BOWRING'S

DECIMAL SYSTEM.

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SIR JOHN BOWRING, LL.D.

THE DECIMAL SYSTEM

IN NUMBERS, COINS, AND ACCOUNTS:

ESPECIALLY WITH REFERENCE TO THE DECIMALISATION OF THE CURRENCY AND ACCOUNTANCY OF THE UNITED KINGDOM.

BY

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PREFACE.

In bringing this little work before the public, the Author has to request more than usual indulgence at the hands of his readers. The pressing calls upon his time, and the impossibility of delaying his departure for the scene of his duties in a distant land, have prevented his being able to give as much attention to the final revision of this work as he could have desired. Some errors, in such circumstances, and in a work of this character, are almost unavoidable; but the Author hopes they will be found to be neither numerous, nor of much importance.

ERRATA.

Page 2, line 13, *is* omitted.
„ 20, note, for *Balthorn* read *Ballhorn*.
„ 35, note *, for cap. i. read cap. x.
„ 46, note †, line 4, for *four* read *five*.
„ 48, line 28, for *If* read *Or*.
„ 69, line 29, for 438 read ·438.
„ 106, note *, for *Gerard* read *Girard*.
„ 106, note †. for *Leirinde alle Reckeningen* read *leerende alle rekeninghen*.
„ 111, line 11, for *testime* read *testerne*..
„ 111, line 14, for *well-wisher* read *well-willer*.
„ 137, note ‡, for *Spix and Martin* read *Spix and Martius*.
„ 143, note *, for *p*. 586 read *p*. 386.
„ 153, line 1, for *Pehleir* read *Pehlevi*.
„ 161, note, for 5÷1 read 5+1.

THE DECIMAL SYSTEM,

IN

NUMBERS, COINS, AND ACCOUNTS.

CHAPTER I.

ANCIENT HISTORY OF ARITHMETICAL NUMERALS.

EVERY human being—man, woman, and child—has been provided with a set of decimal machines, in the shape of fingers and toes, which, even from early childhood, and among the rudest nations, have been used for the purposes of account. Ovid speaks of the fingers with which we are accustomed to enumerate *—the word *digits*, in its Latin signification, meaning equally fingers and arithmetical figures. So, in German, *Zehen* is used alike for *tens* and *toes*. John Quincy Adams says, "The division of numbers by decimal arithmetic is distinctly proved to have been established before the general deluge,"—which proof may, indeed, be deduced from the fact that as ten fingers were given to man, they would naturally be employed for intellectual as well as physical purposes, to calculate with, and to perform the common handicraft functions of existence. Certain it is, that the years of the antediluvian patriarchs are spoken of, in the Book of Genesis, in hundreds, and tens, and units; and that three tens, and five tens, and three hundreds of cubits are reported as the height, and the breadth, and the length of the ark. So four times ten days, and four times ten nights, are stated as the time during which the rain fell upon the earth, where it rested a hundred and half a hundred days. The first time that the word "thousand" occurs in the Bible is where Abimelech tells Sarah he has given her brother a thousand pieces of silver—(Gen. xx. 16). The word "thousands" first is found where

* See p. 48.

millions are also mentioned, and benedictions are brought to Rebekah (Gen. xxiv. 60) as the mother of future "thousands of millions;" and it is somewhat remarkable that this is the only instance where the word "million" occurs from one end of the Bible to the other. The greatest numbers mentioned anterior to the flood are the years of Methuselah, which amounted to nine hundred (*i. e.* hundreds) and sixty (*i. e.* six tens) and nine years.

It is curious to trace the various exhibitions of the decimal notation through all the tongues and tribes of the world. In all early histories, the Bible not excepted, men are grouped together in tens, and hundreds, and thousands, and tens of thousands. The common title given to the Emperor of China, in the temples of that empire, *Wan Sui, wan sui, wan wan sui*—ten thousand, ten thousand, ten thousand times ten thousand years; which, indeed, implies immortality. *Viva usted mil años*—"May you live a thousand years"—is the ordinary phrase in Spain for wishing longevity to a friend. So in Chinese, for a man of unchangeable purpose, they say, "One mind ten thousand years;" and to teach prudence in conversation, they have a proverb, "A whispered word may be heard a thousand miles away." We, to express a strong conviction, say "Ten to one," "A hundred to one," "A thousand to one."—One of the commonest forms of asseveration in Chinese is, *Wan yih*, which means, "Ten thousand to one it is so and so." Again, instead of saying, "Wine assists the settlement of disputes," the Chinese proverb runs, "One cup will arrange ten thousand affairs."

The opposite Table, exhibiting the comparative number of times in which arithmetical figures occur in the Bible, has been calculated from the passages referred to in Cruden's concordance.*

In the Book of I. Genesis (xviii. 24-32), Abraham implores the Lord to spare the city of Sodom if there be *fifty* righteous found within the city: he lowers the number by *five* to *forty-five*, and then to *forty*, and then to *thirty*, and then to *twenty*, and then to *ten*, and proceeds no farther in his intercessions.

The groupings in scores (*i.e.*, two tens) is a common mode of representing numbers, and the phrase "forty less one" is found an apter and more popular way of speaking than simply to use "thirty-nine." Threescore, threescore and ten, and fourscore, are commonly employed for sixty, seventy, and eighty. In various parts of the

* London 4to edition, 1828.

		Times.		Times.		Times.		Times.		Times.		Times.	Total number
One	occurs	715	Ones	4	Once	55	First	457	Firstling	9	Firstlings	6	1246
Two	,,	270	Twain	16	Twice	18	Second	130	Secondarily	1	Twofold	1	436
Three	,,	256			Thrice	16	Third	281	Thirdly	1	Threefold	1	555
Four	,,	108	Quaternions	1	Four times	1	Fourth	67			Fourfold	2	179
Five	,,	100					Fifth	47					147
Six	,,	84			Six times	1	Sixth	38					123
Seven	,,	269	Sevens	2	Seven times	34	Seventh	102			Sevenfold	6	413
Eight	,,	27					Eighth	29					56
Nine	,,	8					Ninth	30					38
Ten	,,	114	Tens	3	Ten times	6	Tenth	72			Tithe, tithes, tithing	32	227
Eleven	,,	20					Eleventh	16					36
Twelve	,,	117					Twelfth	21					138
Thirteen	,,	6					Thirteenth	11					17
Fifteen	,,	17					Fifteenth	13					30
Nineteen	,,	1					Nineteenth	2					3
Twenty	,,	54											54
Twenty-one	,,												0
Twenty-five	,,	12					Twenty-fifth	2					14
Twenty-six	,,	1											1
Thirty	,,	71					Thirtieth	8			Thirtyfold	2	81
Thirty-one	,,	4											4
Forty	,,	76											79
Forty-nine	,,	1											1
Fifty	,,	60	Fifties	7			Fiftieth	3			Sixtyfold	1	70
Sixty	,,	11	Threescore	18									30
Seventy	,,	44	Threescore and ten	17									61
Eighty	,,		Fourscore	15									15
Ninety-nine	,,	6											6
Hundred	,,	71	Hundreds	19							Hundredfold	2	92
Five hundred	,,	19											19
Nine hundred	,,	2											2
One thousand	,,	66	Thousands	35									101
Eleven hundred	,,	3											3
Nine thousand	,,												0
Ten thousand	,,	39	Ten thousands	9									48
Fifty thousand	,,	3											3
100,000	,,	10											10
250,000	,,	1											1
500,000	,,	2											2
1,000,000	,,		Thousand thousand	3	Millions	1							4

Bible decimal progression is employed. In the Book of Genesis, in Jethro's counsel to Moses, he is recommended to nominate "rulers of thousands, and rulers of hundreds, rulers of fifties, and rulers of tens" (Exodus xviii. 21); and in the assembly of the people spoken of in the Book of Judges (xx. 10), they decided to take "ten men of a hundred throughout all the tribes of Israel, and a hundred of a thousand, and a thousand of ten thousand, to fetch victuals for the people." So in Amos, Jehovah decrees, "The city that went out by a thousand shall have a hundred, and that which went forth by a hundred shall have ten." In Leviticus (xxvi. 6) it is foretold to the Hebrews that "Five shall chase a hundred, and a hundred put ten thousand to flight." "A thousand shall fall at thy side, and ten thousand at thy right hand." (Psalm xci. 7.) Again in the Apocrypha, "There is no inquisition in the years, whether thou have lived ten, or an hundred, or a thousand years." (Ecclesiasticus xli. 4.) "Judas ordained captains over the people, even captains over thousands, and over hundreds, and over fifties, and over tens." (1 Maccabees iii. 55.)

