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BRUSH TALKS FROM DREAM BROOK

II

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梦溪笔谈

Brush Talks from Dream Brook

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四川出版集团　四川人民出版社

Sichuan Publishing Group　Sichuan People's Publishing House

图书在版编目(CIP)数据

梦溪笔谈:汉英对照/(北宋)沈括著;胡道静,金良年,胡小静今译;王宏,赵峥英译.—成都:四川人民出版社,2009.1

(大中华文库)

ISBN 978-7-220-07741-8

Ⅰ.梦… Ⅱ.①沈…②胡…③金…④胡…⑤王…⑥赵… Ⅲ.笔记-中国-北宋-汉、英 Ⅳ.Z429.441

中国版本图书馆 CIP 数据核字(2008)第 209465 号

责任编辑:韩　波　蒋跃梅

大中华文库

梦溪笔谈

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出版发行者:

四川人民出版社

(四川省成都市槐树街 2 号　邮政编码 610031)

http://www.scpph.com　http://www.booksss.com.cn

制版、排版者:

成都勤慧彩色制版印务有限公司

印制者:

深圳佳信达印务有限公司

开本:960×640　1/16(精装)　印张:70　印数:2,000

2008 年第 1 版第 1 次印刷

(汉英)

ISBN 978-7-220-07741-8

定价:198.00 元

卷十八·技艺

298. 方士许我

【原文】

贾魏公为相日，有方士姓许，对人未尝称名，无贵贱皆称“我”，时人谓之许我。言谈颇有可采，然傲诞，视公卿蔑如也。公欲见，使人邀召数四，卒不至。又使门人苦邀致之，许骑驴径欲造丞相厅事。门吏止之不可。吏曰：“此丞相厅门，虽丞郎亦须下。”许曰：“我无所求于丞相，丞相召我来。若如此，但须我去耳。”不下驴而去。门吏急追之不还，以白丞相。魏公又使人谢而召之，终不至。公叹曰：“许市井人耳。惟其无所求于人，尚不可以势屈，况其以道义自任者乎？”

【译文】

贾昌朝担任丞相的那段日子，有一位姓许的方士，他对人从来没有说过自己的名字，不论对方是有身份的人，还是社会地位低下的人他都自称“我”，当时的人就叫他“许我”。言谈很有些可取之处，但性情高傲不合常理，对达官显贵常显露轻视的样子。贾昌朝想见他，派人邀请了多次，还是不来。又派手下门客苦苦邀请他来，许我骑着毛驴要直接进丞相客厅。守门的官吏阻止他不能这样。说：“这是丞相的厅门，即使是寺丞郎官也必须下马。”许我说：“我没什么求丞相的，丞相召我来。如果这样，只能让我走了。”他便没下驴而去。守门的官吏急忙追赶他，他也不肯回头。守门的官吏将实情向丞相禀告。贾昌朝又派人去道歉并邀请他，许我最终还是没有来。贾昌朝感叹地说：“许我只不过是个平民百姓罢了。只因为他无所求于人，尚不能以权势让他屈服，更何况他是以道义为己任的人呢？”

Section Eighteen Crafts

298. Alchemist Xu

When Jia Changchao became the prime minister, there was an alchemist surnamed Xu, who never made known to others his given name.* As he always called himself "I" when talking to people of high social status and of low social position, he got a nickname "Xu Wo, "meaning "I am Xu." Knowledgeable and talented, he was a man of peevish temper who had little regard for eminent officials. Jia longed to see him. He had invited him for several times, but he declined all his invitations. Jia sent his men to invite him again and again. Xu finally consented to meet Jia in his official residence. He rode on a donkey and intended to go directly into the reception hall. However, the guard in front of the entrance stopped him, saying,"This is the prime minister's official residence. Whoever you are, you will have to dismount from your donkey." Xu replied, "I am not here to ask the prime minister for help.It is the prime minister who invites me here. If I cannot get in, I will have to leave." Then he left without dismounting from his donkey. The guard then chased Xu in a hurry, pleading with him to stay, but he refused to come back.The guard had to report the event to Jia, who sent his men to apologize to Xu and invited him again, but he would not come. Jia sighed with mixed feeling, saying, "Xu is only a civilian, but he does not yield to influential officials because he seeks no profit for himself. What a responsible and virtuous man he is!"

