] (The Records in the Rock Chamber; a Thai-Chhing Scripture), compiled by Chhu Tsê[19] in the early sixth century A.D., probably including earlier work from the third century A.D. onwards, W/874.

Tshan Thung Chhi Wu Hsiang Lei Pi Yao[4] (Arcane Essentials of the Similarities and Categories of the Five [Substances] in the *Kinship of the Three*), author unknown (attributed to Wei Po-Yang[7]), probably before the ninth century A.D., with commentary written probably by Lu Thien-Chi[20] *ca.* A.D. 1111, W/898.

Wei Po-Yang Chhi Fan Tan-Sha Chüeh[21] (Explanation of the Seven-fold Cyclically Transformed Cinnabar [Elixir] of Wei Po-Yang), attributed to Wei Po-Yang of the second century A.D., with a commentary by Huang Thung-Chün[22] of unknown date, but at least earlier than A.D. 806, W/881. Alternative title: *Chhi Fan Ling-Sha Ko.*

Yin Chen-Chün Chin Shih Wu Hsiang Lei[23] (The Similarities and Categories of the Five [Substances] among Metals and Minerals by Yin Chen-Chün), attributed to Yin Chhang-Sêng[8] of the second century A.D., W/899.

(b) Other Sources:

Chhun Chhiu Fan Lu[24] (String of Pearls on the Spring and Autumn Annals) by Tung Chung-Shu[3], *ca.* 135 B.C.

Chhung Hsiu Chêng-Ho Ching Shih Chêng Lei Pei Yung Pên Tshao[25] (The Official Practical Reclassified Pharmacopoeia of the Chêng-Ho Reign-Period), revised by Chang Tshun-Hui[26] in A.D. 1249.

Kan Ying Ching[27] (On Stimuli and Responses [in Nature]) by Li Shun-Fêng[28] (*fl.* A.D. 620 to 680).

Kan Ying Lei Tshung Chih[29] (Record of the Mutual Resonances of Things) by Chang Hua[30], *ca.* A.D. 295.

Ko Wu Tshu Than[31] (Simple Discourses on the Investigation of Things) by Su Tung-Pho[32] (A.D. 1036 to 1101).

Pên Tshao Kang Mu[33] (The Great Pharmacopoeia) by Li Shih-Chen[34] in A.D. 1596.

Sung Shih[35] (History of the Sung Dynasty) by Toktaga and Ouyang Hsüan[36] in A.D. 1345.

Thung Chih Lüeh[37] (Compendium of Information) by Chêng Chhiao[38], *ca.* A.D. 1150.

Wu Lei Hsiang Kan Chih[39] (On the Mutual Responses of Things According to their Categories) by Su Tung-Pho[32] (A.D. 1036 to 1101).

III

Dating of the Main Text

The first step is to try to pin down the date when our text, the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*[4] was written. Although its introduction claims Wei Po-Yang[7] (second century A.D.) as the author, many of its chemical terms are not mentioned in the *Shih Yao Erh Ya*[14] (Synonymic Dictionary of Minerals and Drugs), a text known to have been written around the year A.D. 806. This suggests either that it was written after the *Shih Yao Erh Ya*, or that it was written earlier but not known to Mei Piao[15], the author of the latter. We shall have more to say about this presently.

Besides claiming that it emanated from Wei Po-Yang, the text also mentions that it was submitted to the throne by a civil servant called Lu Thien-Chi[20], whose ranks and titles are given as Hsüan-Tê-Lang[40] *chhüan*[41] *fa-chhien*[42] Thi-Chü[43] Huai-nan-hsi-lu[44] Hsüeh-Shih[45] *chieh-fei*[46] *yü-tai*[47]. The name of Lu Thien-Chi is not found in the Dynastic Histories. The words in the text were next examined for "tabu" abnormalities, because it was thought that Lu Thien-Chi, being a civil servant, would avoid the use of certain words connected with the names of the emperors or the royal family (*hui tzu*[48]) by omitting a stroke or changing a word. But this did not give any helpful clue.

The next step was to study the ranks and titles of Lu. Hsüan-Tê-Lang, or Education Officer, was his titular office. It was a civil prestige title during the Thang and Sung dynasties of the upper seventh grade (*chêng chhi phin*[49]), but during the Chêng-Ho[50] reign-period (A.D. 1111 to 1117) the name was changed to that of Hsüan-Chiao-Lang[51] (Education Officer).[1] This sets 1117 as the lower limit to the date of our text.

The word *chhüan*[41] means authority, and referred to the actual duties of the officer. It was included by the civil servants of the Sung dynasty in their official ranks and titles, but was dropped not long after the Shao-Hsing[52] reign-period, i.e. after A.D. 1132. It actually meant the provisional duty of the officer concerned. This gives another indication about the lower limit of the text's date.

Fa-chhien[42] probably means *chhai-chhien*[53], i.e. "commissioned as." Thi-Chü[43], or Intendant, was an official title instituted during the Sung dynasty. The Thi-Chü Hsüeh-Shih[54], or Circuit Educational Intendant, was established in the year 1103, but was abolished in 1121.[2] It might perhaps be called a Circuit Inspector of Schools. This narrows down the range of the date to between 1103 and 1117.

Before the year 1051 there was only a single Huai-nan[55] circuit, but after that year it was split into two—the Huai-nan-tung[56] circuit on the east and

[1] *Sung Shih* (History of the Sung Dynasty), ch. 169, pp. 14a, 17b.

[2] *Ibid.*, ch. 167, pp. 20b, 21a.

the Huai-nan-hsi[57] circuit on the west.[3] This again suggests the upper limit of Lu Thien-Chi's date. He must have held the titular office of Hsüan-Tê-Lang (Education Officer) and was then provisionally commissioned to the duty of Circuit Educational Intendant in the Huai-nan-hsi circuit.

According to the regulations of the Sung dynasty an officer of the seventh grade like Lu Thien-Chi would be allowed only to wear green. But in the year A.D. 977 the Emperor Thai-Tsung[58] permitted those commissioned for duty outside the capital to wear a colour one grade above the normal standing of the officer concerned; for example, officers belonging to the sixth and seventh grades who normally wore green would thus be permitted to wear red, worn at the capital by officers of the fourth and fifth grades. This was known as *chieh-fei*[46] ("borrowing the red").[4] Since Lu Thien-Chi belonged to the upper seventh grade, normally wearing green, he had to indicate his brevet grade with the words *chieh-fei.*

Yü-tai[47] ("fish-pouch") was a fish-shaped tally carried in a pouch. Officers carried their fish-pouches in accordance with the colour of their official robes. During the first year of the Chêng-Ho[50] reign-period (A.D. 1111) the Emperor permitted the *chieh-fei* ("borrowing the red") (sixth and seventh grades) and the *chieh-tzu*[59] ("borrowing the purple") (fourth and fifth grades) to carry fish-pouches in accordance with the colour of the robes "borrowed."[5] This sets our upper limit to the year 1111. Hence we may conclude that Lu Thien-Chi submitted to the throne this alchemical text and commentary within the period 1111 to 1117.

Under the name Lu Hsiang[60] in the *Chung-Kuo Jen Ming Ta Tzhu Tien*[61] (Dictionary of Chinese Personal Names) is found the following:

> Lu Hsiang, native of Chhü-chou[62] in the Sung period; original name Thien-Chi[63], style (*tzu*[64]) Chün-Yuan[65]; avoided the word "thien"[66] during the reign of Hui-Tsung[67] (1101 to 1126) and changed his own name to Hsiang[68], but kept his style Chün-Yuan. Gained his *chin-shih*[69] degree (approximating to a literary doctorate) during the Ta-Kuan[70] reign-period (1107 to 1110), and during the Ching-Khang[71] reign-period (1126 to 1127) was appointed to the post of Li-Pu-Shih-Lang[72] (Secretary in the Ministry of Personnel). Wrote *Hsi Chêng Chi*[73] (Travels in the West).

The *Hsi Chêng Chi* can be found, for example, in the *Shuo Fu*[74] collection. As for its authorship it gives: "Sung dynasty; Lu Hsiang[60], style Tsan-Yuan[75], a man of San-chhü[76]." The work, written in good literary style, shows the unworldly outlook of the author. Thus it is very likely that the same person was the writer of the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao* and of the *Hsi Chêng Chi.*

All that we have established so far is that the work was presented to the throne by Lu Thien-Chi in the period 1111 to 1117, but we do not know for certain who wrote the text and who wrote the commentary. The latter must at any rate have been completed in or before 1111. Lu Thien-Chi may of course have written the commentary himself. It is most unlikely that the text and the commentary were written by the same person—the difference

[3] Kracke (12), p. 50.

[4] *Sung Shih* (History of the Sung Dynasty), ch. 153, p. 1a.

[5] *Sung Shih* (History of the Sung Dynasty), ch. 153, p. 8a.

in style is too great, and furthermore this was not a common practice of Chinese writers. The text must have come from earlier Taoist notes which had been kept unpublished, or rather uncopied. It should be borne in mind here that the date of Lu Thien-Chi's activities coincides exactly with the time when blocks were first made for the printing of the Taoist texts.[6]

In the Bibliographies of the *Chiu Thang Shu*[77] (Old Official History of the Thang Dynasty)[7] we find a book called *Chou I Wu Hsiang Lei*[79] in one chapter said to be by Wei Po-Yang[7]. Here the two words *Chou I*[79] could well be an abbreviation of the name *Chou I Tshan Thung Chhi*[6] and so refer to Wei Po-Yang's work. We may therefore consider that the book called *Tshan Thung Chhi Wu Hsiang Lei*[80] is mentioned in the *Chiu Thang Shu* and that the two words *Pi Yao*[81] were added later when the text was furnished with its commentary.

We now return to the question whether the text was written before or after the year A.D. 806, the time when Mei Piao[15] wrote the *Shih Yao Erh Ya*[14]. Mei Piao obviously did not know about this text. Was it because he had not seen it or because it was not yet written? Either possibility is equally likely for no one could claim to have read all the manuscripts scattered and kept secretly in so many different places over so wide an area during the eighth century A.D. We cannot rely on the bibliographies of the earlier dynastic histories, because they do not include all the existing alchemical texts.

Fortunately another independent text in the *Tao Tsang*[5] (Taoist Patrology) helps us to answer this question at least partially. The early part of the text we are studying is found to be almost identical with that of the *Wei Po-Yang Chhi Fan Tan-Sha Chüeh*[21], which has annotations by Huang Thung-Chün[22]. This must be the same book as that entitled *Chhi Fan Ling-Sha Ko*[82] (Song of the Sevenfold Cyclically Transformed Cinnabar [Elixir]) by Wei Po-Yang, also annotated by Huang (Thung-)Chün mentioned in the *Shih Yao Erh Ya* (ch. 2, p. 3b). Huang Thung-Chün is also quoted elsewhere in the same book by Mei Piao. This means that Huang Thung-Chün must have lived earlier than A.D. 806 and that he commented on still earlier texts. Hence we know that at least part of the text of the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao* must have arisen not later than the eighth century A.D. All the bibliographies we have examined attribute both the *Tshan Thung Chhi Wu Hsiang Lei* and the *Chhi Fan Ling-Sha Ko*[82] to Wei Po-Yang of the second century A.D.[8] But until we can find further evidence, whether Wei Po-Yang was really the author of these texts remains an entirely open question. Certainly the style of the former, with which we are here mainly concerned, is much less obscure than the basic work of Wei Po-Yang, the *Chou I Tshan Thung Chhi*[6] itself. But such is the continuity of Chinese prose style through the ages that there is no intrinsic ground for denying that this is a later Han text. Yet the probabilities are that it is early Thang or of the Liu Chhao period (third to seventh centuries A.D.).

[6] See Ho & Needham (9). The general background of a court atmosphere of learned curiosity in all matters of science, art and magic (if not of strong and prudent government) has been sketched in Needham (18), IV, sect. 27*j*(4) and Needham, Wang & Price (40), pp. 118 ff.

[7] Ch. 47, p. 7b.

[8] See, for example, *Thung Chih Lüeh*[37] (*I wên*, ch. 5; ch. 43, pp. 6b, 23b).

In sum, therefore, the following text is not later than the eighth century A.D. and may be pre-Thang, while the commentary must have been finished by 1117. Thus we may make a chronological comparison with the history of alchemy in the West by noting that our text is quite probably contemporaneous with the writings of Stephanus of Alexandria in the early seventh century.

IV

Full Translation of "Tshan Thung Chhi Wu Hsiang Lei Pi Yao" and its Commentary

We give in what follows a full translation of the text. Our explanatory notes and other additions to make the text more readable are included in brackets. The commentary is also translated and included in the footnotes.

TSHAN THUNG CHHI WU HSIANG LEI PI YAO

Emanating from the Thai-Su Chen-Jen[83] (Highest-Purity Adept) Wei Po-Yang[7];
Submitted (to the throne) by Lu Thien-Chi[20] (titular office) Hsüan-Tê-Lang (Education Officer), provisionally commissioned to (the post of) Thi-Chü Hsüeh-Shih (Circuit Educational Intendant) in the Huai-nan-hsi circuit (and entitled to wear the official robe of the colour) *chieh-fei* ("borrowing the red") (and to carry the fish-shaped tally) *yü-tai*.