Fix on what portion we may of ancient history, we shall find the decimal notation prevailing. When Herodotus (Book II.) gives an account of the building of the pyramids, he says, they were the work of bodies of 100,000 men, who were occupied 10 years in making the road over which the stones were dragged for erecting the pyramids, and that 20 years were employed in the construction; that each stone was 30 feet in length; that the cost of radishes, onions, and garlic, for the consumption of the workmen, was 160,000 silver talents; and that the pyramids stood on a hill, which is 100 feet high. Herodotus reports that the Egyptians accurately number the years, and states that between Hercules and Amases 17,000 years elapsed, and between Pan and Abasis 15,000 years; but, as he comes nearer to his own time, he uses the word "*about*," and says he lived *about* 800 years after the siege of Troy. (Book II.)

The employment of numerals representing large amounts is an evidence of considerable intellectual development, and may be accepted as an undoubted proof that the civilisation of the earliest periods recorded in the Bible was greatly superior to that of the more barbarous tribes who now occupy large portions of the earth's surface. The associations of vast numbers with the sands of the sea, or the stars of heaven, which are found in the earliest biblical records, would be alike discovered in the traditions and in the language of uncultivated tribes; but we should nowhere find, as in the book of Job, among barbarous people, references to flocks of sheep in seven thousands—to herds of camels in three thousands—to yokes of oxen and multitudes of she-asses in five hundreds—representing at the same time approximation to what is definite in numbers associated with vastness in amounts.

The system of numerals adopted by the Hebrews was natural enough. They took their alphabet and applied the first nine letters to the nine digits, the second nine to the tens, and the third nine to the hundreds. By this means they arrived at the amount of 900, the maximum sum represented by a single sign or letter; but 1000 was represented by two dots upon the character for 1.

א	ב	ג	ד	ה	ו	ז	ח	ט	י	כ	ל	מ	נ	ס	ע	פ	צ
1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90
a	*b*	*g*	*d*	*h*	*u*	*v*	*ch*	*t*	*j*	*k*	*l*	*m*	*n*	*s*	*kh*	*p*	*z*

ק	ר	ש	ת	ך	ם	ן	ף	ץ
100	200	300	400	500	600	700	800	900
k	*v*	*s*	*sh*					

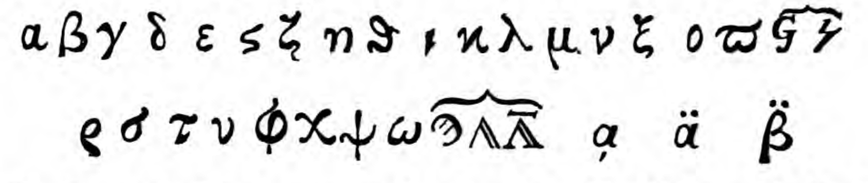
א̈	בא̈
1000	2000

Unlike the Arabs, whom we have imitated by placing the highest numbers on the left hand, the Hebrews placed their units on the left, thus: יא is 11, קכא 121; the number 15, however, is not written יה but הי.

The Greeks generally employed the same method as the Hebrews, by using as their numerals the letters of their alphabet; but inscriptions are found, showing that they also used, like the Romans, the first letter of numeral words as signs to represent quantities.* They employed a single line for the unit; the letter Π, the initial of πεντε, (Pente,) to represent 5; —Δ, the initial of Δεκα, (Deka,) for 10; and H, the initial of Hέκατον, (Hekaton,) for 100. Five of any number are represented by enclosing the number in Π: thus, |Δ| is 50, or five tens; |H| is 500; and |H| HH |Δ| ΔΔΔ ΠIIII is 789. In the Greek alphabet the first nine letters, from α to θ, represent the nine digits; the next eight, from ι to π, the tens up to 80; for the numeral 90, a character resembling the Hebrew *koph* is employed, ϙ; the following eight, from ρ to ω,

* Greek numerals :— I Π Δ H X M̃ |X| |H| |H|

exhibit the hundreds up to 800, where again a character somewhat resembling the Hebrew Tsaddi ϡ is used to denote 900. Thousands are represented by a dash following the letter, thus: *α/*, *β/*—1000, 2000.



Professor De Morgan remarks, that the English word *air* is a convenient key to the three stages of Greek numeration.

	α	β	γ	δ	ε	ϛ‡	ζ	η	θ
a . .	1	2	3	4	5	6	7	8	9
	ι	κ	λ	μ	ν	ξ	ο	π	ϙ‡
i . .	10	20	30	40	50	60	70	80	90
	ρ	σ	τ	υ	φ	χ	ψ	ω	ϡ‡
r . .	100	200	300	400	500	600	700	800	900
	α/	β/	γ/	δ/	ε/	ϛ/	ζ/	η/	θ/
	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000

Of the three letters ‡ which do not form a part of the common Greek alphabet, it has been supposed that two, ϙ and ϡ, representing 90 and 900, were used at a time when the Greek alphabet consisted of 27 instead of 24 letters. The character ϛ (stigma) is a well-known and frequently-used combination of ς sigma, and τ tau.

There is a curious passage in Aristotle's "Problems" in which, recognising the universality of a decimal system equally among civilised and barbarous nations, he attributes its existence to some universal and all-pervading law, and denies that it could be the result of accident.* This law, or the habit of decenary grouping, is indeed, as before observed, a necessary emanation from the fact, that every child is born with the instruments of quinary and decimal notation.

Archimedes, in his tract entitled "Psammites,"† professes to find the means of representing the number of sands which would be required to fill the sphere of the universe; and starting from the unit of a hundred millions, he proposes to proceed multiplying

* Τὸ δὲ αἰεί καὶ ἐπί παντων, οὐκ απὸ τύχης, αλλα φύσικον.

† Ψαμμιτης.

each number by itself and then by the product, so that the progression would be eight times faster than in a multiplication by tens. He would carry on this system as far as eight periods, which would correspond to a number which we should express by sixty-five digits in Arabic numerals. But the introduction of the cipher to mark the rank of the digits, and thus determine their value, gives to our forms of notation an immense superiority over any of those of antiquity.

The powers of the Greek notation, as exhibited by the letters of the alphabet, were limited to the amount of 9999: but their word myriad (μυριὰς), which they represented by M or Mυ, augmented the means of notation ten thousandfold, and enabled them to record by symbols the sum of 99999999 thus, θϡϞθMθϡϞθ.* But Archimedes, whose grasp of mind and notions of numbers were not to be satisfied by instruments so limited as eight places of figures, insisted that the numbers of the sands of the sea were not infinite, but were within the powers of language. Starting from the point at which arithmetic had reached, he made a myriad myriads the new point of departure or unit for secondary numbers, and this secondary unit another point for numbers of a third and fourth, and so up to the eighth progression, each added step of progress being represented by eight figures; and he then shows that eight of these progressions, or 63 places of figures, would exceed the number of sands which would be contained in what was called the Cosmos, (Κοσμος,) or the sphere of which the earth is the centre, and its radius the distance of the sun. †

* Examples will be found in the Commentaries of Latinus, and the works of Diophantus and Pappus, quoted by Dr. Peacock. See Note, p. 12.