Translator's note:

* According to ancient Chinese etiquette, a man should make known his given name as a way of showing his respect when meeting with people of high social status

299. 喻皓《木经》

【原文】

营舍之法，谓之《木经》，或云喻皓所撰。凡屋有三分：自梁以上为上分，地以上为中分，阶为下分。凡梁长几何，则配极几何，以为榱等。如梁长八尺，配极三尺五寸，则厅堂法也。此谓之上分。楹若干尺，则配堂基若干尺，以为榱等。若楹一丈一尺，则阶基四尺五寸之类，以至承拱榱桷，皆有定法。谓之中分。阶级有峻、平、慢三等。宫中则以御辇为法：凡自下而登，前竿垂尽臂，后竿展尽臂为峻道；荷辇十二人：前二人曰前竿，次二人曰前脩，又次曰前胁，后二人曰后胁，又后曰后脩，末后曰后竿。辇前队长一人，曰传唱，后一人曰报赛。前竿平肘，后竿平肩为慢道；前竿垂手，后竿平肩为平道。此之为下分。其书三卷。近岁土木之工，益为严善，旧《木经》多不用，未有人重为之，亦良工之一业也。

【译文】

讲建造房屋方法的书，叫《木经》，有人说是喻皓写的。大凡把层屋分为三个部分。房梁以上为上分，地面以上为中分，台阶为下分。一般梁长多少，那么梁至屋脊的高度也要相应地定为多少，以此来制作相应的椽子。例如，梁长八尺，梁至屋脊的高度应是三尺五寸，这是厅堂的造法，这叫做上分。柱子高若干尺，厅堂的阶基也要按比例高若干尺，用相应的比例来制作椽子。假如柱子高一丈一尺，相应的台基部分就应高四尺五寸等等，一直到斗拱、椽条等材料，都有固定的法则，这叫做中分。台阶的倾斜度分为峻、平、慢三等。皇宫中就以皇帝御轿作为标准：凡从下往上登台阶，前竿臂下垂伸直来抬，后竿臂举高伸直来抬的是峻道；抬辇的有十二人：前面两个人叫前竿，其后的两个人叫前脩，再后的两个人叫前胁；轿后两人叫后胁，其后的叫后脩，最后的叫后竿。御轿前的队长一人叫传唱，后面一人叫报赛。前竿用肘抬，后竿用肩抬的是慢道；前竿垂手抬，后竿用肩来抬的是平道。这些是下分。这部书有三卷。近年来的土木工程技术，更加严密完善，旧《木经》大多不用了，还没有人重新编著，这也是优秀匠师们的一项任务啊。

