Volume 2, Chapter 3: Deliberations over Accurate Measurements[1]

Measurements in antiquity and at the present time are dissimilar. Since the Three Dynasties[2], and the Han and the Tang, each period has had its system of measurement. In examining the evidence and theories concerning the past, it is evident that the foot measure arose from millet. *C:[The best (millet) is the kind produced at Shangdang (上黨) which is in Lu-an (潞安) prefecture in Shanhsi.]* A distinction was drawn between the horizontal and vertical foot. One took one hundred vertical millet grains to be one foot. *C:[Ten grains make one inch. One grain equals one-tenth inch.]* The other considered one hundred horizontal millet grains to be one foot. *C:[Ten grains make one inch. One grain equals one tenth of an inch.]* So the length of the two-foot measures was not equivalent. The vertical millet foot corresponds to 1.234 of the horizontal foot. The horizontal foot corresponds to .81 of the vertical foot. These are the methods by which millet is lined up and a foot measurement is fixed.

As for millet as a material, the "breath" (ch'i) of the ground differs (from place to place) so the size of the millet may differ. It is necessary that one choose a mean here. So take those of median size, arranging them vertically or horizontally. (But) how can a method be determined?

Ten K'ai-yuan cash (開元), nine ta-ch'uan (大泉), ch'i-tao (契刀) or ts'o-tao (錯刀) coins[3] are equivalent to one hundred horizontal grains of millet. They are equivalent to eighty-one vertical millet grains and also to ninety-one diagonally slanted millet grains.

The Hsia (dynasty) foot was equivalent to one hundred horizontal grains. This was .81 of the Shang foot, 1.25 of the Chou foot, .9 of the Han foot, 1.0 of the Tang foot, and .81 of the Sung foot.

The Shang foot was equal to one hundred vertical grains and that equals 1.23 of the Hsia foot, 1.54 of the Chou foot, 1.1 of the Han foot, 1.2 of the Tang foot, and 1.0 of the Sung foot.

Further, eighty-one vertical millet grains equal nine inches. *C:[Each inch takes nine grains.]* This is the "regulated foot" (律尺)(lu-chih) of the Yellow Emperor.[4] One hundred horizontal grains equal ten inches. *C:[Each inch takes ten grains.]* This is the foot of Shun[5].

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[1] The goal of this chapter is to give an absolute measure for "foot" and "inch", as these units have varied in size during the history of Imperial China. The author chooses to fix lengths by comparing them with the size of millet grains or certain coins, well known to history.

[2] The Hsia, Shang, and Chou dynasties - "high antiquity". Of these the Hsia has no historical basis and can be considered pre-history. The Shang ended roughly at the first millennium B.C. The Chou followed the Shang - down to 221 B.C.

[3] For a discussion of these Han-era coins (other than K'ai-yuan) see Pan Ku, *History of the Former Han Dynasty*, trans. Homer Dubs et al. (Baltimore: Waverly Press Inc, 1955) III, pp. 482-6. The K'ai-yuan ("new beginning") coin is from the T'ang dynasty and is said to be about 25 millimeters in width (slightly less than an inch).

[4] A mythical sage-emperor or culture hero.

[5] Another legendary sage emperor.

These then are the rules for linear measurement through the successive dynasties.