† The following description of the mode of calculation adopted by Archimedes in his "Arenarius," has been condensed by Col. T. P. Thompson.

He takes "a myriad of myriads," or 100,000,000, and uses it precisely as Locke does "million." He calls 100,000,000 "the unit of the second class,"[1] and then takes of these units 100,000,000. This he calls "the unit of the third class,"[2] and so on (p. 42).

He assumes the diameter of a poppy-seed to be the 40th part of an inch (p. 49), and then calculates that a sphere of an inch diameter must contain six myriads and four thousand (64,000) of these seeds

[1] Μονὰς δευτέρων ἀριθμῶν. [2] Μονὰς τρίτων ἀριθμῶν.

But the word myriad, being the highest numeral employed by the Greeks, had a definite and indefinite meaning: the definite implying 10,000, the indefinite any vast number. And it is often similarly employed in the English language.

By Homer, and some of the earlier Greek writers, it is always used in the vague sense of multitude.

The passage in Homer where Proteus numbers the seals by fives has often been quoted as one of the earliest examples of digital notation.*

> "First, of the seals there assembled he reckoned the numbers,
> Five after five did he count them and set them in order,
> Then, like a herd with his flock, did he lay down among them."

Most of our translators have allowed the manner of counting, which is the most remarkable characteristic of the passage, wholly to escape notice, and, moreover, give very inaccurate renderings.

Pope says, as if phocæ (sea calves) were fishes :—

> "Stretch'd on the shelly shore, he first surveys
> The flouncing herd ascending from the seas,
> Their numbers summ'd; repos'd in sleep profound,
> The *scaly* charge their guardian God surround."

(p. 51). He then assumes that a myriad grains of sand are equal in dimension to one poppy-seed; and thence proceeds to calculate how many must be in his sphere of 3,000,000 of stadia in circumference. He finally makes the number to be a thousand myriads of a myriad of myriads to the 8th power, or, 1000,0000,0000,0000,0000,0000,0000, 0000,0000,0000,0000,0000,0000,0000,0000,0000.

In the treatise on the Measurement of the Circle, he ascertains that the proportion of the circumference to the diameter lies between $3\frac{10}{70}$ and $3\frac{10}{71}$ to 1.[1] A wonderful improvement on Solomon's knowledge, as expressed in 1 Kings, vii. 23 (p. 97.)

* *Φώκας μέν τοι πρῶτον ἀριθμήσει κὰι ἔπεισιν·*
Αὐτὰρ ἐπὴν πάσας πεμπάσσεται, ἠδὲ ἴδηται,
Λέξεται ἐν μέσσησι, νομεύς ὥς πώεσι μήλων·
Οδυσσ. s. 411-14.

[1] Taken from small 8vo edition of "Arenarius," and "Dimensio Circuli," by Wallis, Oxon., 1666. See also Archimedis Opera (Oxon, 1792), pp. 325-6, &c.

Cowper is scarcely more literal, and sadly feeble :—

> "And now the numerous phocæ, from the deep,
> Emerging, slept along the shore; and he
> At noon came also, and perceiving there
> His fatted monsters, through the flock his course
> Took regular, and summ'd them."

Sotheby is better :—

> "He first his herd will count,
> And passing through them, tell their just amount,
> Tell five by five —"

The best of the English translations is Hobbes', though he has lost sight of the quinquinary * counting :—

> "The old sea-god his flock will number then,
> And, having done, i' the midst of them will lie,
> Just as a shepherd lies among his sheep."

But how superior to all, in accuracy and point, is the German Voss :—

> "Erstlich zählt er der Robben gelagerte Reihen umwandelnd
> Aber nachdem er alle bei Fünfen gezählt und gemustert,
> Legt er sich mitten hinein wie ein Hirt in die Heerde der Schafe."

There is great vagueness among classical authorities in many of the terms used to denote distance. Herodotus sometimes reckons a day's journey at 150 stadia, and at others at 200. The Roman lawyers allowed 20 miles, or 160 stadia, as the legal day's journey,† but in ordinary language the idea was as undefined as among the Greeks. A Sabbath day's journey among the Hebrews was much shorter than the journey of a working day, as it implied merely such a distance as might be walked for the purposes of recreation, and such as would not interrupt attendance upon the services of the Temple.

Mr. Edwin Norris says, there can be no doubt that the Assyrians, and all the nations who used the cuniform character,

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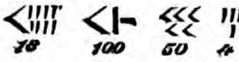
* Other instances of Greek quinary notation occur in Æsch. Eum. 748; Apoll. Rod. ii. 975; iv. 350, ib.

† Larcher on Herodotus, iv. xcix.

adopted the decimal system as their notation, though not in their weights and measures. All numbers, from 1 to 9, were made by perpendicular strokes. The Assyrians used ı ıı ııı ıııı ııııı and so forth; the Persians had ı ıı ııı ıııı ııııı, or some modifications of these modes. All used < for 10, adding strokes for the digits, as <ı for 11; <ıı for 12; <ıııı 14; up to 20, which was <<; 50 was written <<<<< ; when they reached 100, the character was <ı- ; 1,000 was <<ı-. Of higher notation than thousands no evidence is found; but as they had astronomers among them, they may have used signs for millions. The year 1854 would have been thus written :—



Of ancient Assyrian numerals Dr. Hincks writes :—

"The Assyrians were partial to the sexagesimal system as opposed to the decimal, of which they were probably the inventors. They had a noun denoting 'a sixty,'* analogous to our score or dozen; and, in expressing 360, would say three hundred and a sixty. Their talent (*tikun*), from the root 'to weigh,' contained 60 manah (*mana*), from the root 'to count;' and this again contained 60 of what we may call provisionally shekels, but of which the Assyrian name is unknown, the monogram only having been yet found. With reference to the measures of the Assyrians, I believe they invented the sexagesimal divisions still in use in this country; but it would seem that their measurement of terrestrial lengths was *decimal*. The oldest palace recorded to have been built (on Michaux's stone) is said to have been in length three lengths, and in breadth one length and fifty—ᵛᵛᵛ. The palace was probably, then, as long as it was broad, which would give 100 of the smaller measures, equal to that called 'a length.' I take the monument to be of the date 1200 B.C. In confirmation of this, we have in the Khorsabad balls the cubication, 6 lengths and 50 cubits. What I here suppose to be a cubit, must be nearly of that value; but some colossal figures are said to have been nine of this measure in length. Now we know that the Assyrians

* The ancient Bohemians had *kopa*, and the Danes to this day use *skok*, for sixty.

had a cubit (in the inscription of Nebuchadnezzar, at the India House, 680 *ammat* are mentioned), and it is extremely unlikely that they had another measure so near this in magnitude, as that a statue should contain nine of it—a statue spoken of as 'the pride of Khamana,' and evidently of colossal size. I regard it, then, as certain, that the smaller measures were cubits, and 'the length,' of course, 100 cubits. It is natural to suppose (and yet not certain) that the series was continued in decimal progression. In Egypt, however, though the square measures in the time of the Ptolemies were certainly the arura of 10,000 square cubits, the square measure of 100 square cubits, and the cubit itself; and though we may presume the existence of measures of length equal to the sides of the two latter, we know that the royal cubit contained 7 hands, or 28 digits; and it is possible, I may say probable, that the Assyrians had a similar division of their cubit."*

The Latins were even less provided with terms for high numbers than were the Greeks. *Centum* and *mille*, or 100 and 1,000, were their highest denominations. The common use of definite terms for the higher ranges of numbers is due to the Arabic numerals, which brought into familiar use numbers far greater than could be expressed by Roman characters—of which the Italian word *millione* is one of the most striking examples. *Millione* is the augmentation of *mille*, meaning a great thousand, and was employed to represent a thousand multiplied by itself. The natural analogy of language led to the use of *billions*, *trillions*, &c., and to such combinations, once introduced and understood, there are no limits.

