The Cal en dar 1.Introduction The numbers of the date on the calendar changed as the time runs, it might indicates some reg u la tions behind those numbers. Starting from the Math e mat ics point of view, I try to surmise a "Week-Col la tion" table that can be used for thou sands of years. Furthermore, based on the knowl edge I learned from different Calendar's system I have in te grat ed the "Julian" and "Gregorian" into a "Per pet u al Cal en dar Board". In addition, a new think ing of calendar system is also proposed.2.Purpose (1) Studying Calendar systems from their histori- cal background and searching for their reg u la- tions by observing the number of days of each week, month and the beginning of each year. (2) By studying the regulation of the Julian and the Gregorian Calendars and in te grat ing them to cre ate the "Perpetual Cal en dar Board" that can con nect with all A.D. (3) By comparing the calendar's systems to pro- pose my "Ring-Calendar" which can pro vide hu man be ings a new thinking di rec tion for the establishment of calendar.3.Procedure (1) The historical background, principle and evolution: a. The origination of number of days per month in the year: Conclusion: The numbers of days for each month is arranged by human beings. If we can have same numbers of day for ev- ery month and then we just need one paper for the calendar. Assumption:One year has 12 months, and every month has 30days and the rest 5 or 6 days can be the holidays! (This will make the life easier) b. The Origination of week: (a) Origin: Babylon used Sun, Moon, and Five planets as 7 weekdays. (b) Sequence:

	Year	Background	Regulation
Solar Calendar	B.C.46	Roman, Julius Caesar adopted astrophysicist Sosigenes's suggestion to constitute the Julian Calendar.	1.One year has 12 months. 2. The odd (even) numbers month has 31 (30)days. 3.Every four years have an embolism. Common-year February of 29 days, leap-year February of 30 days.
	B.C.8	The Roman Parliament wanted to express their monarch, Augustus Caesar's greatness.	1.Same as above, but changed the August to 31 days and reversed the number of days after August. 2.The day increased in August is recouped by February. Let February of Common-year has 28days, and for leap-year has 29days.
	A.D.1582	Holy Father, Gregorian 13th decreed that the 5th of Oct. should changed to 15th, this makes the vernal equinox next year has the correct days, on March 21.	1. Same system of B.C. 8. 2. Besides every 4 years with the embolism, there is no leap year in every one hundred years but a leap year in every four hundred years.
	A.D.1912	Most countries adopt the Gregorian Calendar until now.	
Lunar Calendar	1. In the lunar Calendar, one month is adjusted by the change of the moon, about 29.53 days per month. 2. The new moon is the beginning of the month and the number of days (30 or 29) has not been fixed depends on the moon period. 3. It might have 3 or 4 30 days months in a row.		

Problem: If there has 7 days per week and there might has 31,30,29, or even 28 days per month.Since the number of days is not an in te ger multiple of 7 and will result ing the start of every month can't be fixed. Assumption: If we let one month has 30 days, 5 days per week , and 6 weeks per month , then we will have the same starting date of every month. Of cause the rest 5 or 6days will be the happy holidays! c. Origination of Year-Head: Problem: The four seasons have close correlation with the Solar Calendar, but the year-head has less meaning for us.

background	Based on	Sequence of 7 days
The Ptolemy period of Egypt	From geocentric point of view, arranged by the Globe distance of the Sun, Moon, and Five Planets from the earth.	Sat. ‧ Thu. ‧ Tue. ‧ Sun. ‧ Fri. ‧ Wed. ‧ Mon.
In Horoscope	Starting from the Saturday and took the name of every weekday as an hour and made the name of the first hour in everyday as the name of the day.	Sat. ‧ Sun. ‧ Mon. ‧ Tue. ‧ Wed. ‧ Thu. ‧ Fri.
The present sequence of weekdays	Sunday is the first day of the week.	Sun. ‧ Mon. ‧ Tue. ‧ Wed. ‧ Th. ‧ Fri. ‧ Sat.
In Chinese	To be simple.	Sun, 1, 2, 3, 4, 5, 6
England	Named by God they believe.	Sun. Mon. Tue. Wen. Thu. Fri. Sat.