¶ *Chart*

Yang	one;	two;	three;	four;	five
	Water;	Fire;	Wood;	Metal;	Earth
Yin	six;	seven;	eight;	nine;	ten

¶ *Introduction*

Formerly the adept (*chen-jen*[84]) Wei Po-Yang and Shunyu Shu-Thung[85] taught Hsü Tshung-Shih[86] of Chhing-chou[87] the *Tshan Thung Chhi*[88] (The Kinship of the Three) and the *Ku Ko*[89] (Ancient Mnemonic Rhymes). When Wei (Po-Yang) achieved the elixir he wrote the *Wu Hsiang Lei*[90] (Similarities of the Five [Substances]). Later he departed, mounting into the clouds, but he ordered his disciples to inscribe (this book) in *ta-chhuan*[91] (seal characters). (This book) is not found among the various collections, and though most people say that it is actually the middle chapter of the *Tshan Thung Chhi*, this is indeed a very shallow view. Besides, the *Wu Hsiang Lei* deals with the similarities and the harnessing (*fu-chih*[92]) of the three "yellow (substances)" (*san huang*[93]) (i.e. sulphur, realgar and orpiment) and the two "precious (things)" (*erh-pao*[94]) (i.e. mercury and lead), from which the name "Five" (*Wu*[95]) is derived.

¶ *The Book says:*

The "Original Celestial Girl" (*thien-sêng-yuan-nü*[96]) is really mercury (*shui-yin*[97]), while the "Yellow Earth-Born Boy" (*ti-sêng-huang-nan*[98]) is really gold (*huang-chin*[99]).[9] They both derive their individual properties from the most subtle *chhi* (*pneumata*) of Nature. When substances take their respective places, *Yang* is on the left and *Yin* on the right, but they can inter-communicate.[10] The first change occurs when the Chang[103] and the I[104] (twenty-sixth and twenty-seventh lunar mansions) fly round to the Hsü[105] and the Wei[106] (eleventh and twelfth lunar mansions) (i.e. cinnabar changing to mercury).[11] Having a nature capable of rebirth (the latter) can be transformed back to *tan(-sha)*[107] (cinnabar),[12] and having thus ascended to the Upper Palace (*shang kung*[108])[13] it will be beyond ordinary things.[14] "White *Hung* of the Great *Yang*" (*thai-yang-pai-hung*[109]) (mercury)[15] originally contains "Red Water" (*chhih-shui*[110]) (cinnabar),[16] because from (the former) we can recover the "Elixir Juice" (*tan-i*[111]) (also cinnabar).[17] The "Black Essence of the Original Pure (Primordial Substance)" (*shun-hei-ching-yuan*[112]) (cinnabar) has within itself the blue-green (colour) (mercury).[18] Thus the Four Symbols (*ssu hsiang*[114]) have determined the origins, each of which has its explanation; so for those who understand it is easy to compound them in accordance with their nature, but difficult for those who do not.[19] In spring the "Offspring

[9] The *Shih Yao Erh Ya* does not give these two rather uncommon synonyms, but it says instead (ch. 1, p. 1b) that "Heaven-Born" (*thien-sêng*[100]) is mercury and "Yellow Boy" (*huang-nan*[101]) is lead.

[10] The Commentary says: "This means that mercury and gold are born from the mixture of the pure *chhi* (*pneumata*) of Heaven and Earth (i.e. Nature). At first cinnabar belonged to the left and stayed at the east, but afterwards it changed to mercury and stayed on the right at the west. This is known as 'borrowing a position' (*chieh-wei*[102])."

[11] The Commentary says: "The Chang and I lunar mansions belong to the south, denoting cinnabar. Hsü and Wei are the lunar mansions of the north, and denote mercury. This means that mercury is formed from cinnabar, and is described as a flight from the south to the north. Here is one change."

[12] The Commentary says: "Cinnabar can be converted to mercury and mercury can be changed back to cinnabar. This is one of the transformations that cinnabar can undergo." Such remarks as this remind us strongly of the Greek alchemical symbol of Ouroboros, the serpent eating its tail; cf. Berthelot (1), p. 132.

[13] The Commentary says: "This palace is that of the south, the palace of cinnabar. This determines the change of mercury."

Note that the Chinese cardinal point south was generally represented above the cardinal point north, i.e. if we rotate the modern representation of the cardinal points by 180° we get the Chinese system.

[14] The Commentary says: "That is to say, many changes can be accomplished with mercury."

[15] The Commentary says: "*Hung* is mercury and is the essence of Yang."

[16] The Commentary says: "Cinnabar is obtainable from mercury. Hence the latter is said to contain the 'Red Water' (*chhih-shui*), which is cinnabar."

[17] The Commentary says: "Mercury changes back to cinnabar. The relationship between these two substances is similar to that between husband and wife. In the beginning mercury first came from cinnabar."

[18] The meaning of the Commentary here is rather obscure. It says: "The substance *hei-chhien*[113] (black lead) is of the same colour as mercury. It is blue-green and belongs to the east. Cinnabar is the essence of the Wood element, and hence it is said to be caerulean (blue-green)." Fortunately the Commentary of the *Wei Po-Yang Chhi Fan Tan-Sha Chüeh*[21] gives us a clearer explanation by saying that cinnabar was formed by the primordial *chhi* (*pneuma*), and within cinnabar was contained mercury (represented by the colour caerulean).

[19] The Commentary says: "It is easy for those who understand, but difficult for those who do not."

of the Original Essence" (*yuan-ching-tzu*[115]) (mercury) follows the handle of the (*Pei-*)*Tou*[116] (the Dipper or Great Bear).[20] The east and the west also engulf each other.[21] Yin advances and occupies the Yu[118] position, moving to and from the Central Palace.[22] The two clans combine.[23] Here are (the relationships of) wife, son, mother, prince, minister and assistant.[24] Now if we can control them with the *chieh-fu*[121] (correct time of heating, talismans and other procedures), it may be likened to the use of water to extinguish fire to bring about the ultimate submission of the latter.[25] When (the proper time of heating in accordance with the hours) *chih-fu*[122] (23.00 to 11.00 hrs.) and *chih-shih*[123] (11.00 to 23.00 hrs.) are determined, *shêng-chiang*[124] (literally rise and fall; sublimation and precipitation; perhaps also distillation and "destillatio per descensum") will definitely be accomplished.[26]

Now the *Tshan Thung* (*Chhi Wu Hsiang Lei*), by means of the Five Elements, the inner and outer (forces) and the six (acoustic) pitches (*liu lü*[125]), divides all things into two parts and so recognizes those (substances) which are of the same category (*thung lei*[126]).[27] According to the Five Element (theory) just mentioned "Red Marrow" (*chhih-sui*[129]) (mercury) and the "Great Yang" (*thai-yang*[130]) (cinnabar) belong to the same category (*thung lei*).[28] Realgar (*hsiung-huang*[119]), or the "Male Essence" (*hsiung-ching*[134]) contains and receives the "Great Yin" (*thai-yin*[135]), which is orpiment (*tzhu-huang*[136]). The condensation of liquids of the same class is the great Tao of the *huan-tan*[137] (cyclically transformed elixir).[29] Moreover, realgar (*hsiung-huang*) and sal ammoniac (*nao-sha*[140]) belong to the same category (*thung lei*)[30] forasmuch as without sal

[20] The Commentary says: "*Yuan-ching-tzu*[115] is mercury. During the eleventh lunar month, or *chien-tzu*[117] (the month when the year began during the Chou dynasty), the *chhi* of Yang is born in spring. Hence (mercury) receives its measures from (the *chhi* of) Yang during the eleventh month. In other words, (heating) should begin in the eleventh month, or *chien-tzu*."

[21] The Commentary says: "East is cinnabar, and west mercury. The two substances engulf each other."

[22] The Commentary says: "The Central Palace refers to realgar (*hsiung-huang*[119]). Here it means that the two substances mercury of Yin and gold of Yu[118] are put together. First the *chhi* of realgar is subdued (*fu*[120]) and then mercury is suppressed." The process obscurely referred to here must be amalgamation.

[23] The Commentary says: "Gold and mercury are mixed together. A second interpretation says that mercury is mixed with cinnabar."

[24] The Commentary says: "Mercury takes lead as its wife. This also resembles the relationship between the son and his mother and that between the prince and his minister." Again amalgamation.

[25] The Commentary says: "When the process of heating is undertaken at the right time and for the proper duration the Five Elements will take their proper course. Gold and mercury will naturally be subdued (*fu*[120])." Must be gold amalgam.

[26] The two terms *chih-fu* and *chih-shih* are defined at the end of the text itself (p. 187 below).

[27] The Commentary says: "Now (in the making of) the great elixir (*ta-tan*[127]) success will never be attained if the Yin and Yang principle and the Five Element theory are not followed to classify substances into categories (*kho ting thung lei*[128])."

[28] The Commentary says: "*Thai-yang shui-yin*[131] is the same (substance) as *thai-yang chhih-sui*[132]. It is mercury recovered from cinnabar, and is also known as *thai-yang-hung*[133]. *Thai-yang*[130] is a synonym for cinnabar." Note that the *Shih Yao Erh Ya* (ch. 1, p. 1b) gives the term *thai-yang* as a synonym for mercury as well as for cinnabar.

[29] The Commentary says: "*Hsiung-ching*[134] is realgar (*hsiung-huang*), and *yin-chin*[138] is orpiment (*tzhu-huang*[136]). *Huan-tan* is another name for the 'Great Cyclically Transformed Elixir' (*ta-huan-tan*[139])."

[30] The Commentary says: "When realgar

ammoniac the colour of realgar will not change. Orpiment (*tzhu-huang*[136]) belongs to the same category as liquid honey (*mi-shui*[141]) and fritillary corms (*pei-mu*[142]).[31] In the presence of *shih-chih*[144] (a kind of clay) arsenious acid (*phi-huang*[145]) immediately coagulates (*ning*[146]) and becomes incapable of taking flight (*fei*[147]) (i.e. subliming).[32] When sulphur (*shih-liu-huang*[148]) is added to magnetite (*tzhu-shih*[149]) we have two different (*shu*[150]) liquids of the same category (*thung lei*) which can be made to boil together.[33] Mercury (*hung*[154]) and sulphur (*thing-chih*[155]) belong to the same category; both quickly liquefy when heated.[34] The "Mountain Spirit of the Greater Yin" (*thai-yin-shan-hun*[157]) (orpiment) and the "Son of Cinnabar" (*sha-tzu*[158]) (mercury) belong to the same category since they turn immediately into a white clay-like substance.[35] The "Elixir Spirit of the Greater Yang" (*thai-yang-tan-hun*[162]) or cinnabar (*chu-sha*[163]) and vinegar from thrice-fermented wine (*shun-hsi*[164]) belong to the same category.[36] Lead (*chhien*[167]) belongs to the same category

and sal ammoniac are heated together in the same container a blood-like liquid will be formed after a short while. Heating is continued for a whole day and night in a closed vessel. Hence we know the truth of the statement." Presumably the chloride acted to prevent oxidation of the fused arsenic disulphide.

[31] *Fritillaria roylei*; Read (23), no. 678. The Commentary says: "Put some orpiment in a small pot, and after the vapour (*sha*[143]) has come out introduce some powder of the corms of *pei-mu* and stir vigorously. When poured into liquid honey it is found that each substance retains its original properties. It is difficult to demonstrate by other methods that these substances belong to the same category (*thung lei*). Hence other methods might well be discarded." The plant *Fritillaria roylei* contains a number of active alkaloids, and is still used in Chinese medicine. See Chang Chhang-Shao (3), pp. 78 ff.; Lu Khuei-Sêng (14), pp. 95 ff.

[32] The Commentary says: "When magnetite made into powdered form is enclosed and heated for 20 days in a cylindrical container it will be subdued (*fu*[120]), but after this it will not suffer any bodily change." Does this refer to iron smelting? In any case, the Commentary does not seem to explain the text. It may have been inserted in the wrong place. Arsenious acid sublimes at a temperature of 193°. The text probably means that sublimation will not occur when arsenious acid is mixed with *shih-chih*, a kind of clay.

[33] The Commentary says: "The word *shu* means *lu shu*[151]. (Sulphur) is gently heated in a porcelain vessel so that it is not allowed to burn or catch fire. To prevent it from burning the fire must not be strong. (The Emperor) Chhêng-Ti[152] spent one hundred days heating and trying to transform the Five Metals using liquid sulphur." Unless this is an error for Wu-Ti[153] of the Former Han (140 to 87 B.C.) it may mean Chhêng-Ti of the same dynasty (32 to 7 B.C., a very alchemical period), or Chhêng-Ti of the Chin (A.D. 326 to 342), who could have been a disciple of the alchemist Ko Hung.

[34] The Commentary says: "*Thing-chih* is sulphur. As soon as it liquefies it must be removed quickly, otherwise it will catch fire and burn away. After repeating this process several times it can be used to make the 'Middle Cyclically Transformed Elixir, (*chung-huan-tan*[156]), which, when taken, brings longevity and enlightenment. *Thing-chih* (sulphur) is also called *shih-liu-huang*[148]. It changes mercury into cinnabar. Mercury remains stationary in the presence of sulphur, because it is under the control of the Earth element, to which sulphur belongs. When under control mercury has a muddy look. When (the two substances) are heated inside the furnace cinnabar is formed." Ouroboros again.

[35] The Commentary says: "*Sha-tzu* is mercury and (*thai-yin-*) *shan-hun* is orpiment. They are mixed with silver (*yin*[159]) and treated for 15 days. Hsin[160] and Yu[118] represent the position occupied by gold (*chin*[161])." Amalgam with silver.