299. Yu Hao's *Building Houses with Timber*

Yu Hao is said to have written a book entitled *Building Houses with Timber*. In this book, a house is divided into three parts. The upper part is above the beam. The middle part is between the beam and the floor while the lower part is below the steps. The length of a beam is proportional to the height from the beam to the roof, and a matching rafter is made in the same proportion. For example, if the length of the beam is 8 *chi*, the height from the beam to the roof should be 3.5 *chi*. This is the rule for the construction of the upper part of the reception hall.In addition, the height of the pillar is proportional to the height from the bottom of the steps to the floor of the hall, and matching rafters are made in the same proportion. For example, if the height of a pillar is 11 *chi*, the height from the bottom of steps to the floor should be 4.5 *chi*. There are also fixed rules for the manufacturing of rafters and sets of supporting brackets in the middle part. The degrees of steepness of steps are classified into three types. A standard is made by estimating how the emperor's sedan chair is carried onto steps in the royal palace. When the carriers in the front lower their arms and the carriers in the rear raise their arms, the gradient of steps is large.(There are totally 12 carriers. The two in the front are called "front poles," the two behind them are called "front ribbons"and the two further behind are called "front ribs." The two carriers right behind the sedan chair are called "back ribs," the two behind them are called "back ribbons"and the two further behind are called "back poles." The chief in front of the sedan chair is called "yelling officer" while the one behind the sedan chair is called "reporting officer.") When "front poles"carry the sedan chair with their elbows while "back poles"carry it on their shoulders, the gradient of steps is small. When "front poles" carry the sedan chair by lowering their hands and "back poles" carry it on their shoulders, the gradient of steps is medium. These are the three types of degrees of steepness in the construction of the lower part. *Building Houses with Timber* contains three volumes. In recent years a very high demand is set for the technology of civil engineering and the book is getting outdated. But no one has compiled a new one, which is the task that today's outstanding craftsmen must accomplish.

300. 冪术和缀术

【原文】

审方面势，覆量高深远近，算家谓之“冪术”。冪文象形，如绳木所用墨斗也。求星辰之行，步气朔消长，谓之“缀术”。谓不可以形察，但以算数缀之而已。北齐祖亘有《缀术》二卷。

【译文】

推求方位和地形，测量高低和远近，数学家把这类方法叫做“冪术”。冪是个象形字，像在木头上画线用的墨斗。求出星辰的运行，推算节气朔望的变化，所用的方法叫做“缀术”。意思是说不可以用外部的形状来考察，只能用数学的方法来推算补缀罢了。北齐祖亘著有《缀术》二卷。

301. “隙积术”和“会圆术”

【原文】

算数求积尺之法，如刍甍、刍童、方池、冥谷、堑堵、鳖臑、圆锥、阳马之类，物形备矣，独未有隙积一术。古法，凡算方积之物，有立方，谓六幕皆方者。其法再自乘则得之。有堑堵，谓如土墙者，两边杀，两头齐。其法并上下广折半以为之广，以直高乘之，又以直高为股，以上广减下广，余者半之为句。句股求弦，以为斜高。有刍童，谓如覆斗者，

【译文】

算术中求体积的方法，诸如“刍甍”、“刍童”、“方池”、“冥谷”、“堑堵”、“鳖臑”、“圆锥”、“阳马”等，差不多都有了，唯独没有“隙积”这一种算法。古代的方法，凡是计算物体体积，有立方体，指的是六个面都是正方形的物体。它的计算法是把一条边的长自乘两次，就可求得体积。有堑堵，是指像土墙形状的物体，两个墙面是斜面，两头是垂直面。它的截面积的算法是用上下底面的宽度的和的一半，乘以直高即得。再以直高为股，用其上底面宽、下底面宽的差的一半为勾，用勾股定理求出弦，这就是“堑堵”的斜边长。再如“刍童”，像倒扣在地上的斗那样，四个侧面都是斜面。求“刍童”体积的算法，是用上底面的长乘二加下底面的长，

300. "*Weishu*" and "*Zhuishu*"

The method to survey positions, terrain, height and distance is called by mathematicians as "*weishu.*" The Chinese character "*wei*" is a pictograph, which looks like a carpenter's ink marker. The method to observe the movements of stars and the changes of the lunar calendar is called "*zhuishu,*" which indicates that the movement of the celestial bodies cannot be known by their outward shapes and movements. Only by using mathematical method can we know the truth. Zu Geng, a scientist in the state of Northern Qi of Southern Dynasties, wrote two volumes of *Zhuishu.*