Assumption: If we use the day of "The Waking of

Title	Era	Based on
Astronomy Year-head		Starting the year at midwinter because the location of Sun is at the southern most and the shadow is longest at this day.
Year-head of Solar Calendar	B.C.3000	Egyptian found the Nero-River start flooding when Sirius shows at the eastern low sky. They make the day which Sirius and Sun rise together to be the starting of the year.
	B.C. 738	Roman calendar used the current March for year-head.
	B.C. 46	Caesar calendar moved new year's day from Mar 1 to Jan 1.
	A.D.235	The Nice conference used March 21 to be the starting of spring.
Year-head of Lunar Calendar	The Xia Dynasty of China	Use the third month from midwinter to be the First month, called Jian-yin.
	The Yin Dynasty of China	Use the second month from midwinter to be the First month, called Jian-chou.
	The Shang Dynasty of China	Use the month of midwinter to be the First month, called Jian-zi.
	The Qin and Han Dynasty of China	Use the month before midwinter to be the First month, called Jian-hai.
	The Wu emperor of Han Dynasty, till now (B.C.104)	Adopt the Jian-yin system. Used the third month from midwinter to be the First month.

Insects, Jing-zhe" to be the beginning of the year, then the months of the year can match with the 4 seasons, spring, summer, fall, and winter, in our country. The Solar terms: (a) The revolving orbit for earth around the Sun was divided into 24 sectors with 15 degrees each called a solar term. Therefore, there has 24 solar terms in a year. (b) When the Sun irradiates directly on the equator which the sun are the vernal equinox and the au tum nal equinox. The angle of vernal equinox is de fined as zero degree, summer equinox is 90 degrees, the autumnal quinox is 180 degrees, and midwinter is 270 degrees.The Jing-zhe is at 345 degrees. (2) The procedure of the Thousand Calendar: a. Reckoning the date and week of Solar Calendar: There has 7 days per week, if we choice a par tic u lar month with the first day is Monday as benchmark, then we divide the date by 7. If the re sid u al is zero then the date should be Sunday else the day will be count as many times starting from Sunday as residual. For examples; Assume the first day of a particular month is Monday, then what day is the 23 of this month? And what day is 28 ? Ans: 23/7 ....2 (You have to count twice start ing from Sunday hence 23 is Tuesday . And 28/7 ..... 0 Hence 28 is Sunday b. Reckoning the week and month of Solar Calendar: Since there has different days in each month, rd th rd

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if we can create a monthly radix which can let the sum of monthly radix and the date to be a basis then it will be much easier to calculate what day of the date. If the sum can be divided by 7 then that day is Sun day else if the residual is not zero then the day will be count as many times from Sunday as residual. Fol low ing is the way to define the monthly radix; If the radix equals to 0 at Jan u ary of some-year's and since the January has 31 days that di vid ed by 7 with residual equals to 3. Thus the radix of Feb ru ary is equals to 3. February of common year has 28 days that can be divided by 7, so the radix of March is also equals to 3. With the same procedure, it can surmise all the twelve months. If the year is in ter ca lary year, then Feb ru ary has 29 days, the ra dix es of March to December should be added by 1 then in common year. See Table-1 below; Illustration of the Table-1: (a) Find the date of the month first. (b) The residual of the date divided by 7 is equiva- lent to the radix increased in next month. (c) Take January for benchmark, the radix of April is the accumulation from January to March. 3+0+3=6. (d) The residual of the original radix divided by 7 is equivalent to the adjusted radix.

