



Chinese Zhusuan : Advancing with Times and Keeping Young Forever

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The establishment of Chinese Zhusuan Association signifies that world mental arithmetic by image of abacus cause has entered into a wide and brand – new stage. At the same time, it embodies the profound historical cultural deposit and the modernized charming of Zhusuan, shows the dynamic energy and predicts the promising future of Zhusuan. This is worthy of looking back, thinking over and making research especially of looking forward to the future.

I. The Long Standing Chinese Zhusuan Has a Centuries - old History

Chinese suanpan made of wood is extremely difficult to preserve with few left behind; and it is really hard to discover the operational process with the pictures of suanpan owing to the difficulty of carving and printing them. Of course, we cannot exclude that people in that time looked down upon Zhusuan due to the restraining – business idea, and they considered Zhusuan as insignificant – skill of folk peddler, thus various possibilities of Zhusuan were consciously avoided. As a result, people could not arrive at conscious on the history of Zhusuan.

Zhusuan is a sort of calculation technology based on the “bead”. Zhusuan is in essence the “bead”. The little Western beads (1066 B.C –771) – pottery beads – unearthed in Jishan county Shanxi province, were the “bead” after textual research, which proved that Zhusuan had been existed in China 3000 years ago. The hereafter structural changes and the calculation method’s development of Zhusuan, is only the perfection and development process and has nothing to do with the original8ty of Zhusuan.

Nowadays, we can see the beam – and – rod abacus; the little Western Zhou pottery beads and the “suanpan” recorded in *Arithmetic Chronicle* are ancient suanpan. Zhusuan includes two aspects, i.e. the calculation tools (hard ware) and calculation method (soft ware). It is not difficult to speculate the calculation method according to the calculation tools’ structure due to the simplicity and conciseness of the ancient suanpan. For example, the *Arithmetic Chronicle* recorded “in bead – calculation one bead controls the other four and they over across three parts”. Zhen Juan noted its calculation method “Carve the plates into three parts. The upper and lower parts are for the movable beads while the middle part if for calculation. At each position are five beads and the upper one bead that stands for 5 is different in color from the other four beads, of which each bead only stands for I. The upper bead controls the other four, hence being called 1 beads 4 and they are moved in three other parts hence the saying “Three – area longitude – latitude movement”. Therefore, it is not difficult for people to understand the calculation method for many of the later generations made various kinds of demonstrations. The rhombus suanpan with a string of six beads Lu Weizhen (AD 1543 – 1610) unearthed in the grave of Lu Weizhen enables people to understand the general calculation method of Zhusuan conveniently. It is also not difficult to catch the calculation method of the familiar drum shape suanpan with a string of seven beads and it is conveniently to think of the 16 carrying system (for example one jin equals

16 liang). In Ming dynasty, Zhusuan was regulated and mostly the demonstrated with a string – of seven – beads suanpan. The present suanpan with a string of five beads obviously can be traced back to the upper and lower beads’ set up recorded in *Mathematics Chronicle* and also it has the binary number convenience.

Historically, even in China, there were many kinds of calculation tools and methods existed side by side with Zhusuan, for example, 14 kinds existed in *Mathematics Chronicle*. Zhusuan bolted out in its development and perfection period and by the end of 15th century it replaced completely the arithmetic by calculation – sticks. It is not until the popularization of computer did the state of Zhusuan unification was altered in practical use. Abacuses in other areas of the world functioned considerably different from Chinese suanpan, for example, the Roman abacus and the abacus with 10 beads on each rod (like those in Russia and Northern Europe); however, only the Chinese suanpan was spread worldwide and has been used till now. So it is appropriate to say that Chinese suanpan is the fifth invention of China due to its clever structure, powerful function, concise calculation method, convenient application and profound effect.

There had been mental arithmetic since human beings possessed the ability of calculation. The 14th calculation method recorded in *Mathematics Chronicle* is: “It should start to calculate mentally as for the mathematics”, which refers to mental arithmetic. The Master said, “The one that good at mathematics does not adopt the arithmetic by calculating – sticks”. Mental arithmetic by calculating – sticks is to calculate by fiddling with the chips mentally. When familiar with Zhusuan, we can do the mental arithmetic by image of abacus. There are various kinds of mental arithmetic, for example, finger arithmetic, numeral arithmetic etc. Only mental arithmetic by image of abacus is easy to be popularized because it is easy to be calculated quickly, and simple to learn, which is beyond compare with other mental arithmetic.

II. To Move Forward and Enhance Chinese Zhusuan

It is the historical laws for Zhusuan to develop vigorously and quickly in the form of mental arithmetic by image of abacus in the computer popularized environment from the initial going side by side with other calculation method to taking the lead by competition and then to unifying others, which also has its profound scientific contents.