As for the measurements for making a ch'in, the *Shih-chi*[6] says: "The length of a ch'in is eight feet, one inch",[7] which is nine times the measurement for huang-chung (黃種) ("yellow bell")[8]. The *Erh-ya*[9] says: "The great ch'in is a name for a li (離)".[10] The commentary notes: "The ch'in has twenty seven strings."[11] The *Han-shih-wai-chuan* (韓詩外傳) [12] states: "Fu Hsi's[13] ch'in was seven feet, two inches in length"[14]; that is, eight times the length of huang-chung. From this point of view, are not all too big? The *Book of Rites* mentions the "great ch'in, great tse (瑟), middle ch'in, and middle tse."[15] Is this the "great ch'in" of antiquity? The *T'ung-k'ao* (通考)[16] says: "Confucius' ch'in was three feet, six inches in length"; that is, four times the length of huang-chung. The fingering of the long ones could not have been very convenient. And if they were too short, the sound was bottled up and unclear. Three feet, six inches is the most appropriate. So the ch'in of Confucius has been the model for generations. I think that this three feet, six inches was (measured) from the bridge to the nut. If one adds on the forehead and tail, then the whole body equals three feet, nine inches. This is the rule for the ch'in's body. Examine the forms and they are the forms of the ch'in of Confucius, which is a case of continuity between olden times and present day. For example, there is the ch'in of Yu-lin Tung-yuan (玉林洞元)[17], called "Cheng-ho" (正合) ("upright harmony")[18]. And the ch'in of Liu Ch'ing-t'ian (劉青田)[19] entitled "Chiao-yeh" (蕉葉) ("plantain leaf") was a change, which still preserved the true sound. Of the rest, the forms of various makers have been different. They slightly change the form, set up theories, and are intoxicated by novelty even to the point of changing the methods of the ancients. This is not a worthy model. I have made ch'in using the Tsz chun (此君) form but I think it is essential to keep this in mind at all times. This then is the form that the ch'in has taken.

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[6] *Shi-ji* (Records of the Historian) compiled by Ssz-ma Ch'ien (145-ca. 86 B.C.), is a history of China from earliest times to the period when Ssz-ma Ch'ien himself lived during the Han dynasty.

[7] *Shi-ji*, (HY concordance) 24/406.

[8] "Yellow bell" is the name of the first pitch in the series of twelve semi-tones produced by pitch pipes and was the base tone which the Chinese used to generate the other pitches through the cycle of fifths.

[9] The *Erh-ya*, an ancient dictionary, is one of the Confucian classics.

[10] *Erh-ya* in Ssz-pu pu-yao (C), 5/11b.

[11] Ibid, 5/12a. This is the textual commentary in the *Erh-ya* to the passage previously quoted.

[12] This is a Han dynasty book full of anecdotes of earlier personages and times.

[13] A legendary sage-emperor.

[14] I have not been able to find this quote in *Han-shi-wai-chuan*, and I do not know where the author came by this information.

[15] Li-chi, 14/16.

[16] This may be in reference to Ma Tuan-lin's Wen-hsuan-t'ung-k'ao (文選通考), although he may have had some other text in mind. I have been unable to locate the quote in Ma's work.

[17] No information.

[18] Cheng-ho basically refers to a simple straight boxy ch'in with no fancy edges. See the pictures in the next section.

[19] No information.

As for the construction of a ch'in, the length of the strings is taken as three feet, six inches[20]. In addition there are the head and tail, which make a total of three feet, nine inches. It does not matter about the length of the foot of antiquity or present day. In all cases ch'in can still be built according to the model. But if they are different (in measurement), how can they still be said to be one? (The answer is) even if the length is different, still the length of the strings is taken as three feet, six inches, so everything is the same. When it comes to the head and tail, there is no constraint. This method makes for no effect on the sound. But (assuming a change in the overall string length) the longer ones accordingly have their hui (徽 or 暉) ("stops")[21] positions extended; and the shorter ones accordingly have their hui positions shortened. What need is there to be so finicky about measuring out the exact length then? Although, assuming one is not particular about the length, one still has to fix the rules for measurement. Otherwise if one runs into a long one, then in stopping at the thirteenth hui, first fen (分), first li (釐)[22] position, and in trying to use the techniques of yen (罨) and t'ao (掐)[23] (21) at the tenth hui, then the thumb and index finger will not be able to reach it. On the other hand, if the ch'in is too small, then the positions around the fourth hui will be too close together and the sounds in that region will be hard to get clear. So one must consider this by taking the ring finger and stretching it out to the stopped position and taking the thumb and executing the yen and t'ao techniques there. The two fingers' separation should be considered to be five inches. *C:[The tenth hui is two feet, seven inches (from the bridge), and the thirteenth hui, first fen, first li is then three feet, two inches]*. Altogether this equals five inches. - Then one has a half-foot and if one doubles it, one has the measure for a foot. Then take this as the measure for making a ch'in. So the yen and t'ao techniques will be suitable in every position and nowhere will there be problems with obtaining clear sound. This system of measurement is based on the vertical millet foot measure[24]; that is, the present Board of Works building measure. Shorter ch'in should use the horizontal millet foot measure.[25] The *Ch'in-fu*[26] states: "As the strings are long, each can give the entire scale."[27] Naturally the vertical millet foot measure should be considered as suitable for the work.