[36] The Commentary says: "*Shun*[165] is Spring wine. When it is put into a vessel at the third month and kept till the fifth month when the days become warmer it will change by itself into vinegar (*shuang*[166]). How then can we doubt the fact that Yin and Yang will form the 'Cyclically Transformed Elixir' (*huan-tan*[137]) just as naturally? This is con-

as mulberry ashes (*sang-hui*[168]) which bring it under control.[37] Tin (*hsi*[177]) and litharge (*mi-tho-sêng*)[178] belong to the same category (*thung lei*), and to them the "Five-Coloured Mountain Spirits" (*wu-sê-shan-hun*[179]) (the five siliceous clays) may be added.[38] Bronze coins (*chiang*[185]) and the "Spiritual Essence of Heavy Sand" (*chung-sha-tzu-hun-ching*[186]) (cinnabar) belong to the same category.[39] Five catties of broken brass fragments (*chê-yü*[189]) from Persia can enter "Pure and White Frost" (*su-pai-shuang*[190]) (mercury)—the two belong to the same category.[40] The "Khun-lun[200] (Mountain)" (copper carbonate) and mutton(-fat) from wethers (*chieh-yang*[201]) belong to the same category.[41]

trary to popular belief, but Nature always has her own ways. How can one say that man can act contrary to Nature?"

[37] The Commentary says: "Lead is put into a combustion chamber filled with ash (*hui-phei*[169]). After being treated nine times it is mixed with the 'Residue of the Red Bird' (*chhih-niao-chiao*[170]) (calcium sulphate) and a fatty white powder (*chih-shuang*[171]) is obtained. Men gain longevity after taking the eight minerals and the Five Elements in the 'Ninefold Cyclically Transformed Elixir of the Holy Immortals' (*chiu-phien-shen-hsien-tan*[172])."

The *Lung Hu Huan Tan Chüeh* says (ch. 2, p. 18b) that *chhih-niao*[173] ("Red Bird") is an impurity in calomel (*ni-fên*[174]) and is composed of *ni-tan*[175] (probably gypsum) and ordinary salt (*yen*[176]). This substance is also mentioned in the *Tan Fang Chien Yuan* (ch. 2, p. 5a) and the *Kêng Tao Chi* (ch. 3, p. 7b).

[38] The Commentary says: "*Shan-hun*[180] refers to the five types of siliceous clays (*shih-chih*[144]), the powders (*shuang*[166]) of which show five different colours. They are put into a bowl-shaped reaction-vessel (*tan-fu*[181]), which is then smeared with a lute (*sha-niu-chin*[182]). The cover is a wooden bowl (*sha-phên-tzu*[183]). The substances are allowed to sublime (*fei*[147]; literally, to fly) from the Yin double-hour (03.00 to 05.00 hrs.) to that of Hsü (19.00 to 21.00 hrs.) until the sublimate (*shuang*[166]) in the vessel has settled (*fu*[120]). Strong fire is used continuously by day and night. The gold reaction-chamber (*chin-ting*[184]) is of metal and dislikes being sealed too tightly. The sublimate (*shuang*) shows its colour in a striking way."

[39] The Commentary says: "What is meant by 'the essence forming cinnabar' is that cinnabar is mixed with the ingredients in a *lou-lu*[187] stove. After 50 operations the coins will turn into silver (*pai-chin*[188]) in threes and fives (at a time). These can be used immediately for the relief of those in need." This sounds like another amalgamation process with copper and tin to simulate silver.

[40] The Commentary says: "Five catties of Persian brass are mixed with 'White Frost' (*pai-shuang*[191]), which is mercury (or silver) (*yin*) in a pottery crucible (*thu-kuo*[192]) and above this is put some 'Walking Magical Bone' (*tao-hsing-shen-ku*[193]) about 5 inches thick and added slowly a little at a time. 'Juice from the Yin Animal' (*yin-shou-chih*[194]) is then poured over the mixture. Fire is increased gradually. After three seasons small lumps of brass (*yü-hsieh*[195]) will be formed. The 'Animal Juice' (*shou-chih*[196]) means the urine of a black ox (*hei-niu-niao*[197]) and the 'Walking Magical Bone' refers to crystal salt (*jung-shih-yen*[198])."

According to the *Shih Yao Erh Ya* (ch. 1, p. 3b), "Walking Magical Bone" was a synonym for fluorspar (*tzu-shih-ying*[199]). The process looks like another amalgamation with copper and zinc. If sulphur had been mentioned one would incline to think that ammonium sulphide and polysulphides were aimed at. Urine was a common constituent in European alchemical technology also (cf. Berthelot (1), p. 46).

[41] The Commentary says: "Khun-lun (Mountain) is copper carbonate, which appears like the 'Moisture of the Sheep' (*yang-chin*[202]), i.e. mutton fat (*yang-chih*[203]). Copper carbonate is made into powder, mixed with mutton fat and put inside a steamer (*sha-tsêng*[204]) (see Ho & Needham (9)). After steaming 50 times the contents is allowed to settle down (*fu*) in a small room. It can then be made into any one of the Five Metals. During the process the *chhi* of the essence must not be allowed to escape (i.e. the reaction-vessel must be tightly sealed with a lute). After 100 days it will turn into the 'Tail of the Blue Dragon' (*chhing-lung-chhiao*[205]) (a purer form of copper carbonate). This can be used to fix the 'Original Essence of Cinnabar' (*chu-yuan-ching*[206]), which is mercury. Mercury can be used to fix the 'Red Yang' (*tan-yang*[207]), which is copper (*chhih-thung*[208])."

Khung(-chhing)[209] (blue copper carbonate) and red hematite (*tai-tan*[210]) belong to the same category.[42]

To subdue (*yin-fu*[218]) metallic lead (*chin-kung*[219]) immediate results are obtained when "Flying Frost" (*fei-shuang*[220]) (perhaps calomel) is used; to control (*yang-chih*[221]) it sulphur (*thing-chih*[155]) is necessary.[43] When the son receives his mother he puts on a dark brown garment and invites her to stay.[44] When the mother transforms into the son fixation takes place under the aegis of (the cyclical sign) *kêng*[224].[45] The causes (*yin*[225]) of the transformations and completions of processes must be (discovered and) utilized, the minute beginnings of things (*kên wei*[226])[46] must be fostered to the utmost (*pi-fu*[227]), the efficient causes (*yuan*[228]) of the operations must not be allowed to escape (literally fly away, condense).[47] All this indeed depends upon the Greater Yang[48] conquering the opposing (substances in reactions) and making them mutually use each other and so transform.[49] Also they may uselessly remain as they were.[50] But if for the tube length you take "Metal" as the number (i.e. 4) there will be ascending and descending (*shêng-chiang*[124]) and distillation or sublimation (*fei-hun*[229]) according to your desire. When the number 9 (also "Metal" but Yin) is reached the process is finished, and the 7 (i.e. "Fire") tallies (*chhi-fu*[230]) will cause no further change.[51] The substances return to the Five Elements. As

According to the *Yin Chen-Chün Chin Shih Wu Hsiang Lei* (p. 8b) the "Tail of the Blue Dragon" (*chhing-lung-chhiao*) is a purer form of copper carbonate. Could the formation of organic compounds of copper here have been another way of making the golden-coloured Cu-Hg amalgam?

[42] The Commentary says: "*Khung* is *khung-chhing* (blue copper carbonate) and *tai-tan* is *tai-chê*[211] (red haematite). They are ground to a powder in a basin and then mixed with mercury (*yuan-ching*[212]) before being placed inside a steamer (*sha-tsêng*). After some heating the contents are transferred to a yellow-earth crucible (*huang-thu-kuo*[213]) which is tightly sealed and heated by charcoal from the eastern side. In a few moments silver (*pai-chin*) will be formed. This is also a method for the relief of the poor. *Yuan-chin*[214] is the 'Lu-Shu Juice' (*lu-shu-chih*[215]), also called the 'Mysterious Essence of the Greater Yin' (*thai-yin-yuan-ching*[216]) (mercury)." It has not been possible to find another reference to *thai-yin-yuan-ching*. But the *Shih Yao Erh Ya* (ch. 3, p. 1a) mentions that *thai-yin-hsüan-ching*[217] is a synonym for mercury. Our Commentary has also previously referred to *yuan-ching-tzu*[115] as mercury. Amalgamation with copper and iron is probable.

[43] The Commentary says: "*Thing-chih* is sulphur. Metallic lead (*chin-kung*) and the 'Flying Frost' (*fei-shuang*) (presumably calomel) with mercury turn after a short while into a black muddy substance. When placed in a container of Fêng-chhêng[222] porcelain it can be made into the 'Red Frost Elixir' (*chhiang-shuang*[223]). This is one of the secrets of transformation." Presumably mercuric sulphide is the product here.

[44] The Commentary says: "The 'son' refers to mercury and the 'mother' to silver."

[45] The Commentary says: "(The cyclical sign) *kêng* refers to gold. Mercury, which is the son, is fixed by silver."

[46] This phrase is of much interest in connection with atomic conceptions in ancient China; see Needham (18), IV, pt. 1, sect. 26*b*, and Needham & Robinson (20).

[47] The word *yuan*[228] (causes) is of course a common Buddhist term. But there is no evidence in the text to suggest any Buddhist influence on an extensive scale.

[48] The Commentary says: "(The Greater) Yang denotes mercury."

[49] The Commentary says: "Mercury and silver act against and mutually subdue each other."

[50] The Commentary says: "The word *khung*[231] means 'great hardness'." Perhaps the state of a metal remaining unattacked.

[51] The Commentary says: "The number 9 refers to cinnabar and 7 to mercury. Gold is changed back to an elixir, which, when eaten, enables the soul (*shen-hun*[232]) to become immortal and live as long as the sun and the moon, or the heavens and the earth."

for father and mother, prince and minister, how could the great elixir be placed next in importance to them?[52]

I have heard the teachings of the various schools. All said that they could (manage things) without differentiating the Yin from the Yang and without understanding (the doctrine of) substances of the same category. Perhaps the sages intentionally described the secret in an obscure way. Thus there are those who cannot understand their meanings but make their own arbitrary interpretations, far astray from the real thought of the sages. Now those who wish to understand the making of mineral preparations by the methods of the furnace and the fire must search out the recipes, reading (as many of) the records and techniques in the classical texts (as possible), till they become fully conversant with the literature of the ancients and reach the original meaning. That is the great Tao. Nowadays (those who frequent) the many famous caves in the mountains, seeking the teachings of the various masters, find that no two of them are alike. However, if one has seen a large number of classical recipes and understands the explanations and discussions of the different schools, one may turn one's hand to the matter oneself.[52a] The dragon and the horse (*lung ma*[235]) are harnessed (to the carriage).[53] The dragon (*lung*[236]) and the tiger (*hu*[237]) engulf each other.[54] The man and the girl have mutual commerce.[55] Father and son respect each other.[56] That change (can take place in) the mother (is because) she holds within herself (a being of) the (same) class.[57] The white and the red mingle together.[58] The black and the caerulean capture (*chü*[241]) each other.[59] A turn to the left (in the cycle) is made in the course of six double-hours (*liu-shen*[243]) (literally, six spirits).[60] (The cyclical sign) *ssu*[61] passes our palace.[62] Then again, a turn to the right (in the cycle) involves temporarily

[52] The Commentary says: "Mercury belongs to one of the Five Elements and can take the place of father, mother, prince, or minister. If it is properly controlled the great elixir will be formed by cyclical transformation."

[52a] The Commentary says: "It is generally agreed that one must (know) the explanations and subtle meanings of the various processes, and (be able to make) inferences about the Yin and Yang, (before one can) understand the pattern-principle (of Nature) (*Yin Yang chih li*[233]) and how substances of similar (category) go together (*erh chih thung chê*[234])." The expression used here for "making inferences" is of much interest in the history of Chinese scientific thought; cf. Needham (18), II, pp. 183 ff.; III, p. 165.

[53] The Commentary says: "The dragon corresponds to (the trigram) Chhien and the horse to Khun. They denote the apparatus."

[54] The Commentary says: "The dragon is mercury and the tiger silver. The two substances mutually enlace and swallow each other."

[55] The Commentary says: "The man and the girl denote realgar and orpiment. They are combined with gold and mercury."

[56] The Commentary says: "The father denotes cinnabar and the son mercury."

[57] The Commentary says: "The mother is gold, which contains (literally, cherishes within itself, *han*[238]) mercury, symbolized by the son."

It is interesting to find this statement of "philosophical mercury" in a text so far from the mediaeval European tradition.

[58] The Commentary says: "This refers to alum (*pai-fan*[239]) and red salt (*chhih-yen*[240])."

[59] The Commentary says: "Black refers to silver and blue to copper carbonate (*tshêng-chhing*[242])."

[60] The Commentary says: "From (the cyclical sign) *tzu*[244] to that of *ssu*[245]." In other words, from 23.00 hrs. to 11.00 hrs.

[61] The Commentary says: "This means mercury changing to cinnabar, because *tzu*[244] denotes mercury and *ssu*[245] cinnabar."