Ancient Zhusuan was to do the arithmetic by driving beads with hands. For the convenience of mastering, various calculation methods evolved from the ten numbers of ancient Zhusuan were compiled to pithy formulas. When time came to Ming dynasty (AD 1368 – 1644). Wu Jing, Wang Wensu, Zhu Peiyu and Cheng Dawei generalized and regulated the ancient Zhusuan, thus developed its application fields ranging from commercial trade to scientific research. For example, it advocated in Cheng Dawei’s “General Rules of Calculation” (1592 AD) addition in the pithy formula of adding, subtraction in the pithy formula of withdrawing, second place multiplication, return – division and the way of deciding the decimal point etc. The central idea of regulating Zhusuan calculation method in Ming Dynasty was to improve mechanization degree and to aim at obtaining the result by driving beads without thinking.

The direct consequence of perfection in the mechanization of Zhusuan in Ming Dynasty was to popularize mathematics among the massive grass roots at an unprecedented level. Using the calculation method of mechanization Zhusuan to recite the pithy formulas orally and to practice by driving beads can enable people to master Zhusuan even they know nothing about the principles. Whether public schools, private schools, family tutors, businessmen, workers, shoppers or apprentices could all teach Zhusuan, even the kids could learn and master it well. This kind of Zhusuan lasted until 1950s and in certain places lasted until now. Due to this reason, Zhusuan was disseminated quickly and even to the overseas countries.

Zhu Zai (1536 – 1611) applied Zhusuan to scientific research and created the method of using suanpan in series and parallel way and he also designed the extremely concise calculation procedure. In his scientific discoveries, inventions and creations, with the help of suanpan, he finished his extremely complicated calculation, which led to his 12 temperaments, a top discovery in the world.

In the past, we only rested on the practical methods of Zhusuan and driving beads with hands and failed to discuss and recognize the profound significance and irreplaceable value of Zhusuan from its foundation or “genes”. However, when introducing the western mathematics teaching mechanism, we did not use it to replace the accordingly lag – behind parts in the western mathematics curriculum but excluded it from the mathematics courses. As a result, the mathematics in schools could not meet the practical requirements and another Zhusuan course had to be opened up.

As for the phenomenon of “learning those without usage and using those excluded in learning”, there had been learners who constantly questioned about it since 1920s and in the 1950 – 1960s, the learners that arrived at a common understanding had been on the rise. They called on Zhusuan informal discussion besides researching on the published works and submitted their suggestions on innovation Zhusuan teaching and establishment academic organization to the ministry of education in the 1060s. In 1970s, the worldwide 3 – arithmetic mathematics arithmetic (written arithmetic, oral arithmetic and Zhusuan) was carried out and obtained favorable results.

The Chinese Zhusuan Association was founded in October 1979, which made a firm organizational foundation for pushing Chinese Zhusuan cause and signified Chinese Zhusuan milestone. In the past 20 years, various Zhusuan associations and the massive workers, educators and researchers of Zhusuan associations devoted themselves into Zhusuan cause and worked conscientiously, as a result they obtained glorious achievements. For example, since 1984, there were over 1 million people who participated in grade – evaluation of skill in Zhusuan annually, and by the end of 2001; about 30 million people took part in it. Another example, Zhusuan contests have been held in various regions in the country since 1981, with diversified forms and varied and colorful contents, among which were 28 national contests. The contests promoted the improvement of Zhusuan skills. During the national 4th Zhusuan contest in 1997, the original six records were totally broken and the personal all 0 round (five items and 5 minutes for each one) scores arrived at 3250. The champion Zhu Qingying calculated 60 addition – subtraction questions within 5 minutes with 120 characters in each question, which required calculation 7200 numbers within 300 seconds and operations of 24 number per second on average (including

writing out the answer), thus proceeded the world level. Furthermore, the number of the children that took part in the national mental arithmetic by image of abacus has arrived at 2.95 million by the end of 2001; and the number of those participated in the 3 - arithmetic mathematics teaching experimental classes has arrived at 3.27 million by the end of 2001.

