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JOURNAL OF WEIGHTS AND MEASURES

ABBREVIATION FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUB-MULTIPLES

Prefix	Value in Terms of Unit	Abbreviation
Kilo	1,000	k
centi	$0 \cdot 01(10^{-2})$	c
milli	$0 \cdot 001(10^{-3})$	m
micro	$0 \cdot 000\ 001(10^{-6})$	u

(2) WEIGHTS

Denomination	Value	Abbreviation
tonne	1,000 kg	t
quintal	100 kg	q
kilogram	1 kg	kg
gram	1 g	g
milligram	1 mg	[illegible]
carat	200 mg	[illegible]
(3) CAPACITY		
kilolitre	1 00[illegible]	kl
litre	1 [illegible]	l
millilitre	1 m[illegible]	ml
(4) VOLUME		
cubic metre	m^3	[illegible] cu m*
cubic centimetre	cm^3	cm^3 or cu cm*
cubic millimetre	mm^3	mm^3 or cu mm*
(5) LENGTH		
kilometre	1 000 m	km
metre	1 m	m
centimetre	1 cm	cm
millimetre	1 mm	mm
micron	1/1 000 mm or 10^{-3} mm	um
(6) AREA		
square kilometre	1 000 000 m^2	km^2 or sq km*
square metre	1 m2	m^2 or sq m*
square centimetre	1 cm^2	cm^2 or sq cm*
square millimetre	1 mm^2	mm^2 or sq mm*
(7) LAND MEASURE		
are	100 m^2	a
hectare	100 a	ha
centiare	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20 g, 5 g, 10 t, 20 ml, 271, 165 km, 2 mm, 100 cm^3, 66 km^2.

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM; the right way is to write 1 kg, **2 kg**, 20 mm, 50 mm, etc.

(3) Do not use any other abbreviations except those given above.

metric measures

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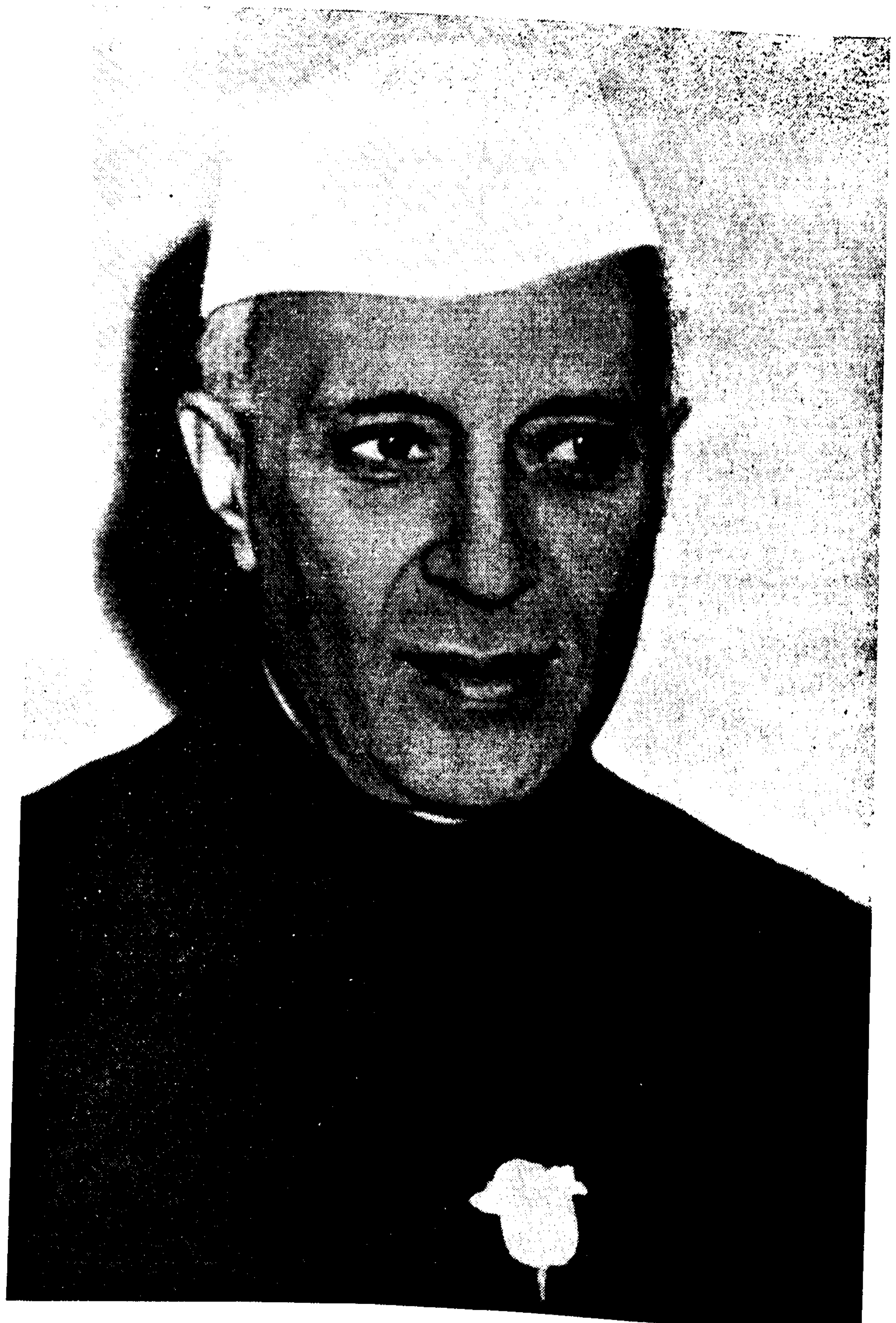

Born 14 Nov. 1889 JAWAHARLAL NEHRU Died 27 May 1964

JAWAHARLAL NEHRU

The passing away of India's beloved leader and Prime Minister, Jawaharlal Nehru, on 27, May 1964, has plunged the whole nation into the profoundest grief. A valiant fighter for the people of India all his life, Jawaharlal Nehru was the chief architect of modern India. His entire life was dedicated not only to the ideals of national freedom, unity and solidarity but equally to those of world peace and progress.

Born at Allahabad on 14 November 1889, Jawaharlal Nehru was the son of Pandit Motilal Nehru, an eminent lawyer and one of India's greatest patriots. At the age of 15 he went to England and after two years at Harrow, studied at Trinity College, Cambridge. He was later called to the Bar from the Inner Temple and he returned to India in 1912.

Destiny had not intended him to confine himself to the legal profession and he was drawn irresistibly towards the movement for India's freedom. His meeting with Mahatma Gandhi in 1916 was the coming together of two great souls and was to prove to be a landmark in Jawaharlal Nehru's life. In the same year he was married to Kamala Kaul who stood by him through all the joys and tribulations of his life until her early death in 1936, leaving behind her only child and daughter, Indira.

Fight for Freedom

After the epochal meeting with Mahatma Gandhi Jawaharlal Nehru and his whole family were plunged in the main stream of the freedom struggle. In 1918 he was elected Secretary of the Home Rule League, Allahabad, and became a member of the All India Congress Committee of which he remained a member for the rest of his life.

In 1929 he was elected President of the Lahore Session of the Indian National Congress. The national struggle entered a new and significant phase when, on the sacred banks of the Ravi, the Congress took the pledge of complete independence as its goal.

On the solemn midnight when India became free Jawaharlal Nehru declared "Long years ago we made a tryst with destiny, and now the time comes when we shall redeem our pledge, not wholly or in full measure but very substantially"......"To the people of India, whose representatives we are, we make an appeal to join us with faith and confidence in this great adventure. We have to build the noble mansion of a free India where all her children may dwell".

Apostle of Peace

Jawaharlal Nehru was dedicated to the ideals of the United Nations and the principles of the Charter. He addressed the Third General Assembly Session in Paris in 1948. His last appearance at the United Nations was in 1960. There he moved a significant resolution stressing the need for world peace and urging the leaders of the great powers to renew their contacts. He was the first Head of Government to support the partial test-ban pact signed by the three Nuclear Powers in August 1963.

He strove tirelessly against war and for total disarmament. He initiated and supported action for the liberation of dependent countries. He fought against the exploitation of man by man and worked ceaselessly to bring freedom from fear and hunger not only to his own people but to the world at large. He set his face against all political and military blocs as the greatest impediments to world peace.

Secular India

Jawaharlal Nehru was unremitting in his endeavour for the unity and solidarity of the Indian nation. He struggled ceaselessly to blend the different elements of our national life into an integrated social structure. He fought against all the barriers of caste, religion and language and for the uplift of the less privileged. He constantly affirmed the secular concept of our State as necessary for all sections of the people to live together in peace and harmony.

There could be no finer epitaph for Jawaharlal Nehru than that which he himself suggested in a pensive mood,—with characteristic humility—"If any people choose to think of me then, I should like them to say 'This was a man who with all his mind and heart loved India and the Indian people. And they, in turn, were indulgent to him and gave all their love most abundantly and extravagantly'."

Development of Length and Area Measures in South India—Part 4

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IN Parts 1, 2 and 3 we examined the various twists and turns in the traditions of length and area measures in South India in the light of the *Arthasastra* measures and their transformed relations in later periods.

Two More Inscriptions

Before proceeding to analyse the more modern variants of the ancient measures, it is intended to discuss two more inscriptions which are also apparently related with the kisku of 32 angula *i.e.* 57·14 cm. In Part 3, the 'jena' of inscription 4 was explained as being 8/10 or 4/5 of this kisku *i.e.* 57·14 $\times$4/5=45·71 cm. This was an alternative independent explanation of the jena.