[62] The Commentary says: "When mercury moves from the left to the right it attains the physical form of gold."

passing the original period of heating (*ku fu*[246]). Heaven and Earth rotating through eight fortnightly periods (*pa-chieh*[247]) decide the four seasons. They all take the lead in turn[63] so as to occupy the "Earth" position corresponding to the number 5.[64]

¶ *The Eulogy says:*

The Sage and the Worthy are renowned for their three transformations,[65] each knowing his own position. The dragon and the tiger compete for the leading place, while the "Red Marrow" (*chhih-sui*[129]) (mercury) gradually turns purple.[66] Alum (*pai-fan*[239]) communicates with the mystery (of the Tao),[67] and contains the eight minerals (and metals) (*pa shih*[251]).[68] These all have to be determined continuously.[69] The five directions have to be established.[70] Things of miscellaneous categories are difficult to decide upon. Thus the "Red Emperor" (*chhih-ti*[253]) (mercury)[71] comes forth from the domain of the element Earth, and the number 5[72] removes the minerals (*shih*[254]). The number 1 is used to capture (*chü*[241]) the number 9.[73] The number 5 can be utilized to fix the number 7.[74] (The period) *chhi*[255] consists of three shorter periods *chieh*[256].[75] The numbers 7 and 8 combine.[76] These are what one sees in the making of the "Cyclically Transformed Elixir" (*huan-tan*[137]). With alum (*fan-shih*[257]) one must use the "Three Envoys" (*san-shih*[258]) as ingredients[77]

[63] The Commentary says: "In the application of fire the time and duration are determined according to the two solstices."

[64] The Commentary says: "The number 5 denotes Earth. This means the combination of the *chhi* of the male and the female."

[65] The Commentary says: "Cinnabar belongs to the south and also to the east, but mercury belongs to the north."

[66] The Commentary says: "The tiger is silver, the dragon mercury and red refers to cinnabar. The name *tan-sha*[248] ('Red Sand') (for cinnabar) is derived from the red colour."

[67] The Commentary says: "The type of alum called *tê-sêng-fan-shih*[249] contains the *ming-fan*[250] alum, which can fix (*chih*[251]) mercury." This is a statement very often found in mediaeval Chinese alchemical texts. Presumably the mixed sulphates were so treated as to generate small amounts of impure sulphuric acid which under heat and pressure acted on mercury to form its sulphates and sulphides.

[68] The Commentary says: "The 'eight minerals and metals' are the three 'yellow substances' (*san-huang*[93]) (i.e. sulphur, realgar and orpiment) and the five metals (*wu chin*[252]) (i.e. gold, silver, copper, iron and lead)."

[69] The Commentary says: "Mercury belongs to the north, and is of the same (category) as gold."

[70] The Commentary says: "In the five quarters cinnabar corresponds to the Five Elements. Substances must be placed accordingly."

[71] The Commentary says: "The 'Red Emperor' is a synonym for mercury."

[72] The Commentary says: "This is like the action of a son in accordance with the wishes of his mother."

[73] The Commentary says: "The number 1 is silver and 9 is mercury. Gold captures (*chü*[241]) mercury and they both fix and subdue each other." Amalgamation.

[74] The Commentary says: "(The number) 7 is gold and 5 is orpiment."

[75] The Commentary says: "One *chhi* is 15 days and one *chieh* is 5 days." Note that while the first of these terms is approximately equivalent to the calendrical *chhi* of 14 days, the latter divides it into three parts, not the usual calendrical two. Cf. Needham (18), III, p. 404.

[76] The Commentary says: "With regard to the meanings of the numbers 7 and 8, 7 means 7 ounces of mercury and 8 means 8 ounces of silver. A second interpretation is that 7 and 8 together make 15 days."

[77] The Commentary says: "The 'Three Envoys' are alum (*shih-fan*[259]), yellow alum (*huang-fan*[260]) and white alum (*pai-fan*[239])."

and also the two "Blue (Substances)" (*chhing*[261]),[78] but not the "Original Water Stone of the Greater Yin" (*thai-yin-yuan-shui-shih*[262]) (lake salt).[79] Realgar (*hsiung-huang*[119]), orpiment (*tzhu-huang*[136]), arsenious acid (*phi-huang*[145]) and sulphur (*shih-liu-huang*[148]) are heated together with rock-salt (*shui-shih-yen*[264]) for one month until the fire dies down (*fu-huo*[265]).[80] The two alums hold on to each other for a long time.[81] For (heating) the ingredients used for making the great elixir one must not put in any fresh charcoal, but must keep up a slow fire.

¶ *The Mnemonic Rhyme says:*

The edges (of the vessel) must be deep and long, combining to capture (the *chhi* of) Yin and Yang.[82] The base must be thick so that the ingredients within will prosper.[83] The "Running Pearls of the Greater Yang" (*thai-yang-liu-chu*[267]) (mercury) are put into vinegar (*hua-chhih*[268]).[84] Red salt (*chhih-yen*[240]) and "White Snow" (*pai-hsüeh*[271]) (calomel) together form the male and the female substances.[85] This is not far from the Tao, but people do not realize it.[86] The "Red Dragon" (*chhih-lung*[275]) (cinnabar) turns into powder.[87] The "White Tiger" (*pai-hu*[277]) becomes as bright as frost.[88] The "Stone Juice"

[78] The Commentary says: "They refer to copper carbonate (*tshêng-chhing*[242]) and blue copper carbonate (*khung-chhing*[209])."

[79] The Commentary says: "This is crude lake-salt (*lu-yen*[263])."

[80] The Commentary says: "(The first four substances) are first heated over the fire."

[81] The Commentary says: "When the 'Four Yellow Substances' (i.e. sulphur, realgar, orpiment and arsenious acid) are used for heating and fixation the category of the five alums is not required." This is quite comprehensible as the products of the two processes would have been altogether different.

[82] The Commentary says: "The reaction-vessel (*ting-chhi*[266]) resembles an inverted crescent moon in shape. It also looks like a round body. From the two upper portions downwards the two edges meet. The edges (or flanges) must be carefully made and the slightest fault is not permissible." See Ho & Needham (9).

[83] The Commentary says: "It means that it is made of lead and silver, symbolizing the state of chaos at the beginning of time. It holds and nourishes the efficacious ingredients and brings prosperity."

[84] The Commentary says: " 'Running Pearls' refers to mercury. The 'Black Pool' (*hei-chhih*[269]) or the 'Delicacy on the Left' (*tso-wei*[270]) (vinegar) is used to boil mercury and silver. The substance formed is mixed and ground before it is put in a container." Presumably this refers to the formation of acetates.

[85] The Commentary says: "Alum and salt are heated together until a red substance is formed—hence the name 'Red Salt' (*chhih-yen*[240]). It is used for making the elixir by the method of sublimation (*fei-tsao*[272]). This is called the 'White Snow (Elixir)', which is also known by the names 'Feminine Snow' (*tzhu-hsüeh*[273]) and 'Masculine Snow' (*hsiung-hsüeh*[274])." Presumably coloured salts of iron are referred to here. De Mély (17) says (p. 76) that *pai-hsüeh*[271] is a synonym for calomel.

[86] The Commentary says: "It means that the method is easily available, but people are unaware of it."

[87] The Commentary says: "Mercury turns into the 'Red Powder' (*chhih-fên*[276]) (cinnabar)."

[88] The Commentary says: "At a certain time lead and mercury will turn into the form of frost and snow."

This must assuredly refer to the making of lead carbonate (probably by the acetic acid method) and to the sublimation of the chlorides of mercury; processes all employed in ancient or mediaeval China. The oldest mention of the making of white lead is of the 5th or early 4th century B.C. (*Mo Tzu*, and very clearly in *Chi Ni Tzu*; cf. Theophrastus in Europe a little later). Further on this, see Schafer (41). The sublimation of the chlorides of mercury was accomplished dur-

(*shih-i*[278]) (sulphur) is next introduced,[89] and then the "Imperial Flowing Mush" (*ti-liu-chiang*[279]) (weak magnetite suspension) is used.[90] By nourishing the spirit the Five Organs become purified.[91] The three "Yellow (Substances)" (*san-huang*[93]) (i.e. sulphur, realgar and orpiment) can be refined.[92] The Great Cyclically Transformed Elixir (*ta-huan-tan*[139]) employs lead as the master, mercury as the prince, sulphur as the minister, realgar as the general, orpiment as the assistant and copper carbonate as the envoy. Hence the prince and the minister are matched, the master and the general are seized and conquered, and the envoy and the assistant announced and exchanged. Although other substances are borrowed to render help, after a long time they will eventually change into ashes in the fire. Not to understand the nature of a mixed solid (literally, of hardness) may be called "mother and son not yet separated."[93] Understanding how to use the concepts of Yin and Yang may be called "pre-determined (theory)." The two chemical substances reacting in the reaction-vessel (*ting-chhi*[266]) are subject to heating according to the art *huo-chi*[284]. The procedure must follow the two trigrams of Chhien[285] and Khun[286], and must be done according to the rules. From the *tzu*[244] double-hour (23.00 to 01.00 hrs.) to those of *chhen*[287] (07.00 to 09.00 hrs.) and *ssu*[245] (09.00 to 11.00 hrs.) is known as the *chih-fu*[122] and from *wu*[288] (11.00 to 13.00 hrs.) to *hsü*[289] (19.00 to 21.00 hrs.) and *hai*[290] (21.00 to 23.00 hrs.) the *chih-shih*[123]. The symbols of the trigrams are imitated in fixing the periods of heating.

[End of *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*]

V

Discussion

First let us dispose of the positive experimental content of this interesting text. So far as we can see, it contains references to the following operations:

ing the Thang or Wu Tai periods, and calomel was incorporated in the pharmacopoeias from the 10th century A.D. onwards (*Jih Hua Pên Tshao*). This is just about the same period as the mention of the chlorides in the Syriac texts studied by Berthelot & Duval (see von Lippmann (42), pp. 388, 393, 437).

[89] The Commentary says: "The 'Stone Juice' (*shih-i*) is sulphur."

[90] The Commentary says: "To subdue and fix (*fu-chih*[92]) the 'Stone Juice' (sulphur) it is necessary to use the 'Flowing Mush of the Black Emperor' (*hsüan-ti-liu-chiang*[280]), which is a suspension made from magnetite (*tzhu-mu*[281])." This may refer to the making of sulphides and perhaps sulphates of iron. *Ti-liu-chiang*[279] is magnetite of weak attractive power according to the *Shih Yao Erh Ya* (ch. 1, p. 2a) and the *Thai-Chhing Shih Pi Chi* (ch. 2, p. 10a).

[91] The Commentary says: "The fire must be regulated to keep and nourish the efficacious *chhi* of the Five Elements in the reaction-chamber (*tan-shih*[282]), like a person maintaining his Five Viscera in a pure state."

[92] The Commentary says: "Lead and mercury require a subdued fire and the presence of the three 'Yellow (Substances)' to return to the state of absolute Yang. The three 'Yellow (Substances)' belong to Earth, which can generate Metal, and this is why they are used. Besides they are very *jê*[283] (literally, hot) by nature, since all three of them are the essence of the Greater Yang. They are used together with mercury, because mercury is 'cold'. The three 'Yellow (Substances)' are realgar, orpiment and sulphur. Copper carbonate is a very active substance; it is the 'sprout' or 'envoy' of gold. Realgar, orpiment, sulphur and gold are 'flowers'."

[93] The Commentary says: " 'Plain Mercury' (*su-hung*[291]) is silver, the properties of which have not been examined in the classifications. Yin and Yang refer to (the tri-

(a) Interconversion of the metals and their sulphides for mercury and iron.
(b) Amalgamation of mercury in a variety of different ways with gold, silver, copper, tin, iron, zinc and lead; in one case seemingly involving organic copper compounds, and frequently in the presence of the sulphides of arsenic.
(c) Formation of acetates of mercury and silver.
(d) Sublimation of the chlorides of mercury, and preparation of lead carbonate.
(e) Formation of sulphides and sulphates of mercury by treatment with alum.
(f) Treatment of arsenic disulphide with ammonium chloride.
(g) Association of arsenic trisulphide with alkaloid-containing liliaceous corms.

Thus many of the processes discussed are of a quasi-metallurgical nature quite parallel to the Western developments from the chemical technology of the Leiden papyri and the early Greek alchemists. Others are more characteristically Chinese. But the chief interest of the text resides in the fact that it contains a conscious body of theory, and this we must now examine.

The proto-scientific system of ancient and mediaeval Chinese thought involved two fundamental principles or forces in the universe, the Yang (symbolized by brightness and masculinity) and the Yin (symbolized by darkness and the feminine); and five "Elements" of which all process and all substance was composed. With these five Elements were aligned and associated, in symbolic correlation, everything else in the universe which could be got into a fivefold arrangement.[94] The key-word in the old Chinese thought-system was Order, but this was an order based on organic pattern, and indeed on a hierarchy of organisms. The symbolic correlations or correspondences all formed part of one colossal pattern. Things behaved in particular ways not necessarily because of prior actions or chance impulsions of other things, but because their position in the ever-moving cyclical universe was such that they were endowed with intrinsic natures which made that behaviour inevitable for them. If they did not behave in those particular ways they would lose their relational positions in the whole (which made them what they were), and turn into something other than themselves. They were thus organic parts in existential dependence upon the whole world-organism. And they reacted upon one another not so much by mechanical impulsion or causation as by a kind of mysterious resonance.[95]

Nowhere are such conceptions better stated than in the fifty-seventh chapter of Tung Chung-Shu's[3] *Chhun Chhiu Fan Lu*[24] (String of Pearls on the Spring and Autumn Annals), written about 135 B.C., which is entitled "Thung Lei Hsiang Tung[294]," i.e. in Hughes' (10) translation "Things of the Same Genus Energize Each Other." We read:

grams) Chhien and Khun." These of course are the two first *kua*[292] of the *I Ching*[293] (Book of Changes).