The Roman numerals exhibit some of the simplest forms of record.† They have their foundation in decimal progression. The first nine numerals being represented by so many *single* strokes, thus, /, //, ///, and so forth, the next step would be a line in a different direction, upon the last of the nine; thus X, or two

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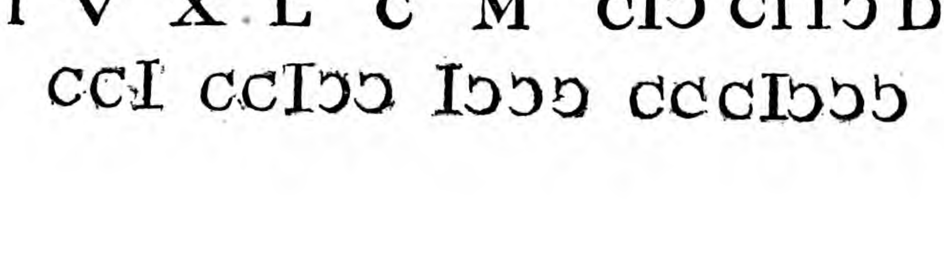
* M. S. Letter from Dr. Hincks.

† Forms of Roman numerals:—



strokes, would represent ten; the next series, up to a hundred, would be a repetition of X's—as XX twenty, XXX thirty, and so on; and *three* strokes, Ε (the ancient form of C), would denote a hundred; which carried on by ΕΕ, ΕΕΕ, exhibit two hundred, three hundred, &c. The fourth stage, beginning by a thousand, M, has *four* strokes I\/I to represent it; and two or three M's recorded two or three thousand. In process of time a division of these marks furnished characters for intermediate numbers. Half of X (10) was V (5); half of Ε (100) was L (50); and as the form of M became rounded into ⅭⅠↃ, the character D, being half of the ⅭⅠↃ, was employed for 500.*

There may be some doubt whether the Romans did not take the letters C and M as the capitals of *centum* and *mille*. As, however, the Latin words are obviously of Greek derivation, from ἑκατον (Hekaton, the consonant c was by the Latins pronounced hard, as *Kentum*), and χιλια, Khilia, which have neither C nor M in their composition, the coincidence may have been accidental.

The Roman numerals are not very creditable to the sagacity of that nation in the field of arithmetical notation. They are exceedingly cumbrous, and, in the higher regions of figures, utterly unmanageable.

By the table on the opposite page it will be seen, however, that no other figures are employed than those which represent decimal progression, as:—

I
V which is the half of X,
X or double V,
L half of C, anciently written Ε,
C or double L,
D five hundred, or half of ⅭⅠↃ, or mille,
M the initial of mille.

All the intermediate numbers are represented by figures placed either to the right or the left of the decimal numbers—those to the right imply addition, those to the left subtraction. Thus:—

IV	is	4,	1 subtracted from V.
VI	„	6,	1 added to V.
LXXX	„	80,	30 added to L.
XXC	„	80,	20 subtracted from C.

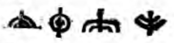
* See Dr. Peacock's article on Arithmetic, Encyclopædia Brit., p. 532,—an invaluable and almost exhaustive contribution to our knowledge of the history and application of numerals.

ROMAN NUMERALS.

1	I	10	X	20	XX	100	C	1,000	CIƆ, M, ∞, T
2	II	11	XI	30	XXX	200	CC	2,000	CIƆCIƆ, IICIC, IIM
3	III	12	XII	40	XXXX	300	CCC	5,000	IƆƆ, V̄
4	IIII or IV	13	XIII or XIIV	50	L	400	CCCC	10,000	CCIƆƆ
5	V	14	XIIII or XIV	60	LX	500	D, IƆ	50,000	IƆƆƆ
6	VI	15	XV	70	LXX	600	DC, IƆC	100,000	CCCIƆƆƆ
7	VII	16	XVI	80	LXXX or XXC	700	DCC, IƆCC	1,000,000	CCCCIƆƆƆƆ
8	VIII or IIX	17	XVII	90	LXXXX or XC	800	DCCC, IƆCCC		
9	VIIII or IX	18	XVIII or XIIX			900	DCCCC, IƆCCCC		
		19	XVIIII or XIX						

The mental arithmetic of the Romans was, no doubt, far advanced beyond their writing symbols; their language exhibited the decimal stages, at all events, as far as the hundreds and thousands are concerned. Our dictionaries give the word *myrias* as representing ten thousand; I do not know that there is any classical authority for its use.

The following examples of Roman numerals, with the authorities quoted, are taken from "Facciolati's Dictionary":—

Ð	500	Ursatus
C 9	100	
Ↄ	50	Nicolaus
M	1,000	[Nicolaus
	10,000	Vet. Glos. Anon. &
C̄	100,000	Probus
CCIↃↃ	10,000	Augustinus
CCIↃↃ ∞	11,000	"
CCIↃↃ CCIↃↃ	20,000	"
CCIↃↃ CCIↃↃ CCIↃↃ	30,000	"
CCIↃↃ IↃↃ IↃC	15,600	Ursatus
CCIↃↃ IↃↃↃ	40,000	Augustinus
CCIↃↃ CCIↃↃ CCIↃↃ IↃ LX	30,560	Rosinus
CCIↃↃ CCIↃↃ CCIↃↃ CCIↃↃ	40,000	Augustinus
CCIↃↃ CCCIↃↃↃ	90,000	"
CCIↃↃ ∞ ∞ ∞ CC	13,200	Rosinus
CCIↃↃ CCIↃↃ ∞ IↃↃ	24,000	"
CCIↃↃ CCIↃↃ ∞ ∞ ∞ DCC	23,700	"
CCIↃↃ CCIↃↃ ∞ ∞ ∞ CDXXCIX	23,489	"
CCIↃↃ IↃↃↃ ∞ C ∞ XII	41,912	"
CCIↃↃ IↃↃ DCCC LXVII	15,867	"
CCIↃↃ IↃↃ ∞ CCC	16,300	"
CCIↃↃ ∞ IↃC	11,600	"
CCIↃↃ ∞ ∞ ∞ CC XX III	13,223	"
CCIↃↃ IↃↃ DCCCC L	15,950	"*

