**Al Mkni fi’l-jabr wa’l-muqābala "Exposition of Algebraic Operations" by Ibn Al-Ha’im**

**A line by line translation by Ishraq Al-Awamleh**

1. By praising God I start my task,

and I send my prayer along with a corresponding salutation

1. to his chosen Prophet [Muhammed], the best of mankind, and his family,

and to his companions, then supplications continue

1. to [my teacher], renowned in his time, who belongs to Jelawa [tribe],

Ali upon whom there are continuous rain clouds,

1. And then the science of Algebra is great,

to which the best and most skillful people are attracted.

1. And I will contain its [algebra] core in a poem,

through which the discerning person will be pleased and go forward.

1. And here I start with my undertaking; my endeavor,

and I ask the help of the provider of reason.

1. Names of [unknown] kinds of numbers, their ranks and exponents
2. and by root, square and cube they are named,

quantities to which it was not known, at the beginning, how to apply algebraic operations.

1. When multiplying a number by itself, the number is a root,

and the result [of multiplication] is called a square.

1. And multiplying a thing by a square makes a cube,

and from a square and a cube you produce various categories [secondary kinds];

1. so that you can say square square, then square cube;

unknown kinds of numbers have defined exponents and ranks.

1. Root and thing are equivalent in one case,

and they differ in other cases.

1. "Kaab" and "Mukaab" both meaning cube are used by the majority

and their meaning differs in some other cases.

1. Their ranks are either primary, as their exponents [1, 2, 3],

or secondary, where the next exponent is one more than the previous one.

1. The first [rank] is for the root, and its exponent is one,

and the square follows with exponent two which exceeds the first exponent by one.

1. The third [rank] is for the cube and you know its exponent,

it’s three, just like the positional base ten; and these are the primary [exponents of the unknown numbers].

1. Whatever exponent there is beyond [the three will be called secondary] name it;

double it or treble depending on what the seeker says.

1. [To find out the kind of a given exponent], You name square for each two and a cube

for each three and get the result.

1. Attach the square to the cube and put the square first [square cube]

[this] is the result for the learner.

1. For the opposite case [that is, to know the exponents from a given kind],combine the separated exponents [values]

by adding them, you obtain the exponent sought and this method is all inclusive.

1. Addition and Subtraction
2. Whatever kind is the same, and you want to add,

apply to it what you do with adding known numbers.

1. And you say, in subtracting unknown numbers, follow the same rule, but when the kinds differ,

addition is accomplished by adding “and”.

1. And subtraction [with different kinds] is accomplished by using [the method of] exception. If there is

an exception in one of them [subtrahend and minuend] or in both,

1. first, add the exception of each quantity to both

in order to balance [to achieve one of the six forms];

1. and in each case [i.e., subtraction and balancing], remove the exception,

and complete the work after removing the exception.

1. Multiplication and Division
2. Whenever you multiply a kind by a number,

the answer will be of the same kind a seeker asked about.

1. Whenever multiplying two kinds add the exponents of the two kinds

to obtain the exponent of the result, and then obtain the quantity of the result.

1. And you say, additive term multiplied by subtractive term gives subtractive term,

but when the terms are similar [either both are additive or subtractive], [an] additive term is obtained.

1. When dividing two kinds of the same rank, the result is a number.

And if the ranks are different,

1. when the numerator has higher rank [than the denominator], the excess value of the exponents,

is the exponent of the resulting kind.

1. And [when] the reverse of this [the numerator has lower rank than the denominator], make the answer be the question,

and the same rule applies when dividing a number by a kind.

1. For the reverse [i.e., dividing any kind by a number], the result will have the same kind [as the question].

And for the cases [i.e., lower rank by higher rank, or number by kind] remove the division and equate the terms.

1. And with this method using mathematics,

you should improve your skills so that others will not surpass you.

1. The Six Equations [six canonical forms]
2. And take these six original forms,

ordered, and they are known as equations.

1. A number and a thing and a square, they [the six equations] encompass,

half of them are simple and the other half are the opposite [compound].

1. Roots and squares in the first one [first equation] are equated,

and squares in the intermediate one [the second equation] are equated with numbers.

1. And things [or roots] are equated with numbers in the last one [third equation] of the simple equations,

and then you follow what I say.

1. In the first two [simple equations], divide [both terms: roots and numbers, respectively ] by the number of squares,

and in the third [equation] divide the number by what it's equated to [the number of roots].

1. The result is a root except for the intermediate [second equation],

and your answer [in the second equation] will be square for the seeker.

1. And take AJM [A:Adad (number), J:Jadther(root) and M:Mal (Square)] to order the others [compound equations],

in the fourth [equation] the number is isolated.