The first inscription (659 of 1920) is referred to in Part 3 under the section *Five Inscriptions*. The reference[56] further mentions that 'A vertical line is cut over the inscription to give the exact measurement, evidently of the vitasti. It measures a little over 1 foot and 3 inches'. Apparently the modern metrologist has not been very exact in measuring the length! Assuming that it is exactly 1 foot 3 inches *i.e.* 15 inches or 38·10 cm, it can easily be seen to be equal to 10 angula of 3·812 cm. Alternatively it could also be treated as 2/3 of the kisku of 32 angula mentioned in the *Arthasastra* *i.e.* 57.14$\times$2/3=38·09 cm. This inscription could represent the basic unit used in the Trivandrum district which is described later. It should also be noted that like the 45·74 cm jena, this 38·10 cm jena is also divided into 12 angula, thus giving an angula of 3·175 cm.

The second inscription[57] belonging to the Chola dynasty occurs on the north of the mandapa in front of the Tirthapurisvara temple in the village Tiruvaduturai in Vriddachalam taluk of South Arcot district. It gives the length of the measuring rod Muvairavan-kol by two marks which are 'nearly 15 feet apart'. The measurement is rather vague, but if it is assumed to be 15 feet *i.e.* 4·572 m, it is clearly equal to 8 kisku of 32 angula *i.e.* 57·14$\times$8=4·5712. Alternatively it is ten times the jena of 45.74 cm derived in Part 3.

There are many other inscriptions in which the vitasti has been sketched but the measurements are not recorded in the available literature. Even in the above two inscriptions, the measurements have been inaccurately recorded as 'a little over' or 'nearly'. We have approached the Archaeological authorities to arrange accurate measurements of these and other length measures. We shall, therefore, discuss these further when the results are made available.

British Records

It is now intended to analyse, in the light of the discussions earlier, the comparatively modern land area measures mentioned in certain British records of the 17th—20th centuries. The most important source for this information is the *Manual of Administration of South India*,[41] published in 1885. It is supplemented by data derived from other sources like the *District Gazetteers*.

While commenting generally on the area measures in the old Madras Presidency, the *Manual* cautions that the measuring rod often varied in length but the term by which its square was known was the same. The terms kunta and kuli are the land measures next below the maximum of the place. Thus the putti of Rajahmundry, the kathi of Masulipatam, the kuchchala of Guntur, the gurtu of Nellore, the kani of Chinglepat, the acre of Bellary and the ma of Thanjavur are all subdivided into kunta and kuli. These two units need not, therefore, be the same everywhere.

It should also be noted that the smaller unit may be taken 24, 32, 35, 40, 50, 56, 64 &100 or any suitable number of times to give the higher unit. So it is necessary to analyse in many cases both the smaller unit and its basic length measure as well as the final unit to discover their relation, if any, with old traditions.

In order to evaluate the area or length measures it is necessary to examine certain peculiar length measures. The adi or 'foot' is one such measure and the tutcha-kol or artificer's rod is another. The mura and the bauham also deserve attention because they are the very base of many South Indian area measures.

Adi Tradition

The kani, ma and many other area measures are sometimes based on a unique length measure called adi which exists in a large variety. Adi means the length of the foot, *i.e.* pada of *Arthasastra* ($\frac{1}{3} \times 42 = 14$ angula). So the adi could have a value of 25 cm (9·84 in.) .. .. .. (1)

According to South Indian tradition however, the adi is usually taken as $\frac{1}{3}$ of double hasta or a kol. The hasta and kol measures can vary as we have seen earlier. So depending upon the hasta measure or kol used, the adi acquires different values; alternatively it is 7/6 of the vitasti value. But what is worse, in course of time, it lost its traditional meaning and merely became a subdivision of another larger unit, the adi then varying in length from 23 cm to 29 cm. We shall have occasions to refer to such variants later on.

We may, however, examine the adi units that can be derived on the basis of ancient literature.

The *Arthasastra* defines the pada as 14 angula and the vitasti as 12 angula. As we have seen earlier in the South Indian tradition the kol or measuring rod was also divided into jena (vitasti) and angula, the proportion being 12 angula=jena, but the angula was variable and could be as large as 3·812 cm. To obtain the magnitude of the adi, let us take the kol of 7·31852 m and divide into 32 jena. The resultant jena is 22·87 cm. Assuming that the relation between the pada (adi) and vitasti (jena) is the same as in *Arthasastra viz.* 14/12, we have:

$$\text{adi} = \frac{22 \cdot 87 \times 14}{12} = 26 \cdot 68 \text{cm} \quad (10 \cdot 50 \text{ in}) \cdot\cdot (2)$$

A third adi can be derived from the 108 angula paurusha as follows: The bauham in South Indian tradition is equal to the distance between the outstretched arms of a man. This is normally equal to the paurusha of 108 angula of *Arthasastra*. The South Indian tradition sometimes requires that it be divided into 4 parts called mulam, which is not necessarily equal to the mulam of commerce. This mulam is again divided into 24 angula, 12 of which form a jena or vitasti. If we take the *Arthasastra* pattern 14 angula should make an adi. Thus the adi would have a length of 28·1254 cm, as derived below:

$$\text{bauham} = 1 \cdot 9286 \text{ m} \quad (75 \cdot 93 \text{ in})$$

$$\therefore \tfrac{1}{4}\text{bauham} = 48 \cdot 215 \text{ cm (24 angula)} \quad (18 \cdot 98 \text{ in})$$

$$\therefore \tfrac{1}{8} \text{ bauham or vitasti} = 24 \cdot 1075 \text{ cm (12 angula)} \quad (9 \cdot 491 \text{ in})$$

$$\text{So adi} = \frac{24 \cdot 1075 \times 14}{12} = 28 \cdot 1254 \text{ cm} \quad (11 \cdot 073\text{ in}) \quad .. \quad ..(3)$$

A fourth adi can be derived in a similar manner from the hasta measure of 48·79 cm calculated in Part 3 while examining inscription (5), assuming the hasta to be divided into 24 angula.

$$\therefore \text{adi} = \frac{14 \times 48 \cdot 79}{24} = 28.46 \; (11.21 \text{ in}) \quad ..(4)$$

A fifth adi based on the tutcha-kol examined later, has a value of:

$$83.86 \times \tfrac{1}{3} = 27 \cdot 95 \text{ cm } (11.00 \text{ in}) \quad .. \quad ..(5)$$

This is sufficient indication of the immense variety of adi that can be derived from ancient traditions. The number of adi which are merely a subdivision of a larger unit are discussed later on.

The ancient adi measures, therefore, cannot be evaluated unless we have more knowledge about their lengths or the area units derived from them. An example or two will indicate the difficulties in the way of an adequate analysis.

In the Pudukottai region[53] kol of 9, 12, 16, 18, 22 and 24 'country feet' or adi were in vogue from the 12th to the 19th century. Further, an inscription[53] mentions that 522 kuli measured with the kol of 18 'feet' or adi gave a ma. Two other inscriptions mention a ma of 256 kuli measured by the kol of 16 'feet' or adi. Unless we know something about the length of the kol or at least the approximate value of the ma it is not possible to assign a value either to the adi or the ma.

Tutcha-kol

An extremely peculiar unit of length is what is called tutcha-kol (artificer's rod) in Madurai and Tirunelveli and tutcha-mulam (artificer's cubit) in Tirucherapalli. Its value can be derived by correlating the following statements:

(1) The tutcha-kol is about 33 in (83·82 cm) and according to inscriptions represents the length between two marks on a temple.[41]

(2) It is also equal to 44 'finger breadths'[41]

(3) The angulam is considered to be equa to 2 virulcaday or finger-breadths[25,41]

In Part 3, it was noted that the jena found in certain inscriptions measured 45·74 cm and was supposed to be divided into 12 angulam, each measuring 3·81 cm. From statements (2) and (3) we may assume that the tutcha-kol is 22 of these angulam.

Let us assume that the above jena of 12 angulam is the basic length measure, then

$$22 \text{ angulam} = \frac{45 \cdot 74 \times 22}{12} = 83 \cdot 86 \text{ cm.}$$

This should be taken as the original length of the tutcha-kol.

Then 32 jena (14·63704 m) contain 17·454 tutcha-kol. Why such an odd measuring rod was devised by the ancients is not clear. Perhaps it represented half the average height of man. It should also be noted that the calculated value and the measured values differ by 0·4 mm, (83·86—83·82), a difference which is almost imperceptible when lengths are measured on stone.

It may also be mentioned that the tutcha-kol was also divided into 3 adi, each adi being thus $\frac{83\cdot86}{3}=27\cdot95$ cm (11·00 in), as shown earlier.

In Part 3, another derivation for the jena of 12 angulam was given which was related with the kisku of 32 angula laid down in the *Arthasastra.* In essence it worked out to be 4/5 of the kisku *i.e.* $57\cdot14\times4/5=45\cdot71$ cm. If the tutcha-kol is worked out on this basis it works out to be $\frac{45\cdot71\times22}{12}$ $=83\cdot80$ cm. This is 0·6 mm smaller than the value derived above. The difference is negligible.

Mura-Mulam

Another important unit which occurs again and again is the cubit, called mura, mora, moolam etc. It is often between 19·5—19·8 in (49·53—50·30 cm) though it can be less or more. We shall discuss the variations later on.

Bauham

The bauham is a very peculiar unit and has many values. By definition it would appear to be related to the paurusha of 108 angula (1·9286 m). But there are other bauham which have different values. Some of them could be satisfactorily explained on the basis of the angulam of 3·812 cm derived in Part 3. It will be shown later on that the angulam played a very important role in South Indian area measures. We have, therefore, taken the angulam basis for explaining the length of the bauham. Normally, the bauham varied between 1·9 m to 2·5 m.

We may now examine the various area measures district by district.

MADRAS STATE

Arcot, North

In North Arcot, the kani was the most generally used measure. It was equal to the kani of 5356 m² derived in Part 3.

In some of the taluks, area measures other than the kani were in use. Of these, 4 types of goru are important from our point of view mainly because the lengths of the basic 'ropes' by which the measurements were carried out were *actually measured and recorded.* The unit immediately below the goru was called kunta and varying number of kunta went into the goru.

Another peculiar factor should also be noted. The 'rope' is divided into 'country feet' which we shall call adi. Two sets of values are recorded below, one of which is tabulated from the data in the *Manual* [41] and the other is derived on the basis of ancient traditions and suitably rounded off. The reasoning for the second set is explained later.

