When one considers, moreover, the records of the great migration which heralded the arrival of the Philistines upon the threshold of Egypt in the reign of Rameses III, and takes into account the episodes of the movement, the long, struggling, adventurous journey around the coast, it would not be surprising to find little or nothing in the earliest strata of Philistine occupation to represent the culture of their homeland, unless it were their arms which they would not relinquish and which were not subject to ordinary accidents. It is the contact re-established after settlement, and the coming of fresh settlers of their kind, that would leave more common traces. Consequently it is possible that our earliest material is not the most distinctive. If, however, tombs of the early Philistines can be found with some good examples of their armour, we shall add greatly to the essential element of our evidence. We can also proceed at once to determine by soundings the area of Philistine occupation in successive centuries as indicated by the distribution of their remains already identified; and in the course of this investigation over a more extended field we may hope for some new material clues which may be recognized and followed up with increasing prospect of success.

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## NOTES ON ANCIENT WEIGHTS AND MEASURES.

By Major-General Sir Charles Warren, G.C.M.G., K.C.B., F.R.S., etc.

The publication by Mr. Pilcher of Mr. Raffaeli's bronze weight from Petra (*Q.S.*, April, pp. 71–73) suggests a reconsideration of some of the problems of ancient weights and measures, in particular that of the use of the multiple of 7.

Without a fixed standard for comparison, weights and measures in the past would be of little value to us; but with one standard all over the world, running on through the ages, they form an accurate record connecting our present-day operations with prehistoric times. We do possess, though inadequately recognised, an absolutely accurate standard of comparison, by which our weights and measures can be tested; but though recognised, it has hitherto been made little use of. Even the highest authorities who have written on weights and measures appear to be hopelessly at variance, and differ greatly in their results, but this is only apparent.

In fact, the best authorities closely agree, and their differences are due to their studying weights and measures at different times in history, in different parts of the world, and amongst different races. With a knowledge of the correct standard of comparison, it will be found that all these differences can be synchronised. Throughout the ages, until the time of the Roman Empire, all weights and measures were arranged on fixed principles and in fixed proportions one to another. They were regarded as a sacred trust, and nations venerated the national systems of their rivals, knowing that for trade purposes and tribute their fixed ratios must be maintained.

There were originally only three systems, which are still in use in a modified form, and they owed their existence to the methods of computation of original peoples. (1) The development of numbers by 4 and 5, adopted by Aryan and northern races in Asia and Europe, led to the use of the so-called Euboic system in Greece, Egypt, and China, giving us the pint, gallon, bushel, and quarter. (2) The use of 3, 4, and 5 as multiples gave us the Eginetan or sexagesimal system, and the double cubit cubed, the Artaba and the Log. (3) The Sumerian system, taking 6/7ths of the double cubit cubed, gave us the cubic metre (almost the same as in the modern metrical system), the double pound of 60 cubic inches, and the cubic inch of 250 grains Troy.[1] These three systems developed and struggled with each other in the hands of rival nations, the northern races by force constantly imposing their primitive system on the more elaborate and scientific systems of the Babylonians.

In order to prove that all the weights and measures of the world, up to the time of the Roman Empire, were derived from one source and standard, *the diameter of the earth*, we will consider the circular measures most familiar to us, namely, latitude and

[1] All inches mentioned are Imperial inches unless otherwise stated.

longitude, and the divisions of the great circle into degrees, minutes, seconds, and feet. We are all so familiar with these that we forget their immense antiquity. We know that we have derived them from the Greeks, but we are apt to forget that we get them through the Greeks from the Eastern Babylonians, who evolved them at a very remote period, when the grain of barley took the place of the Rati and the numeral 3 was introduced as a multiple, at least 3,000 years B.C.

Aristotle has related (*c.* 330 B.C.) that the most early measures of the earth's circumference (earlier than the sexagesimal system) were adopted by Thales, in Greece, from the Babylonians (*c.* 600 B.C.); Aristotle himself received the Babylonian records of the sexagesimal system from Babylonia about 330 B.C. This was nearly one hundred years before Eratosthenes of Cyrene measured an arc of the meridian from Syene to Alexandria (*c.* 220 B.C.). It is clear then that in the early days of the Greeks the lengths of a degree and consequently of a Stade and foot were known, and the circumference of the earth could be computed, just as we can compute it now if we know the length of a Greek Stade or Greek foot.