[94] Cf. Needham (18), II, pp. 261 ff.

[95] For a full account of this nature-philosophy see Needham (18), II, pp. 279 ff., 291 ff.

> If water is poured on level ground it will avoid the parts which are dry and move towards those that are wet. If (two) identical pieces of firewood are exposed to fire, the latter will avoid the damp and ignite the dry one. All things reject what is different (to themselves) and follow what is akin. Thus it is that if (two) *chhi* are similar, they will coalesce; if notes correspond, they resonate. The experimental proof (*yen*[295]) of this is extraordinarily clear. Try tuning musical instruments. The *kung*[296] note or the *shang*[297] note struck upon one lute will be answered by the *kung* or the *shang* notes from other stringed instruments. They sound by themselves. This is nothing miraculous (*shen*[298]) but the Five Notes being in relation; they are what they are according to the Numbers (*shu*[299]) (whereby the world is constructed).
>
> (Similarly) lovely things summon others among the class of lovely things; repulsive things summon others among the class of repulsive things. This arises from the complementary way in which a thing of the same class responds (*lei chih hsiang ying erh chhi yeh*[300]) —as for instance if a horse whinnies another horse whinnies in answer, and if a cow lows, another cow lows in response . . .

Similar passages occur elsewhere in the same book. In this instance one can see how each element was associated with a particular musical note and a particular animal, and in general how things of the same category (*thung lei*, cf. p. 180 and p. 199) were conceived to act as receptors only to disturbances originating within the same category.

Thus the classifiability of which Tung Chung-Shu speaks is the capacity of the various things in the universe to go into the fivefold categorization, or others of different numerical values. Chinese thought was particularly fond of such categorizations; Mayers (16) could list 317 of them from the Two Primary Forces to the Hundred Officials. No less than eleven chapters of the *Thu Shu Chi Chhêng*[301] encyclopaedia (A.D. 1726) are consecrated to this subject in its calendrical-mathematical section.[96] Bodde (2) has devoted a special paper to Chinese "categorical thinking" in which he analyses the curious tabulation in the twentieth chapter of the *Chhien Han Shu*[303] (History of the Early Han Dynasty), where nearly 2,000 historical and semi-legendary individuals were arranged in nine grades according to their virtue.

Tung Chung-Shu was elaborating a philosophy quite widespread among the scholars of the Han; the idea that actions and reactions in the natural world come about by specific stimulus and specific response of one organism upon another according to their intrinsic natures as classifiable in tables of correspondences and categories. Of course this systematization was not based on critical observation or experiment. And for the effects it was not necessary that the bodies should be in contact; action at a distance made no difficulty for the Chinese mind, which visualized a sort of wave-motion transmissible almost infinitely through the aetheric *chhi*.[97] Yet bodies (organisms, whether animate or inanimate) influenced one another not at random but always in accordance with their positions in the perpetually moving cyclical universe. Thus just as the astronomer had to study the motions of his celestial bodies the alchemist had to pay attention to his "fire-times," suitable moments and durations for his works. It will be clear from this that the intellectual obstacles inhibitory to a proper understanding of chemical combination in China were rather different from those in Europe. For in the West the Greek atomic theories were always waiting in the wings ready to take the centre of the stage

[96] *Li fa tien*[302], chs. 129-40.

[97] Cf. Needham & Robinson (20).

when the time was ripe, while in China the atomic theories of the Indians, though often brought in, had never seduced Chinese thinkers from their instinctive adhesion to what was essentially a prototypic wave theory, the reciprocally dependent rise and fall of the Yin and Yang forces. Thus it came about that in spite of the relatively advanced scientific character of mediaeval Chinese physical theory, and in spite of the numerous empirical discoveries and inventions of mediaeval Chinese alchemy and chemical technology, modern chemistry (like the rest of distinctively modern science) originated in Europe, and passed to China only in the eighteenth and nineteenth centuries.

Nevertheless the ancient and mediaeval Chinese category theories gave rise to a literature which is still of much historical interest, and has received almost no attention from sinologists. It forms the wider background of what we have here discussed in a particular alchemical text. The first tractate which we have in mind derives from the early Chin period, at which time Chang Hua[30] (*fl.* A.D. 232 to 300) wrote the *Kan Ying Lei Tshung Chih*[29] (Record of the Mutual Resonances of Things). Chang Hua is better known of course for his *Po Wu Chih*[304] (Record of the Investigation of Things), a miscellany of scientific interest datable *ca.* A.D. 290. Then in the early Thang the astronomer Li Shun-Fêng[28] (*fl.* A.D. 620 to 680) wrote a *Kan Ying Ching*[27] (On Stimuli and Responses in Nature). Lastly we wish to refer to two small books written by the great poet and scholar-official Su Tung-Pho[32] (A.D. 1036 to 1101); first his *Wu Lei Hsiang Kan Chih*[39] (On the Mutual Responses of Things According to their Categories) and secondly his *Ko Wu Tshu Than*[31] (Simple Discourses on the Investigation of Things). This is far from exhausting the available literature which deals with categories and resonances in nature-philosophy, but we shall discuss these books sufficiently as representative.

Before proceeding further, however, we must make mention of a text which might be regarded as the *fons et origo* of the whole group. We refer to the *Huai Nan Wan Pi Shu*[305] (The Ten Thousand Infallible Arts of the Prince of Huai-nan). This strange work dates mostly from the time of the prince of Huai-nan, Liu An[306] (d. 120 B.C.), a great patron of alchemists and other naturalists.[98] It is supposed to have formed a complement to the existing, and very well-known, *Huai Nan Tzu*[307] book, a compendium of natural philosophy the authenticity of which is quite unquestioned. A clear tradition among Chinese scholars going back to the first century asserts that much of the *Huai Nan Wan Pi Shu* was concerned with alchemy (*shen hsien huang pai shu*[308] —the Magical Immortals' Art of the Yellow and White, i.e. elixirs and the making of gold and silver).[99] We now have only fragments of this book, but it is reasonable to look on it as the forerunner of the whole class of proto-scientific literature which we are discussing. In this connection we may recall that its date is very close to that of the *Chhun Chhiu Fan Lu*, since Tung Chung-Shu was a younger contemporary of Liu An. Broadly speaking, in this class of literature, the later the text the less the admixture of magic and the stronger the practical technological element.

Modern scholars such as Yeh Tê-Hui[327] and Sun Fêng-I[328] have collected

[98] For an account of what is known of the genesis and bibliography of this book, see Kaltenmark (11), p. 32.

[99] Cf. *Chhien Han Shu*[303], ch. 44, p. 8b.

together the fragments of the *Huai Nan Wan Pi Shu* from numerous sources—mainly encyclopaedias and pharmacopoeias. Of one hundred and fifteen entries, fifty-six are concerned with charms and omens, but there are thirty-two which deal with medicine, pharmaceutics, nutrition and animal lore, while thirteen involve physical phenomena and twelve alchemy or chemistry. Thus side by side with a charm to make people tell the truth by giving them insects from the bamboo plant to eat, or hanging up a piece of lodestone in a well to draw back a runaway person, one finds a clear statement of the precipitation of metallic copper from copper-containing waters[100] or a prescription for a longevity elixir using copper carbonate. Of sympathies and antipathies there are plenty—roasting crab-meat attracts rats, and horn is burnt to keep away leopards and tigers in the mountains.

We believe that the remarkable parallelism between this text and the Περὶ συμπαθειῶν καὶ ἀντιπαθειῶν (also called the Φυσικὰ δυναμερά) of Bolus of Mendes the Democritean, has not so far been pointed out. Bolus, who lived at Mendes in Egypt between 200 and 150 B.C., is generally regarded[101] as the initiator of that long line of western alchemical and chemical literature which begins with Pseudo-Democritus[102] and Mary the Jewess in the first century and runs on continuously through Syriac and Arabic into the late Latin books. The first-century Graeco-Egyptian "alchemists," or rather practitioners of chrysopoiesis,[103] were chiefly concerned with making substitutes for precious things from more ordinary materials,[104] and it was among them that operations such as calcination, sublimation, reflux heating and distillation were first thoroughly studied in the West. Colouring processes were particularly important for them. Hence it is doubtless that the title of one of Bolus' lost books was Βαφικά (on Dyeing), while that of another, which we have just mentioned, was closely similar to the title of the truly chemical-metallurgical work of Pseudo-Democritus Φυσικὰ καὶ μυστικά. Besides these there was a Χειρόκμητα (Prescriptions based on Sympathies and Antipathies). Bolus of Mendes, as the first theorist of natural phenomena in their chemical and technological aspects, applying Greek ideas to the interpretation of Egyptian

[100] Cf. Tshao, Ho & Needham (25).

[101] See Festugière (36), pp. 197 ff., 219 ff., 229 ff. On the social background of Hellenistic Egypt see Cumont (31).

[102] The real Democritus of Abdera, so renowned for his atomic materialism, had died in 375 B.C.

[103] The term "alchemists" is most unsatisfactory for these men and women, for they were not concerned with preparing drugs of longevity or immortality, or with the later "philosophers' stone." They were interested in the techniques which had grown up in Hellenistic Egypt for imitating gold, silver, purple and precious stones, whether by the making of alloys or by methods of dyeing, "tingeing," veneering with superficial metal or oxide layers, etc., etc. These techniques they interpreted by means of semi-mystical philosophies of the nature of matter, but "spiritual" or psychological allegories based on alchemical procedures were undeveloped among them. Not until the heyday of Arabic alchemy from the eighth century onwards did the idea of an elixir of life become prominent in the West; and in this many students are now prepared to see the influence of Chinese thought. If alchemy is to be defined as the transmutation of metals in the strict sense, and as the search for elixirs of life, the term is applicable in the West only during and after the intervention of the Islamic centuries.

[104] Exactly the same tendency existed in Chou, Chhin and Han China, when, e.g., green glass was used to substitute for jade in symbolic objects buried in tombs. Cf. Needham (18), IV, pt. 1.

techniques, occupies a position similar to that of Tsou Yen[329] in China, though perhaps an even more shadowy figure than the great systematizer of Five-Element theory.[105]

The reconstructed book[106] of Bolus on sympathies and antipathies is much smaller than the *Huai Nan Wan Pi Shu* but the similarity is obvious. Of its thirty-four items, twenty concern natural antipathies, three tell of sympathies, and the rest have to do with marvellous properties of animals, plants or minerals. Thus with the same juxtaposition of magic and science as in the Chinese text, we find a charm to make a person tell the truth by laying the tongue taken from a live frog upon her sleeping breast, or a notice of the antipathy of serpents for the saliva of a fasting man, side by side with information about the attractive powers of amber and lodestone or about poisonous fruits. On the whole there is relatively more magic in the Greek than in the Chinese text.

The significance of this whole train of thought can well be seen in an epigram which appears several times among the Greek "alchemical" writings.[107] At the beginning of the book of Pseudo-Democritus, the author relates how, being tormented by the desire to know "how substances and natures unite and combine themselves into one substance," he invoked the shade of his master Ostanes, who had died before transmitting all his chemical learning. The answer was that the books were all hidden in a temple, but they could not be found there, and no illumination came until upon a festival evening one of the columns spontaneously split open revealing the marrow of the doctrine in an inscription: "One nature is charmed by another nature, one nature conquers another nature, one nature dominates over another nature."[108] Here then,[109] within the field of the metals and minerals, is just the same principle of sympathies and antipathies about which not only Bolus of Mendes but also the adepts of the Prince of Huai-nan had so much to say. However far away this may seem from the history of chemistry, it is actually one of the most important roots of chemical thinking, for antipathies and sympathies are nothing but the prehistoric ancestors of reactivities and affinities. Tabulation of affinities according to categories was of course another and considerably later development.[110]

[105] On Tsou Yen (fourth century B.C.) see Needham (18), II, pp. 232 ff.

[106] See the learned contribution of Wellman (38). On Bolus' pseudo-Persian sources see Bidez & Cumont (30), I, pp. 203 ff., 244 ff.; II, pp. 311 ff., 320.

[107] Berthelot & Ruelle (29), II, pp. 42 ff.; III, pp. 44 ff., retranslated by Festugière (36), pp. 228 ff. The aphorism recurs repeatedly in Pseudo-Democritus, cf. pp. 47 ff., 50, 51, 52, 55; as also in Synesius, p. 61. Cf. Bidez & Cumont (30), I, pp. 203 ff., 244 ff.; II, pp. 311 ff., 320. Similar thoughts recur in Ptolemy, *Tetrabiblos*, I, 3.

[108] It is impossible not to be reminded, in this formulation, of the Principles of Mutual Conquest and Mutual Production in Chinese Five-Element theory (see Needham (18), II, pp. 253 ff.), at least contemporary, indeed in some respects going back to the fourth century B.C. But one also senses a connection with the "love and hate" of the pre-Socratic philosophers, especially Empedocles. This, too, has striking Chinese parallels (Needham (18), II, p. 40).

[109] As Festugière (36), p. 231, has acutely pointed out.