				As given	As Calculated
(1)	84 adi	=1 rope	79·25 ft	=24·155 m	24·108 m
	square rope	=1 kunta		= 583·5 m²	581·2 m²
	35 kunta	=1 goru	5 acres	= 20421 m²	20341 m²
(2)	72 adi	=1 rope	66 ft	= 20·117 m	20·124 m
	sq. rope	=1 kunta		= 404·7 m²	405·0 m²
	40 kunta	=1 goru	4 acres	= 16188 m²	16199 m²

				As Given	As Calculated
(3)	64 adi	=1 rope	60·25 ft	=18·364 m	18·296 m
	sq. rope	=1 kunta		=337·2 m²	334·8 m²
	56 kunta	=1 goru	4.66 acres	=18885 m²	18746 m²
(4)	48 adi	=1 rope	42 ft	= 12·802 m	12·806 m
	sq. rope	=1 kunta		=163·9 m²	164·0 m²
	25 kunta	=1 goru	1·01 acres	=4097 m²	4100 m²

The 'ropes' present an interesting study. If we work out the values of the adi in the four cases, they work out to be 28·76 cm, 27·94 cm, 28·69 cm and 26·67 cm. Of these we can find parallels for only two, *viz.* 27·95 cm and 26·68 cm derived earlier. The adi in the other two cases has apparently no traditional equivalent and has to be treated merely as a subdivision of the rope into 84 or 64 parts for convenience, the subdivision being called an adi because it had a dimension of the order of an adi. The equivalents for (2) and (4) have, therefore, been worked out from old traditions (adi = 27·95 cm and 26·68 cm) and the difference between the actual and calculated values is less than 7 mm and 4 mm in the two cases, *i.e.* 1 in 3000 which is negligible. We may also note that the goru of (2) is about 2 times the nivartana based on 75 cm kishku (*see* Table 5, Part 2), the difference being 16200—16199=1 m², which is negligible.

Let us now examine the 'rope' of equation (1). An equivalent for it can be obtained only if we take 25 *Arthasastra* hasta of 54 angula *i.e.* 96·43 cm=24·108 m. This length was perhaps subdivided into 84 parts for convenience. While examining the equivalence of the calculated value against the actual length, we should note that a rope of 158·25 ft. was also used in Madura (*see later*). The 79·25 ft. rope should obviously be half of the Madura rope. It is, however, slightly larger *i.e.* by 1¼ in. We should then reduce the rope in (1) to 79·125 ft. (24·117 m). The difference between this value and the calculated value is 24·117—24·108=9 mm or about 1 in 2500 which is negligible.

The remaining rope of 60·25 ft. is peculiar. If we, however, assume that the actual measurement was made to the nearest ¼ ft., then it could be equated to 5 times the kol used for evaluating the ma in Part 3 *i.e.* $3\cdot65926\times5=18\cdot296$ m. The difference between the measured and actual values is 18·364=18·296=70 mm, *i.e.* 1 in 250. Even this difference is not substantial as the actual measurement may have been carried out correct to the nearest ¼ ft. At the moment, this explanation seems to be the most satisfactory.

The goru contains 35, 40, 56 and 25 kunta, and the kunta itself varies. So it is not likely that except for value (2) explained earlier, any relation can be established between these area units and the standardized ancient ones. The main point is that the basic 'rope' has in every case a very close relation with old traditions.

These area measures have been examined in detail because the 'ropes' were actually measured and their lengths recorded. This fact will be of value in later analysis.

The *Manual*[41] also records that kunta based on 'ropes' of 56 and 60 adi were also known. But as no indication of the length of the adi or the area of kunta is given it is not possible to assign any value to these two 'ropes'.

Arcot, South

In South Arcot, as in North Arcot, the standard kani of 5356 m^2 was in general use. Ancient Sanads are said to mention a kol of 72 feet, but it is not known whether the kani was 100 kuli. The 72 'feet' or adi, are reminiscent of the rope of 72 adi discussed under Arcot, North.

Chingleput

In Chingleput district the kani of 5356 m^2 was used, as in South and North Arcot. There was, however, a peculiar variation. The kol of 7·31852 m did not consist of 32 'jena' but of 28 adi. The possibility is that the kol was divided into 28 portions, and each called adi, to suit perhaps some ratio with coinage or for some other convenience, as we saw earlier under Arcot, North in the case of the 84 adi kunta. The adi in this case, however, works out to be $\frac{7\cdot31852}{28}=$ 26·14 cm, which does not appear to have an equivalent in old tradition.

The peculiarity of the adi is not restricted to only one. There was in existence another adi leading to the following equation:

24 adi = kol

1 sq kol = kuli

100 kuli = 1 kani = 43778 ft^2 or 4067 m^2

This unit is perhaps equal to $\frac{1}{2}\times 8100 = 4050\ m^2$ (*see* 8100 m^2 nivartana, Table 5 Part 2).

Here the adi acquires a value of 26·56 cm and the kol 6·374 m. The kol would be 6·364 m if we take the kani as 4050 m^2 and the adi would be 26·52 cm. But out of what is called 'charity' the kol was made equal to 26 adi and resulting customary kani became 5708 yd^2 or 4772·6 m^2.

The 'mani' or ground, equal to 24th part of the kani, was also used.

Coimbatore

The traditional kani of 5356 m^2 was in general use for irrigated land. There were, however, in use certain specialized units *e.g.* balla for unirrigated land. The equation for it was also follows :[58]

The bauham of 1·943 m is possibly based on the angula of 3·812 cm derived in Part 3.

			As Given	As Calculated
1 bauham		6 ft. 4½ in	1·943 m	1·944 m
16 bauham	= 1 rope	102 ft.	31·090 m	31·098 m
4 ropes	= 1 sangili	408 ft	124·36 m	124·39 m
1 sq. chain	= 1 balla	3·82 acre	15459 m^2	15464 m^2

The derivation is as follows: $3\cdot812\times51=1\cdot94412\ m=1\cdot944\ m$. The reason for taking 51 angula is not clear but such peculiarities of derivation are common and will occur later on also.

This balla was also used in Salem district.

The ma was also taken as equal to 240 kuli or 2·4 kani *i.e.* 12855 m^2, as the kani is 5356·077 m^2 as derived in Part 3.

The sei or chei was half of the above ma *i.e.* 120 kuli or 1.2 kani = 6427 m^2.

Madura

The district of Madura provides a large variety of area measures based on different units, although the kani of 5356 m^2 was generally in use. Other varieties are discussed below.

According to early accounts a kuli or kunta, a square with each side of 158·25 ft.

(48·235 m) was used in certain regions. This gives a kunta or kuli or 2781 yd^2 or 2325·3 m^2. The basic side was made 160 ft. by the British Government. The kol of 48·235 m is just the double of the 84 adi 'rope', we examined under Arcot, North. On the same assumption, it should be 96·43 cm × 50 = 48·215 m. The difference between the two is 48·235—48·215 = 20 mm or 1 in 2400 which is negligible. The real kunta based on the traditional length of 48·215 m, is then 2324·7 m^2.

A kol of 21 ft. (6·401 m) was also in use, giving a kani of 44100 ft^2 or 4097 m^2. This kol is ½ of the rope of 12·806 m analysed under Arcot, North, and could be treated as equal to 24 adi, the kani then being 4100 m^2, being equal to the North Arcot goru.

There were in use in certain regions units called chey for denoting areas of irrigated lands, the kurukkam for unirrigated lands and the garden kunta for garden lands.

There were two varieties of chey as shown below.

The chey in (1) can also be looked upon as the square of 124 tutcha-kol ($7\frac{3}{4}\times16$). It is difficult to explain why 124 tutcha-kol made the basic length.

The second chey is even more peculiar.

The adi in (2) works out to be 23·88 cm, which does not seem to have any basis in ancient tradition. The basic length measure for chey, however, could be looked upon as 100 tutcha-kol (83·86 m).

			As Given		As Calculated
(1)	tutcha-kol		33 in	83·82 cm	83·86 cm
	7¾ tutcha-kol	= 1 kol	21-5/16 ft.	6·496 m	6·499 m
	kuli	= $(kol)^2$	—	42·20 m^2	42·24 m^2
	256 kuli	= 1 chey	2·6695 acre	10803 m^2	10813 m^2

			As Given		As Calculated I	As Calculated II
(2)	22 adi	= 1 kol	17·25 ft.	5·258 m	5·24 m	5·259 m
	$(kol)^2$	= 1 kuli	—	27·65 m^2	27·46 m^2	27·66 m^2
	256 kuli	= 1 chey	1·7488 acres	7078 m^2	7032·5 m^2	7081 m^2
	16 kol	=	276 ft.	84·128 m	83·86 m	84·147 m

Another way of looking at the kol is that it is equal to 138 angulam *i.e.* $138\times3\cdot811=5\cdot259$ m. The 138 angula are equal to 23 vitasti or jena (jena = 6 angulam). The value of 16 kol is then 84·147 m and chey is 7081 m^2.

There were in use the following 4 types of kurukkam:

			As Given		As Calculated
(1)	72 tutcha-kol	= 1 chain	198 ft	60·350 m	60·379 m
	1 sq. chain	= 1 kurukkam	0·9 acres	3642·1 m^2	3646 m^2
(2)	210 tutcha-kol	= 1 chain	577½ ft	176·022 m	176·106 m
	1 sq. chain	= 1 kurukkam	7·656 acres	30984 m^2	31013 m^2

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				As Given	As Calculated
(3)					
	24 bauham	=189 adi=1 chain	156 ft.	47·549 m	47·561 m
	1 sq. chain	=1 kurukkam	0·559 acre	2260·9 m²	2262·0 m²
(4)					
	32 bauham	=1 chain	208 ft.	63·398 m	63·415 m
	1 sq. chain	=1 kurukkam	0·993 acre	4019·3 m²	4021·5 m

The first two kurukkam are based on the tutcha-kol, and the extent of variation is dependent upon the difference in the two values of the tutcha-kol as given and as calculated *i.e.* 83·82 cm and 83·86 cm.