Of the many computations of the Stade (600 Greek feet) and of the Greek foot by experts, from remains in Greece and elsewhere, I take that of Philip Smith, given in W. Smith's "Greek and Roman Antiquities." He shows that the Greek and Roman feet were in the proportion of 25 : 24, and thus obtains his results from both Greek and Roman remains; and he arrives at the conclusion that the Greek foot was 12·145 inches, and the Greek Stade 606¾ English feet, or 7,281 inches. There is so little difference between his results and those of other experts that they may be said to agree. The length of the Stade, I have also obtained by deductive analysis, is 7,275 inches (difference 1 in 1,000). Now the Stade being 1/10th of a minute of arc, we can compute a great circle of latitude of the earth as 15,714,000,000 inches, and by use of 22/7 for $\pi$ we have a result of 499,990,000 inches for the polar diameter of the earth.

The subject of the length of the diameter of the earth as known to the ancients has occupied the astronomers for many years past. Sir John Herschel, in 1869, pointed out that if the polar axis of the earth was divided into 500,000,000 geometrical units or inches, the geometrical inch would be to the Imperial inch as 999 to 1,000, and Mr. Piazzi Smyth pointed out in 1890 that the earth's axis of rotation measures 500,500,000 Imperial inches. It will be seen then that the measures of Greece and elsewhere give to the unit or inch of early days a length almost identical with that of the present day, the difference being 1 in 1,000. We may assume then that in the weights and measures of the ancients the diameter of the earth was used as their standard and the inch as their unit of measure. We may now probe still further into the past, to the beginning of the establishment of sexagesimal measures, but before the circle was divided into 360 degrees.

We have the statement of Aristotle that the early measure of the circumference of the earth was 400,000 Stades, so that each quadrant was divided into 100,000 Stades of 3,928·5 inches, or 10 million double cubits of 39·285 inches, as in the metrical system; the Babylonian to the modern metre being as 39·285 : 39·370. Aristotle also refers to 1,111 Stades to a degree. This number (of 1,111) marks the change from the (80) and (100) systems of the Euboic to the (60) system of the Eginetan :—$400 \times 1{,}000 = 400{,}000$ Stades and $360 \times 1{,}111 = 399{,}999 = 400{,}000$ Stades. It is therefore apparent that in very early days the circumference of the earth was divided as it is now on the metrical system, and that the double cubit was almost identical with the present metre.

This is confirmed by the excavations of de Sarzec and others in Babylonia.[1] The ancient unit of the Babylonians is given by Prof. Kennedy as 39·250 inches. I make it (from de Sarzec's plan of the Statue of Gudea) as 39·276, and Hommel tells us that this double cubit cubed was divided into 1,000 parts or minas, each weighing a *litre* or about 60 cubic inches of water, just as in the modern metrical measures. Actual weight, 15,600 G.T.

Prof. F. Petrie (art. "Weights and Measures," Ency. Brit.), speaking of the Attic system of measures, says "the best data are the stone slabs each with several standard volumes cut in them." I have no doubt that this was the custom, all over the world, from the earliest times, the furlong or Stade being laid down on buildings as a linear standard, and the volumes cut in stone in the form of Sarcophagi. The most noted and conspicuous measure of ancient times is the Great Pyramid of Gizeh in Egypt. The ancient building cubit is the standard of measure in the King's and Queen Chambers, and the base is in length 220 double

[1] See articles: Babylonia, Money, Weights and Measures (Hastings, Bib. Dict.).

cubits of $41\frac{2}{9}$ or 9,068·8 inches, and the building stones average 70,000 C.I. in volume. For the circumstances under which this volume of 70,000 C.I. arose, see p. 10, *Early Weights and Measures.* It arose out of the exigencies of early numeration, and as it is fixed in stone we have to take it as we find it.