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[20] Meaning from the inner "string-side" of the bridge to the nut on the top surface of the ch'in. The translator has measured three ch'in in his possession, and they measure in English inches, 1. 45", 2. 45 and 7/16", and 3. 45 and 1/8". If we assume 3 feet, 6 inches in Chinese measurement terms, and remember there are 10 inches to a foot, then we have 45 English inches to 36 Chinese inches or a ratio of 1.25 to 1 English to Chinese.

[21] The ch'in has thirteen hui, which function as acoustic node markers, marking harmonic positions, and in a lesser sense as rough guides for the left hand.

[22])In ch'in tablature, the hui are numbered from one (closest to the bridge) to thirteen (closest to the nut). The divisions between hui are further subdivided into fen or tenths, li which are tenths of fen.

[23] These are both techniques for the left hand thumb. Yen is analogous to a guitarist's slur; that is, the thumb "hammers on" at for example, the 9th hui, after a note has been played with the ring finger which was previously placed at the 10th hui. T'ao is a legato technique; that is, the thumb "pulls off". See Van Gulik, *The Lore of the Chinese Lute*, pp 133-4 for further explanation. Chu's point is that if the ch'in was too big, fingers will not be able to reach to the proper places. Also note that the characters used here are the long classical forms, not the ch'in tablature short-hand forms.

[24] One hundred grains of millet placed lengthwise equal ten Chinese inches or one Chinese foot. This is the vertical millet foot measure mentioned earlier .

[25] One hundred grains of millet placed side to side.

[26]) The *Ch'in-fu* is a long expository poem on the ch'in written by Hsi Kang (A.D. 223-62), politician, writer, technologist, Tao seeker, and of course a famous ch'in player.

[27] See R. H. Van Gulik's translation of *Ch'in-fu* in his *Hsi Kang and his Poetical Essay on the Lute* (Tokyo: Charles Tuttle Co., 1969), p. 115.

The method for distinguishing K'ai-yuan cash:

There are genuine and false K'ai-yuan cash. Their sizes differ. If one selects the bigger ones, these will be genuine. One should know that the Tang hui-yao (唐會要)[28] gives the information that in the fourth year of the Wu-te (period) of the Emperor Kao-tsu (高祖) [29], on the seventeenth day of the seventh month (August 3, 621), K'ai-yuan currency was put into circulation.[30] Ou-yang Hsun (歐陽詢)[31] decided on the inscription and the calligraphy, of which there were three styles, pa-fen (八分) (small) seal, and official script (li-shu).

Note that K'ai-yuan cash is the name of the money, and K'ai-yuan is not the name of a reign period. The coining took place in the fourth year of the Wu-te period of the early Tang.

As soon as this money was issued, (the older) Wu-shu (五銖) money was abandoned. The K'ai-yuan money is probably the best quality money in the world. People nowadays consider K'ai-yuan cash to have been coined in (Emperor) Hsuan Tsung's (玄宗)[32] K'ai-yuan reign period, but this is incorrect.

If one wants to measure the foot, then one should select the very best money. The calligraphy should be standard. Ornamentation and the body should be precisely defined. The disc and hole should be well proportioned. The engraved edge should be neatly done. This is the true K'ai-yuan cash, coined in the fourth year of the Wu-te period.

The coins privately minted among the people are the reverse of this. These are commonly referred to as "base coinage". There is one variety that has a character on its reverse (that looks like a flattened U) and this is also spurious. Among thousands of such cash there will only be a few that are genuine. Many years have passed since that era, and so the genuine are few, while the false coins are numerous. If the money is obtained from an underground location the oxidized copper must be removed. Scour the coins clean, and then they can be used for measuring the foot. If one does not clean them and tries to measure a foot, the least divergence will lead him astray. In constructing a foot measure, should not fine powers of judgment be exercised?