301. The *Xiji* and *Huiyuan* Methods

In mathematics, the methods to calculate the volumes of various polyhedrons such as "*chumeng,*" "*chutong,*" "*fangchi,*" "*minggu,*" "*qiandu,*" "*bienao,*" "*yuanzhui*" and "*yangma*" are many. However, only the "*xiji*" method is missing. According to ancient methods, the volume of a cube or an object whose six planes are all squares can be got by multiplying the length of one of its sides for two times."*Qiandu*" is an object shaped like an earthen wall whose two sides are inclined while the two ends are perpendicular. The area of its cross-section can be got by multiplying the height of the object and half of the sum of the widths of the top base and the bottom base together. If we take the height of the object as the longer leg of a right triangular while half of the difference between the widths of the top base and the bottom base as the shorter leg of a right triangular, the hypotenuse of the triangular can be calculated out by using the Pythagorean theorem, which is the length of the inclined side "*qiandu.*""*Chutong*" is a truncated pyramid which is placed upside down and its four sides are all inclined.The method to calculate its volume goes as follows. First, multiply the length of its top base by two and add the result to the length of the bottom base before multiplying the sum by the width of the top base; Second, multiply the

【原文】

四面皆杀，其法倍上长加入下长，以上广乘之。倍下长加入上长，以下广乘之，并二位，以高乘之，六而一。隙积者，谓积之有隙者，如累棋、层坛及酒家积罌之类。虽似覆斗四面皆杀，缘有刻缺及虚隙之处，用刍童法求之，常失于数少。予思而得之：用刍童法为上位、下位，别列下广，以上广减之，余者以高乘之，六而一，并入上位。假令积罌，最上行纵广各二罌，最下行各十二罌，行行相次。先以上二行相次，率至十二，当十一行也。以刍童法求之，倍上行长得四，并入下长得十六，以上广乘之，得之三十二，又倍下行长得二十四，并入上长，得二十六，以下广乘之，得三百一十二，并二位得三百四十四，以高乘之，得三千七百八十四。重列下广十二，以上广减之，余十，以高乘之，得一百一十，并入上位，得三千八百九十四。

【译文】

再用上底面的宽乘它；然后把下度面的长乘二加上底面的长，再用下底面的宽乘以它；合并以上两项，乘以高，再用六除，即得体积。所谓“隙积”，是指有空隙的堆垛体，像垒起来的棋子、分层筑造的土坛和酒店里垛起来的酒坛一类的东西。它们虽然像倒扣的斗，四个侧面也都是斜的，但由于边缘有残缺和空隙的地方，如果用求“刍童”体积的方法计算，得出的数目往往比实际的少。我思考以后找出了一种算法，就是用“刍童”法求出它的上位、下位，再单独列出它的下底宽，减去上底宽，把这差数乘以高，再用六除，并入前面的数值就可以了。现在举个垛酒坛子的例子：设最上层长宽都是两只坛子，最下层长宽都是十二只坛子，一层层错开垛好，从最上层数起，数到有十二只坛子时正好十一层。用“刍童法”来算，把上层长乘二得四，加下层长得十六，再乘以上层的宽，得三十二。又把下层的长乘二得二十四，加上层的长得二十六，再乘以下层的宽，得三百一十二。上下两项相加得三百四十四，再乘以高，得三千七百八十四。另列下层的宽十二，减去上层的宽，得十，再乘以高，得一百一十。加上前面的数字