In the method of calculating in early days, without the use of decimals and the Arabic numerals, and with the use of only a limited number of fractions, it was difficult to extract the cube root of or to cube a given quantity accurately. 41·2 cubed is 70,048 C.I., and even now we can get no nearer approach to the cube root of 70,000 with a small fraction than $41\frac{2}{9}$. The ancients, with their octogental system of reckoning with 4 and 5 as multiples, could not get nearer to 70,000 than 69,120. The Babylonians with the additional multiple of 3 approximated much more closely and arrived at 69,984, only 16 short of 70,000. These two amounts are to each other as 80 : 81, and the first is exactly 40 cubic feet and the second exactly 40·5 cubic feet. The first (69,120 C.I.) represents 4 quarters of 8 bushels of 80 pounds of 27 C.I., the bushel being consequently 2,160 C.I. The Winchester bushel being 2,178 C.I. and 2,150 C.I. = 2,164 C.I. (Chaney, *Our Weights and Measures*) and 2,150·42 C.I. (Buchanan). This close approximation shows how carefully our English weights and measures have been preserved. Our old commercial pound of 6,750 G.T. and Tower pound of 5,400 G.T. are exactly correct.

The second volume of 69,984 C.I. has been equally well preserved to recent times. Divided by 27, we have the well-known Babylonian or Alexandrian talent of 2,952 C.I., and by 30 the Artaba of 2,332·8. Petrie gives 2,300 and 2,380 C.I. for very late varieties of the Artaba in the East. All the sub-divisions of the sexagesimal system, the Greek and Roman pounds, are close approximations to those obtained from the double cubit cubed. The most striking approximation is the identity of our cubic yard with two-thirds of the double cubit cubed.

| | |
|---|---|
| Cubic yard ... ... ... | 46,656 C.I. |
| Add $\frac{1}{2}$ (10 Artabas) ... ... | 23,328 C.I. |
| The double cubit cubed ... | 69,984 C.I. |

There is only one point about which there is a discrepancy and that is in the weight of the Troy grain. It has lost about 1 per cent. in weight for at least 2,000 years, and whether this is due to errors, or to some pressure of northern races on Babylon, has yet to be found out. It may be taken as quite certain that the original division was 250 grains Troy to the cubic inch of water, as the ancients could not have calculated 252·5 G.T. to the cubic inch.

So far we have looked upon weights and measures only from the point of view of the inch and its multiples, linear and solid. We must now consider the subject briefly from the point of view of weight in grains, the original weight of ancient people.

The Rati or Gunga seed (wild liquorice) was the first seed used, and is still used as a weight for gold in India and Africa. Ages after this, when corn was grown in the uplands of the East, and in the plains of Babylonia, the grains of wheat and barley came into use and superseded Rati amongst sexagesimal races, but the Rati weights have been used amongst northern races till quite modern times. The proportions (since the inch was established) are 32 Rati = 64 wheat = 48 barley = 54 O.G.T. = 54·54 G.T. This was the universal first weight of the world, the Ducat of Europe, the Veraha or Purana of India.

The elaboration of what now seems so simple a matter occupied my attention for several years, from 1903 to 1910. In *The Ancient Cubit* (1902) I could not get further back in the ancient records, beyond the sexagesimal measures; but when the book was published I saw plainly that there was an ancient *hinterland* of octogintal measures to which records of the past gave no access, and I conceived the idea of beginning at the beginning and working down through the ages just as the ancients did themselves; and I was completely successful. I tried to divest myself of all knowledge, except of woodcraft and the heavens, and assumed two positions, that of the intelligent aboriginal as representing the people, and that of the calculator and observer as representing the Temple Priests.

Starting as an aboriginal I tried various forms of multiples, but could make no progress till I worked by *heaps* (as in the Rhind Papyrus) and with this as the keynote I solved the mysteries. My world in which I located myself was too young for multiples, and I had at first only the numeral 2 to start with. I simply added heap to heap. 2 to 2 = 4, 4 to 4 = 8. 8 to 8 = 16 and 16 to 16 = 32 Rati. This gave us the first small weight, the Veraha or Purana of the East. On we went till we arrived at 512 Rati, and now the business was so laborious that we put the

512 Rati into cubes and cylinders and, being now able to multiply, we doubled the height and radius, thus multiplying by 8 each time. The first result was 4,096 Rati (6,912 Troy grains), a very convenient weight for general use as a pound; again by 8 and 8 and we had 64 pounds, the burden of a man.