[110] Without enlarging on a matter which needs separate treatment, we cannot forbear from pointing out here the far-reaching parallels which are being revealed in the development of alchemy and chemistry in Mediterranean and Chinese antiquity. Not only does Bolus of Mendes parallel in time

We may now pass to the line of literary descent already adumbrated. Chang Hua's third-century tractate[111] contains some matters of genuine scientific interest, set down more or less at random alongside a good deal of magical and superstitious material. Among the former we may mention his descriptions of fish poisons and of the charcoal hygrometer[112] and his account of the optical phenomena of reflection in plane mirrors. Both this and some of the magical recipes[113] are almost identical with what is found in the *Huai Nan Wan Pi Shu.*

In his seventh-century *Kan Ying Ching* Li Shun-Fêng again describes the charcoal hygrometer and has something to say on strange animals, the generation of insects from grain and of fireflies from rotting grass. He says that swallows have a sense of direction, for apart from migrations their nests always face north. Unfortunately his book is only available today in fragmentary form.[114]

Both Su Tung-Pho's books are much more advanced (though magic is not entirely absent), and each is well classified into subjects. Significantly, both mention magnetic attraction.[115] The *Ko Wu Tshu Than* opens with weather forecasting and continues with miner's lore concerning signs of ore beds, including plant indicators.[116] Su Tung-Pho knows of poisoning by the fumes of burning coal and recommends a remedy for it. In both books he mentions the use of lime as a dehydrator for preventing iron and steel implements from rusting. Corrosion of bronze and brass, he says, can be removed by vinegar. Another interesting reference of his is to the so-called wet method of copper production where copper-containing mine waters are led over waste iron and the copper metal is precipitated as a powder; this technique, mentioned as early as the second century B.C. in the *Huai Nan Wan Pi Shu*[117] had become a standard industrial art by Su Tung-Pho's time.[118] One comes across all kinds of things; for example, statements such as this: "For the Floating Elixir, mould camphor and vermilion into a cake; when you put it on water it will rush to and fro." Or on disinfection: "When an epidemic comes, put the clothes of the first person falling ill in a steamer and steam well, then the whole household will escape the infection." On invisible ink: "Write characters with a solution of (iron) alum, allow it to dry, then to make the writing visible wet it with an extract of gall-nuts."

As for the *Wu Lei Hsiang Kan Chih* it tells how tung oil spread on the water kills lotuses, how liquids can be clarified by filtration through sand, how spots

and nature the school of Liu An, but Liu Hsiang and Wei Po-Yang bracket the first-century developments, and then the two great synthetic writers Zosimus of Panopolis and Ko Hung appear at about the same time (*c.* A.D. 300). To say nothing of the Thang and Arabic alchemists, we end by finding the Chinese alchemical corpus first going into print in 1019, just about the date when the codices to which all our knowledge of Hellenistic "alchemy" is due were being written.

[111] In *Shuo Fu*[74], ch. 24, pp. 18b ff.

[112] Cf. Needham (18), III, p. 471.

[113] E.g. charms for getting a runaway person to come back.

[114] In *Shuo Fu*, ch. 9, pp. 1a ff. It will be remembered (from p. 177) that our main text probably dates from about this period.

[115] But curiously not the polarity, though it was well known in his time in China. See Needham (18), IV, pt. 1.

[116] See further on this Needham (19).

[117] In *Thai-Phing Yü Lan*, ch. 988, p. 5a.

[118] Cf. Needham (18), II, p. 267. More detailed information will be given in V, pt. 2; meanwhile see Tshao, Ho & Needham (25).

can be bleached by the uric acid in bird droppings, how grease can be absorbed on charcoal or talc, and how sterilized salt should be added to vinegar to prevent the formation of a white pellicle by moulds.

Lastly we may refer to another Sung book, dating from the twelfth century, the *Hsü Po Wu Chih*[309] (Continuation of the Record of the Investigation of Things) by Li Shih[310]. In the ninth chapter he quotes (p. 5a) the (*Shen Nung*) *Pên Tshao Ching*[311] as follows:

> When the tiger roars, the wind rises.[119] When the dragon utters its sounds the clouds gather. The lodestone attracts needles. Amber attracts bits of straw (literally mustard seeds).[120] After coming into contact with crabs lacquer will not concrete.[121] Lacquer added to hemp(-seed oil) makes it bubble.[122] Treated with the *tshung*[312] onion, cinnamon (bark? wood?) softens. Cinnamon causes (certain) trees (or plants) to wither.[123] Crude salt preserves piles of eggs.[124] The gall of the otter cracks (literally, divides) wine-cups. (All these phenomena occur because) the *chhi* (*pneumata*) of these things are in sympathy (*chhi chhi shuang chih*[313]) and thus bring about mutual resonance (*hsiang kuan kan yeh*[314]).[125]

If this is what it purports to be it could date from the second century B.C., but the passage is not to be found in the version of the *Shen Nung Pên Tshao Ching* reconstructed by modern scholars such as Mori Tateyuki (1845). We cannot say whether this is because they rejected it or because they did not happen to come across it, but the text has an archaic air, and a Han dating would not seem unjustified for it.

Thus although the consciously chemical content of these texts is not great, they form a corpus cognate to the specifically alchemical theories which we have seen worked out in the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*. For the oldest application of the theory of categories in alchemy we have to go back to Wei Po-Yang who in his *Chou I Tshan Thung Chhi*[6] speaks as follows:[126]

[119] A parallel statement of Han date occurs in the *Huai Nan Wan Pi Shu* (*Thai-Phing Yü Lan*, ch. 89, p. 5a).

[120] The development of knowledge of magnetism and electrostatics in China is fully dealt with in Needham (18), IV, pt. 1.

[121] On this whole subject, which involves an ancient empirical discovery of a powerful laccase inhibitor, see Tshao, Ho & Needham (25).

[122] It has in fact been the practice for centuries past to add tung oil to lacquer latex as an adulterant; as Li Shih-Chen pointed out (*Pên Tshao Kang Mu*, ch. 35, p. 20a), this makes it very poisonous. The bubbling could easily have been disengagement of CO_2 because of an acidity difference.

[123] *Pên Tshao Kang Mu* (ch. 34, p. 15b) quotes the *Lü Shih Chhun Chhiu*[315] (239 B.C.) as saying, "Under the branches of the cinnamon tree no other saplings will come up." This passage does not appear to be in the *Lü Shih Chhun Chhiu* now, but there is no reason for doubting its antiquity. The *Phao Chiu Lun*[316] (*c.* A.D. 470) of Lei Kung[317] is also quoted in the same place as saying that if you drive a peg of cinnamon wood into the root of another tree the latter will wither.

[124] A parallel statement of Han date occurs in the *Huai Nan Wan Pi Shu* (*Thai-Phing Yü Lan*, ch. 865, p. 5a and ch. 928, p. 6b).

[125] We should like to draw attention to the fact that the whole passage partakes grammatically of the nature of a sorites, each statement beginning with an agent which was the patient of the previous statement. This can be seen in the fifth and sixth, and the seventh and eighth, statements. On the sorites as a logical form see Welton (26), p. 393; Maspero (15), and Granet (8), pp. 337, 443, 487. But here the whole content is empirical, and one cannot help being reminded of the successive dominances in the Mutual Conquest Principle of the Five Element Theory (see Needham (18), II, pp. 257 ff.).

[126] *Tshan Thung Chhi Fên Chang Chi Chieh* ed., ch. 12 (ch. 1, p. 25b); W/990, ch. 1, p. 37a, b; cf. *Ku Wên Tshan Thung Chhi Chien Chu Chi Chieh*, ch. 6, p. 1a. We differ here from the translation by Wu & Davis (28),

Lead carbonate (*hu-fên*[318]), being placed on the fire, becomes discoloured and changes back to lead. Mixed with hot liquids ice and snow melt into water (*thai-hsüan*[319]). The Gold (Elixir) is mainly derived from cinnabar ([*tan-*]*sha*[248]) which is naturally endowed with mercury. Transformations depend on the true nature (of the substances)—beginnings and ends are mutually related. The way to become an immortal (*hsien*[320]) through taking drugs lies in the use of substances of the same category (*thung lei*[126]). Grains are used for raising crops, hen's eggs are used for hatching chicks. With substances of (similar) categories as the assistants of natural spontaneity the formation and moulding of things is easily accomplished. Fish eyes cannot replace pearls, neither can weeds be used for timber. Things of similar category go together (*lei thung chê hsiang tshung*[321]): precious substances cannot be made from the wrong materials. This is why swallows and sparrows do not generate the *fêng*[322] (male phoenix), this is why foxes and rabbits do not suckle the horse. Flowing water does not heat what is above it, and a fire does not wet what is underneath it.

These words were written, we suppose, in the neighbourhood of A.D. 140, but the same ideas must also have been in the mind of Chhen Chih-Hsü[13] (Shang-Yang-Tzu[323]) when he wrote the *Chin Tan Ta Yao*[324] (Essentials of Gold Elixirs) during the Chih-Shun[325] reign-period (1330 to 1333 A.D.) of the Yuan dynasty.[127]

Mention of Shang-Yang-Tzu brings up a difficult question. We have seen how the writer of the *Wu Hsiang Lei Pi Yao* believed that for two things to react there must be something similar about them. But this seems at first sight to conflict with the fact that if all things in the universe belonged either to the Yin or the Yang, reactions might more naturally have been expected to occur between things which were opposite or different. And indeed it was from one of the writings appended to the *Chin Tan Ta Yao* of Shang-Yang-Tzu[128] that the late Tenney L. Davis drew great support for his favourite theory (by no means necessarily erroneous) of the identity of principle in Chinese and Western alchemy.[129]

The *Chin Tan Ta Yao Thu*, a small tractate of diagrams in the *Tao Tsang*,[130] contains a page (p. 8a) entitled "Diagram of the Precious Mirror of the Elixir Elaboratory of the Purple Yang" (Tzu Yang Tan Fang Pao Chien chih Thu[330]). This is undoubtedly a reference to Chhen Chih-Hsü's forerunner Chang Po-Tuan[331], perhaps the greatest Sung alchemist (A.D. 983 to 1082),

p. 241. Compare another interesting passage: "When the categories (of the reacting substances) are the same it is easy to perform the work; but with discrepant species difficulty will defeat the greatest skill. This is indeed a marvellous art" (ch. 32 (ch. 3, p. 5a); W/990, ch. 3, p. 6b). On this the 3rd-century commentary of Yin Chhang-Sêng says that when mercury-lead amalgam is made the "yellow sprouts" appear, and that when these are added to more mercury the cyclically transformed elixir spontaneously develops. This is because the species are right. But trying to make gold from aqueous solutions of various minerals and drugs will effect nothing for the categories are not congruent. Labour and skill will be vain, and success will not follow. Here also the translation of Wu & Davis (28), p. 259, misses the point.

[127] Cf. Davis & Chhen Kuo-Fu (5).

[128] The book itself is disappointing for the historian of chemistry as it is so largely concerned with spiritual alchemy (*nei tan*[1]) rather than the practical operations.

[129] See especially Davis & Chhen Kuo-Fu (5) and the work of Davis (32, 39) cited by them. The other paper to which the reader is referred therein is somewhat mysterious (Davis, 33) since according to all library information available to us, the journal in question ceased publication with the previous volume, which itself certainly does not contain the paper.

[130] W/1054. It is also contained in the *Tao Tsang Chi Yao*[333] Mao section, no. 3.

who took the name of Tzu-Yang[332] (Purple Yang) whence he became known as Tzu-Yang Chen Jen[334] (the Adept of the Purple Yang). In his *Wu Chen Phien*[335] (Poetical Treatise on the Understanding of the Truth),[131] completed in 1075, and in his earlier *Chin Tan Ssu Pai Tzu*[336] (Four-hundred Word Epitome of the Gold Elixirs),[132] *ca.* 1065, he enumerated many opposites according to the Yin-Yang dichotomy. Some of these we find tabulated in the *Chin Tan Ta Yao Thu*, which arranges a number of entities (some of which are doubtless cover-names for substances) into two groups, the Yang and the Yin (see Table I and Pl. 21a).[133]

From this it will be seen that Chhen Chih-Hsü drew up a complex array of chemical substances, elements, natural phenomena and regions, names of trigrams, and numbers less than 10, in a mirror-image arrangement. Another list, constructed from the text of the *Wu Chen Phien*,[134] includes also on the Yang side lead (*chin kung*[219]), litharge (literally "yellow sprout", *huang ya*[337]), and a so far unidentified substance called "jade buds" (*yü jui*[338]). On the Yin side there is mercury (*chha nü*[339]) and calomel (*pai hsüeh*[271]). The conception that reaction would occur across the boundary, as it were, is typified by the caption of a foregoing picture (p. 6b) which says "Diagram of the Mutual Reactions of Forms and Things" (Hsing Wu Hsiang Kan chih Thu[340]). This depicts a woman above riding on a tiger under stylized clouds and rain, while below there is a man holding a sword and riding on a dragon amidst stylized flames; in between there is a tortoise entwined by a serpent (Pl. 21b). The Yin and Yang forces are thus clearly symbolized, and the two reptiles evidently show forth their mutual interaction.[135]

That the Yin and Yang forces by such interaction produced and upheld all things in the universe was a commonplace of Chinese thought for which sinological authority is superfluous. We need only refer to two fundamental statements in the *I Ching* (Book of Changes). The Great Appendix (a text of Chhin and Han date, not likely to be later than the third century B.C.) says:[136] "One Yin and one Yang—that is the Tao!"; and also:[137] "When Heaven and Earth combine their generative forces the changes and fermentations of the myriad things are completed; when male and female mingle their seminal essences the births and transformations of the ten thousand things are accomplished." To this we need only add one from a multitude of similar statements in books of the classical period, the words in the *Li Chi* (Record of Rites),[138] completed by 50 B.C.: "When the Yin and the Yang (unite) in harmony the myriad things are begotten."