length of the bottom base by two and add the result to the length of the top base before multiplying the sum by the width of the bottom base; Third, add the two results together before multiplying the sum by the height of the object and then divide it by six."*Xiyi*"refers to a pile of objects which have gaps in between them, resembling piled-up chess pieces or earthen platforms being piled up one after another or wine jars being piled up in a wine shop.Though they look like a truncated pyramid which is placed upside down and their four sides are all inclined, there are broken parts and gaps at the edges. If we calculate the volume of "*xiyi*" by using the "*chutong*" method, the figure we get will be smaller. Later I think out of a calculating method which goes as follows: First, calculate the area of its top layer and that of its bottom layer by using the "*chutong*" method; Second, list the width of its bottom base and subtract the width of the top base from it before multiplying the difference by its height and dividing the product by six and combining it with the previous number. (Below is an example of how to calculate a pile of wine jars. Let's suppose that the width and length of the top layer are two jars and the width and length of the bottom layer are twelve jars, which are all piled up from the bottom to the top at random. If we count the number of the jars from the top layer down to the bottom layer, we arrive at eleven layers when the number of jars in the layer is twelve. If we use the"*chutong*" method, we can know the number of the wine jars in the pile. First, we get four by multiplying the width and the length of the top layer together.Then by adding four and the length of the bottom layer, we get sixteen and by multiplying it by the width of the top layer, we get thirty-two. Second, after multiplying the length of the bottom layer by two, we get twenty-four.Then by adding it with the length of the top layer, we get twenty-six and by multiplying it by the width of the bottom layer, we get 312. To add these two sums, we get 344. After multiplying 344 by the height, we get 3,784, which is the volume achieved according to the "*chutong*"method. Next, if we subtract the width of the top layer from that of the bottom layer, we get ten and by multiplying it by the height, we get 110.When adding it with the previous 3,784, we get 3,894.Then dividing it by six, we finally get 649, which is the total number of the wine jars.

【原文】

六而一，得六百四十九，此为罂数也。刍童求见实方之积，隙积求见合角不尽，益出羡积也。

履亩之法，方圆曲直尽矣，未有会圆之术。凡圆田既能拆之，须使会之复圆。古法惟以中破圆法拆之，其失有及三倍者。予别为拆会之术：置圆田，径半之以为弦；又以半径减去所割数，余者为股；各自乘，以股除弦，余者开方除为句；倍之，为割田之直径。以所割之数自乘，倍之，又以圆径除所得，加入直径，为割田之弧。再割亦如之，减去已割之弧，则再割之弧也。假令有圆田，径十步，欲割二步，以半径为弦，五步自乘得二十五，又以半径减去所割二步，余三步为股，自乘得九，用减弦外，有十六，开平方，除得四步为句，倍之，为所割直径，以所割之数二步自乘为四，倍之得为八，

【译文】

得三千八百九十四，再除以六，得六百四十九。这就是总的酒坛数目。用“刍童法”算出的是实方的体积，而用“隙积法”求出的是截剩部分拼合成的体积，可以求出多余的体积。

测量田亩土地的算法，无论方圆曲直，都有方法可求，但是没有“会圆”的算法。凡是圆形的田，既能拆开它，也应该能够使它复原。古时只用平分一个圆的方法拆开计算，误差有可能达到三倍。我另作“拆会”的算法。设有一圆形土地，用其半径作弦，又从半径减去所割弧形的高，得到的差作为股，弦、股各自乘平方，用弦的平方减去股的平方，得到的差再开方作为股，然后乘以二就得到所割的弧形田的弦长。另外把所割弧形田的高平方，再乘以二，再除以圆的直径，所得的商与弧形田的弦长相加，就得到所割弧形田的弧长。再割一块田，算法还是一样。总弧长减去已割部分的弧长，即得再割田弧长了。假设有一块圆形的田，直径为十步，想使割出的圆弧高二步，就以半径作为弦，它的长度是五步，自乘就得二十五；再将半径减去弧形的高二步，剩下的三步作为股，自乘就得九。用弦方二十五减去股方九，得十六，开方得四，这就是勾，然后乘以二就得所割弧形的弦长。将所割弧形的高二步自乘得四，再乘以二得八，

The volume calculated with the "*chutong*"method is the actual one while the volume calculated with the "*xiji*" method is the one that is pieced together from the gaps, so the extra volume can be known.)