Now as a calculator I found that the sum of 4,096 was intolerably tedious, and we (in my two functions) agreed to cut off the 96 and so made 4,000 Rati to a pound. And thus we had arrived at the multiple of 5. About this time we found that a cube or cylinder of water weighing 4,000 Rati was about equal to a cube or cylinder of grain of one-quarter more bulk, and so we elaborated the pint equal to $1\frac{1}{4}$ pounds of water, or 5,000 Rati. In the meantime my colleagues, the calculators, had arrived at the unit of the inch, already mentioned, and it was found that water of the weight of 4,000 Rati just fitted into a 3-inch cube, with a little picking of the seed; and consequently the weight of 5,000 Rati to a pint of water was one-quarter more than 3-inch cube. 80 pounds or 64 pints gave a bushel of 2,160 C.I. and 8 bushel gave a quarter of 17,280 C.I. or 10 cubic feet. And in later times four quarters of 40 cubic feet gave the Aryan double cubit cubed of 69,120 C.I.

We now came to the use of 3 barleycorns to 2 Rati, and we found the pint measures of the Aryan or northern races would not suit the multiple of 3. The cylinder of the quarter (10 feet), equal height and diameter, when quadrupled gave a cylinder of radius and height of 28 inches, and when calculated for volumes brought out 70,000 C.I. (This is due to the use of 50 for diameter of cylinder and 22/7 for $\pi$. See "Early Weights and Measures," p. 10.)

I have already shown that the Aryans and Babylonians could not get nearer to 70,000 than 69,120 and 69,984 C.I. These two volumes were now used as the great units of volume and the progression was downwards. Half quarters, half bushels and half gallons came into use by necessity; the comb, tovit, pottle, and gill. In the sexagesimal systems the double cubit cubed was divided by 27 and 30, yielding the Babylonian or Eginetan talent of 2,592 C.I. (648,000 G.T.) and the Artaba of 2,332 C.I., and dividing the talent of 648,000 G.T. by 100, 80, and 64, we get the Greek pound of 6,480, and others. In the east of Babylonia, as already stated, the Sumerian elaborated another system, 6/7ths of 70,000 C.I., namely, 60,000 C.I., giving the cubic metre and its side of 39·285 inches, as already alluded to.

In all these weights and measures there is no trace of the use of 7 except in 22/7 for $\pi$, and consequently 28 for the length and radius of cylinder.

The early Aryan, Babylonian, and Sumerian systems (existing side by side) were now complete and were introduced into Europe under the names of Euboic, Eginetan, and Phoenician at an early date. But they were disturbed and thrown out of gear in Babylonia by an incursion of northern tribes about 2000 B.C. (see Appendix I). There was also in Assyria, about 1100 B.C. (owing to northern influence) a reduction of the Eginetan Mina or log from 8,100 G.T. to 8,000 G.T.

I can find no use of the multiple 7 in weights and measures till a comparatively late period (2000 B.C.), and then it was forced on the Babylonians or Sumerians as a matter of necessity. But the use of 7 in calculating must have been in use even before the multiple of 3 came in.

(1) In the computation of the cylinder of volume equal to the double cubit cubed, the diameter and height of the cylinder was 28 inches, and the volume was 70,000 C.I., but this arose from the use of 22/7 for $\pi$. From this it is apparent that the use of the cylinder came in after the value of $\pi$ had been changed from the Aryan $(\frac{4}{3})^4$ to the Babylonian (22/7). Petrie points out (*Pyramid of Gizeh*) that the stones of which the Pyramid is built average 70,000 cubic inches in volume. (2) The next use of the numeral 7 was in the Pyramid coffer, whose bulk was 69,984 C.I. and volume of interior space 72,576 C.I., as 27 : 28. I think that the coffer was possibly introduced into the Pyramid about the time of Hammurabi. (3) The first use of the numeral 7 as a multiple by the general public was very late, say after 2000 B.C., when some northern race (possibly the Kassites) overran Babylonia and forced on the people the use of the Euboic pint (see Appendix I). (4) The following appear to be cases where the use of 7 follows from its use in No. 3: (*a*) In Spain a pound of about 7,000 G.T. is found (see Appendix II). (*b*) In India the multiple of 7 under the Moslems was the rule (see Appendix III). (*c*) In Constantinople the Eginetan pound of 6,480 G.T. was converted into the Pois de Marc by adding one-sixth, thus making it exactly equal to the Babylonian pound of same number of grains ($\frac{3}{4}$ Eginetan) (see Appendix I). (*d*) This Paris Pois de Marc of 7,560 G.T. was brought to Paris in the middle ages, and passed on into England as our avoirdupois

weight about A.D. 1400 (see Appendix IV). Subsequently our pound of 6,750 G.T. was raised to 7,000 G.T. (Appendix IV). (*e*) Finally, in the remains of Egypt the Kat of 135 G.T. became 140, and the uten 1,400 G.T. a double pound of 14,000 G.T. (see Appendix V).[1]