Month	Date	The residual of Date/7	The original radix	Adjusted radix	
1	31	3	0	0	
2	28	0	3	3	
				Common year	Leap year
3	31	3	3	3	4
4	30	2	6	6	0
5	31	3	8	1	2
6	30	2	11	4	5
7	31	3	13	6	0
8	31	3	16	2	3
9	30	2	19	5	6
10	31	3	21	0	1
11	30	2	24	3	4
12	31	3	26	5	6
1	31	3	29	1	2

(e) February in leap year has 29 days and it makes the radix added by 1 after March. Examples: It is Monday for January 1of a com mon year, what day is February 13 , and what day is April 13 ? Sol: from the table the radix of Feb. is 3 then (3+13)/7....2 thus February 13 is Tuesday (counting twice from Sunday) From the table the radix of April is 6 then (6+13)/7.....5 thus April 13 is Friday (count 5 times from Sunday) Examples: If the January 1st of a leap year is Monday,what day is February 17 and April 17 ? Sol: (3+17)/7.....6 February 17 is Saturday (0+17)/7.....3 April 17 is Wednesday C. Reckoning of the week in each year of Solar Calendar: January 1 is not always to be Monday, if we can define the year radix then it will be much eas i er to know what day is January 1 of the year. Then the

residual of (year radix + month radix + date)/7 is satisfies the counting rule mentioned above to fig ure the day. From the table-1 we can have following conclusions; (a) If this year is a common year then the year radix of next year is added by 1 (because 365days/ 7=52...1). (b) If this year is leap year then the year radix of the next year is added by 2 than(because 366 days/ 7=52...2). The affirmation of leap year is take Gregorian Cal en dar as standard. Each year has 365 days, 4 years has a embolism (366days); but non em bo lism for 100 or its multiple, but has a embolism for 400 and its multiple. Thus the year radix of 2001 is zero and we can calculate each year-radix by taking this as basis. Since the number of the week cycle is 7 th th th th th th th th st st

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and the number of the year is four, without count ing the sit u a tion of "no leap year in every one hun dred years but a leap year in every four hundred years", then the lowest com mon multiple of the two is 28. Thus it presents a 28 years' cycle with fol low ing problems when process: (a) When the hundreds are leap years: It still corresponds to the cycle of 4 years 1 embolism, then keep surmising. (b) When the hundreds are common year: It doesn't correspond to the cycle of 4 years 1embolism, can't keep surmising . It must use the year-radix of the following year minus 1 for the cur rent radix. (Leap year is subtracted 2), but if it be longs to 4 multiple-regulation the current year is leap year. So we should measure by using the year-radix be fore the current year from the same year ra dix sub tract ed by 1. During the procedure we found the year-radix in 2001 and 1601 are the same. We can conclude the cycle is 400 years and is consistent with leap year for every 400 years. Thus the year-radix of 1201, 801, 401, and 1 are all zero. According the year-radix has only seven numbers, in the order of 6, 0, 1, 2, 3, 4, and 5. So we re-arrange them by colors, Red, Orange, Yellow, Green, Blue, Indigo, and Pur ple present in the table for easier usage.

14	42	70	98	10	38	66	94		06	34	62	90		02	30	58	86	2	Green
15	43	71	99	11	39	67	95		07	35	63	91		03	31	59	87	3	Blue
16	44	72		12	40	68	96		08	36	64	92		04	32	60	88	4	Indigo
17	45	73		13	41	69	97		09	37	65	93		05	33	61	89	6	Red
18	46	74		14	42	70	98		10	38	66	94		06	34	62	90	0	Orange
19	47	75		15	43	71	99		11	39	67	95		07	35	63	91	1	Yellow
20	48	76		16	44	72			12	40	68	96		08	36	64	92	2	Green
21	49	77		17	45	73			13	41	69	97		09	37	65	93	4	Indigo
22	50	78		18	46	74			14	42	70	98		10	38	66	94	5	Purple
23	51	79		19	47	75			15	43	71	99		11	39	67	95	6	Red
24	52	80		20	48	76			16	44	72			12	40	68	96	0	Orange
25	53	81		21	49	77			17	45	73			13	41	69	97	2	Green
26	54	82		22	50	78			18	46	74			14	42	70	98	3	Blue
27	55	83	00	23	51	79			19	47	75			15	43	71	99	4	Indigo
28	56	84		24	52	80			20	48	76			16	44	72	00	5	Purple