When it comes to measuring a piece of land, we always have a way out whether it is square or round, curve or straight.However we lack the method to calculate "*huiyuan.*" For any piece of land with a round shape, we must be able to dismantle it as well as restore it. In ancient times people only used the method of calculation by dividing the round shape into two even parts. Its error may reach three times more than the usual situation. Hence I figure out a method called "*chaihui*" to solve the problem. Let's suppose that we have a round piece of land whose radius is taken as the hypotenuse of a right triangular. Then by subtracting the height of a segmented arc from the radius, we get the difference which is taken as the longer leg of the triangular. Next we have the square of the hypotenuse minus that of the longer leg of the triangular.The difference we get is used as the shorter leg of the triangular. Finally by multiplying it by two, we get the length of the longer leg of the triangular. In addition, the square of the height of the separated piece of the land is multiplied by two before it is divided by the diameter of the circle. To add the quotient and the longer leg of the triangular, we can get the segmented arc. When segmenting another round piece of land, the same method can be applied. By subtracting the length of the arc of the segmented part from the total length of the arc, we can get the length of second segmented part.(Let's suppose there is a round piece of land whose diameter is ten steps. If we want to make the segmented arc two steps higher, we need to take the radius as the hypotenuse of a right triangular. As the length of the radius is five steps, five multiplied by five is twenty-five. Next by subtracting the height of the segmented arc from the radius, we get three which is taken as the longer leg of the triangular and three multiplied by three is nine. Then using twenty-five minus nine, we get sixteen. And its square root is four, which is the shorter leg of the right triangular. Then by multiplying it by two, we get the length of the hypotenuse of the segmented arc. By multiplying the height of the segmented arc, we get four. Four times two is eight. Then this eight

【原文】

退上一位为四尺，以圆径除。会圆径十，已足盈数，无可除，只用四尺加入直径，为所割之弧，凡得圆径八步四尺也。再割亦依此法。如圆径二十步，求弧数，则当折半，乃所谓以圆径除之也。此二类皆造微之术，古书所不到者，漫志于此。

【译文】

退上一位为四尺，用圆的直径相除。现今圆的直径为十，已经满了整十数，不可除，只用四尺加上圆弧直径，就是圆弧的弧长，共得圆弧直径为八步四尺。再割一块圆田，算法还是一样。如果圆的直径为二十步，求所割圆弧的弧长，就应折半，也就是说要用圆弧直径来除它。这两种算法，都是涉及精微的方法。古书上是没有的，随笔在这里记述下来。

302. 蹙　融

【原文】

蹙融，或谓之“蹙戎”，《汉书》谓之“格五”。虽止用数棋，共行一道，亦有能否，徐德占善移，遂至无敌。其法以己常欲有余裕，而致敌人于险。虽知其术止如是，然卒莫能胜之。

【译文】

蹙融，有人称做“蹙戎”，《汉书》称做“格五”。虽只用几枚棋子，在一条路中争行，但技艺也有高下。徐德占擅长争道移步，以至于没有敌手。他的方法是让自己时常处于有余地的境界，而给对方造成有险境的局面。尽管知道他的战术就是这样，但是始终没有人能战胜他。

should be divided by the diameter of the circle. However the diameter is ten steps which cannot be divided. So by adding four *chi* and the diameter of the arc, we can get its radiant length and work out the diameter of the arc which is eight steps and four *chi*. When measuring another segmented round piece of land, the same method can be applied. If the diameter of the circle is twenty steps, the radiant length of the segmented arc should be halved, which means that it should be divided by the diameter of the arc.) The above-mentioned two methods both involve intricate calculation. As they are not recorded in any ancient books, I write them down here.

302. *Curong*

"*Curong*," a chess game, is otherwise called "*gewu*" in *The Book of Han*. Though only five chess pieces are involved in the competition, the chess players' skills in playing it do vary with each other. Xu Xi is very good at scrambling for the route and moving his chess piece flexibly. As a result, no one can match him. His method is to occupy enough space for his own chessmen and force his opponent into a corner. Though everybody knows his tactics, no one can defeat him.