That these conceptions were present at the birth as well as the early development of Chinese alchemy and chemistry is also indubitable. Their first synthesis was with Tsou Yen in the Warring States Period (fourth century B.C.). In the Later Han (second century A.D.) Wei Po-Yang devotes

[131] See Davis & Chao Yün-Tshung (34).

[132] See Davis & Chao Yün-Tshung (35).

[133] Our translation of the names of some of the entities differs considerably from that of Davis & Chhen Kuo-Fu (5).

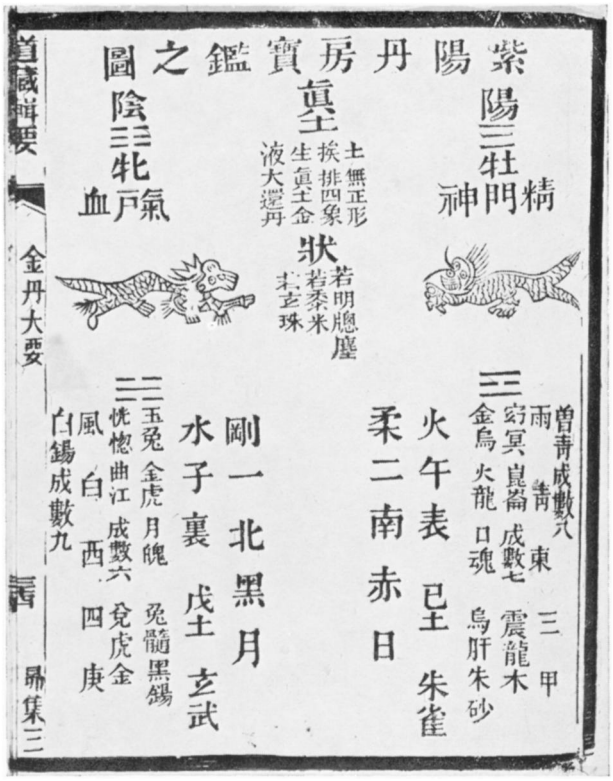
[134] Davis & Chao Yün-Tshung (34), p. 98.

[135] In some editions the female figure is pouring liquid from a vase, so that the lance and grail symbolism is intensified.

[136] *Hsi Tzu Chuan*, Pt. 1, ch. 5, cf. Baynes tr. I, p. 319.

[137] *Hsi Tzu Chuan*, Pt. 2, ch. 5, cf. Baynes tr. I, p. 368, cf. Granet (8), p. 138.

[138] Ch. 11, p. 27a. Cf. Legge tr. I, p. 420.



a—A fourteenth-century table of chemical signs and categories, entitled "Diagram of the Precious Mirror of the Elixir Elaboratory of the Purple Yang"; from Chhen Chih-Haü's *Chin Tan Ta Yao Thu* (Diagrams to illustrate the "Essentials of Gold Elixirs"), *ca.* 1331 A.D. (*p.* 196)

b—"Diagram of the Mutual Reactions of Forms and Things", a picture illustrating the interaction of substances of Yin and Yang sign, from the same tractate (*p.* 196)

N.B. Both these illustrations, not hitherto reproduced in the West, are taken from the *Tao Tsang Chi Yao*, a copy of the Chhêngtu edition of which was obtained from the Taoists of the Erh Hsien Ssu abbey for the Cambridge University Library by one of us (J.N.) in 1945 (mao sect. no. 3, han 42). The arrangement of the table differs slightly from that in some of the *Tao Tsang* editions.

TABLE I

Chhen Chih-Hsü's table of signs and categories. From his *Chin Tan Ta Yao Thu* (*ca.* 1331), part of the "Diagram of the Precious Mirror of the Elixir Elaboratory of the Purple Yang"

Yin						Yang					
white tin (zinc)	wind	trance	jade rabbit (moon)	Water	hardness	softness	Fire	golden crow (sun)	tran-quillity	rain	copper carbonate
the completed number **9**	white	Chhü-chiang (River)	Metal tiger	Cyclical character *tzu*	**1**	**2**	Cyclical character *wu*	Fire dragon	Khun-lun (Mtn.)	blue-green	the completed number **8**
	west	the completed number **6**	moon and *hun* soul	internals	north	south	externals	sun and *pho* soul	the completed number **7**	east	
	4	tiger of Tui *kua*	marrow of the rabbit	*hsü* earth	black	red	*ssu* earth	liver of the crow	dragon of Chen *kua*	**3**	
	cyclical character *kêng*	Metal	black tin (lead)	Sombre Warrior (northern sky palace)	moon	sun	Red Bird (southern sky palace)	cinnabar	Wood	cyclical character *chia*	
					mountain and marshes	thunder and lightning					

a whole chapter to this subject, speaking of "endowment by the Yang and acceptance by the Yin" (*Yang pin Yin shou*[341]), and of the "mutual necessity of male and female by which all changes are accomplished" (*tzhu hsiung hsiang hsü, hsü i tsao hua*[342]).[139] In his commentary of about A.D. 1285, Yü Yen[343] took the trouble to collect together most of the expressions used by Wei Po-Yang for this "sexual reactivity" of things,[140] for example the "sexual union of the dragon and the tiger" (*lung hu chiao kou*[344]), the "combination of Metal and Wood" (*chin mu chiao ping*[345]), the "meeting of gold and mercury in the same vessel" (*chin hung thung ting*[346]), and so on. Parallels could be found in nearly all the later alchemists, though in many cases, such as the great Ko Hung (Pao Phu Tzu) himself (*ca.* A.D. 300), they were more interested in the practice than the theory.

Tenney Davis and his collaborators had no difficulty in finding occidental comparisons for the mating of contraries in the Great Work, the marriage of Sol and Luna, of sophic sulphur and sophic mercury, under a hundred synonyms; nor did they lack western texts which emphasized the maleness and femaleness of the fundamental essences in a strangely Chinese manner.[141] Though few would now subscribe to Davis' belief that the sulphur-mercury theory occurs already in the early Greek alchemists (first to fourth centuries A.D.), it is certainly flourishing in the Jābirian corpus (ninth and tenth centuries), perhaps derived (as some think) from the two mineral exhalations of Aristotle.[142] Then it continues to flourish in the Geberian books (late thirteenth and fourteenth centuries) and so comes down to Paracelsian times. On the other hand statements of Yin-Yang type undoubtedly occur in the Greek writings. In Zosimus we find the fundamental sexual aphorism twice—"Above what is heavenly, below what is earthly; by the male and the female the work is accomplished";[143] and again, "Mary said 'Join the male and the female and you will find what you are seeking.'"[144] These quotations were made early in the fourth century and the latter is ascribed to the first. Then there is another epigram attributed by Olympiodorus (*ca.* 420) to Mary (first century); "If you do not make corporeal substances incorporeal and *vice versa*, and if you do not turn two bodies into a single one, none of the results you hope for will be produced."[145]

But whatever may be the case with the western alchemists this was only half the story for the thought of the Chinese. Besides something like the

[139] *Tshan Thung Chhi*, ch. 16 (ch. 2, p. 1a).

[140] *Tshan Thung Chhi Fa Hui* (W/996), ch. 5, p. 2a ff.

[141] Davis brought under contribution, e.g. Basil Valentine, the *Speculum Alchemiae*, *Le Texte d'Alchymie*, and Norton's *Catholicon*.

[142] We leave on one side for the present the fascinating question of Chinese influence on the Shi'ite and Isma'ilite writers of the Jābirian books. It could have taken at least two forms, the emphasis on immortality and longevity elixirs as opposed to chrysopoiesis as such, and a powerful reinforcement of chemical dualism.

[143] Berthelot & Ruelle (29), III, p. 147. This aphorism also occurs as a kind of caption below a picture of alchemical apparatus in the eleventh-century Paris MS. 2327, f. 81^{v}; see I, pp. 161, 163.

[144] Berthelot & Ruelle (29), III, p. 196. Berthelot considered this text as due to a Pseudo-Zosimus of the seventh century, but Sherwood Taylor (37) accepted it as genuine.

[145] Berthelot & Ruelle (29), III, p. 101. Elsewhere, p. 124, the first part of the aphorism is attributed to Hermes, who is placed in the second century by Sherwood Taylor (37). Cf. Festugière (36), p. 242.

marriage of contraries there was the firm conviction that *similia cum similibus agunt.* These two principles were combined in the thought that substances of opposite sign will react only if they belong to the same category (*lei*). This is most clearly explained in the *Wu Chen Phien* where Chang Po-Tuan says:[146] "Yin and Yang (things), if they are of (the same) category, respond and interact with each other." On this Chhen Chih-Hsü (Shang-Yang-Tzu) comments: "What is meant by 'categories' is the partnership of Heaven and Earth, the complementarity of the moon and sun, and the mutuality of female and male; hence it follows that mercury must require lead as its category partner." Later on Chang Po-Tuan says in homely analogy:[147] "For repairing something made of bamboo, bamboo must be used. If you want a hen to hatch chickens, she must sit upon eggs. Expending labour on (trying to bring together) innumerable substances which are not of the same category (*fei lei*) is a complete waste of energy." And the commentators elaborate the point at length. Thus the Chinese alchemists had in their minds a kind of table divided one way into Yin and Yang signs and the other way into a series of categories. Looking again at Table I this is exactly what we see, the items corresponding to one another like conjugate points of object images in a lens or mirror system. Read downwards the chart shows substances and entities arrayed according to their sign, read from side to side it differentiates the categories (*lei*). Furthermore, one can appreciate the connection between the little numerological chart at the beginning of our text (p. 178) and the diagram of Shang-Yang-Tzu in Table I. Yin Water generates 1 and 6, Yang Fire 2 and 7, Yang Wood 3 and 8, Yin Metal 4 and 9, while to Neutral Earth belong the "perfect numbers" 5 and 10. These numbers will now be seen to occupy rational conjugate places in the diagram of Shang-Yang-Tzu.[148]

It only remains to construct a chemical table according to the explicit statements of our text, the *Wu Hsiang Lei Pi Yao.* No less than fifteen of these *thung lei* categories are given (pp. 180 ff.) and five further statements can be collected from other parts of the text (pp. 183 ff.). All are shown in Table II. When the sign of a substance is not clear from the text itself, it may follow from the substance with which it is paired, or it may be obtainable from other texts. We wish to remark only on two especially interesting entries, nos. 8 and b, which indicate clearly there was a gradation of Yang-ness and that while mercury might be female to sulphur it would act as male to silver. Hence further vistas of complication open up, and we may expect to find in course of time due explorations of them in other mediaeval Chinese texts. For example, the *Wu Chen Phien* says:[149] "The sun when in the Li (*kua*) position becomes female, and when the moon is paired with the Khan (*kua*) it becomes

[146] Ch. 8. Cf. Davis & Chao Yün-Tshung (34), p. 104. We may remember, moreover, the pregnant statement of the eleventh- or very early twelfth-century commentator of our own text, the *Wu Hsiang Lei Pi Yao*, given in footnote 27 above. Note also his statement in footnote 52a.

[147] Ch. 25. Cf. Davis & Chao Yün-Tshung (34), p. 106.

[148] Some of the statements in our text are fairly easy to understand in the light of the Five-Element theories of Mutual Production and Mutual Conquest (see Needham (18), II, p. 257). Thus on p. 185 we read of 1 capturing 9 (Water overcoming Metal), 5 fixing 7 (Earth subjugating Fire) and 7 combining with 8 (i.e. Fire with Wood).

[149] Ch. 32. Cf. Davis & Chao Yün-Tshung (34), p. 107.

TABLE II

Table of chemical categories from the *Wu Hsiang Lei Pi Yao* (seventh century A.D. or earlier)

Lei	Yang	Yin	Neutral
1	cinnabar	mercury	
2	realgar	orpiment	
3	realgar	sal ammoniac	
4	honey and fritillary corms	orpiment	
5		arsenious acid	clay
6	sulphur	magnetite	
7	sulphur	mercury	
8		mercury; orpiment	
9	cinnabar	vinegar	
10	lead	mulberry ashes	
11	litharge	tin	five coloured clays
12	cinnabar	bronze coins	
13	Persian brass fragments	mercury	
14	copper carbonate	mutton fat	
15	blue copper carbonate	red haematite	
a	lead	calomel	
b		mercury; silver	
c	red salt	alum	
d	copper carbonate	silver	
e	red salt	calomel	

male. If one does not understand this conception of interchangeability, one should not presume to expatiate on what one has done and observed." All this may well be related to the doctrine of the inseparability of the Yin and the Yang, the idea that there could hardly be anything so Yang as not to have some Yin within it and *vice versa*.[150] Bodies thus ascended to a quantitative plane, at least in theory, taking precedence one of another in accordance with their Yin-Yang *mistio* or κρᾶσις, so that a given substance might act as Yin in one relation and Yang in a second, forming a kind of hierarchy analogous to the electrochemical series of the elements, the order in which elements displace one another from their salts.

