SHELVING NAUTICAL MILE IN FAVOUR OF NAUTICAL KILOMETRE

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ABSTRACT

This author attempted to define the Nautical Kilometre via his paper entitled: *THE METRIC SECOND (1973 April)* in order to fill the 'gap' left by proponents of the Metric System deliberately or otherwise after Prieur of Cote d'Or failed to press for adoption of 'DECIMALE TIME' by the decree of 1795 April 7.

This contribution attempts to trace the historiography of changes felt by the original tussle between 'cgs' and 'fps' system of measurement units into Systeme Internationale d'Unites (SI in all languages) since adoption of the 'metre' and hence the Metric System, in France that forced the world scientific family to gradually see its merits. Why is it, then, that the metric reformists confuse the metre-related measuring units with the 'count to decimal' multiples/sub-multiples of units? We still play with Nautical Mile & Knots but failed to arrive at a viable definition favoring the adoption of Nautical Kilometre to replace Nautical Mile

It may be worth considering to define Nautical Kilometre as: '1/100th of 1 degree of arc angle' at earth surface and realise the unfulfilled dream of French Academy of Sciences leading to Decimalisation of Time of the Day/Hour, further leading to Calendar Reform!

HISTRIOGRAPHY

It is a known fact, that from METRE - the unit of length, all other measurement units are derived. The metre originally intended to be acceptable to all nations and was arrived at by actual measurement of a quarter of the terrestrial meridian from North Pole to Equator. This, although, was acceptable but all meridians are not equal. The difference being of no account for commercial transactions. The METRE was divided into parts of 'ten', and those further into 'ten' times smaller or larger. The 'metric system' is often confused with the decimal notation:

> **"Metric, pertaining to or of the metre; -system, decimal measuring system with the metre, & litre and the gram determined by it, as the units of length, capacity and weight; the prefixing to the metre etc., of the Greek derived 'deca-, hecto-, kilo-' denoting multiplication by 10, 100, 1000 as in kilometre of 1000 metres; that of Latin derived 'deci-, centi-, milli-, denoting division by 10, 100, 1000 as in decilitre, one-tenth of a litre".**

The Metre was first officially established in 1795 by French Convention as one-ten millionth part of the length of the earth meridian from North Pole to Equator, and academicians Delambre and Mechain (1792-98) achieved (at that time) the calibration of a specific bar by comparing its length to the part of the meridian between Dunkerque (France) and Barcelona (Spain) using triangulation technique. The signatories of Convention du Metre (1875 May 20) and the Conference Generale des Poids et Mesures (CGPM) chose the well known χ-profile (10% Iridium and 90 % Platinum) bar prototype, as the International reference and made its use obligatory on 1799 December 10. This definition remained unaltered until 1960. The Atomic metre was defined as 1650763.7 wavelengths of orange-shift at $2p_{10}$ and $5d_5$ transition of krypton-86, achieved by interferometry. The CGPM has now established this definition of the Metre (1983) on fixing the SI numerical value for the velocity of light in vacuum; and established the light related metre as the distance traveled by light during:'1/299792458TH of the time interval, 'Second'. It is now desirable to re-establish the light related metre by extending the

length of the metre by the factor 1.11194886884 times in order to define the Nautical Kilometre, in accordance with the new interval for time unit, Decimal Second **(s_d)** or 36% of the SI-second. *(Refer reworked table for MISE en PRATIQE (19992) & The Nautical Kilometre, pp.259 of the MQGT-'99 proceedings).*

The 'cgs vs. fps' Units

After signing 'Convention du Metre' on 1875 May 20, the maintenance responsibility of the Laboratory wing of Bureau Internationale des Poids et Mesures (BIPM) was entrusted and to be shared by 'signatory states'. France made the use of length unit - metre, obligatory by the law passed on 1799 December 10.

The United Kingdom and the United States stood firm to the usage of 'old fps' system of units due to practical controversies, as they are even now after accepting the metric system of units. The 'centimetre-gram-second' system suffered because the centimetre or the gram was too small for day to day commercial transactions, except in the laboratory or the bullion trade. The 'Metre-Kilogram-Second' system emerged victorious in commercial trade and higher order derived units, the Kilometre and the Metric Ton even better for inter-state dealings. This was a recognition to the work done by the group of scientists, under the statesmanship of French Statesman M.Talleyrand to: ' aim at the establishment of an international system of basic quantities, based on the metre and the gram'.

The gravitational system of units suffered due to varying local constant, **g** - the value for acceleration due to gravity. The 'foot-pound-second' system found itself a way towards retirement in favor of the metric system of units, in all spheres of science and technology. Prof. Givoanni Georgi of Rome University (1901) professed that **the mechanics system** of units be linked with electromagnetic units by adopting Ampere, as the fourth unit for electric current. This was the birth of Georgi MKSA system of units on a recommendation of International Electro-technical Commission (IEC) in 1948; and accepted at 9^{TH} Conference Generale des Poids et Mesures (CGPM).