The third and fourth values require some explanation.

The bauham in (3) and (4) works out to be 6½ft. or 6 ft. 6 in (1·9812 m). This is equal to 52 angulam *i.e.* 3·812×52=1·98224 m= 1·982 m. This bauham is one angulam longer than the Coimbatore bauham discussed earlier. The reason for such minor differences is not available in literature. The values are calculated for (3) and (4) on the basis of this bauham. Was the Kurukkam in (4) intended to be equal to half-nivartana *i.e.* $\frac{8100}{2}$=4050 m² (*see* Table 5, Part 2) ?

The adi is peculiar. The 24 bauham are divided into 189 adi, thus giving an adi of 47·561/189=25·16 cm. Had the *Arthasastra* relation been valid here, there would have been 192 adi. It is not clear why the chain was divided into 189 adi, unless it was to suit some land revenue practice or to have a convenient relation with coinage.

There were four garden kunta, also called kuli as, shown below:

For Irrigated Gardens

			As Given		As Calculated
(1)	rod (kol)		14¼ ft.	4·953 m	4·953 m
	kunta		264·6 ft²	24·53 m²	24·53 m²
(2)	rod (kol)		7-1/16 ft.	2·153 m	2·143 m
	kunta		51·36 ft²	4·635 m²	4·592 m²
(3)	rod (kol)	=21 adi	16-1/6 ft.	4·896 m	4·899 m
	kunta		258·3 ft²	23·97 m²	24·00 m²
(4)	rod (kol)	=8 adi	6¼ ft.	1·905 m	1·905 m
	kunta		—	3·629 m²	3·629 m²

It is also stated that there were 7 lengths of rod used *viz.* 21, 18, 16, 11, 10, 9 and 8 adi. The length of adi is not mentioned in every case.

Let us, however, analyse the four garden kunta, taking (3) and (4) first. The adi in these two cases is 23·31 cm and 23·81 cm respectively. These adi measures have no apparent basis in tradition. The kol of (3), however, appears to be related to the 64 adi rope of North Arcot and is equal to $\frac{3\cdot65926\times4}{3}$=4·899 m *i.e.* it is 1⅓ of the kol we derived for the ma measure in Part 3.

Now let us take kol in (4). We saw in Part 3 that the angulam was 3·811 cm. The 1·905 m kol is then 50 of these angulam.

The kol in (2) would appear to be 1/4 ×(42·86 × 5)=2·143 m. This hasta (42·86 cm) is the Prajapatya hasta of *Arthasastra*. The difference between the values is 2·153—2·143=10 mm, which would have been introduced as the measurements given here appear to be correct to 1/16 of a foot (20 mm) and also because there is already a divergence between the measures given in the *Manual* and those derived from ancient literature, supported by tradition.

Another possible explanation of the kol in (2) is that it is 113 viral-kadai or 56-1/2 angulam *i.e.* 3·811 ×56·5=2·153 m which is exactly equal to the given value. Why 56·5 angulam should be chosen as a unit is not very clear.

The kol in (1) is exactly 2·6 times the kol in (4) *i.e.* 1·905 × 2·6=4·953 m *i.e.* it is equal to 130 angulam of 3·811 cm. Why such an odd relation was necessary is not clear.

Salem

In Salem district all the taluks except 5 were subjected to field measurements by *local rods* early in the 19th century, and the results entered in terms of local area measures. In the remaining five taluks measurements were carried out with a 33 ft chain and results entered in acres and kunta (40 kunta=1 acre) as in Bellary and Cuddappah. We shall examine here only those area measures which were measured with the local rods. The measures were divided into two groups—those used for unirrigated land and those for irrigated land.

For Unirrigated Land

The fathom *i.e.* bauham used was 8 ft and the table is as follows:—

	As Given		As Calculated
bauham	8 ft	2·438 m	2·439 m
24 bauham=kol	192 ft	58·522 m	58·548 m
(kol)² =kunta	0·846 acres	3424·8 m²	3427·9 m²

The bauham of 2·438 m is peculiar. It reminds us of the basic kol for kamma derived in Part 3 *i.e.* 4·879 m. The bauham is ½ of this *i.e.* $\frac{4\cdot879}{2}$=2·439 m. The difference of 1 mm between the given and calculated values is negligible. The kunta is then equal to 144 kamma.

In other taluks, however, the bauham was usually taken as 6 ft 4½ in (1·9431m). On the basis of the Coimbatore tradition this bauham should be 1·944m. The following kunta based on this bauham were in use.

Kunta	As Given	As Calculated
(36 bauham)²	(229·5 ft 69·951 m)² =1·209 acres 4897 m²	(36× 1·944=69·984 m)² =4898 m²
(64 bauham)²	(408 ft or 124·358 m² =3·82 acres 15459 m²	(64×1·944=124·416 m)² =15479 m²
(96 bauham)²	(612 ft or 186·538 m)² =8·6 acres 34803 m²	(96 ×1·944=186·624m)² =34829 m²

A chain of 36 ft. (10·973 m) was also in use. This will be explained later under Tirunelveli district.

For Irrigated Land

A chain of 32 ft (9·754 m) was in use as the base for the kunta. This is obviously twice the besic length for the kamma *i.e.* 4·879 × 2 = 9·758 m. a difference of 4 mm in about 10 m *i.e.* 1 in 2500, which is negligible. The kunta is then equal to 4 kamma, or 95·2 m^2.

In one taluk, a kunta based on a 32-adi kol or 29 ft (8·839 m) was in use, the adi being 27·62 cm. This adi is also non-traditional. Another kol used was based on 24 adi and measured 21·7435 ft (6·627m) the adi being 27·61 cm as derived above.

These two kol have to be looked upon as based on the angula of 3·811 cm. The first is 232×3·811 = 8·842 m. and the 24 adi-kol is 174×3·811 = 6·631 m. The ratio of 232 to 174 is 4:3 the same as 32:24 adi.

A third kol measured 9 bauham, or 57·2 ft (17·435 m). The bauham works out to be 6 ft 4-11/32 in (1·939 m). If this bauham is equated with the Coimbatore bauham of 1·944 m, the kol has a length of 17·496 m, the kunta being 306·1 m^2.

Thanjavur

The ma of 1339 m^2 and veli of 26780 m^2 was generally in use.

Tirunelveli

The tutcha-kol again figures prominently in the area measures used in this district. Unirrigated land was measured in sangili or chains, and irrigated land in vitheicottay or seed-cottay.

The most fantastic ratios were taken to represent the basic kol. The following is an example:

16 adi = 4-60/64 tutcha-kol = 162-60/64 inches (4·140 m)

If we take the true tutcha-kol to be 83·86 cm, the 16 adi work out to be 4·141m, the adi being 25·88 cm, which has no basis in old tradition except the tenuous one with the tutcha-kol given above.

We have now to examine the area units.

For Unirrigated Land

		As Given		As Calculated
4-17/32 tutcha-kol	= 1 kol	12-7/16 ft	3·791 m	3·800 m
(32 kol)^2	=	(398 ft or	121·310 m^2	121·597 m
1 chain	=	3·636 acres	14716 m^2	14786 m^2

The tutcha-kol here works out to 32·94 in (against the usual 33 in) on the basis of the given data. The basic length for chain is made up of 145 tutcha-kol.

For Irrigated Land

		As Given		As Calculated
7·5 tutcha-kol	= kol	20·5 ft	6·248 m	6·290 m
1 kuli	= 1 padi .. .. .. = 1 nali	420·5 ft^2	39·03 m^2	39·56 m^2
8 padi	= 1 markkal .. .. = 1 kuruni	3362 ft^2	312·3 m^2	316·46 m^2
21 marakkal	= 1 seed-cottay	1·621 acres	6556 m^2	6646 m^2

The seed-cottay is comparable with the kurukkam of 6695 m^2 derived in Part 3.

The tutcha-kol here works out to 32·8 in. or 83·31 cm which is much lower than the traditional value of the tutcha-kol (83·86 cm). Hence the differences between given and calculated values.

Tirucherapalli

The kani of 5356 m^2 was generally in use. The kol, however, was divided into 28 adi, instead of 32 jena. In certain taluks a kol of 21 ft. (6·401m) was used as follows:

(kol)^2 = 1 kuli = 441 ft^2 (40·97 m^2)
100 kuli = 1 kani = 4097 m^2

In the *Gazetteer* the kol has been given as 21-1/6ft (6·452ft) but the 6·4m kol has a parallel in North Arcot, Madura etc. and is therefore more acceptable.

References

(56) *Annual Report on South Indian Epigraphy* for the year ending 31 March 1921, No. 659 of 1920.

(57) *Annual Report on South Indian Epigraphy* for the year ending 31 March 1929, No. 249.

(58) Nicholson, F. A., *Madras District Manuals, Coimbatore*, Vol. 2 (Government of Madras), 1898.

*New Values for the Physical Constants**

A NEW consistent set of values for the physical constant has been recommended by the Committee on Fundamental Constants of the National Academy of Sciences-National Research Council. The work of this committee is a continuation of the work of an earlier NAS-NRC Committee.

The National Bureau of Standards has adopted these values[1] for use in all NBS publications, except where for some special reason the author is required to use others. No doubt these constants will have additional wide use. It is anticipated that the International Union of Pure and Applied Chemistry and the International Union of Pure and Applied Physics will encourage their employment on an international basis.

Previous to this action of the NAS-NRC Committee, several lists of "best values" for the physical constants were available. The current issue of the Smithsonian physical tables, for example, lists three separate sets of values. The individual research worker is then forced to make a choice as to which list he is going to follow.

Uniformity and consistency in the use of such values are necessary for an adequate exchange of information among scientists. For example, the Faraday constant is given by $F = N_A e$. Different values for all three of these constants appear in the various

*Reproduced from NBS Technical News Bulletin, October 1963, pp. 175—177.

tables, but in order to satisfy the equation it is necessary that all values be taken from the same consistent set.