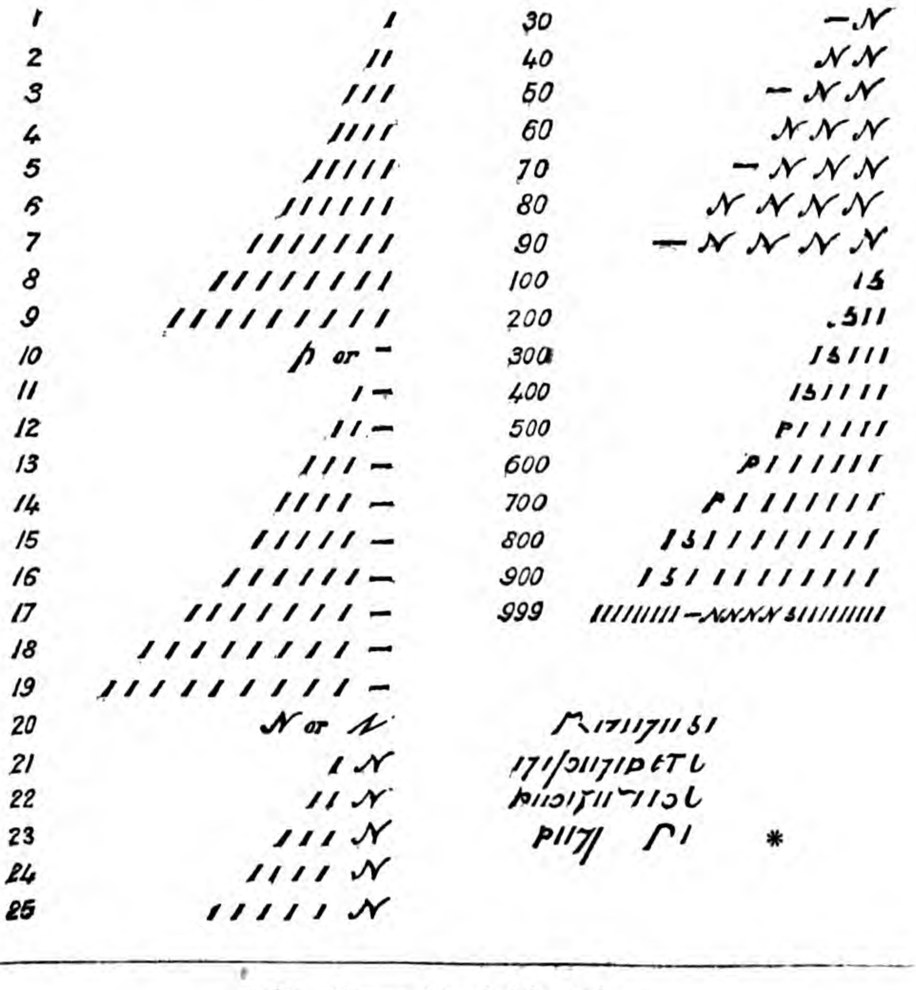
* Other forms of ancient Roman numerals :—

The notation of the ancient Egyptians is given by Sir Gardner Wilkinson, as in the annexed plate, and presents some remarkable evidences of the influence of the decimal points, since both in the hieroglyphic and hieratic—*i. e.*, the mystical and commoner forms, a new series of characters is adopted at every decimal division. In the hieroglyphics the units are represented by one up to nine strokes (ı); ten by ∩, and tens by the repetition of the same sign; the

EGYPTIAN NUMERALS.

hundreds by ℮ ; the thousands by ⚘ ; the ten thousands by ˥, the writing being from left to right. In the hieratic, the figures are written from right to left, and though less simple than the hieroglyphic forms, a new character is adopted at every decimal division—thus, ʅ represents 1; ∩ (as in the hieroglyphic) or ⋋, or ɓ, 10; ˥, 100; ʖ, 1,000; ʔ, 10,000; but, instead of simple repetitions of the same signs, modifications or combinations are adopted for the numbers between the decimal divisions. Thus, 4 is written ⁓; 20 ⅄; 300 ⌣; 4,000 ⌣. In the numeral employed for reckoning the days of the months, some extraordinary resemblances to our modern figures appear—and some combinations not less remarkable: thus, the 5th day is thus represented:—2ʒ—2 + 3; the 6th, ʒʒ—3 + 3; the 7th, ʒד—3 + 4; the 8th, דד—4 + 4; while, for the 9th, we have the simple figure ⟍; and at the 10th a new notation begins by כ; the 11th being כ.

The numerals of Palmyra present new signs at 5, 10, and 20—and new combinations at 100, 500, and 1,000. Like the Phœnician, they are to be read from right to left. Up to 19 they remarkably resemble the Roman numerals, both in the form and combinations, after which all resemblance ceases.



* Dr. Peacock's Arithmetic.

The Phœnician numerals, which Dr. Swinton elucidated in the "Philosophical Transactions," from coins found at Sidon, have simple signs for ten and twenty, by which they proceeded up to 99, and at 100 adopted a new form of notation, thus :—

1	/	26	/>ɔ
2	//	27	//>ɔ
3	///	28	///>ɔ
4	////	29	////>ɔ
5	>	30	⊳ɔ
6	/>	40	ɔɔ
7	//>	50	⊳ɔɔ
8	///>	60	ɔɔɔ
9	////>	70	⊳ɔɔɔ
10	⊳	80	ɔɔɔɔ
11	/⊳	90	⊳ɔɔɔɔ
12	//⊳	100	⊳/
13	///⊳	200	⊳//
14	////⊳	300	⊳///
15	>⊳	400	⊳////
16	/>⊳	500	⊳>
17	//>⊳	600	⊳/>
18	///>⊳	700	⊳//>
19	////>⊳	800	⊳///>
20	ɔ	900	⊳////>
21	/ɔ	920	ɔ⊳////>
22	//ɔ	940	ɔɔ⊳////>
23	///ɔ	960	ɔɔɔ⊳////>
24	////ɔ	980	ɔɔɔɔ⊳////>
25	>ɔ	1000	⊳⊳/ *

Few languages proceed so far as the Sanskrit in pursuing a decimal system into numbers of immensity.

Eka	1
Das'a	10
S'ata....................	100
Sahasra	1,000
Ayuta	10,000
Laksha	100,000
Prayuta, or Nujuta..	1,000,000

* Dr. Peacock's Arithmetic.

Coti	10,000,000	
Arvuda	100,000,000	
Abja or .... } Padma	1,000,000,000	
C'harva	10,000,000,000	
Nicharva	100,000,000,000	
Mahadpadma	1,000,000,000,000	the large Padma, or
Saucur	10,000,000,000,000	[billion
Saludhi or .... } Samudra	100,000,000,000,000	meaning the ocean
Antya	1,000,000,000,000,000	
Madya	10,000,000,000,000,000	
Parard'ha	100,000,000,000,000,000	

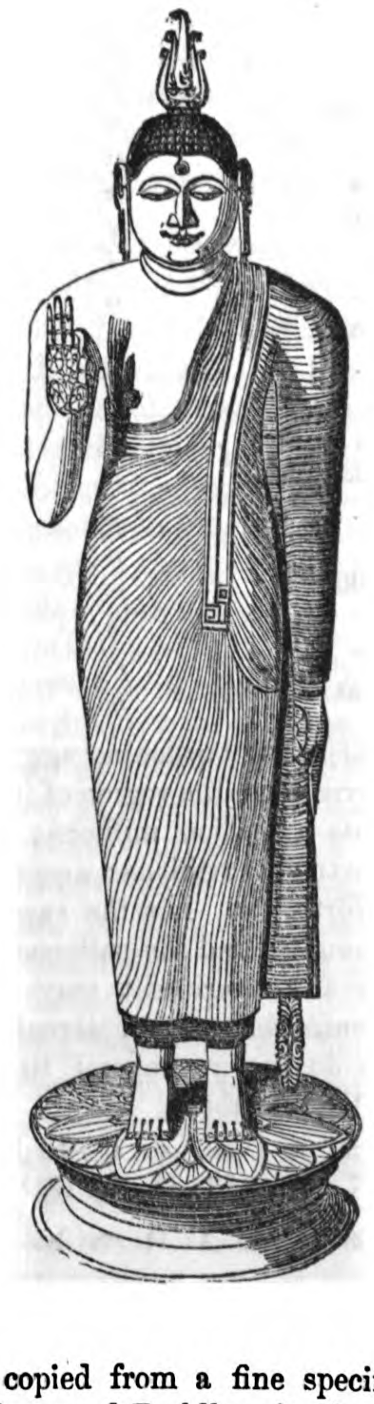
Of all Orientals the Buddhists appear to have advanced farthest into the regions of interminable numbers. In order to obtain the sanctification and deification of a Buddha, it is declared by the great authorities of that extraordinary religion, which is professed by about one-third of the human race, that a mortal man may acquire omniscience and the attributes of divinity, if, for a million of *asankas* of *calpas*, he persevere in holy aspirations after deification —that he then continues to give expression to such aspirations during the existence of 387,000 successive Buddhas, who has each undergone the same probation—and that, in the course of 400,000 asankas of calpas he obtains admission to the presence of twenty-four Buddhas, and receives from each an assurance that at some future time he shall be exalted to the rank of a Buddha godhead. During the 400,000 asankas of calpas, the sacrifices he will have to make exceed all powers of numbers, and the aggregate will exceed the drops to be found in a thousand oceans added to the numbers of the stars.