International Organisation for Standardisation (ISO) and International Electro-technical Commission (IEC) accepted the MKSA system of units in 1956 & 1959 respectively, by which time another TWO (2) units: degree Kelvin (for temperature) and Candela (unit of Luminous Intensity), were also added. The 11^{TH} CGPM, in 1960, acknowledged the advantages of the metric system; and decided to rename these measurement system of units as: Systeme International d'Unites (SI), in all languages.

But, why is it that scientist community could not co-relate the Arc-**angle** (Hour Angle) with the Time unit (Second), after accepting METRE as the unit for length standard in order to define The Nautical Kilometre for almost over 200 years of ' Signing the Metre Convention'? WHY a definition for 'new' time interval, the nautical kilometre and the World Decimal Calendar is not considered, now?

OF Pi (π), RADIAN AND METRE

By choosing any length as the radius of a circle, the diameter and length of its circumference get automatically fixed *(ISI Bulln.; V27 N10; 1975 October; p.381).* Does the statement, a circle has 2π Radians make sense without defining 'either the value for Pi (π) or the arc-angle radian. Pi (π) so far remain an undefined point on the number line between 3.141 and 3.142, whose evaluation suffers due to truncation limits of mathematical operations.

Normalising the value for Pi (π) equal to 100 000/31 831(exactly) is arrived at, after examining most values used by past civilizations, based on the argument that: 'by choosing any radius, the diameter and the circumference of any circle get prefixed'. **By definition,** the value for Pi (π) is the ratio between the circumference of the circle to its diameter; it *must be* representable in the form **a/b** and also define the angle radian which by definition is:' the arc-angle formed at the

center by arc-length equal to the radius of the circle'. A study of all known values for Pi (π) reveal that the radian can be fixed at 57^0 .2958 (57^0 17' 44.88") and the above value for Pi (π) repeat all by itself after 5244^{TH} decimal place.

Sr. No.	NAME OF DISCOVERER	YEAR of Discovery	VALUE OF π		RATIO		VALUE OF RADIAN			Value of 1 METRIC or 1/100 Rad.
			FRACTION	DECIMAL	2/π RADIUS / QUAD. ARC	π/2 QUAD. ARC / RADIUS	Degrees DECIMAL	Degrees CONVENTIONAL	Degrees METRIC	
1	2	3	4	5	6	7	8	9	10	11
1.	SULBASUTRA & Chou Pei	Antiquity c. 700 BC	$\sqrt{10}$	3.16227 8	0.63245 5464...	1.58113 9	56.920992	56° 55' 15".355	63.24554 64	0.01581 139
2.	HIPPOCRATES & ARCHEMEDES	240 BC to	$3\frac{1}{7}$ or 22/7	3.14285 714..	0.636363	1.57142 85	57.272727	57° 16' 21.81818	63.63636 3	0.01571 42857 1
3.	King HERON (used 22/7)	3rd Century	$3\frac{10}{71}$ or 223/71	3.14084 50704 2	0.63677 13004 4	1.57042 25352 3	57.30941 70396..	57° 18' 33".98134	63.67713 0044...	0.01570 42553 52
4.	ARYABHATTA II	450 AD	62832/20000	3.1416	0.63661 82836 77	1.5708	57.29564 5531..	57° 17' 44".32391	63.66182 93677..	0.01570 8
5.	BHAVATA & Tsu Ching Chi	480 AD	355/113	3.14159 29203 5	0.63661 97183	1.57079 64601 7.	57.29577 46478	57° 17' 44".78873	63.66197 183..	0.01570 79646 07
6.	Al Kashi	1430 AD	3.14159 26535 89793 2.		0.63661 97723 76	1.57079 63267 8.	57.29577 95133	57° 17' 44".90625	63.66197 72379..	0.01570 79632 6.
7.	LEIBNIZ SERIES	3.14159 20257 58836			0.63661 98995 94	1.57079 60128 7..	57.29579 09635	57° 17' 44".84747	63.66198 99594..	0.01570 79601 2..
8.	Author's RATIONAL VALUE ©	(Kali) 2543 / 1974 AD	100 000 / 31831 (exactly)	= 3.14159 15302 69234 394... (Value repeats after 5244 DECIMALS)	0.636620	1.57079 57651 3....	57.2958	57° 17' 44".88 (CBB VIJ) Fig.	63.66 20	0.01570 79576 513..

Table Showing Values of Pi (π) used Through the Age

This 'rationalized' value for Pi (π) becomes unique, which is only 15.771 x 10^6 % deviated from best of the values used today. As a corollary: 'Choosing a length of distance 159.155 Metre as the radius of a circle, *its circumference will be ONE KILOMETRE'*.