The method for distinguishing: "Ta-chien fifty cash", "Ch'i-tao five hundred (cash)", "I-tao worth five thousand (cash)":[33]

According to the "Treatise on Food and Goods" in the *Ch'ien Han-shu*:[34] 'When Wang Mang[35] held the regency, he changed the Han system. In so much as the Chou (dynasty) large and small

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[28]An encyclopedia begun in T'ang dynasty times that concerned itself mostly with T'ang governmental affairs.
[29]A T'ang emperor, he reigned from A.D. 618-626.
[30]*T'ang-hui-yao* (Peking: *Chung-hua shu-chu*, 1955) pp. 1623-3.
[31]Ou-yang Hsun (A.D. 557-641), a Confucian scholar-official in the early T'ang, was famous for his calligraphy, as well as his scholarship.
[32]Another T'ang emperor, he reigned from A.D. 712-755.
[33]"Ta-ch'ien fifty cash", etc. were the inscriptions on the coins.
[34]The *Ch'ien Han-shu* is the history of the former Han dynasty by Pan Yu (A.D. 32-92) et al.
[35]Wang Mang reigned as emperor from A.D. 9-22. He established his own short-lived dynasty, interrupting the Han period.

cash acted as standards for each other, thus he (also) created a larger cash, with circumference measuring 1.2 inches. The inscription read "Ta-ch'ien fifty cash". He also created Ch'i-tao and I-tao knife coins, with a circular top like the large cash and a body shaped like a knife The inscription on the Ch'i-tao knife money said: "Ch'i-tao five hundred". Gold was inlaid in the I-tao (coins) and the inscription read: "One knife worth five thousand".'[36] The commentary to *The Rites of Chou*[37] reads: "Ta Chuan" [38] was coined by King Ching of Chou[39] ."[40] The *Han (history)*[41] also state that Chou possessed coinage of equal weight, thus it is clear that this did not begin with Wang Mang. *Huai-nan-tzu*(淮南子)[42] refers to "twelve grains making up one inch"[43] and this was probably the Han system. When Wang Mang transformed (the Han systems) and created "Ta-ch'ien", the diameter was 1.2 inches. This is to say a Han inch equals 1.2 inches of Wang Mang's foot measure. So it can be stated that change was made in the Han system, and not that the Chou cash was changed. The "Ta-ch'ien" were made beginning from the Chou and Wang Mang followed this. When the coins were first issued, the dimensions were identical with the Ch'i-tao and ts'o-tao knife coins. After this period the knife monies fell into disuse, and only the "Ta-ch'ien" circulated. There was much counterfeiting and these cash gradually became lighter and thinner. At this time it is best to take the two knife monies as standards. If the relative widths match up, then (the "Ta-ch'ien") are genuine.

Arrange eighty-one vertical Shangtang millet grains, ninety diagonal Shangtang millet grains, one hundred horizontal Shangtang millet grains, and these will match up with nine of the "Ta-ch'ien" and the knife monies, and with ten of the K'ai-yuan cash.

But this variety of excellent millet is difficult to obtain. If it does not fill up the space occupied by nine of the "Ta-ch'ien" and knife monies, then it will be useless for creating a standard and the music (made from such a measure) will be strident. The defect will stem from the fact that the millet was not of the best quality.

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[36] *Ch'ien Han-shu*. See *Ssz-pu-pei-yao* edition 24 Hsia (C)/16a.

[37] *The Rites of Chou* is an ancient Confucian text on ritual.

[38] Same as "Ta-ch'ien".

[39] An emperor of the Chou dynasty, he reigned from 544-520 B.C.

[40] Actually the locus classicus for this statement seems to be in the *Kuo-yu* (Tale of the States), an early text full of stories of the Chou period. See *Kuo-yu* in *Ssa-pu ts'eng k'an* (四部叢刊) edition 3/13b.

[41] That is, "The Treatise on Food and Goods" in the *Ch'ien Han-shu*.

[42] *Huai-nan-tzu* is an encyclopedia-compendium of natural philosophy compiled by a group of scholars gathered by the Prince of Huai Nan, Liu An , c. B.C. 120.