## APPENDICES.

### I.

*The Multiple* 7 *in Babylonia.*—Prof. Kennedy (art. "Money," Hastings, Bib. Dict.) gives the Babylonian–Phoenician weight system as in intimate relation to the Egyptian Kat of 140 G.T. (*c.* 2000 B.C.). He instances four Babylonian shekels, three 50 to the mina and one 60 to the mina, as respectively 6/5ths, (2) 9/10ths, and 4/5ths of the Egyptian Ket of 140 G.T. All these minas are 60 to a talent. I have shown elsewhere (*Early Weights and Measures*, Table XXXIX) that these minas are all portions of a revised pint of 5,000 Rati, equal to 8,437 ·5 G.T. in the proportion of 60 (6/5ths), 45 (9/10ths), 50 (9/10ths × 6/5ths), 50 (1), 40 (4/5th), with a reduction of about 0·5 °/$_{\circ}$ to make the amount divisible by 7. So that each mina weighs in grains Troy 140 multiplied by the number of pints of corn in the Table. For example, the talent of 60 pints has a mina of 8,437 ·5 G.T., and thus became 8,400 G.T. (= 60 × 140 G.T.).

The cause of these proportions in the pint talents is quite evident and shows that the invading race was content to take the Babylouian proportions so long as in their minas they had fractions of the pint that they could comprehend.

It is evident that on the arrival of the northern invaders there were the following talents in use at 60 minas to a talent. The pound being 9,000 G.T., 60 lb. Euboic, 45 lb. $\frac{3}{4}$ Euboic, 54 lb. $\frac{3}{4}$ Eginetan, 50 lb. Gudean or Phoenician, 40 lb. $\frac{3}{4}$ Gudean. The western Babylonians were forced to reduce their talents $\frac{96}{100}$ so as to bring them near to the pint measures. For example, the 60 lb. of 9,000 G.T., 540,000 G.T., became 518,200, with a mina of 8,640 G.T., as compared with a pint of 8,437 ·5 G.T. This the western Babylonians could do, using the barley grain. But the Sumerian Babylonians, with the Troy grain, were forced to adopt another method. They lopped off about 0 ·5 °/$_{\circ}$ to make the pint measures divisible by 7. Thus 8,437 ·8 became 8,400 G.T. Owing to all the talents being in exact proportion one to another, all minas and shekels were then divisible by 7. I conclude then that the Babylonians did not use the mutliple of 7 by preference, but were forced to do so by necessity.

[1] The Rhind Papyrus (1600 B.C.) shews the Building Cubit as divided into seven palms; also the cubits of the Nileometer (of comparatively late date) does the same.

## Table shewing Conversion of Original Talents to Pint Measure.

The number of pints in each Talent are given under the column of Northern Races: for example, 60 pints of 84,375 G.T. = 506,250 G.T.

| | Original Talents. | | | 100 | Western Babylonia. 96 | | Northern Races. | | Sumerian Babylon. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Proportion. | | Talents. | | Pints of Grain. | Talent. | Talent. | Minas. | Proportion. |
| C.I. | C.I. | | | G.T. | G.T. | | | G.T. | G.T. | G.T. | |
| (4) 80 × 27 | 2,160 | Euboic ... | 100 | 540,000 | 518,000 | — | 60 | 506,250 | 504,000 | 84,000 | 6/5ths. |
| (3) 60 × 27 | 1,620 | „ ... | 75 | 405,000 | 388,800 | Attic | 45 | 379,687 | 378,000 | 63,000 | 9/10ths. |
| (4) 80 × 32·4 | 2,592 | Eginetan | 120 | — | — | — | 72 | — | | Not used. | |
| | | | | | | | | | | Pois de Marc. | |
| (3) 60 × 32·4 | 1,944 | „ | 90 | 486,000 | 466,560 | late Bab. | 54 | 455,625 | 453,600 | 7,560 | $\frac{84}{50}$ |
| (5) 60 × 30 | 1,800 | Gudean ... | 83·3 | 450,000 | 432,000 | Egypt | 50 | 421,875 | 420,000 | 7,000 | (1) |
| (4) 48 × 30 | 1,440 | „ ... | 66·6 | 360,000 | 345,600 | Troy | 40 | 337,500 | 336,000 | 5,600 | 4/3rds. |

II.