" To form a notion of the duration of a calpa, imagine a cube of solid rock, whose squares are 4 *goros* each, and that a person endued with *Ird'hi*, or the power of soaring in the air, should once in a thousand years pass over it, allowing the hem of his garment to trail on the rock — the rock might, in consequence of such slight attrition, become dwindled to the size of a mustard seed, but the years of a calpa will not yet have expired—thus, the number of individuals' lives in the course of a calpa is inconceivable."*

I do not find the extent of a *goro* any where defined; the

* " Kitelegama Dewamitta Unnasee," as translated in the Ceylon Almanac for 1832.

inquiry as to its size might probably open another door into illimitable and incalculable quantity.



This figure is copied from a fine specimen of carved ivory, representing the figure of Buddha, in the possession of Sir J. Emerson Tennant.

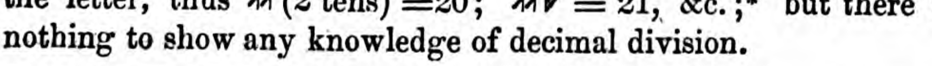
The Buddhist system of notation is thus recorded:—

10	decads	. . . .	are equal to	100
10	hundreds	. . . . . .	,,	1,000
100	thousand, or laksha	. .	,,	100,000
100	lakshas	. . . . . .	,,	1 kela or koti
100	,, of koti	. . .	,,	1 kotiprekoti
100	,, of kotiprekoti	.	,,	1 nahuta
100	,, of nahuta	. . .	,,	1 ninnahuta
100	,, of ninnahuta	. .	,,	1 akshohini
100	,, of akshohini	. .	,,	1 bindu
100	,, of bindu	. .	,,	1 arbuda
100	,, of arbuda	. . .	,,	1 ninarbuda
100	,, of ninarbuda	. .	,,	1 ahapa
100	,, of ahapa	. . .	,,	1 ababa
100	,, of ababa	. . .	,,	1 atata
100	,, of atata	. . .	,,	1 soghandika
100	,, of soghandika	.	,,	1 uppala
100	,, of uppala	. . .	,,	1 kumuda
100	,, of kumuda	. .	,,	1 poondareka
100	,, of poondareka	. .	,,	1 paduma
100	,, of paduma	. .	,,	1 kat'haa
100	,, of kat'haa	. . .	,,	1 mahakat'haa
100	mahakat'haa (or great kat'haa)		,,	1 asanka.

Notwithstanding this most burdening aggregation of decimal force, it is more easy to rush into the region of infinity by supposing that a billion represents a million millions; a trillion, a billion billions; a quadrillion, a trillion trillions; a quintillion, a quadrillion of quadrillions, and so forth, &c. Let the experiment be made of recording such vast amounts, and the patience will be thoroughly exhausted. But such an experiment may help our imperfect notions of what is interminable, infinite, eternal.

The ancient Runes do not go beyond 19 in their numerals. They are the letters of the alphabet.

i	u	th	o	r	k	h	n	i	a	s	t	b	l	m	y	al	mm	tt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19



For any number above 19 the amount was represented by repeating the letter, thus ᛅᛅ (2 tens) =20; ᛅᛅᚠ = 21, &c.;* but there is nothing to show any knowledge of decimal division.

* "Balthorn's Alphabets," p. 4.

No higher numbers than a hundred or a thousand are to be found till the 16th century in any of the languages of Gothic or Scandinavian origin. In the Sclavonic dialects the introduction was still later. The word million was unknown in the Russian language till the time of Peter the Great; and the Russian word for thousand is still ten hundred.*

As among rude tribes the hands and fingers have been always employed for the commonest purposes of numeration; so have they among more cultivated races been used in the higher regions of arithmetic, and multitudes of allusions to digital calculations will be found in classical authors.† The left hand and fingers were employed to denote the nine digits and the succession of numbers up to 100; while the hundreds and thousands were exhibited on the right hand up to the amount of 10,000, by the same inflections which exhibited the digits and the tens on the left. Bede extended this digital numeration to a million by adding ten variations, such as opening or closing the hands, raising the fingers upwards or pointing them downwards, placing them on different parts of the body. He suggests, too, a system of communication by the fingers in which the numbers should be taken to represent the natural order of the letters; so that if a person wanted to convey the information to a friend that he was surrounded by sharpers, he might make signs representing 3, 1, 20, 19, 5, 1, 7, 5, which would convey the words *Caute age*, or *take care!* ‡ or in other numbers in English it would be 19, 1, 11, 5, 3, 1, 18, 5.

Thus, from the remotest times traces of the quinary, decenary, and vicenary scale may be found in the languages that have come down to us. Their universality may be traced to the physiological construction of the human being; and in the same way in which the finger (*digit*) has been employed as the primary elemen of notation; so the palm, the span, the foot, the cubit (1½ foot), the arm (braccio), the yard (gyrd — Anglo-Saxon for girth) — all measures which every human being carries about with him, have been employed from all times and in all regions of the world.§

* The ancient Russians, like the other Sclavonic tribes, had the word *tisyashcha* for 1,000.

† Juvenal Sat., x. 248. Pliny's Epistol., 20, lib. ii. Seneca's Epist., 88, lib. i.

‡ De Compoto vel de Loquela per Gestum Digitorum.

§ V. Pott Zahlmethode anhang über Fingernamen.

CHAPTER II.

ARITHMETICAL HISTORY POSTERIOR TO THE INTRODUCTION OF ARABIC NUMERALS.

THE introduction of what is called the Arabic system of numbers was the grandest step ever made towards the introduction of a universal language among the nations of the world. In the whole field of arithmetic and accountancy the same or nearly similar signs are now used, not only throughout the European continent and its adjacent islands, but in all the civilised parts of North and South America, through Northern Africa, and Western Asia, and in every locality where European adventurers or their descendants have fixed themselves. By whatever variety of name the numeral symbol is called, the symbol itself is everywhere nearly the same; and though the languages employed are multitudinous, and few of the various peoples of the world could teach an arithmetical sum, or convey by language to any other people the idea associated with a particular numeral sign, yet the written sign itself would be intelligible to them all, from the tropics to the pole. In the domains of language translation often fails to convey correct ideas; for words supposed to be synonymous are frequently really different in their signification and association. *House*, for example, rendered into various idioms, would present images to the mind as varied as *houses* present in their infinite variety of construction in different regions. The notions of *industry*, *virtue*, *valour*, *patriotism*, and every abstract quality would take their coloring from an infinite variety of sources, modifying the original idea to the peculiar circumstance of the individual or the nation employing the term which represents the idea itself. But in the numeral signs everything is definite; the ideas *they* present are the same to every mind; their exact value is recognised and understood by all who employ them.

It has been shown by a variety of evidence that the Hindoos used the numerals, which we call Arabic, many centuries before the Arabians. Aryabhatta, wrote in Sanscrit on Algebra and Arithmetic as early as the fifth century. He is quoted as an

THE DEAN OF ELY

authority by Brahmegupta, who flourished in the early part of the seventh century. Brahmegupta is again frequently referred to by Bhascara, whose works were published in the middle of the twelfth century, and exhibit those forms of decimal notation which are now universally adopted by civilised nations.