0001-0100	0101-0200	0201-0300	0301-0400	Radix Of Year	
0401-0500	0501-0600	0601-0700	0701-0800		
0801-0900	0901-1000	1001-1100	1101-1200		
1201-1300	1301-1400	1401-1500	1501-1600		
1601-1700	1701-1800	1801-1900	1901-2000		
2001-2100	2101-2200	2201-2300	2301-2400		
01 29 57 85	25 53 81	21 49 77	17 45 73	0	Orange
02 30 58 86	26 54 82	22 50 78	18 46 74	1	Yellow
03 31 59 87	27 55 83 00	23 51 79	19 47 75	2	Green
04 32 60 88	28 56 84	24 52 80	20 48 76	3	Blue
05 33 61 89	01 29 57 85	25 53 81	21 49 77	5	Purple
06 34 62 90	02 30 58 86	26 54 82	22 50 78	6	Red
07 35 63 91	03 31 59 87	27 55 83 00	23 51 79	0	Orange
08 36 64 92	04 32 60 88	28 56 84	24 52 80	1	Yellow
09 37 65 93	05 33 61 89	01 29 57 85	25 53 81	3	Blue
10 38 66 94	06 34 62 90	02 30 58 86	26 54 82	4	Indigo
11 39 67 95	07 35 63 91	03 31 59 87	27 55 83	5	Purple
12 40 68 96	08 36 64 92	04 32 60 88	28 56 84	6	Red
13 41 69 97	09 37 65 93	05 33 61 89	01 29 57 85	1	Yellow

Table-2 Illustration Table-2: What is the year-radix in 1789? (a) From the table find the range of 1789 which is located in 1701-1800. (b) In the same column below 1701-1800 we can find 89 which presents 1789. (c) From 89 point to the most rightward column, we can see the year-radix of 3 and the year color is blue. Examples: What day is February 13th and April 13 of 1995? Sol: 1995 is the common year, from table 1 and 2 we found the year-radix is 6 and the month radix are 3 for Feb. and 6 for April relatively. The residual of (Year-radix + month-radix + date- radix)/7 is day we are looking for. (6+3+13)/7...1 February 13 is Monday (6+6+13)/7...4 April 13 is Thursday Example: What day is 1996/02/17 and 1996/04/ 17 ? (yy/mm/dd) Ans: 1996 is a leap year (0+3+17)/7...6 February 17 is Saturday (0+0+17)/7...3 April 17 is Wednesday The purpose of Gregorian Calendar was to mod i fy the mistake of the Julian Calendar. It th th th th th th

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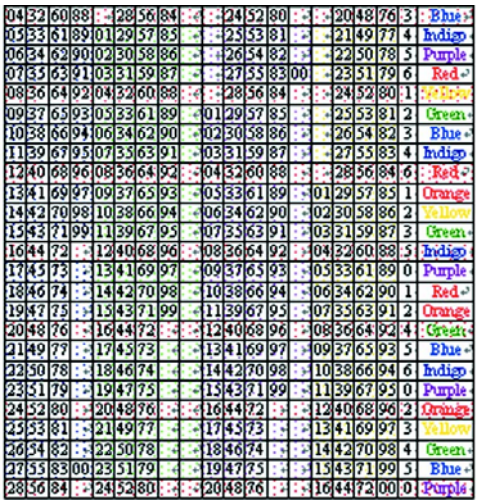
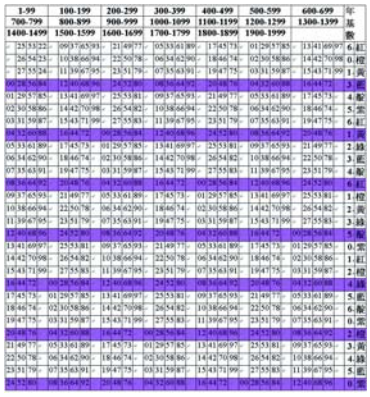
table-4 g. Julian Calendar Table: From the 1582 year of A.D. October 4 Thursday, calculate backward to get the calendar compari son table as follows: table-5 h. Making of "Perpetual Calendar Board": Based on the summaries mentioned above, I de signed the monthly moving calendar board as shown below. Follow the instruction, it is very easy for everyone to find the