[43] Huai-nan-tzu, Ssz-pu ts'eng-k'an (C), 3/11b.

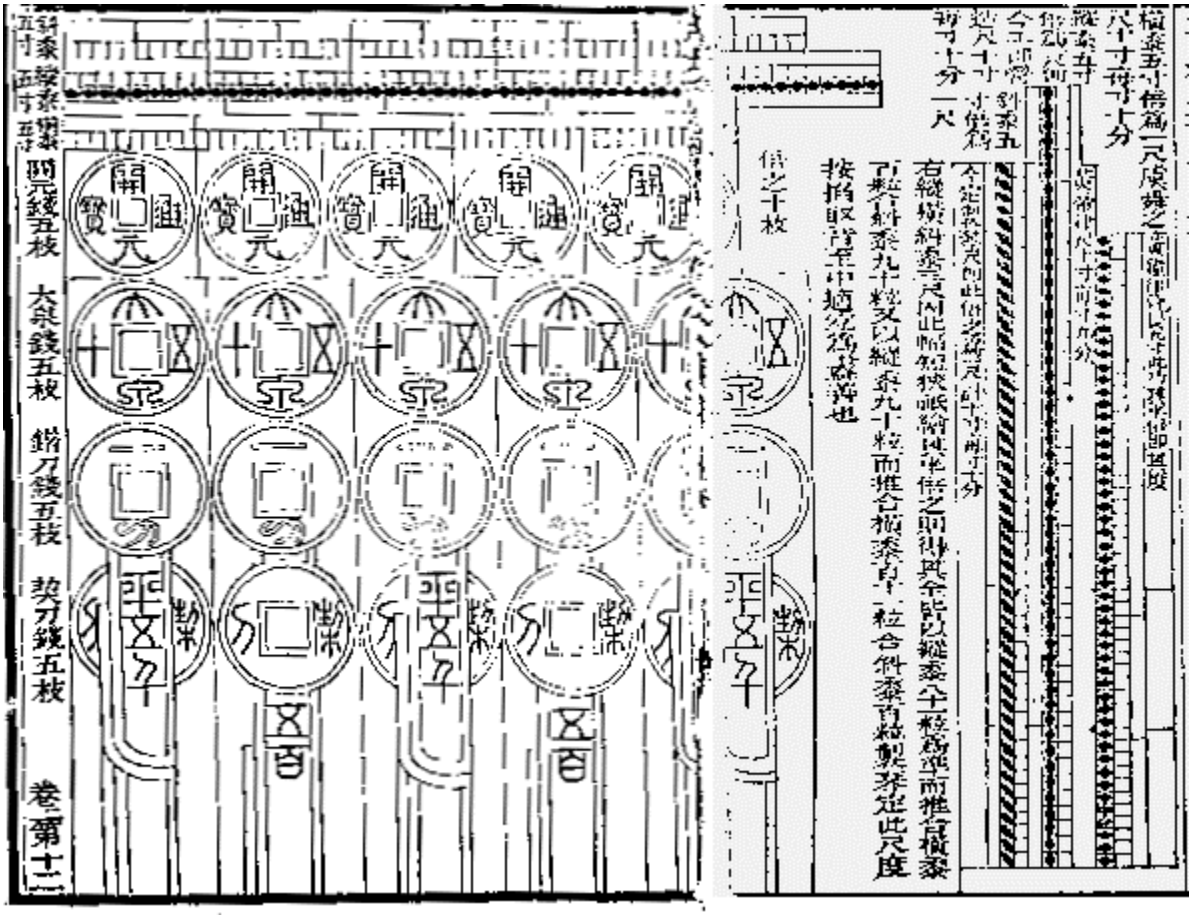

Figure 1: Two figures, although on separate pages in the original, are overlapped here. In terms of grains, we have at the right side, horizontal, vertical, and diagonal millet grains. In terms of coins, on the left from top to bottom are the K'ai-yuan, Ta-ch'ien, ch'i-tao and I-tao coins. Horizontal millet is at the top of the coins. We can also see that a Kai-yuan coin is the size of 8 horizontal millet grains, or 10 vertical millet grains.