"The first Arabian," says Dr. Peacock,* "who wrote upon Algebra and the Indian mode of computation is stated, with the common consent of Arabic authors, to have been Mohammed Ben Musa, the Khuwarezmite, who flourished about the end of the ninth century; an author who is celebrated as having made known to his countrymen other parts of Hindu science, to which he is said to have been very partial. Before the end of the tenth century those figures, which are called *Hindusi* from their origin, were in general use throughout Arabia; among others is mentioned the celebrated Alkindi, who was nearly contemporary with Ben Musa, and who, among his numerous other works, wrote one on the Indian mode of computation (*Hisabu 'lHindi*). The same testimony is repeated in almost every subsequent author on Arithmetic or Algebra, and is completely confirmed by their writing their figures from left to right after the manner of the Hindoos, but which is directly contrary to the order of their own writing.†

ORIENTAL FORMS OF ARABIC NUMERALS.

* Ib. 413.

† Though the method of writing the Arabic numerals from left to right has been deemed conclusive of their Sanscrit origin, independently of other evidence, might it not be maintained that the Arabic numerals

"The use of this notation became general among Arabic writers, not merely on Arithmetic and Algebra, but likewise on Astronomy, about the beginning of the tenth century. We find it in the works of the astronomer Ebn Younis, who died in the year 1008, and it is found likewise in all subsequent astronomical tables. It was, of course, communicated to all those countries where their language and science were known. In the eleventh century the Moors were not merely in possession of the southern provinces of Spain, but had established a flourishing kingdom, where the favourite sciences of their Eastern ancestors were cultivated with uncommon activity and success; and from that quarter, and from the Moors in Africa, they chiefly appear to have been communicated to the Spaniards and other Europeans. *

"The learned Abbé Andres considers that the earliest example of the use of these figures, which is to be found in Spain or in Europe, is in a translation of Ptolemy in the year 1136; fac-similes of the former of these figures are said to be given in the Paleografia Española of Terreros, who found them in all the mathematical MSS. subsequent to that period, but in no other books or documents—not even in accounts which were kept in the Castilian, which differed little from the Roman numerals;—the calendars which were chiefly constructed in Spain, both in that age, and

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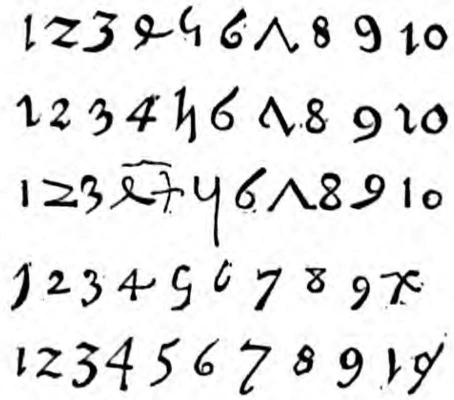
were invented by a people accustomed to write like the Hebrews, Arabs, and many other Oriental nations, from right to left, and not as we do, from left to right, on the very ground that the simplest of the arithmetical signs, the units or digits, are placed on the right side, and the larger and more complicated on the left. Arithmetical science, like every other, must have commenced with the simpler form, and have proceeded to the more elaborate. Had a people, writing as we are accustomed to write, from left to right, introduced a new system of notation, would it not be natural that the highest amounts should be the farthest from, and not the nearest to, the starting point? We should have probably written the units first, and then the tens, and then the hundreds, and then the thousands, and so on—just in the contrary way in which the record would be made by a Persian or an Arab. Language easily accommodates itself to the symbols which represent it, and the use of one and twenty is quite as familiar to our ears as twenty-one; three score, as sixty; or half a hundred as fifty.

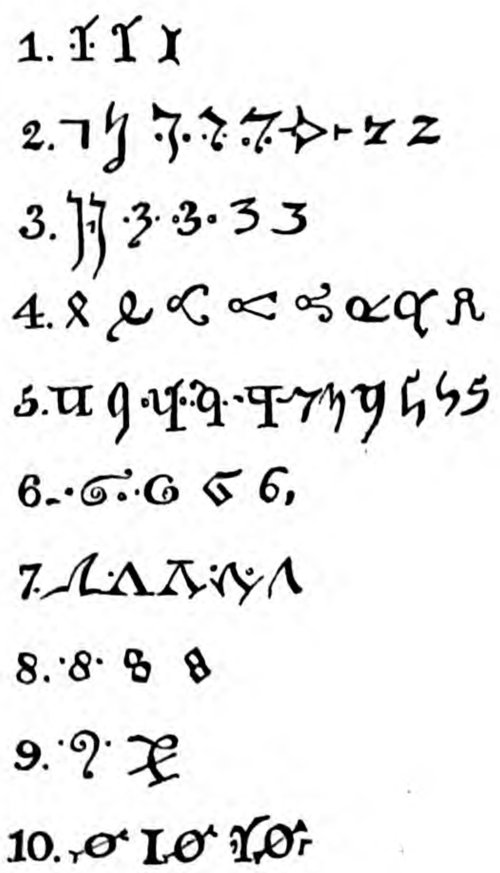
* It has been held by some writers that Leonardo's writings are to be referred to the beginning of the fifteenth century; but the great weight of evidence gives him two centuries earlier.

until the end of the fourteenth century, and were sent from thence to other parts of Europe, continued to be written in the old notation."

ANCIENT EUROPEAN FORMS OF ARABIC NUMERALS.



SUNDRY FORMS OF ARABIC NUMERALS.



The Arabs indeed do not claim the honour of having invented, the decimal system of numeration, but attribute it to the Hindoos, whose name in Arabic * it bears; but its progress is not very clearly traceable in Europe. It is certain that in the beginning of the sixteenth century Roman figures were used by merchants and accountants. They lingered longer in England than in any other part of the European world, having found an asylum in the dark and dull regions of the Exchequer.

According to the Hindus, numeration is of divine origin; the invention of nine figures *(anca)*, with the device of places to make them suffice for all numbers, being ascribed to the beneficent Creator of the universe, in Bhascara's "Vásaná," and its glossary, and in Crishna's "Commentary on the Vija-ganita." Here nine figures are specified; the place where none belongs to it being shown by a blank, Súnja, which, to obviate mistake, is denoted by a dot, or small circle.

From the right, where the first and lowest number is placed, towards the left hand, increasing regularly in decuple proportion: namely, unit, ten, hundred, thousand, myriad, hundred thousands, million, ten millions, hundred millions, thousand milllions, ten thousand millions, hundred thousand millions, billion, ten billions, hundred billions, thousand billions, ten thousand billions, hundred thousand billions.

A passage of the "Véda," which is cited by Súrya-dása, exhibits the decimal notation thus:—"Be these milch-kine before me, one, ten, a hundred, a thousand, ten thousand, a hundred thousand, a million. . . . . . . Be these milch-kine my guides in this world."† Ganésa observes, that numeration has been carried to a greater number of places by Sríd'hara and others; but adds, that the names are omitted on account of the numerous contradictions, and the little utility of those designations. The text of the Ganita-Sara, or abridgement of Sríd'hara, does not correspond with this reference, for it exhibits the same eighteen places, and no more.‡

The subject of numbers is approached with reverence by the great Hindoo writers. The Brahmagapta is introduced by this invocation:—"Salutation to Ganesa, resplendent as a blue and spotless lotus, and delighting in the tremulous motion of the dark

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* Hindi. † "Colebrooke's Hindoo Algebra," p. 4.
‡ Gan-sár., §§ 2, 3.

serpent, which is perpetually twining within his throat." And the volume is ushered in by this flowery announcement:—"Having bowed to the deity, whose head is like an elephant's,* whose feet are adored by gods; who, when called to mind, relieves his votaries from embarrassment, and bestows happiness on his worshippers; I propound this easy process of computation,† delightful by its elegance,‡ perspicuous, with words concise, soft, and correct, and pleasing to the learned." §

While on the subject of Hindoo numerals, it may be amusing to see a specimen or two of the delicate and winning forms in which arithmetical questions are propounded to the student for solution:—"Beautiful and dear Liliávati, whose eyes are like a fawn's! tell me what are the numbers resulting from one hundred and thirty-five, taken into twelve? If thou be skilled in multiplication, by whole, or by parts, whether by subdivision of form, or separation of digits, tell me, auspicious woman, what is the quotient of the product divided by the same multiplier?" Colebrooke, p. 6.