day you are look changed Oct 5, 1582 in Julian Calendar to Oct 15. Hence the Gregorian Calendar started at Oct 15, 1582 A.D Oct, 1582 d. Summaries: The residual of (Year-radix + month-radix +date-radix)/7 a. =0 Sunday b. ≠0 Residual = day of the week starting from Monday e. Adjustment of month-radix: a. If we make the month-radix of January in common year to be 1 then the radix for both common and leap years need to added by 1 in ta ble-1, but the radix of year need to subtract by 1 to make the total radix unchanged. b. In order to assort the common year, the radix af ter February of the leap year need to sub tract by 1, but the radix of year need to add 1. table-3 (c) Though the radix of month changed, if we ad- just the radix of year then it can back to the correct values. f. Adjustment of year-radix: According the adjustment mentioned above, we make a new table as following for year-radix with color index;(only good for Gregorian Calendar):

Month	Common Year	Leap Year	Month	Radix of year
Jan.	1	0	July	0
Feb.	4	3	Aug.	3
Mar.	4		Sep.	6
Apr.	0		Oct.	1
May	2		Nov.	4
Jun.	5		Dec.	6

A.D Oct, 1582						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	15	16
17	18	19	20	21	22	23

0001-0100	0101-0200	0201-0300	0301-0400	Year Radixes
0401-0500	0501-0600	0601-0700	0701-0800	
0801-0900	0901-1000	1001-1100	1101-1200	
1201-1300	1301-1400	1401-1500	1501-1600	
1601-1700	1701-1800	1801-1900	1901-2000	
2001-2100	2101-2200	2201-2300	2301-2400	
01 29 57 85	25 53 81	21 49 77	17 45 73 6	Red
02 30 58 86	26 54 82	22 50 78	18 46 74 0	Orange
03 31 59 87	27 55 83 00	23 51 79	19 47 75 1	Yellow

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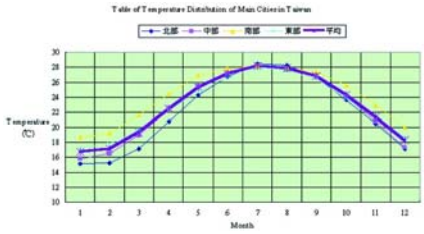
ing for and this board can used for thousands of years. Instruction: (a) From the table of the year-radix, one can find thecolor for each year.Take blue for example. (b) The color and the day of each week are on the same moving board. (c) Let the blue part of the moving board move to the same column of the month wanted. Take Sep tember for example. The region under the week-days on the moving board is just the cal en dar for this month. (3) Developing The "Ring

Calendar": a. The comparison of different calendars: b. Comparison of Ring Calendar and Gregorian Calendars: c. Comparison of the four seasons: Middle latitude and Temperate Zone: 4 seasons a year, suitable to Taiwan. Low latitude and Tropic Zone: dry season and rain season in a year. High latitude and Frigid Zone: distinguish sea-sons according to the length of daytime. (a) Astronomical seasons in Taiwan: Use "Si-li, the four beginnings" as the beginnings of seasons. (b) Western astronomical seasons: Use "Er-fen Er-zhi,

the two Equinox and two Solstice" as the be gin nings of seasons. (c) Meteorological seasons in Taiwan : Use March, June, September, and December as the beginnings of seasons. According the average temperature verses month in Taiwan shown below, we can con clude that both Astronomical and Meteorological sea sons are suit able in Taiwan.

	Define the year	Define the year-head	Define the month	Define the week
Gregorian Calendar	Common year has 365days Leap year has 366days leap year: one leap year every 4 years; no leap year in every one hundred years but a leap year in every four hundred years.	Follows the rule of Julian Calendar -- January 1 is the year-head.	Jan. March, May, July, Aug. Oct. Dec. has 31days and April, June, Sept. Nov. has 30days with February has 28(29) for common (leap) year	Seven days a week, cause the first day of each month changed.
Ring Calendar	Use the interval between two "Jing-zhe" to be one year. Common year has 365days Leap year has 366days leap year correct embolism causes vernal equinox fix on Mar.21	Use the first Solar Term -- "Jing-zhe" as the year-head.	Twelve months a year, 30 days a month, the lasting 5 or 6 days are independent.	Five days a week, because 30 can be divided by 5 or 6, and human beings has five fingers, so Ring Calendar use it.
Advantages of Ring Calendar	Fixed Vernal Equinox, "Chun-fen"	Months fit with four seasons accordingly.	The number of days in a month is fixed.	Fixed day at the beginning of each month.
Disadvantages of Ring Calendar	1. change human consuetude 2. some "red letter"(national holidays) days disappear 3. it is not suitable for other countries			