*Weights of about* 7,000 *G.T. in S.W. Europe.*—These weights average 7,082, and if they are reduced 1°/$_{\circ}$ for loss of weight of Troy grain they would still be 7,012 G.T. or 12 grains over weight. The only other weight to which they may belong is the Moslem rotl, and they are short of that by 118 grains. They are scattered over parts of Spain dominated by the Saracens, but one is found at Geneva and one at Lyons. The following is a list:—

| | | | | | |
|---|---|---|---|---|---|
| 1647. | Greaves' *Roman Foot.* | Gibraltar | (2) | 7,087 | G.T. |
| 1824. | Kelly's *Cambist.* | Portugal | ... | 7,073 | „ |
| | | Madeira | ... | 7,076 | „ |
| | | Lyons | ... | 7,087 | „ |
| | | Geneva | ... | 7,080 | „ |
| | | Average... | | 7,082 | „ |

III.

*The Multiple* 7 *in India.*—The multiple of 7 is found all over India, in weights and measures, where the Moslems have been ruling, but more particularly in parts where the Rati grain was used. And it appears to have been used to get over the difficulty of applying the Troy grain to the binary measures. The principal measures into which the multiple of 7 is introduced is the original half-pint of 2,560 Rati and the revised pound of 4,000 Rati. In the first case the Catty is 800 seers of 2,560 Rati. A seer is 80 Veraha of 32 Rati, and the Moslems reckoned 56 G.T. to the Veraha. Therefore the seer was 4,480 G.T., and 800 seers were 500 pounds of 7,168 G.T., 34 grains short of the Moslem Rotl of 7,200 G.T. In the second case 27 lb. of 7,000 equalled 28 lb. of 6,750 G.T.[1]

IV.

*The Poid de Marc.*—The ancient weight of Paris, probably as early as the 10th century, was the Poid de Marc, given in Kelly's *Cambist* (1824) as 7,555·5 G.T., but by Greaves' *Roman Foot* (1647) as 7,560 G.T., and this is no doubt its actual weight as it is in proportion to other ancient weights. We know this weight as having been constructed at Constantinople in

[1] This is what I say in *Early Weights and Measures*:—"The Moslems came to India using a multiple of 7 and the Troy grain. If they wished to adhere to the 32 Rati standard they could only do so by raising the Rati or lowering the grain Troy, and they chose the former. 56 G.T. is the nearest approach to the unit they required, raising the Rati from 1·6875 to 1·75 G.T. The result is that the revised pound of 6,750 G.T. became 7,000 G.T., equal to our avoirdupois pound; and the question presents itself whether the Moslems did not already use the 56 G.T. for the Purana whilst in Europe, and thus pass it on to western Europeans, for we find in Egypt that there was also a pound of 7,000 G.T."

the middle ages, probably to suit Moslems. It is the result of adding one-sixth to the Attic pound of 6,480 G.T., 6,480 + 1,080 = 7,560. It also coincides exactly with the Babylonian mina of 54 pints to the talent (see Table in Appendix I), and was used in Babylonia *c.* 2000 B.C. It also corresponds to the Babylonian pound weight given by Hommel and Kennedy as 7,580 G.T.

The Poid de Marc is the origin of our present avoirdupois weight, and was introduced from Paris in the 14th century (time of Edward III). It was made by increasing our 100 lb. of 6,750 G.T. to 112 as follows:—

100 lb. of Poid de Marc at 7,560 G.T. = 756,000 G.T.
112 lb. of Commercial pound, 6,750 G.T. = 756,000 G.T.

Therefore 20 cwt. of our Commercial pound, 6,750 (2,240 × 6,750 G.T.) = 1,512,000 G.T. = 60,480 C.I., the cubic metre (nearly) of Babylonia.