The activities in Zhusuan association are very active and attracting, which shows thoroughly the massiveness, practicability, abundant scientific contents and vitality of Zhusuan. In order to promote the academic theoretical research of Zhusuan, Chinese Zhusuan Association has founded consecutively five special committees and match referee committee including Zhusuan methods principles, Zhusuan history, Zhusuan teaching, 3 - arithmetic teaching and calculation, the calculation tools and the two national student corresponding match committees as well. Various committees worked out annually the research subjects and the working plans to encourage and support actively the experts' published works. The committee of Zhusuan methods principles researched on Zhusuan subject and published "Probability of Zhusuan Subject" in 1990; and the cross -straits Zhusuan experts compiled and published "Modern Chinese Zhusuan" in 2000. In recent dozens of years, a great deal of Zhusuan academic theoretical works emerged, for example, the "the History of Chinese Zhusuan" compiled by Hua Yinchun filled in the blanks of Chinese Zhusuan history; Chinese Zhusuan Association organized and supported the experts to jointly compile the works, like "A Complete Collection of Zhusuan in China", "A Dictionary of Chinese Zhusuan", "Zhu - Mathematics", "An Explanation to the Key Questions of Arithmetic" etc, still including the "Universal Dictionary of World Zhusuan" jointly compiled by Sino - Japan Zhusuan experts. At the same time, a large number of Zhusuan and mental arithmetic by image of abacus materials and the related films, telefilms and documentary films were projected constantly.

In order to carry forward the excellent Chinese Zhusuan culture and to spread and popularize Zhusuan scientific knowledge, Chinese Zhusuan Association held a national contest of Zhusuan science and technology in 1990 - 1991. And about 2.47 million people took part in it, thus Zhusuan was propagated and universalized at large and also had a profound significance. Chinese Zhusuan Association and Taiwan Chamber of Commerce have in turn held the Cross - Straits Zhusuan Communication And the Cross - Straits Teenagers Zhusuan Friendship Contest since 1991 and altogether 11 such kinds of activities were held. The cross - straits held Zhusuan corresponding contest annually and by the end of 2002, about 3.2 million people from mainland took part in it. It also held worldwide activities of international Zhusuan academic exchanges of Asia - Pacific in 1991, the international Zhusuan academic theoretical seminar in Huangshan Mountain and the first world conference on Zhusuan Weifang in 1996. etc. They also held frequent international visiting activities on Zhusuan and constant academic exchanges.

III. The Flourishing Zhusuan Education

Electronic computers (calculators) have been gradually popularized in China since 1980s. Once it was predicted facing this situation that "Zhusuan ought to go into museum". For example, an article on saying goodbye Zhusuan was published by a famous university, the advertisement board on "farewell to the one-thousand year old Zhusuan" was set up at the railway station of a certain provincial capital city, and even in some telefilms the appeared the

scene of smashing suanpan. However, the contrary to this “predict”, the abacus / mental arithmetic heat appeared at this time.

Experiences for years that mental arithmetic by image of abacus can be universally popularized, not only the students in primary schools but also those in the kindergartens can learn well and obtain favorable effects. The four or five year old kids are able to master the mental arithmetic of multi-digit numbers. Nowadays, the “children prodigy” that can do the mental abacus / mental arithmetic in China are not scarce any more. This great cause that benefit not only the current generation but also the following up generation is greatly being popularized in the whole country. Many of the common children have become “children prodigies on quick calculation”, which seems unimaginable according to the previous set of teaching method in the kindergartens and primary schools. And we cannot find another kind of effective mental arithmetic teaching method, which enables the abacus / mental arithmetic to be popular with the children, teachers and the parents. Some of the primary schools and kindergartens in certain places that do not setup mental arithmetic by image of abacus will be impacted in their recruitments.

Mental arithmetic by image of abacus can not only help the children to gain the specialties of mathematics but also can help them to cultivate many favorable qualities, thus benefits other subjects. That is to say “an excellent subject benefits the other subjects a great deal”. Especially in the aspect of improving the arithmetic skills, astonishing progress have been made In the Second National Zhusuan Skill Contest in 1988, the personal all around score was more than 1000; in the Third National Zhusuan Skill Contest in 1992, the personal all – around score was more than 2000; in the Fourth National Zhusuan Skill Contest in 1997, the personal all-around score reached 3250 and this contest saw the peak of breeding records and progress extent. This shows fruitful achievements of abacus and mental arithmetic education and remarkable effects of developing the Zhusuan education function.

The arithmetic wisdom of the ancient Chinese may see its climax in 1990's. The abacus and mental education attended by millions of students from middle schools and primary schools announces the irrevocability of the Zhusuan culture. These attendees are better than those of the same age on brain reflection, study records and especially arithmetic and science lessons. Their unimaginable mental arithmetic ability stems from popularizing abacus and mental arithmetic education. This kind of education takes its perfect effects on children at the age of 4 to 13. Application of the abacus with a string of one bead up and four beads down through scientific training acquaints children with mental arithmetic by image of Zhusuan, in other words, with an abacus in the mind. It is in this method that stimulates the worldwide fever of the Zhusuan culture.