Name	Eldership	Trait and questions
Gregorian Calendar	Common year has 365days. Leap year has 366 days.	1. The Nice Conference made "Vernal Equinox, Chun-fen (March 21)" as the beginning of spring. 2. The current way to calculate the leap year leads to the Vernal equinox may happened on Mar.20, Mar.21 and even Mar.22 (A.d.1919), it doesn't fix in the same day.
Constellation-Calendar	1. Use the 12 constellations on the zodiac be the 12 months of a year. 2. The constellation of the month rises and sets with the sun.	1.Originated from Babylon Calendar, there were 354 days each year, and three extra months would be added every eight years so that the calendar was confusing. 2. The spin-axis of earth makes one revolution every 25800 years which results a one-month difference between present time and 2000 years ago.
Trajectory Calendar	Use the time needed for earth to move to the aphelion twice to be one year.	It is difficult to measure the correct date.
Solar-term Calendar	Use the interval between two identical Solar Terms to be one year.	1. It is possible to know the approximate position of earth on the revolution orbit. 2. The interval between two identical Solar Terms is not always the same.
Ring Calendar	Use the interval between two "Jing-zhe" to be one year. Common year: 365days Leap year: 366days	1. The beginning of a year matches with season. 2. Appropriate embolism and fix the vernal equinox on Mar.21.



ta ble-6 d. Ring Calendar production : Explanations: (a) We can use the same calendar for each month in the whole year because there is 30 days for each month. (b) Five days a week, Sun., Mon., Tue, Wed,. and Thu.. (c) The last five days of the year (or six days in leap year) don't belong to any week,for keeping the Jan.1st of next year on Sunday. (d) The calendar is the same for every year and can be used forever. 4.Conclusion (1) Once we know the years, months and days of Solar calendars, then we can figure out what day of that date only need to define the radix of year and month, and use the total radix (the year ra

A.D.2000-3000					
JAN. JULY	FEB. AUG.	MAR. SEP.	APR. OCT.	MAY. NOV.	JUN. DEC.
Sun.	Mon.	Tue.	Wed.	Thu.	
1	2	3	4	5	
6	7	8	9	10	
11	12	13	14	15	
16	17	18	19	20	
21	22	23	24	25	
26	27	28	29	30	

table-7 dix+ month radix + day radix) divided by 7. If the res i due is zero, this day is Sunday, if the resi due is not zero, then from the residue we can count the day we are look ing for. (2)Grouping months and days into one category, and years and days into another and adjusting their cardinal number properly, consider the dif ference between the Gregorian Calendar and Lunar Calendar, then a good perpetual calendar can be made. (3) The trait of Ring Calendar: a. Use "Jing-zhe" as the year-head, the interval between two "Jing-zhe" to be one year: (a) Seasons of a year can be known according to months. (b) The sunshine situation and the position on revolution orbit of earth can be known. b. Common year: 365 day; leap year: 366 days; cor rect embolism: the unfixed problem on Ver- nal Equinox of Gregorian Calendar could be revised. c. Twelve months a year with 30 days for each month, the lasting 5 or 6 days are independent which cause the calendar more clearly. d. Five days a week, 3.5 or 4 working days a week: (a) Apply with the Gregorian Calendar could solve crowded problems on holidays. (b) It can relieve the living and studying pressure. 5.References (1) Astronomical Calendar,Central Weather Bu reau (1995). (2) Su Ming-chun, Kaohsiung Astronomical maga- zine N.o16(1995)

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