The members of the NAS-NRC Committee are J.A. BEARDEN, E.R. COHEN, J.W.M. DUMOND, L.P. McCULLOUGH, N. RAMSEY, F. D. ROSSINI, J. S. THOMSEN, G. WADDINGTON, and ALVIN G. McNISH, Chairman. Many of these individuals have been very active in the development of consistent sets of constants over the past few years.

The Committee eports: "In arriving at these values the Committee had available a large amount of experimental information not all of which appeared to be of consistent reliability and accuracy. In some cases where experiments were suspected of having significant errors and the results were discrepant with other experimental results believed to be of greater reliability, the data were rejected. Inclusion of these rejected data would have altered the rules in the table somewhat but not greatly".

The results of several recent experimental researches of the National Bureau of Standards have been of great importance in extablishing the new values. These were the new determinations of the gyromagnetic ratio, of the electrochemical equivalent of silver, the relative abundances of the isotopes of silver and the value of the absolute ampere. A full report of the calculations and considerations entering into this new set of values was discussed by J.W.M. DuMond and E.R. Cohen at the Second International Conference on Nuclidic Masses in Vienna, in July 1963 (to be published in the Conference Proceedings).

The new values of the constants are given in table 2. The uncertainties assigned represent established limits of error; namely, three standard errors based on standard deviations assigned to the data retained for input to the least-squares adjustment. Those calculated from the residuals of the final least-square adjustment are even smaller. It is therefore unlikely that the true value of any of the constants differs from the value given in the table by as much as the stated uncertainty. The uncertainties in constants computed from elemental ones may be either greater or less than is obtained by a simple combination of the elemental uncertainties because

TABLE 1

Defined Values and Equivalents

Meter	(m)	1650 763·73 wavelengths in vacuo of the unperturbed transition $2p_{10} - 5d_5$ in ^{86}Kr
Kilogram	(kg)	mass of the international kilogram at Sevres, France.
Second	(s)	1/31 556 925·974 7 of the tropical year at 12^h ET, 0 January 1900.
Degree Kelvin	(°K)	defined in the thermodynamic scale by assigning 273·16 °K to the triple point of water (freezing point, 273·15 °K = 0 °C).
Unified atomic mass unit	(u)	1/12 the mass of an atom of the ^{12}C nuclide.
Mole	(mol)	amount of substance containing the same number of atoms as 12 g of pure ^{12}C.
Standard acceleration of free fall	(g_n)	9·806 65 m s^{-2}, 980·665 cm s^{-2}.
Normal atmospheric pressure	(atm)	101 325 N m^{-2}, 1 013 250 dyn cm^{-2}
Thermochemical calorie	(cal_{th})	4·1840 J, 4·1840 × 10^7 erg.
International Steam Table Calorie	(cal_{IT})	4·1868 J, 4·1868 × 10^7 erg.
Liter	(l)	0·001 000 028 m^3, 1 000·028 cm^3 (recommended by CIPM, 1950).
Inch	(in)	0·0254 m, 2·54 cm.
Pound (avdp.)	(lb)	0·453 592 37 kg, 453·592 37 g.

TABLE 2

Adjusted Values of Constants

Constant	Symbol	Value	Est‡ error limit	Unit: Systeme International (MKSA)		Centimeter-gram-second (CGS)	
Speed of light in vacuum	c	2·997925	3	X10^8	m s^{-1}	X10^{10}	cm s^{-1}
Elementary charge	e	1·60210	7	10^{-19}	C	10^{-20}	cm$^{\frac{1}{2}}$ g$^{1/2}$*
		4·80298	20	—	—	10^{-10}	cm$^{3/2}$ g$^{1/2}$s^{-1}†
Avogadro constant	N_A	6·02252	28	10^{23}	mol^{-1}	10^{23}	mol^{-1}
Electron rest mass	m_e	9·1091	4	10^{-31}	kg	10^{-28}	g
		5·48597	9	10^{-4}	u	10^{-4}	u
Proton rest mass ..	m_p	1·67252	8	10^{-27}	kg	10^{-24}	g
		1·00727663	24	10^{0}	u	10^{0}	u
Neutron rest mass	m_n	1·67482	8	10^{-27}	kg	10^{-24}	g
		1·0086654	13	10^{0}	u	10^{0}	u
Faraday constant ..	F	9·64870	16	10^{4}	C mol^{-1}	10^{3}	cm$^{\frac{1}{2}}$ g$^{1/2}$ mol^{-1}*
		2·89261	5	—	—	10^{14}	cm$^{3/2}$g$^{1/2}$ mol^{-1}†
Planck constant ..	$\hbar\kappa$	6·6256	5	10^{-34}	Js	10^{-27}	erg s
	h	1·05450	7	10^{-34}	Js	10^{-27}	erg s
Fine structure constant	α	7·29720	10	10^{-3}	—	10^{-3}	
	$1/\alpha$	1·370388	19	10^{2}	—	10^{2}	
	$\alpha/2\pi$	1·161385	16	10^{-3}	—	10^{-3}	
	α^2	5·32492	14	10^{-5}	—	10^{-5}	
Charge to mass ratio for electron ..	e/m_e	1·758796	19	10^{11}	C kg^{-1}	10^{7}	cm $^{\frac{1}{2}}$g$^{-1/2}$*
		5·27274	6	—	—	10^{17}	cm$^{3/2}$g$^{-1/2}$s^{-1}†
Quantum-charge ratio	h/e	4·13556	12	10^{-15}	JsC^{-1}	10^{-7}	cm$^{3/2}$g$^{1/2}$s^{-1}*
		1·37947	4	—	—	10^{-17}	cm$^{\frac{1}{2}}$g$^{\frac{1}{2}}$†

‡Based on 3 std. dev.; applied to last digits in preceding column.

*Electromagnetic system.

†Electrostatic system.

C—coulomb J—joule Hz—hertz W—watt N—newton T—tesla G—gauss.

Table II—contd.

Constant	Symbol	Value	Est.‡ error limit	Unit: System International (MKSA)		Unit: Centimeter-gram-second (CGS)	
Compton wave-length of electron	λc	2·42621	6	10^{-12}	m	10^{-10}	cm
	$\lambda c/2\pi$	3·86144	9	10^{-13}	m	10^{-11}	cm
Compton wave-length of proton	$\lambda c, \upsilon$	1·32140	4	10^{-15}	m	10^{-13}	cm
	$\lambda c, \upsilon 2\pi$	2·10307	6	10^{-16}	m	10^{-14}	cm
Rydberg constant	R_{co}	1·0973731	3	10^{7}	m^{-1}	10^{5}	cm^{-1}
Bohr radius ..	a_o	5·29167	7	10^{-11}	m	10^{-9}	cm
Electron radius ..	r_e	2·81777	11	10^{-15}	m	10^{-13}	cm
	r^2_e	7·9398	6	10^{-30}	m^2	10^{-26}	cm^2
Thomson cross section	$8\pi \gamma^2 e/3$	6·6516	5	10^{-29}	m^2	10^{-25}	cm^2
Gyromagnetic ratio of proton ..	γ	2·67519	2	10^{8}	rad $s^{-1}T^{-1}$	10^{4}	rad $s^{-1}G^{-1}$*
	$\gamma/2\pi$	4·25770	3	10^{7}	HzT^{-1}	10^{3}	$s^{-1}G^{2}$*
(uncorrected for diamagnetism, H_2O)	γ^1	2·67512	2	10^{8}	rad $s^{-1}T^{-1}$	10^{4}	rad s^{-1}/G^{-1}*
	$\gamma^1/2\pi$	4·25759	3	10^{7}	Hz T^{-1}	10^{3}	s^{-1} G^{-1}*
Bohr magneton ..	μB	9·2732	6	10^{-24}	JT^{-1}	10^{-21}	erg G^{-1}*
Nuclear magneton..	μN	5·0505	4	10^{-27}	JT^{-1}	10^{-24}	erg G^{-1}*
Proton moment ..	μ_p	1·41049	13	10^{-26}	JT^{-1}	10^{-23}	erg G^{-1}*
	$\mu^1 p/\mu_N$	2·79276	7	10^{0}	————	10^{0}	
(uncorrected for diamagnetism, H_2O)		2·79268	7	10^{0}	————	10^{0}	
Anomalous electron moment corrn ..	$\mu e/\mu_o$-1	1·159615	15	10^{-3}	————	10^{-3}	
Zeeman splitting constant	$\mu B/hc$	4·66858	4	10^{1}	$m^{-}T^{-1}$	10^{-5}	cm^{-} G^{-1}*
Gas constant ..	R	8·3143	12	10^{0}	J°K^{-1} mol^{-1}	10^{7}	erg °$K^{-1}mol^{-1}$
Normal volume perfect gas ..	V_o	2·24136	30	10^{-2}	$m^3 mol^{-1}$	10^{4}	cm^3 mol^{-1}
Boltzmann constant	k	1·38054	18	10^{-23}	J°K^{-1}	10^{-16}	erg °K^{-1}
First radiation constant ($2\pi hc^2$) ..	C_1	3·7405	3	10^{-16}	Wm^2	10^{-5}	erg cm^2 s^{-1}
Second radiation constant	C_2	1·43879	19	10^{-2}	m°k	10^{0}	cm °K
Wien displacement constant	b	2·8978	4	10^{-3}	m°k	10^{-1}	cm °K
Stefan-Boltzmann constant	σ	5·6697	29	10^{-8}	Wm^{-2}°K^{-4}	10^{-5}	erg cm^{-2} s^{-1}°K^{-4}
Gravitational constant	G	6·670	15	10^{-11}	N m^2kg^{-2}	10^{-8}	dyn cm^2g^{-2}

‡Based on 3 std. dev.; applied to last digits in preceding column.

*Electromagnetic system. Electrostatic system.