It is needless to add here, again, the continued linkage of the METRE with the Indus Inch, the Mussel-Shell, the Crucunno Stone Rectangle & Stonehenge when the Great Bath of Mohenjo-Daro gets its right interpretation *(My contribution: Relevance of the Metre in Indus Civilisation when Linked with Time Unit and Calendar Reform with Leap Weeks; Proceedings of 2ND International MQGT-'99 Conference; 1999 February 24-26; NPL, New Delhi, refers)*

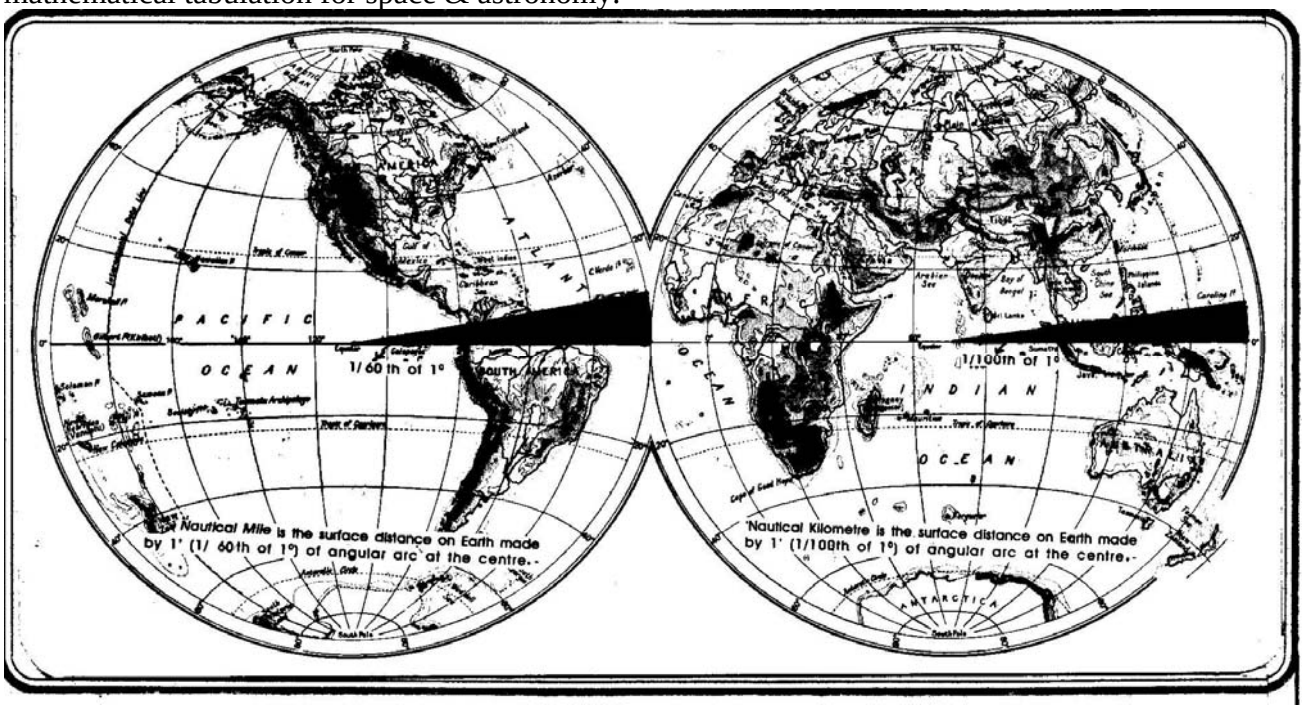
LOOKING FORWARD TO BRIDGE THE GAP

While Length (L), Mass (M) and Time (T) factors have been freely used in the Systeme Internationale d'Unites (SI) to arrive at SI derived units and other derived quantities, many dimensionless quantities like the plane and solid angle are 'quantities of dimension 'ONE'. And, now the velocity of light too join hands, which may be called 'factor one' to represent the velocity of light itself (this being a representation of m/s i.e. **time ÷time**). There are several non-SI units, obtained experimentally, or those included for safeguarding human health.

Prof. AJ Thor of Secretariat ISO/TC-12, in his International Report on International Standard ISO 31, Quantities and Units expressed the reasons for continuation to the use of Nautical Mile equal to 1852 m, defined as: 'One minute of arc **(angle)** at the center of Earth corresponding to one nautical mile at the surface of Earth *(Metrologia 1993-94, V30, p.517-522)'*. My attempts to define the 'Nautical Kilometre' since 1973 could have found favor but number 90 was convenient to use in the 4-quadrant circle and number 60 was so rational and useful that this could be exactly divisible by 2, 3, 4, 5, 6, 10, 12,15, 20,and 30 for all mathematical operations involving trigonometric functions, be handled easily. **This defeated earlier attempts to shelve mile in history books!** My attempts to define: The Metric Second (time&angle) and the Decaday World

Metric Calendar, *could receive**, no more than mute appreciation*** among friends of **Metricology** - the science of Metrication and Metrology.