303. 造 弓

【原文】

予伯兄善射，自能为弓。其弓有六善：一者性体少而劲，二者和而有力，三者久射力不屈，四者寒暑力一，五者弦声清实，六者一张便正。

凡弓性体少则易张而寿，但患其不劲，欲其劲者，妙在治筋。凡筋生长一尺，干则减半，以胶汤濡而梳之，复长一尺，然后用，则筋力已尽，无复伸弛。又揉其材令仰，然后傅角与筋，此两法所以为筋也。凡弓节短则和而虚，虚谓挽过吻则无力。节长则健而柱，柱谓挽过吻则木强而不来。节谓把梢裨木，长则柱，短则虚。节若得中则和而有力，仍弦声清实。

凡弓初射与天寒，则劲强而难挽；射久、天暑，则弱而不胜矢，

【译文】

我大哥擅长射箭，自己能造弓。他造的弓有六个优点：一、弓体轻巧而强度高；二、开弓容易而弹力大；三、多次发射弓力不会减弱；四、天冷天热，弓力保持一致；五、射箭时弦声清脆坚实；六、拉弓时弓体正，不偏扭。

一般说来，弓体轻巧则容易拉开，而且寿命长，只是怕弓力不够刚劲；要想弓力刚劲，关键在于对筋的处理。凡是一尺长的筋，干了以后则缩短一半；用胶汁浸泡而后梳直，还能恢复为一尺，然后再使用。这样，筋已涨到尽头，不会伸长松弛了。再揉制做弓的材料，使向开弓相反的方向弯曲，然后缠上角和筋，这就是处理筋的两种方法。一般地说，弓节短，开弓容易，但弹力小，是说弓开满时，弓弦超过射手口部就显得没有力量了。弓节长，则弓硬，而且很难开满弓，是说弓弦超过射手口部，就显得弓臂木材强硬而不随势弯曲。节是弓柄上的衬木，长就难拉开，而短就无弹力。弓节如果长短适中，则开弓容易而且弹力也大，同时弦声清脆、坚实。

大凡刚用的新弓或在天冷时，弓就硬而很难拉开；使用久了，或在天热时，弓力就减弱而不能发箭，这是胶造成的毛病。一般胶要涂得薄，筋力

303. Making Bows

My elder brother is good at archery and he can make bows. His bows have the following six strong points: 1. They are light in weight and are of high tension-strength; 2.They are easy to draw and are of great elastic force; 3.The strength of the bow will not weaken after it has been drawn repeatedly; 4.The bow keeps the same strength in both cold and hot days; 5.The sound of the string is clear and resounding when arrows are shot; 6.The bow maintains its shape and does not become crooked when being fully drawn.

Generally if a bow is light, it can be easily drawn and used for a long time. The only fear, if there is any, is that the strength of such a bow is not powerful enough. The key to maintaining the strength of a bow lies in the treatment of the animal tendons. A one-*chi*-long tendon will shrink by half when it dries. If it is straightened after being immersed in the glue, it can restore its original length and be reused. In this way, the tendon will swell up to its full capacity and will not stretch out and draw back as before. Next bow makers should bend the bow material to the opposite direction in which it will be drawn and bind it with animal horns and tendons.These are the two ways of processing the tendons. Normally if the handle is short, the bow is easy to draw, but its elastic force is weak. (It means that the bow is lack of elastic force if the string is beyond the archer's mouth when the bow is drawn to its full.) If the handle is long, the bow is hard and strong but is difficult to be drawn to its full (It means that when the string is beyond the archer's mouth, the wooden material of the bow is hard and does not bend easily. A handle is a piece of decorative wood of the bow. If it is too long, the bow is hard to draw. If it is too short, the bow is lack of elastic force.) If a handle is of moderate length, the bow will be easy to draw and has sufficient elastic force. Meanwhile the sound of the string will be clear and resounding when an arrow is shot.

Mostly when a new bow is used for the first time or a bow is used in cold days, the body of the bow will become hard and difficult to draw. If it has been used for a long time or it is used in hot days, its elastic force will be weakened