C—coulomb J—joule Hz—hertz W—watt N—newton T—tesla G—gauss

TABLE III
Energy Conversion Factors

	Formula	Factor	Error limit	Conversion: Systeme International (MKSA)		Conversion: Centimeter-gram-second (CGS)	
Electron-volt ..	eV	1·60210	7	X10^{-19}	$J(eV)^{-1}$	X10^{-12}	erg $(eV)^{-1}$
Energy associated with							
Unified atomic mass unit ..	c^2/Ne	9·31478	15	10^{8}	eV u^{-1}	10^{8}	eV u^{-1}
Proton mass ..	m_pc^2/e	9·38256	15	10^{8}	$eVmp^{-1}$	—10^{8}	$eVmn^{-1}$
Neutron mass ..	m_nc^2/e	9·39550	15	10^{8}	eV mn^{-1}	10^{8}	eV mn^{-1}
Electron mass ..	m_ec^2/e	5·11006	5	10^{5}	eV me^{-1}	10^{5}	eV me^{-1}
Cycle	e/h	2·41804	7	10^{14}	$Hz(eV)^{-1}$	10^{14}	$s^{-1}(eV)^{-1}$
Wavelength ..	ch/e	1·23981	4	10^{-6}	eV m	10^{-4}	eV cm
Wave number ..	e/ch	8·06573	23	10^{5}	$m^{-1}(eV)^{-1}$	10^{3}	cm^{-1} $(eV)^{-1}$
°K	e/k	1·16049	16	10^{4}	°K $(EV)^{-1}$	10^{4}	°K $(eV)^{-1}$

of the correlation among the elemental constants introduced by the least-squares adjustment (*see* ref. Du Mond and Cohen). The values are based upon the assumption that the acceleration of gravity is correctly given by adding −0·013 gal to the value of g given in the Potsdam system. All the values where pertinent are referred the unified system of atomic mass in which the atomic mass of the atom of the nucllde ^{12}C is assigned ,the numerical value 12 exactly. Symbols recommended by the Commission on Symbols, Units, add Nomenclature (SUN Commission) of the international Union of Pure and Applied Physics, are employed. (*See* June 1962 Physics Today.)

[1] A wallet-size card presenting recommended values of selected physical constants may be obtained upon request from the Office of Technical Information, National Bureau of Standards, Washington, D.C. 20234.

Metric System in Industry

THE Government of India have recently announced a series of important steps to introduce the metric system in production of industrial equipment and designs of products.

The Standards of Weights and Measures Act, 1956 which provides for the adoption of the metric system in the country, has been fully brought into force. The metric system is the only system which the law recognises for transactions of any kind. It has come into almost exclusive use in trade, retail as well as wholesale, as well as in transactions by the Railways, Post Offices and Industrial Undertakings. A substantial beginning has yet to be made, however, in adopting the metric system in the design of products an e.uipment of industry.

Much preparatory work had been done to facilitate the adoption of the metric system in design in industry. Indian standards based on the metric system are available for all important materials used in industry as well as for tools and measuring instruments. Indian manufacturers are able and willing to produce materials, tools and instruments according to these standards. Almost the entire production of steel sections in the country is now in standard millimetre sizes. Manufacturers of fasteners have agreed to all demands for fasteners conforming to Indian Standards. Manufacturers of measuring instruments and tools are able and willing to meet all reasonable demands for instruments calibrated in metric units, and tools in metric sizes. The metric system has been adopted at all stages of instruction, in engineering colleges and other higher technical institutions. It should, therefore, be possible to make a substantial beginning in the manufacture of instruments, tools and other equipment designed on the metric system, within the next two years. In view of this progress the Government of India has now laid down the following policy for the change-over in industries within the next two years.

1. New Industrial Enterprises

In all licences for setting up new industrial enterprises to start production on or after 1-4-1966, a condition will be imposed that both the products and, to the extent possible, the machinery installed, should be of metric system design.

2. Existing Industrial Undertakings

Existing undertakings will be advised to re-design their products in the metric system. The aim will be to complete the task and to start production according to the revised designs by 1-4-1966. A longer period of preparation will be allowed if for special reasons, it is considered absolutely necessary. Even in such cases, the dimensions must be expressed in metric units, by exact conversion. Arrangements will be made to meet essential demands for spares and accessories designed on the foot pound system, for the maintenance of existing equipment.

3. Small Scale Industry

The Development Commissioner, Small Scale Industries (DCSSI) will advise undertakings in small scale industry to be prepared by 1-4-1966, to meet demands from large industry for components and accessories designed in the metric system. While granting assistance of any kind, financial or technical, the Department will draw the attention of the managements to the necessity to re-design all products and to provide themselves with tools and instruments to manufacture according to the revised designs. All officials under the DCSSI will be instructed accordingly. All training imparted by the Department will be based on the metric system.

4. Purchase of Stores for Government Departments

The Directorate General of Supplies and Disposals will request all indenting departments to give, in all indents, dimensions for machinery, spares, components and stores of various kinds in metric units. It is illegal to use the inch or the pound, in documents connected with purchases, sales or other transactions of any kind.

Weighing and Measuring Instruments in Textile Mills

WEIGHTS, measures and weighing and measuring instruments used in transactions for trade or commerce are subject to regulation by States. Those used in industry for purposes connected with purchase or sale of commodities, assessment of output for determination of wages or duties payable to the State, etc., must be verified by Government Inspectors of Weights and Measures annually. When they are used for purely technical and scientific purposes they are not subject to any such control.

A Study Group appointed by the Central Government, has classified the following weighing and measuring instruments used in the different departments, in cotton mills, as those serving a commercial purpose and hence subject to regulation.

Mill Gates

Weigh bridges at the mill gates, on which raw materials, fuels, etc., brought into the mill as well as finished products sent out of the mill, are weighed. Purchases and sales take place on the basis of these weighments.

Cotton and Waste Godowns

Scales in the cotton and waste godowns which are used in the purchase of cotton or sale of waste.

Carding and Ring Departments

Hank indicators on the drawing and speed frames in the Carding and Ring Departments. These indicators are used in assessing output for payment of wages.

Ring Department

Scales used in the Ring Department for weighing yarn for sale or for assesssing the output of winders for the payment of wages or bonuses.

Reeling Department

Scales used in the Reeling Department for weighing bundles of yarn. These weighments form the basis of sales as well as payment of wages to reelers.

Winding Department

Scales used in the Winding Department for weighing cones for sale as well as for assessing winders' production.

Warping Machines

Yardage indicators of the warping machines. These indicate the output of warpers for payment of wages and bonuses.

Sizing Department

Scales in the Sizing Department in mills which sell yarn on sized beams.

Weaving Shed

Pick counters on the looms, in mills where pick counters are used for assessing weaver's output for payment of wages.

Grey and Finished Folding Department

Scales on the Grey and Finished Folding Department used for weighing fents, chindies, and rags which are generally sold by weight. Where grey cloth is sold by weight, scales used for this purpose must also be brought under State regulation.

Folding Machines.

Stores Department

Scales used in the Stores.

Canteen and Grain Shop

All scales used in the Canteen and Grain Shops, in the purchase or sale of materials.

Studies would be made to devise efficient methods for the verification of hank indicators, yardage indicators, pick counters and folding machines.

Non-Commercial

Scales used in blow room, mixing room carding department, the sizing department for mixing the size ingredients, in the processing department for big weighing chemicals and dyestuffs, and in the laboratories, are not subject to regulation by the State, since they do not serve any commercial purpose.

Devnagri Abbreviations for Metric Units

ABBREVIATIONS for metric units recommended by the General Conference of Weights and Measures in 1960 were published in '*Metric Measures*', September 1961.

The Commission on Scientific & Technical Terminology of the Government of India has suggested terminology complete as well as abbreviated, for use in Indian languages. These are reproduced below:

Terminology in Indian languages for metric units of measurement

English		Devnagri (or other Indian scripts)	
Term	Abbreviation	Term	Abbreviation
Micro	M	माइक्रो	मा
Milli	m	मिलि	मि
Centi	c	सेन्टि	से
Deci	d	डेसि	डेसि
Deca	da	डेका	डेका
Hecto	h	हैक्टो	हे
Kilo	k	किलो	कि
Mega	M	मेगा	मेगा

Length

English		Devnagri (or other Indian scripts)	
Term	Abbrevation	Term	Abbreviation
Micron (Micro-metre)	Mm	माइक्रोन	मामी
Millimetre	mm	मिलिमीटर	मिमी
Centimetre	cm	सेन्टिमीटर	सेमी
Decimetre	dm	डैसिमीटर	डेसिमी
Metre	m	मीटर	मी
Decametre	dam	डेकामीटर	डेकामी
Hectometre	hm	हैक्टोमीटर	हेमी
Kilometre	km	किलोमीटर	किमी
Megametre	Mm	मेगामीटर	मेगामी

Area

English		Devnagri (or other Indian scripts)	
Term	Abbreviation	Term	Abbreviation
Square millimetre	mm^2	वर्ग मिलिमीटर	मिमी^{2}, वर्ग मिमी
Square centimetre	cm^2	,, सेन्टिमीटर	सेमी^{2}, वर्ग सेमी
Square decimetre	dm^2	,, डेसिमीटर	डेसिमी^{2}, वर्ग डेसिमी
Square metre	m^2	,, मीटर	मी^{2}, वर्ग मी
Square decametre	dam^2	,, डेकामीटर	डेकामी^{2}, वर्ग डेकामी
Square hectometre	hm^2	,, हेक्टोमीटर	हेमी^{2}, वर्ग हेमी
Square kilometre	km^2	,, किलोमीटर	किमी^{2}, वर्ग किमी
Square megametre	Mm^2	,, वर्ग मेगामीटर	मेगामी^{2}, वर्ग मेगामी