The question may now be asked, is there any representative in modern chemical theory of the doctrine that "things of similar category go together"? Transmuted into terms of the deeper insights of today the doctrine in some sense still persists, for valencies in chemical combination have to be equivalent. A trivalent atom, for instance, will not combine wholly with a univalent one, and in so far as atoms can be octavalent there are eight categories to consider. Combining atoms also have to be similar in that they are both in a position to share an electron; some elements such as the inert gases, with their fully filled shells, are unable to co-operate in this way. The doctrine of "similar categories" seems to have joined its opposite in the higher synthesis of modern chemistry, for while many examples of ionic bonds, weak but stable, exist,

[150] Cf. on this Needham (18), II, p. 276, and Davis (32), p. 85.

there are also many examples of covalent bonds between atoms of the same kind.

At the beginning of the eighteenth century modern chemistry set out, as Metzger (43) has so well shown, from the proposition that like attracts like. This was one of the great watchwords of Stahl and his disciples such as Juncker, who preferred it to the Cartesian "mechanical" system of a union of opposites, applying it to the assumed indwelling "earthy", "aqueous", "mercurial", or "sulphurous" (phlogistic) principles rather than to the chemical substances themselves. Newtonian gravitational attraction was then brought in to explain these affinities, and the rest of the century was occupied with the establishment and then the destructive criticism of the doctrine.

In the nineteenth century it was only with the greatest difficulty that the prejudice against envisaging combinations of identical atoms was overcome. The tradition of Davy and Berzelius was that only atoms with opposite electrical charges could form compounds together. Thus Canizzaro had grave difficulty in convincing chemists of the truth of Avogadro's law because it involved double molecules such as O_2, N_2, etc., i.e. combinations of like with like.

But of course there is something very artificial in stretching the vague conceptions of antiquity on the Procrustean bed of modern scientific theory, and it is best not to push such comparisons too far. Moreover, as we have already said, the doctrine of "similar categories" was built up on fancied resemblances and imaginative classification, not on critical observation and experiment. Yet in its two-dimensional or "matrix" character it did find room for both theses of the perennial contradiction—that only opposites unite, and that similar things alone react together.

Looked at in another way, the old Chinese theory of categories is a hitherto unrecorded chapter in the prehistory of the conception of chemical affinity. According to Partington (21) the word *affinitas* was first employed with chemical meaning by the great Dominican scholar-naturalist Albertus Magnus (1206 to 1280), a contemporary of Phêng Ssu[326], the writer of the famous book on the "Golden Flower Elixir".[151] It is evident from reading over the list of "similar category" substances given by our original text (perhaps of the seventh century, but quite probably older, even as early as the second) that though the writer had no way of distinguishing between chemical reaction and physical change or mixture, he did put together pairs or groups of substances which he observed to react in one way or another.

Again, the old Chinese theory of categories seems to take its place in the linear ancestry of the idea that things can be arranged in chemically similar classes the members of which are susceptible of chemically similar processes. These words are Sherlock's (24) in his acute study of the contribution of the *Archidoxis* of Paracelsus (1526), a book which described the preparation of a series of coloured chlorides and nitrates of the metals. Here the great advance was the first conception of a generalized method for making a number of analogous preparations.

The idea that things which belonged to the same classes resonated with, or energized, each other, though so characteristic of Chinese thought, was not

[151] See Ho & Needham (9).

without parallels in Greece. Cornford (4) has detected these in what he calls the maxims of popular belief accepted by the philosophers from "common sense" without scrutiny. Take Aristotle's three kinds of change. Movement in space was explained by asserting that like attracts like; growth, by asserting that like nourishes like; and change of quality, by asserting that like affects like. To quote from Aristotle, "Democritus held that agent and patient must be the same or alike; for if different things act upon one another, it is only accidentally by virtue of some identical property."[152] But there was also an opposite set of maxims that like things repelled one another—"Everything desires, not its like, but its contrary" to quote from Plato.[153] All this has an evident relationship with the ideas of the pre-Socratics about "love" and "hatred" in natural phenomena, and it would be easy to see the origin of it in social practices, exogamy or endogamy, sympathetic magic, and so on. Among the Chinese philosophers of the Warring States period closely similar conceptions were current.[154] The point to be emphasized here is that while Greek thought moved away from these ancient ideas towards concepts of mechanical causation foreshadowing the complete break of the Renaissance, Chinese thought developed their organic aspect, visualizing the universe as a hierarchy of parts and wholes suffused by a harmony of wills. In this development the Chinese alchemists participated according to their lights, so that although their contributions to chemical discovery and invention, certainly not less than those of other civilizations, were made in a largely empirical tradition, they were by no means strangers to theoretical formulations, even though these remained until the end of a typically pre-Renaissance character.

[152] *De Gen. et Corrupt.* 323b 10.
[153] *Lysis* 215c.
[154] Cf. Needham (18), II, p. 39.

1. 内丹
2. 外丹
3. 董仲舒
4. 參同契五相類秘要
5. 道藏
6. 周易參同契
7. 魏伯陽
8. 陰長生
9. 庚道集
10. 龍虎還丹訣
11. 金陵子
12. 上陽子金丹大要圖
13. 陳致虛
14. 石藥爾雅
15. 梅彪
16. 丹方鑑源
17. 獨孤滔
18. 太清石壁記
19. 楚澤
20. 盧天驥
21. 魏伯陽七返丹砂訣
22. 黃童君
23. 陰真君金石五相類
24. 春秋繁露
25. 重修政和經史證類備用本草
26. 張存惠
27. 感應經
28. 李淳風
29. 感應類從志
30. 張華
31. 格物麤談
32. 蘇東坡
33. 本草綱目
34. 李時珍
35. 宋史
36. 歐陽詢
37. 通志略
38. 鄭樵
39. 物類相感志
40. 宣德郎
41. 權
42. 發遣
43. 提舉
44. 淮南西路
45. 學事
46. 借緋
47. 魚袋
48. 諱字
49. 正七品
50. 政和
51. 宣教郎
52. 紹興
53. 差遣
54. 提舉學事
55. 淮南
56. 淮南東
57. 淮南西
58. 太宗
59. 借紫
60. 盧襄
61. 中國人名大辭典
62. 衢州
63. 天驥
64. 字
65. 駿元
66. 天
67. 徽宗
68. 襄
69. 進士
70. 大觀
71. 靖康
72. 吏部侍郎
73. 西征記
74. 說郛
75. 贊元
76. 三衢
77. 舊唐書
78. 周易五相類

79. 周易
80. 參同契五相類
81. 秘要
82. 七返靈砂歌
83. 太素真人
84. 真人
85. 淳于叔通
86. 徐從事
87. 青州
88. 參同契
89. 古歌
90. 五相類
91. 大篆
92. 伏制
93. 三黃
94. 二寶
95. 五
96. 天生元女
97. 水銀
98. 地生黃男
99. 黃金
100. 天生
101. 黃男
102. 借位
103. 張
104. 翼
105. 虛
106. 危
107. 丹砂
108. 上宮
109. 太陽白汞
110. 赤水
111. 丹液
112. 純黑精元
113. 黑鉛
114. 四象
115. 元精子
116. 北斗
117. 建子
118. 酉
119. 雄黃
120. 伏
121. 節符
122. 直符
123. 直事
124. 昇降
125. 六律
126. 同類
127. 大丹
128. 刻定同類
129. 赤髓
130. 太陽
131. 太陽水銀
132. 太陽赤髓
133. 太陽汞
134. 雄精
135. 太陰
136. 雌黃
137. 還丹
138. 陰津
139. 大還丹
140. 硇砂
141. 蜜水
142. 貝母
143. 煞
144. 石脂
145. 砒黃
146. 凝
147. 飛
148. 石硫黃
149. 磁石
150. 殊
151. 鹵殊
152. 成帝
153. 武帝
154. 汞
155. 亭脂
156. 中還丹
157. 太陰山龜
158. 砂子
159. 銀
160. 辛
161. 金
162. 太陽丹龜

163. 朱砂
164. 醇醨
165. 醇
166. 霜
167. 鉛
168. 桑灰
169. 灰坯
170. 赤鳥脚
171. 脂霜
172. 九徧神仙丹
173. 赤鳥
174. 泥粉
175. 泥膽
176. 鹽
177. 錫
178. 蜜陀僧
179. 五色山鼃
180. 山鼃
181. 丹釜
182. 砂牛津
183. 砂盆子
184. 金鼎
185. 鍮石
186. 重砂子鼃精
187. 漏爐
188. 白金
189. 折鍮
190. 素白霜
191. 白霜
192. 土鍋
193. 到行神骨
194. 陰獸汁
195. 鍮屑
196. 獸汁
197. 黑牛尿
198. 戎石鹽
199. 紫石英
200. 崑崙
201. 羯羊
202. 羊津
203. 羊脂
204. 砂甑
205. 青龍翹
206. 朱元精
207. 丹陽
208. 赤銅
209. 空青
210. 代丹
211. 代赭
212. 元精
213. 黃土堝
214. 元津
215. 鹵殊汁
216. 太陰元精
217. 太陰玄精
218. 陰伏
219. 金公
220. 飛霜
221. 陽制
222. 豐城
223. 絳霜
224. 庚
225. 因
226. 根微
227. 畢伏
228. 緣
229. 飛鼃
230. 七符
231. 空
232. 神鼃
233. 陰陽互理
234. 而知同者
235. 龍馬
236. 龍
237. 虎
238. 舍
239. 白礬
240. 赤鹽
241. 拘
242. 曾青
243. 六神
244. 子
245. 巳
246. 故符

247. 八節
248. 丹砂
249. 特生礬石
250. 明礬
251. 八石
252. 五金
253. 赤帝
254. 石
255. 炁
256. 節
257. 礬石
258. 三使
259. 石礬
260. 黃礬
261. 青
262. 太陰元水石
263. 鹵鹽
264. 水石鹽
265. 伏火
266. 鼎器
267. 太陽流珠
268. 華池
269. 黑池
270. 左味
271. 白雪
272. 飛造
273. 雌雪
274. 雄雪
275. 赤龍
276. 赤粉
277. 白虎
278. 石液
279. 帝流漿
280. 玄帝流漿
281. 磁母
282. 丹室
283. 熱
284. 火記
285. 乾
286. 坤
287. 辰
288. 午
289. 戌
290. 亥
291. 素汞
292. 卦
293. 易經
294. 同類相動
295. 驗
296. 宮
297. 商
298. 神
299. 數
300. 類之相應而起也
301. 圖書集成
302. 歷法典
303. 前漢書
304. 博物志
305. 淮南萬畢術
306. 劉安
307. 淮南子
308. 神仙黃白術
309. 續博物志
310. 李石
311. 神農本草經
312. 葱
313. 其氣爽之
314. 相關感也
315. 呂氏春秋
316. 炮炙論
317. 雷公
318. 胡粉
319. 太玄
320. 仙
321. 類同者相從
322. 鳳
323. 上陽子
324. 金丹大要
325. 至順
326. 彭耜
327. 葉德輝
328. 孫馮翼
329. 鄭衍

330. 紫陽丹房寶鑑之圖
331. 張伯端
332. 紫陽
333. 道藏輯要
334. 紫陽真人
335. 悟真篇
336. 金丹四百字
337. 黃芽
338. 玉藥
339. 姹女
340. 形物相感之圖
341. 陽稟陰受
342. 雌雄相須須以造化
343. 俞琰
344. 龍虎交媾
345. 金木交併
346. 金汞同鼎

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CHRONOLOGY OF CHINA

	HSIA kingdom (legendary?)	B.C. *ca.* 2000–*ca.* 1500	
	SHANG (YIN) kingdom	*ca.* 1500–*ca.* 1030	
CHOU dyn. (Feudal Age)	Early Chou period	*ca.* 1030–722	
	Chhun Chhiu period	722–480	
	Warring States period	480–221	
First Unification	CHHIN dyn.	221–207	
	HAN dyn. Earlier or Western Han	202 B.C.–A.D. 9	
	Hsin interregnum	A.D. 9–23	
	Later or Eastern Han	25–220	
First Partition	Three Kingdoms Period (San Kuo)	221–265	
	Shu (west)		221–264
	Wei (north)		220–265
	Wu (south-east)		222–277
Second Unification	CHIN dyn.: Western	265–317	
	Eastern	317–420	
	Former (or Liu) SUNG dyn.	420–479	
	Northern WEI dyn. (Tho-Pa Tartar) later split into Eastern and Western		386–554
Second Partition	Northern and Southern Empires (Nan Pei Chhao)	479–581	
	Chhi (southern)		479–502
	LIANG		502–577
	Chhen		577–581
	Chhi (Northern)		550–581
	Chou (Northern)		557–581
Third Unification	SUI dyn.	581–618	
	THANG dyn.	618–906	
Third Partition	Five Dynasty period (Wu Tai)	907–960	
	Later Liang		907–923
	Later Thang		923–936
	Later Chin		936–946
	Later Han		947–950
	Later Chou		951–960
	LIAO dyn. (Chhi-Tan Mongol)	907–1125	
	Hsi Hsia State		990–1227

Fourth Unification	Northern SUNG dyn.	960–1126
Fourth Partition	Southern SUNG dyn.	1127–1279
	CHIN (Ju-Chen Tartar) dyn.	1115–1234
Fifth Unification	YUAN (Mongol) dyn.	1260–1368
	MING dyn.	1368–1644
	CHHING (Manchu) dyn.	1644–1911
	Republic	1912 on

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