Human mind is resistive and does not accept changes unless thrusted upon! It was, thus, natural that the division of the right angle into 100x100x100 units, when co-ordinated with 5 days x 20-metric Hour x 100 metric minutes x 100 metric seconds during the 'Quinto-day' and the 'Decaday' of TWO quinto-days (or 10^6 metric seconds each) with 73-decadays to the 'metric year', lacked support. Longitude of the maximum altitude of the Sun would be changing **20^o/h (metric)** instead of **15^o/h**, to mark the hour -angle. Also, it would be necessary to recognise that the circle or solid sphere had 400 degrees, causing to revise the trigonometric functions and mathematical tabulation for space & astronomy.



REDEFINING THE NAUTICAL KILOMERTRE

THE NAUTICAL KILOMETRE

While the nautical kilometre was defined, in close relation with the present length unit - METRE (1973), as also the other astronomical values, I felt the need to re-examine my entire work done between 1970-90 to ponder over the question: What happens if the world was unwilling to change the circle or solid sphere of 360 degrees into 4-right angles of 100 degrees (metric) each, and the duration of 'Sidereal' or the 'Solar' day with 7-day week; and the day with 24-hour clock were to retain?

The Nautical Kilometre could still be defined by slightly increasing the unit of length (L) keeping the 24-hour x 100 decimal minutes x 100 decimal seconds clock; as related to the 360 degree 'spin' of the Earth into **15^o/h** to be the Hour-Angle, but one degree (angle) would be further divided into 100 x 100 'decimal' arc-seconds.

Now considering the Earth to be a hypothetical sphere of radius 6371 km, the circumfe- rence would work to 40030.15926869 km (24873.587796448 miles) and $1/36000^{TH}$ of the circle to define the nautical kilometre as**: '$1/100^{TH}$ of one degree'** on earth circumference works to 1.11194886884 km or 0.690932994338 mile - to become the 'new' conversion factors, for length units. The Nautical Kilometre (n km') as related to the decimal clock (of 240000 decimal seconds to the day), can be defined as: **ONE NAUTICAL KILOMETRE (n km') is the surface distance on Earth made by one minute** *($1/100^{TH}$ of 1^0)* **of arc-angle at its center.** The nautical

mile of 1852 m, shall be 1.1507794480235 mile (1.852 km) or *1.665544-2097189 kilometre new (n km')*. It is, then, easy to compute other related units, some among these are:

0.9144 m	**= 1 Yard**	**= 0.8223399705005 m'**
1.609344 km	**= 1 Mile**	**= 1.4473183480809 km'**
39.370078740157"	**= 1 Metre (m)**	**= 1.0936132983377 Yards**
43.777514521259"	**= 1 Metre New (m')**	**= 1.2160420700349 Yards**
0.6213711922373 mile	**= 1 kilometre (km)**	**= 0.899321 927494 km'**
0.690932994338 mile	**= 1 kilometre new (km')**	**= 1.11194886884 km**

An attempt to redefine the Metre New (m') in view of the CIPM Recommendation 3 (CI-1992), showing possible *Radiation and their frequencies* were presented at page 259 in my paper: Relevance of the Metre in Indus Civilisation……..during MQGT-'99.

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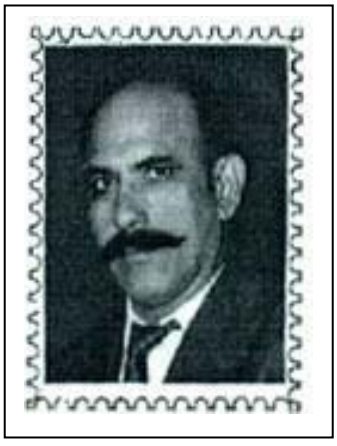

ABOUT THE AUTHOR

Former Air Force engineer, BRIJ BHUSHAN VIJ born at Bhera (Distt. Sargodha, Pakistan) on 1936 April 10 has published two books: (1) Towards A Unified Technology (1982) and (2) The SI Metric Units(1984) elucidating: 'What happens when time standard goes metric'? He has contributed over 200 write-ups in the media exposing. 'Why time and length units still hold themselves out of SI Metric Units, and that these need a fresh revision. Have been reacting with 'intellegentia of USMA@colostate.edu and CALNDR-L@LISTSERV.ECU.EDU

Brij Bhushan Vij holds an entry in Limca Book of Indian Records (1994) on Decimalisation of Time of the Day.