1. And in the fifth [equation] root is isolated, and in the sixth [equation],

square is isolated and is equated [in the fifth, root is equated to square and numbers, and in the sixth, square is equated to roots and numbers]

1. [To solve the compound equations] In all of them, square [the] half of the roots

and add the result, except for the second [fifth compound equation],

1. to the number, and remember the [new] result,

then subtract the half of the roots from the [new] result and so the [final] result

1. is the root for the first [the fourth compound equation]. And in the sixth [the third compound equation] you have to add [the half of the root to the new result],

and the root of the square is the resulting outcome.

1. And in the fifth [compound equation] [ case 1] subtract the number from the square [of the half of the root],

and the root of the result indicates the target.

1. Subtract it [ the target] from the half of the roots or add them together;

the root in both cases is the result.

1. And when the number exceeds the square [of the half of the roots] [case 2],

it's impossible [to find the root]. If they are equal [the number is equal to the square of the half of the root] [case 3],

1. then the half of the roots is the root sought,

and square is obtained from the root [by squaring the actual result].

1. Division [Last] Section
2. And whatever equations [compound equations] we mentioned earlier have only one square,

but if not, they will have a fraction of a square or more than one square.

1. For the square [term], restore the fraction,

and reduce the extra [squares - i.e., divide 1 by the number of squares and multiply the number of squares by this ratio].

1. And for the other two terms, do to them what you have done for the squares

and whatever you get, do to it what you did before the division [last section].

1. Or multiply the compound equation by the seen amount

of squares to find the means [corresponding equation to give rise to a new equation]

1. and find the new external number and adapt the construction[to find the root of your new equation],

and finally divide the root

1. by whatever you multiplied the number before. And after what we have seen,

whenever an equation is introduced to you, try to pick a suitable process [to transform it to one of the six equations].

1. And you have to master my method,

otherwise you won't desire to become an insider [to master algebra]

1. And what I have introduced is convincing,

and for God our praise continues.

1. Afterwards [our prayesrs] prayers are recited with peace to the

blessed Mohammed, the guide who has eminent distinction.

1. Of the best people, which spread over his early followers and then his family and his companions,

his wives with good manners [respectfulness].

1. And its verses are fifty nine composed,

in Al Aqsa in a good month [the third month in the Islamic calendar when Prophet Mohammed was born] so it's auspicious

1. Rabee [the third month in the Islamic calendar] of the year in which its count has been adjusted,

in "dal" [4] and "thad" [800] so absolute praise. [the Arabic letter "dal" has a corresponding number 4 and the letter "thad" has corresponding value 800 so 800 + 4 is 804 AH]