Volume

English		Devnagri (or other Indian scripts)	
Term	Abbreviation	Term	Abbreviation
Cubic millimetre	mm^3	घन मिलिमीटर	मिमी^{3}, घन मिमी
Cubic centimetre	cm^3	,, सेन्टिमीटर	सेमी^{3}, घन सेमी
Cubic decimetre	dm^3	,, डेसिमीटर	डेसिमी^{3}, घन डेसिमी
Cubic metre	m^3	,, मीटर	मी^{3}, घन मी
Cubic decametre	dam^3	,, डेकामीटर	डेकामी^{3}, घन डेकामी
Cubic kilometre	km^3	,, किलोमीटर	किमी^{3}, घन किमी
Cubic megametre	Mm^3	,, मेगामीटर	मेगामी^{3}, घन मेगामी

Weight

Term	English Abbreviation	Devnagri (or other Indian scripts) Term	Abbreviation
Microgram	Mg	माइक्रोग्राम	माग्रा
Milligram	mg	मिलिग्राम	मिग्रा
Centigram	cg	सेन्टिग्राम	सेग्रा
Decigram	dg	डेसिग्राम	डेसिग्रा
Gram	g	ग्राम	ग्रा
Decagram	dag	डेकाग्राम	डेकाग्रा
Hectogram	hg	हेक्टोग्राम	हेग्रा
Kilogram	kg	किलोग्राम	किग्रा, किलो
Quintal	q	क्विन्टल	क्वि
Megagram	Mg	मेगाग्राम	मेगाग्रा
tonne	t	टन	ट

Capacity

Term	English Abbreviation	Devnagri (or other Indian scripts) Term	Abbreviation
Millilitre	ml	मिलिलीटर	मिली
Centilitre	cl	सेन्टिलीटर	सेली
Decilitre	dl	डेसिलीटर	डेसिली
Litre	l	लीटर	ली
Decalitre	dal	डेकालीटर	डेकाली
Hectolitre	hl	हेक्टोलीटर	हेली
Kilolitre	kl	किलोलीटर	किली
Megalitre	Ml	मेगालीटर	मेगाली

Land Area

Term	English Abbreviation	Devnagri (or other Indian scripts) Term	Abbreviation
Centiare	ca	सेन्टिआर	सेआ
Are	a	आर	आ
Hectare	ha	हेक्टार	हेआ

Note:

(*i*) The Devnagri abbreviations are to be used only in trade, elementary education and in popular books.

(*ii*) For all other purposes *i.e.* in secondary and higher education, in Scientific and Technical text books & other literature etc. only the *international abbreviations* should be used.

News & Views

New Packages for Salt from 1 July 1960

A meeting of representatives of salt industry and trade, convened by the Ministry of Industry to consider the introduction of uniform packages in the salt industry has recommended that, from 1 July 1964, salt should be packed only in bags of the capacities 40 kg, 75 kg and 100 kg. 80 kg bags, which are currently in vogue will not be permitted beyond 30 June 1964. Special varieties of salt like table salt and dairy salt may be packed in bags of 50 kg.

Naya Paisa to Become Paisa

From 1 June 1964, the *naya paisa* will be designated *paisa.* The naya paisa coins in circulation will continue to be legal tender. The text of the Indian Coinage (Amendment) Act, No. 17 of 1964, is given below :

THE INDIAN COINAGE (AMENDMENT) ACT, No. 17 of 1964

An

Act

further to amend the Indian Coinage Act, 1906.

Be it enacted by Parliament in the 'Fifteenth Year of the Republic of India as follows :—

Short title and commencement

1. (1) This Act may be called the Indian Coinage (Amendment) Act, 1964.

(2) It shall come into force on the 1st day of June, 1964.

Amendment of section 13

2. In section 13 of the Indian Coinage Act, 1906 (hereinafter referred to as the principal Act), after sub-section (3), the following sub-section shall be inserted namely :—

"(4) All new coins in the *naya paisa* series, designated as such under the notification of the Government of India in the Ministry of Finance, Department of Economic Affairs, No. S.R.O. 1120, dated 11th May, 1956 which may have been issued under this Act prior to the commencement of the Indian Coinage (Amendment) Act, 1964, shall continue to be a legal tender in payment or on account,—

(*a*) in the case of a half-rupee or fifty naye paise coin, for any sum not exceeding ten rupees ;

(*b*) in the case of any other coin, for any sum not exceeding one rupee."

Amendment of section 14

3. In section 14 of the principal Act, after sub-section (3), the following sub-section shall be inserted, namely :—

"(4) As from the commencement of the Indian Coinage (Amendment) Act, No. 17 of 1964, all references in any enactment or in any notification, rule or order under any enactment or in any contract, deed or other instrument to any value in naya paisa or naye paise shall be construed as references to that value expressed respectively in paisa or paise, being the new coins designated as such from 1st day of June, 1964."

Standards News

(Indian Standards which have a particular bearing on the change-over to the metric system are indicated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi or their Branch Offices at Bombay, Calcutta and Madras).

Indian Standard for Single Faced Sluice Gates [(Doc : BDC—3 (745)]

The Indian Standards Institution has prepared draft Indian Standard Specification for Single Faced Sluice Gates (100 to 1,200 mm sizes) [Doc: BDC 3(745)], which covers single faced sluice gates from 100 to 1,200 mm sizes of different shapes with sliding and rotating spindle.

Single faced sluice gates are extensively used in water supply and drainage works. The consuming department do not have at present any standards on which they can base their requirements. The standard which is intended to fulfil the need, gives the dimensions, materials and constructional requirements for two classes of single faced sluice gates from 100 to 1,200 mm sizes.

The draft standard will shortly be circulated to all interests concerned, for eliciting technical comments.

Indian Standard for Glass Milk Bottles [Doc : AFDC 12 (331)]

The Indian Standards Institution has prepared draft Indian Standard Specification for Glass Milk Bottles [Doc : AFDC 12 (331)] (revision of IS: 1392—1959). This draft revision specifies the requirements for glass milk bottles of 1 litre, 500 ml, 250 ml and 200 ml capacities. In the revised draft 200 ml bottle has been included in view of its use, particularly for supply of milk to school children.

The draft standard will shortly be circulated to the interested manufacturers, consumers and technologists for eliciting technical comments.

Steel Drums (Galvanized and Ungalvanised) (IS : 2552—1963)

The Indian Standards Institution has published Indian Standard Specification for Steel Drums (Galvanized and Ungalvanized) IS: 2552—1963), which covers the requirements for a range of galvanized and ungalvanized steel drums up to 150-litre nominal capacity in 13 sizes.

The Indian Standards Institution had issued IS: 442—1954 Specification for Drums for Paints and IS: 618—1956 Specification for Kegs (Open Top Drums) for Paints, for the exclusive use of the paints industry. In 1960, the position was reviewed and it was decided to draw a more comprehensive specification for drums and kegs for use in paints and other industries as well, in the form of IS: 1549—1960 Specification for Steel Drums and Kegs (Galvanized and Ungalvanized) which superseded the earlier two specifications mentioned above. In that standard an attempt was made to rationalize the sizes of drums and kegs manufactured in the country, based on the principle that the standard on metal containers should specify them by volume and not by the weight of material packed in them. Fifteen preferred sizes ranging from 1 to 150 litres were specified in a preferred range of diameters to meet all requirements. In addition to these, a set of non-preferred diameters was also given in order to assist the industry in effecting a smooth changeover.

The Committee responsible for the preparation of this standard recently reviewed IS: 1549—1960 and felt that there should be two separate Indian Standards, one dealing with drums and the other with kegs, as the constructional details and test requirements of these two types of containers are widely different. This standard, therefore, covers drums only and partly supersedes IS: 1549—1960. A separate Indian Standard on kegs and open top drums is under preparation. Further, all requirements relating to closures have been omitted in this standard and a reference is given to the more comprehensive IS: 2474—Specification for Closures for Drums.

Price : Rs. 2·00

Road Milk Tankers (IS : 2492—1963)

The Indian Standards Institution has published Indian Standard Specification for Road Milk Tankers (IS: 2492—1963), which prescribes the requirements for tanks and tank fittings for road milk tankers.

The tanks of road milk tankers are used to transport by road precooled milk, ice cream mix and other fluid milk products in bulk from milk collecting centres to dairies and from one processing plant to another. The tank shall be designed for mounting on trucks or built as a semi-trailer. Precooled milk and milk products are held in these tanks within required temperature limits for long hauls. The capacity and the type of the transportation tank has to be decided by each dairy or processing plant depending on the volume of the dairy products to be moved and the distance to be covered, the weather conditions and the road regulations.

Price Rs. 1·50

Bright Bars for Threaded Components (IS : 2517—1963)

The Indian Standards Institution has published Indian Standard Specification for Bright Bars for Threaded Components (IS: 2517—1963), which covers the sizes and tolerances of Bright bars for the manufacture of threaded components.

While special consideration has been given to cover round and hexagonal bright-bars required for the threaded fastener industry, the requirements regarding square bars have not been included in this standard as they are not used in the threaded fastener industry to any appreciable quantities. However, the sizes of square bars shall conform to those given is IS: 2073—1962 Specification for Steel Bars for Production of Machined Parts for General Engineering Purposes. These sizes are given in Appendix for information.

Price : Re. 1·00

Diameters of Wrought Aluminium and Aluminium Alloys Wire (IS : 2525—1963)

The Indian Standards Institution has published an Indian Standards Diameters of Wrought Aluminium and Aluminium Alloys, Wire (IS: 2525—1963), which lays down diameters and tolerances on the diameters for wrought aluminium and aluminium alloys in the form of wire.

The decision of the Government of India to adopt the metric system of weights and measures makes it essential that the sizes of metal products should be standardized in metric units. Uptil now, in trade and technology, the diameters of wire were expressed in terms of various wire gauges used in the countries following fps system of weights and measures, for example, BG (Birmingham Gauge), SWG (Standard Wire Gauge), etc. The necessity for evolving a series of diameters of wire has been felt by all concerned. Accordingly, the Sectional Committee concerned decided to base it on IS: 1137—1959. Thickness of Sheet and Diameters of Wire, which lays down the basic diameters of wire in millimetres and which is now accepted in the trade.