IV. Bright Prospect and Ever -lasting Youth

As the perfect Chinese traditional culture treasure and a component of the world culture, Zhusuan has exercised far -reaching influences in the world. The development of abacus and mental arithmetic is booming not only in China but also in other countries and regions, such as Japan, Korea, Malaysia, Singapore, Indonesia, Brazil, the US, Canada, Australia, and Taiwan and Hong Kong of China. Abacus and mental arithmetic presents its tangible charm before people, in

primary schools, kindergartens, communities, and rural areas, attracting people and stimulating people to further understand its secrets and laws. Further research is also needed for the Zhusuan associations, related workers, educators and researchers. Through research we have noticed: Only the application of ancient Zhusuan concept cannot explain those phenomena. Further research on Zhusuan must be based on new ideas and perspectives, and the advancement and modern meanings of zhusuan must be understood genetically. Modern scientific and technological achievements and the scientific method, "upholding advantages of the past to get new knowledge", must be applied to gain new discoveries and cognitions, to create new methods in line with modern science and technology, and education environment, thus promoting Zhusuan into a new historical development phase. Through research, some experts at home and abroad have found that Zhusuan not only bears calculation function for practical use but also have good functions of education and intelligence cultivation. In the late 1980's, this social consensus has been reached. The rise of abacus and mental arithmetic education even more embodies its characteristics. In many areas abacus and mental arithmetic is considered as a vital way of intelligence cultivation, and have made remarkable achievements on education have been made for children in kindergartens and for weak-intelligence children.

Through research, some experts find that not only the calculation function of Zhusuan is simple and useful, but also symbolization of Zhusuan and its internal application in mind turn out to be more practical and general. In a genetic perspective, Zhusuan symbols and models are still the most advanced at present. Zhusuan symbolization is the radical difference between the modern Zhusuan and the ancient Zhusuan. First, through application of the moving symbol concept, 10 numeral bead-codes are evolved from the consecutive numeral system and the digit value system, which are composed of two bead-symbols. And then 26 moving bead-code symbols stem out, and at last the parallel arrangement of these codes realizes the calculation. Calculation thus reaches an ideal simple state. The abacus is a symbol translator. These symbols can be arranged on the abacus to fulfill the calculation, can also be internalized to move in mind for calculation fulfillment, and can also be modeled by computers to fulfill the calculation, hence forming a general calculation model for arithmetic by manual operations, mental arithmetic and computer arithmetic. This calculation model can both simplify mathematics and computer teaching and diversify algorithms; it can both foster children's creative thinking and practical abilities through hand-use and brain-use, and foster their excellent qualities such as attention, visual awareness, memory, fortitude, confidence and competition sense, to effectively develop their intelligence. After the Zhusuan symbols are internalized into the mind, their operations can be available in any modern science and technology, thus realizing its integration into the modern science and technology. For example, after research on Zhusuan and electronic computers, some experts have found that: The computer and Zhusuan share the same principle, uniform calculation mode, similar system, corresponding language, equivalent calculation program, and similar methods and skills. The only difference is that the former is driven by electronic technique while the latter is manually driven. Therefore, Zhusuan is nothing but a suitable instrument to foster human intelligence in line with modern technology demand. For example, Zhusuan is a perceivable, flexible and simple teaching tool to teach computer principles and calculation methods.

At present, the development of the Chinese Zhusuan "cause is unprecedented and without parallel in any period of the history. Especially in the electronic era, it's a wonder in the Zhusuan

development history that Zhusuan reaches prosperity instead of decease. Certainly, the wonder comes because the Chinese ancient Zhusuan bears abundant connotations and various functions. In the past, people only considered it as a calculation instrument and applied its calculation function for a long term, but neglected the development and application of its other functions. After the appearance of electronic computers, Zhusuan's functions of education and intelligence cultivation were shown and acknowledged in society, and Zhusuan began to play a positive role in intelligence cultivation and quality education for social development and human progress. Practices prove, Zhusuan not only bears calculation functions but also has important functions of education and intelligence cultivation, turning out to be a useful tool and a short cut for children's intelligence development and quality education.

In conclusion, Chinese Zhusuan enjoys profound historical connotation and mass foundation; especially abacus and mental arithmetic caters to the social demand and enjoys popularity among the masses. Abacus and mental arithmetic study can enlighten intelligence, endow children with wisdom, improve national cultural quality and benefit not only the current generation but also the following up. Modern abacus and mental arithmetic research has a long way to go; and the abacus and mental arithmetic cause will surely see a bright prosperity, advancing with times and keeping adolescent forever.

Main References:

Courtesy:

Hua Yinchun . *Script of Chinese Zhusuan History*. Chinese Finance and Economy Publishing House, Edition 1. December 1987.

Zhu Xi'an, Ye Zongyi. *Modem Chinese Zhusuan*. Chinese Financial and Economic Publishing House, Edition 1. March 2000.

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