Since the introduction of avoirdupois weight, probably in time of Henry VIII, when the Tower pound was raised from 5,400 to 5,760 G.T. (the Troy pound), the Commercial pound was raised from 6,750 G.T. to 7,000 G.T. as 27 : 28, but our ton of 20 cwt. is still close on to the French cubic metre, because the latter is about 0·25°/$_o$ above the ancient cubic metre in length.

V.

*The Multiple* 7 *in Egypt.*—The only remaining point to consider is the origin of the use of the multiple 7 in Egypt, and in the lands between Egypt and Babylonia, with a view, if possible, to throw light on the 5-kat weight recently found at Petra.

I have shown (Appendix I) that the pound of 7,000 G.T. must necessarily have been adopted by people using Eginetan measures and the Troy grain, as it is a means of their using 5/6ths pint under pressure of a tribe using the Rati. But I must point out that it is also $\frac{1}{2500}$ 70,000 C.I.; the double cubic cubed, also that the old Euboic hon of 6,912 G.T. (4,096 Rati) if raised to Eginetan status 80 : 81 becomes 6,998·4 G.T., only 1·6 grains short of 7,000. I cannot think it originated in Egypt, except under Babylonian influence. The Egyptians of the Delta multiplied by 10 and used Euboic measures so far as they were permitted, and the Kat of 135 G.T. (80 Rati) was in very early use; 50 to a Euboic pound of 6,750 G.T., and in Ptolemaic times (see Queipo) the Tower pound of 5,400 G.T. was in use, and after the 18th Dynasty the medimnus of 4,665·6 C.I., the double Artaba, also Eginetan, with a pound of 29·16 C.I. (7,290 G.T.). Also the coffer of King's Chamber, in the Great Pyramid, with its Eginetan measures, was inserted in the Great Pyramid about this period.

In Tables IX and X (pp. 44–45), *Early Weights and Measures*, I give the various pounds of the world in use up to the Roman Empire, but the 7,000 G.T. has no direct connection with them; it is an exotic or sport. At Heliopolis (Petrie, *Weights and Measures*) two weights were found of 139·4 and 141·4 G.T., and the weight 140 ascended by multiples of 10. The Warden of the Standard (1874–5) gives a valuable piece of information about a weight of 700 G.T., but not of the same shape (also see Madden, *Jewish Coins*, p. 277): 5-kat standard weight, this weight was found in the ruins of Thebes, and is now in the British Museum. The normal weight may be taken to be 700 grains. An account of it was given by M. Chabas in the *Revue Archéologique* (Paris, 1861). Mr. Poole shows that the weights of the Ptolemaic copper coins were based on such units, whilst the weights of the gold and silver were Euboic. The weight is of a dark greenish stone; a sketch of it is given in Madden's *Jewish Coins*. It is inscribed in hieroglyphic "Kat 5 of the Treasure of On, belonging to the King."

Mr. F. L. Griffiths (*Proc. Soc. of Bibl. Arch.*, 1894) gives an interesting example of the use of 7 from the Rhind Papyrus (1600 B.C.). It is evidently the precursor of the British 7 wives of St. Ives:—"An old woman had 7 houses, each house had 7 cats, each cat catches 7 rats, each rat eats 7 barley corns, each barley corn produces 7 bushels of corn. How many bushels of corn do the cats save?" Answer, $16{,}807 = (7)^5$. Here is another question from the same: The oxherd says, "I am contributing to you $\frac{2}{3}$ of $\frac{1}{3}$ of the oxen you committed to me." Answer, $\frac{2}{3} \times \frac{1}{3} \times 315 = 70$ brought by the oxherd, 315 having been committed to him. This indicates a use of 7 amongst the people.

My conclusion is that after *c.* 2000 B.C. the numeral 7 came into use amongst the people of Egypt, and we must look for this weight of 700 G.T. (as $\frac{1}{10}$ of 7,000 G.T.) amongst tribes like the Egyptian using multiples of 10 and 7.

## REVIEWS AND NOTICES OF PUBLICATIONS.

*Historical Sites in Palestine.* By Lieut.-Com. Victor L. Trumper, R.N.R., M.R.A.S.

This little book includes in one cloth-bound volume four pamphlets which were issued during the war especially for the benefit of the members of the "Egyptian Expeditionary Force." To some extent it covers the ground taken by the late George Armstrong's *Names and Places in the Old and New Testament*, but differs from it in giving the modern name first and then the known or suggested Historical associations of the Site. It is a handy pocket