This standard is one of a series of Indian Standard Specifications on wrought aluminium and aluminium alloys. Standards covering dimensions for wrought aluminium and aluminium alloys, sheet and strip, plate, drawn tube, and extruded tube are under preparation.

Price : Re. 1.00

Indian Standard Specification for Jute Bags for Packing Cement (IS : 2580—1963)

The Indian Standards Institution has published Indian Standard Specification for Jute Bags for Packing Cement (IS : 2580—1963), which prescribes the constructional details and other particulars of double warp heavy Cee jute bags for packing cement of dimensions 710×480 mm (or 28 ×19 in.).

The question of packing cement suitably has been under consideration of all the manufacturers for the past several years. In view of the fact that bags filled with cement are usually subjected to rough handle during transit and storage, it was found necessary to have packing which would satisfactorily withstand these normal hazards. It is expected that jute bags conforming to this specification would meet this demand.

Price : Rs. 3·00

Indian Standards Specification for Asbestos Cement Building Boards (IS : 2098—1964)

The Indian Standards Institution has published Indian Standard Specification for Asbestos Cement Building Boards (IS: 2098—1964), which lays down the requirements regarding composition, dimensions and tests of asbestos cement building boards.

Asbestos cement building boards find wide application in building industry because of their lightness and flexibility combined with adequate strength. They are mainly used as interior fittings where no load or little load comes on them, such as partitions, false ceilings, almirah panelling dado works, etc. It is important to note that asbestos cement building boards are different from the asbestos cement flats and slates and they are not intended for exterior use. In general, these boards can be worked with ordinary wood working tools.

Price : Rs. 2·00

Licensed Manufacturers and Repairers

(*Metric Measure* has been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A feature on statistics of verification and licences issued is also being published in *Metric Measures*).

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENCES

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Others	Total number of Mfrs. as on 1st day of....	Total number of Dealers as on 1st day of....	Total number of Repairers as on 1st day of....
(1) Andhra Pradesh	1st Oct. '62 to 31 March '63	2,00,101	64,362	6,408	21,747	527	26	14	59	24
(2) Assam ..	1st Dec. '63 to 31st Jan. 64	4,03;260	29,578	7,607	774	24	—	17	22,	14
(3) Bihar ..	1 Apr. '62 to 31 Jan. '63	1,28,211	—	—	19,309	56	—	30	203	43
(4) Gujarat	1 Oct. to 30 Nov. '63	1,98,980	17,977	1,480	24,197	127	13	108	574	145
(5) Kerala ..	1 Apr. '62 to 31 July '62	—	—	—	—	—	—	73	459	142
(6) Jammu & Kashmir	1 Dec. '63 to 31 Jan. '64	5,849	174	579	1,079	1	—	8	171	10
(7) Madhya Pradesh.	—	—	—	—	—	—	—	—	—	—
(8) Madras	—	—	—	—	—	—	—	—	—	—
(9) Maharashtra	1 Apr. '62 to 31 Mar. '63	1,874,286	5,37,135	33,988	—	—	—	—	—	—
(10) Mysore	1 Apr. '62 to 31 Nov. '62	4,81,354	105,253	1,037	59,674	8,420	126	126	493	92
(11) Orissa ..	1 Apr. '62 to 31 Mar. '63	4,23,597	86,060	3,089	1,596	2	—	8	103	6
(12) Punjab	1 Oct. '63 to 31 Jan. '64	2,59,101	19,674	6,079	53,515	159	—	1	3	2
(13) Rajasthan	N.A.	—	—	—	—	—	—	—	—	—
(14) Uttar Pradesh.	1 June to 30 Nov. '62	8,95,335	8,897	20,506	7,505	278	—	200	979	187
(15) West Bengal.	up to 4-4-64	4,682,236	67,330	15,226	261,783	—	—	—	—	—
(16) A&N Islands.	N.A.	—	—	—	—	—	—	—	—	—
(17) Delhi ..	1 Oct. to 30 Nov. '63	41,094	4,139	1,386	6,028	16	—	26	70	24
(18) Goa ..	1 Apr. to 31 May '62	18	3	—	—	—	—	—	—	—
(19) Himachal Pradesh	1 Apr. '62 to 31 July '63	68,020	7,411	2,532	10,628	1	—	1	25	12
(20) L.M.A. Islands.	1 Apr. '62 to Oct. '63	—	—	—	—	—	—	—	—	—
(21) Manipur	1 Apr. '63 to 31 Dec. '63	19,835	4,115	239	599	8	—	—	—	—
(22) Pondicherry.	1 Feb. '64 to 31 Mar. '64	4,038	1,341	36	21	4	37 (Peg measures)	4	10	5
(23) Tripura	1 Apr. '62 to 30 July '62	62,050	8,464	720	9	8	—	4	85	3

N.A.—Statistics not available as yet.

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METRIC MEASURES, VOL. 7, JULY 1964

ANDHRA PRADESH

Manufacturers of Weights and Measures Licensed from 1-10-62 to 31-3-63.

(1) Adabala Satyanarayana & Sons, Dowlaishwaram, E.G. Dist.

(2) Andhra Ratna Iron Foundry, Near Addanki Gate, Ongole, Guntur Dt.

(3) Andhra Scientific Co. Ltd., Cantonment Road, Masulipatam, Krishna Dt.

(4) Bhagavannarayana Iron Balance Works, Dowlaishwaram, E.G. Dt.

(5) Central Metal Works, (Prop: Sarparaz Khan) 15-1-45 Feel Khana, Hyderabad.

(6) Deccan Porcelain & Enamel Work Ltd., 2707 P.B. No. :3 Bakaram, Mushirabad, Hyderabad.

(7) Durga Foundry Works, Kothawada, Warrangal.

(8) Hilal Consumer Goods, (Prop: Maqsood Ali) Joshiwadi, Begum Bazar, Hyderabad.

(9) Federation of Industrial Co-operative Ltd., Bashirabagh, Hyderabad.

(10) Hyderabad Iron & Steel Works Ltd., P.B. No. 10, Industrial Area, Azamabad, Hyderabad-20.

(11) S. K. Industries, Bakaram, Mushirabad, Hyderabad.

(12) Jayakrishna Iron Industrial Works, Dowlaishwaram, E.G. Dist.

(13) Jamsheed Iron & Steel Co., Siddiamber Bazaar, Hyderabad.

(14) Kanakadurga Iron Works, Jagannayakapur, Kakinada, E.G. Dist.

(15) Marwadi Moulding Factory, Kasaratta Road, Hyderabad.

(16) Misrilal Motilal, Tope Khana-Quadeem, Opp. Osmangunj, Hyderabad.

(17) Majestic Metal Works, Mettikasher, Begum Bazaar, Hyderabad.

(18) Panduranga Engineering & Moulding Works, 13-56-A, Railway Feeder Road, Tadparthi, Anantapur Dist.

(19) Pappu Yerakayya & Sons, Dowlaishwaram E. G. Dist.

(20) Pappu Veeranna & Sons, Dowlaishwaram E.G. Dist.

(21) Saraswathi Iron Balance Works, Dowlaishwaram, E.G. Dist.

(22) Star Metal Works (Prop: Leeladhar Jiv Raj Shah) 14-2-179.

(23) Radha Krishna Iron Safe & Balance Work Shop, Dowlaishwaram, E.G. Dist.

(24) Scientific Engineering House, P. Ltd., Bashirbagh, Hyderabad.

(25) Swami Alivelu Industries, Prop: Mangina Sarvarayudu, Lakkavaram P.O., Rajole Tq, E.G. Dist.

(26) Sadananda Engineering Work, No. 1-9-7 Industrial Area, Azamabad, Hyderabad.

(27) Surya Engineering Works, Industrial Estate, Warrangal.

(28) Standard Foundries (Prop: K. L. Vithani), P.B. No. 16, Station Road, Nizamabad, Nizamabad Dt.

(29) Scientific Engineering House P. Ltd. Bashirbagh, Hyderabad.

(30) Taj Industries (Prop. Mohd. Jamaluddin) 5-5-274/7 Behind Gandhi Bhavan, Nampalli, Hyderabad.

(31) Safe Scale Co., 22-6-257, Kalikaman Hyderabad.

(32) S & P Industries, Industrial Estate, Factory Unit, Warrangal.

(33) Venkateswara Iron Works, Dowlaishwaram, E.G. Dist.

(34) Watan Weight Works (Prop. M. A. Rahim), Behind Canara Bank, Pattargatti, Hyderabad.

M38DPD/64—GIPF.

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
		10 grams (g)
(1)	**Gold**	
(2)	**Grocery and Confectionery**	
	Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres	
	Cotton yarn, damaged and seconds cloth, raw silk, rayon silk yarn, raw wool, wool manufactures (when sold by weight).	1 kilogram (kg)
	Paints & Chemicals	
	Paint (if sold by weight), indigo, liquid chlorine.	
	Hides, Skins & Leather	
	Raw hides, leather (hides and skins).	
	Metals	
	Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous	
	Tea, meat, camphor tablets, mica.	
(3)	**Grains and Pulses**	
	Rice, wheat, jowar, arhar, moong, masur, gram.	
	Spices	
	Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products	
	Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products	
	Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres	
	Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes	1 quintal (q) (100 kilograms)
	Vegetable oil, oilseeds, oilcakes.	
	Non-Ferrous Metals	
	Aluminium : ingots, bars, blocks, slabs, billets.	
	Lead : ingots, sheets and strips.	
	Copper : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles.	
	Brass : ingots, rods, sections, pipes, sheets, strips, circles.	
	Zinc : ingots, sheets, strips.	
	Tin : blocks.	
	Chemicals	
	Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others	
	Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals**	
	Iron ore, manganese ore, bauxite, coal.	one metric tonne (t) (1,000 kilograms)
	Iron & Steel	
	Pig iron, iron & steel manufactures, semis (billets for rerolling etc.)	
(5)	Cloth (mill, handloom, silk rayon and woollen cloth)	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i. e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure, use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 10 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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