**The Poem in Arabic.**

قصيدة ابن الهائم المقنع في الجبر والمقابلة

|  |  |  |
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| وأهدي صلاة مع سلام يشاكل | بحمد الله ابتدي ما أحاول | .1 |
| واصحابه ثم الدعا يتواصل | على المصطفى خير الأنام وآله | .2 |
| علي عليه سحب جود هواطل | لفخر الزمان المنتمي لجلاوة | .3 |
| يميل اليه المتقنون الافاضل | وبعد فعلم الجبرعلم معظم | .4 |
| بها يكتفي ذو فطنة ويطاول | واني لحاو لبه في قصيدة | .5 |
| وعونا من المولى الحجي انا سائل | وها أنا ساع في الذي قد قصدته | .6 |
| أسماء الأنواع ومراتبها واسوسها | | .7 |
| مقادير لم تدر ابتداء تحاول | وبالجذر ثم المال فالكعب لقبوا | .8 |
| وبالمال سموا ما بذا هو حاصل | فما ضربه في مثله هو جذرهم | .9 |
| ومن ذين اسمأ البواقي تناول | وذا ضربه في ذاك يبدو مكعبا | .10 |
| اسوس لها معلومة ومنازل | فقل مال مال ثم مال مكعب | .11  .12 |
| وبينهما في آخرين تفاضل | وجذر وشيء في محل تصادق | .12 |
| وبين كلا العرفين قطعا تفاضل | وبالكعب سوى الاكثرون مكعبا | .13 |
| وفرعية بواحد تتفاضل | منازلها اصلية كاسوسها | .14 |
| تلتها المال اسها اثنان فاضل | فالأولى لجذر اسها واحد وما | .15 |
| ثلاث كما في العدّ فهي الأصائل | وثالثة للكعب فادرى واسها | .16 |
| فثنه وثلث حسب ما هو قائل | وما زاد فرع أس كل سمّيه | .17 |
| لكل ثلاث ثم ما هو حاصل | ومالا بكل اثنين خذ ومكعبا | .18 |
| يكن ما بدا جواب من هو سائل | أضف بعض للبعض والمال قدمن | .19 |
| بجمع تقربا بالقصد فالضبط شامل | وفي عكسه ركب اسوسا تفصلت | .20 |
| الجمع والطرح | | .21 |
| ففيه أعملن ما انت بالعد عامل | وما يتفق نوعا وقد رمت جمعه | .22 |
| فجمع بواو العطف قل يتناول | وقل هكذا طرح وعند تخالف | .23 |
| على واحد او فيهما هو داخل | وفي الطرح الاستثنا اعتمد ثم ان يكن | .24 |
| كذا ذوا اختصاص مثل ما يتعادل | ففي البدء مستثناهما زد عليهما | .25 |
| والأعمال تمم بعدما هو زائل | ففي كل باب منهما لفظه أزل | .26 |
| الضرب والقسمة | | .27 |
| جواب من النوع الذي قال سائل | ومهما ضربت النوع في عدد يك ال | .28 |
| فاس جواب ثم كمّ يحاول | واسّي كلا النوعين فاجمع فما بدا | .29 |
| وعند اتفاق زائد هو شامل | وقل زائد في ناقص هو ناقص | .30 |
| وان كان بين الرتبتين تفاضل | ويخرج عد ان قسمت موافقا | .31 |
| هو الاس للنوع الذي هو حاصل | ومقسومك الأعلى فزائد أسّه | .32 |
| وعدّ على نوع لهذا يماثل | وفي عكسه اجعل كالسؤال جوابه | .33 |
| وقسما بمثلويّه نحيّي المعادل | وفي العكس يبدو نوع ما قد قسمته | .34 |
| فحصل قواه لاعدتك الفضائل | ومناهجه يدرى بنوع تحيل | .35 |
| المسائل السّت | | .36 |
| مرتبة في العرف فهي مسائل | وهاك ضروبا ستة قد تاصّلت | .37 |
| فنصف بسيط ثم نصف مقابل | على عدد والشيء والمال دورها | .38 |
| والأموال في الوسطى لعد تعادل | جذور وأموال في الأولى تعادلا | .39 |
| بسيطات فاعمل بعد ما انا قائل | والأشيا عدا عادلت في اخيرة ال | .40 |
| وفي ثالث عدا على ما يعادل | ففي الأولين أقسم على المال عدله | .41 |
| وفيه اجب بالمال من هو سائل | فما كان فهو الجذر من غير اوسط | .42 |
| ففي رابع أفراد عد يقابل | وخذ عجما ضبطا لترتيب مقرن | .43 |

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| تفرد مال واقتران يعادل | وفي خامس افراد جذر وسادس | .44 |
| وزد في سوى الثاني الذي هو حاصل | وفي كلها نصف الجذور فربعا | .45 |
| فنصف الجذور أطرحه منه ففاضل | على العدد واحفظ جذر ما هو كائن | .46 |
| عليه فجذر المال ما هو عائل | هو الجذر في الأولى و زده بسادس | .47 |
| وجذر الذي يبقى على القصد دالل | وفي الخامس اطرح عده من مربع | .48 |
| يك الجذر في الحالين ما هو حاصل | فالقه من التصنيف أو فاجمعنهما | .49 |
| فذاك محال أو تراه يماثل | وحيث يفوق العد فيه مربّعا | .50 |
| فعلم بقدر المال ما عنه حاصل | فنصف الجذور الجذر وهو كجذرهم | .51 |
| فصل | | .52 |
| فان لم يكن بل كسر مال وعائل | وما مر حيث المال في الضرب واحد | .53 |
| ورد بحط زائدا والمعادل | فللمال كما كسر مال بجبره | .54 |
| فما كان فاعمل فيه ما انت عامل | وما قارن اصنع فيه ما قد صنعته | .55 |
| من المال في عد لتدرى الوسائل | او اضرب لدى التركيب قدر الذي يرى | .56 |
| وفي الاخر أقسم ما لجذر يقابل | وقدر كعد خارجا والبنا اعتمد | .57 |
| تناول تحيل حين تاتي المسائل | على ما ضربت العد فيه وبعده | .58 |
| والا فلا تطمع بأنك داخل | ولا بد من إتقان نحو وسيلتي | .59 |
| ولله حمد دائم يتواصل | وهذا الذي أوردته فيه مقنع | .60 |
| محمد الهادي الكريم الشمائل | وتتلو صلاة مع سلام على الرضى | .61 |
| وازواجه الغر الكرام الافاضل | نعم الاؤلى ثم آله ثم صحبه | .62 |
| بالاقصى وشهر اليمن فهي تطاول | وابياتها تسع وخمسون انشأت | .63 |
| بدال وضاد فالثنا يتكامل | ربيع من العام الذي ضبط عدّه | .64 |