Again,—"Pretty girl, with tremulous eyes, if thou knowest the correct method of inversion, tell me what is the number, which multiplied by three, and added to the three-quarters of the product, and divided by seven, and reduced by subtraction of a third part of the quotient, and then multiplied into itself, and having fifty-two subtracted from the product, and the square root of the remainder extracted, and eight added, and the sum divided by ten, yields two?"

To a question so complicated, it is hardly fair to keep back the solution. Statement:—Multiplier, 3; additive, $\frac{3}{4}$; divisor, 7; decrease, $\frac{1}{3}$; square —; subtractive, 52; square root —; additive, 8; divisor 10; given number, two.

Answer:—Proceeding as directed, the result is 28, the number sought. Colebrooke, pp. 21-2.

All the operations are inverted. The known number 2, multiplied by the divisor 10, converted into a multiplicator, makes 20; from which the additive 8 being subtracted, leaves 12; the square whereof (extraction of the root being directed) is 144; and adding

* Gánésa, represented with an elephant's head and human body.

† Arithmetic. Páti ganita; Páti, Paripàti, or Vyaeta ganita.

‡ Lilávati—delightful,—an allusion to the title of the book.

§ Colebrooke's Translation of "Brahmagapta and Bhascara," 4to, 1817. p. 1.

the subtractive 52, becomes 196; the root of this (squaring was directed) is 14; added to its half, 7, it amounts to 21; and multiplied by 7, is 147. This again divided by 7, and multiplied by 3, makes 63; which, subtracted from 147, leaves 84; and this divided by 3, gives 28.—pp. 21-2.

One more example of what is called reduction of differences:*—"Out of a swarm of bees, one fifth-part settled on a blossom of *Cadamba*,† and one-third on a flower of *Sulind'hri*;‡ three times the difference of those numbers flew to the bloom of a *Cutaja*. One bee, which remained, hovered and flew about in the air, allured at the same moment by the pleasing fragrance of a jasmin and pandanus. Tell me, charming woman, the number of bees?"

This reverent and graceful way of dealing with arithmetic and its powers among Orientals, stands in strange contrast to the vituperations of an English writer, one Thomas Lawson, who, addressing specially those he calls "Heptatechnists," thus pours out his scorn upon those who patronise human learning, and the knowledge of figures as one of its branches:—"Herein (*i.e.*, in arithmetical study), any member of Italian Babylon, with mass-book, mass for the dead, fabulous legend; and Mahometan, with his dreggy Alcoran; any flint-hearted Jew, with his Talmud, a mingle-mangle of Jewish, divine, and humane matters; any dead, dry, unfruitful formalist may grow profound, exquisite, nimble; yea, and though involved in the intricate windings of degeneration, out of the royal state of regeneration and heavenly transformation, may apprehend the feats, terms, and parts of this natural art, as digits, articles, mixed numbers, ciphers, terniries, golden rule direct, golden rule reverse, a cube, Pythagoras's table, algorism, &c., yet be strangers to the Divine exercise which leads to Christ, the Lion of the Tribe of Judah, who alone opens the Seals of the Book." Attention is then directed to the number of the Beast.‖

Whatever may be the opinions as to the exact dates in which the Arabic numerals were introduced, it may be safely laid down that their progress was from India to Arabia, from Arabia through the Moors to Spain, from Spain to Italy, and from Italy to the

* *Vislèsha-játi*,—assimilation of difference; reduction of fractional differences.

† *Cadamba*,—Nauclea Orientalis, or N. Cadamba.

‡ *Sulind'hri*,—a plant resembling the Cachóra.

‖ A.D. 1680. *Vide* De Morgan's Arith. Books, p. 49.

rest of Europe. Claims on behalf of Pope Sylvester the Second have been put forward. It is certain he visited Spain in the latter part of the tenth century, and our English historian, William of Malmesbury, who wrote in the middle of the twelfth century, says that Sylvester (whose name was Gerbert) brought the abacus from the Saracens.* But the evidence of his having introduced the Arabic digits is founded on no other *data* than the general reputation he enjoyed of having mastered all the learning of his time. In an inquiry such as this, it is scarcely likely that any investigation should lead to the discovery of the very earliest period in which the "new figures" were employed. MSS. of the fourteenth century show how imperfectly the system was then understood, for not only are Roman and Arabic numerals mixed together, but the value of the zero was unknown—thus we have X, X1, X2, X3, to represent 10, 11, 12, 13; we find in sequence XXX, XXX1, 302, 303, for 30, 31, 32, and 33; XXXX, 401, for 40 and 41.

From the middle of the fourteenth century down to the fifteenth, when the Arabic system began to be generally adopted in calendars (long before its application to common accounts in bookkeeping), explanations clearly pointing out the power of *place*, which gives to the digit its decimal value, are frequently attached. Of one of them the translation is:—

"Every number or figure of algorism in the first place represents itself; in the second place it is multiplied by ten; in the third by a hundred; in the fourth by a thousand; in the fifth by ten thousand; in the sixth by a hundred thousand; in the seventh by a thousand thousand; in the eighth by ten thousand thousand; in the ninth by a hundred thousand thousand; and so multiplying by tens, hundreds, and thousands into infinity."† The first calendar in the English language in which the Arabic numerals are employed, bears the date of 1431.

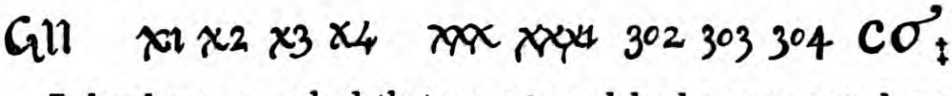
A period much anterior to this has been frequently claimed for the introduction of the Arabic numerals into this country, and some old inscriptions in Arabic ciphers have been referred to the very beginning of the twelfth century; but there is no positive evidence of their employment before the fourteenth century; and

* Abacum certè primus Saracenis rapiens, regulas dedit quæ a sudantibus abacistis vix intelliguntur. The claims of Gerbert are discussed at length by Dr. Peacock, pp. 415, *et seq.*

† Corpus Christi College MSS. Peacock, 418.

all the dates which exist, and which are supposed to be anterior to that period owe their fancied antiquity to the rudeness and imperfection of the character employed, which has allowed some play to the imaginative faculty. There was a brick building at Stratford, in Buckinghamshire, which was at one time supposed to bear the date of 1182, but it was afterwards found to be certainly not older than 1382, and most probably 1582, as in the reign of Elizabeth the figures 3 and 5 were often so written as to lead to considerable confusion between them. A vehement and learned controversy raged at the end of the last century as to the age of a mantel-piece in the Rectory of Helmden, in Northamptonshire. First the date was read Anno Domini 133. Then it was held that the letter M had been erased, and a thousand years were summarily taken away from the antiquity of the inscription. Then the 1 was suspected to be a 5.* The mixture of Roman with Arabic numerals was common for a considerable time after the introduction of the latter. MD58 is found in Northamptonshire, on the monument of Mr. John Carr.†

The following combinations of Roman and Arabic numerals are also found in ancient MSS.:—

 ‡

It has been remarked that on no sepulchral monument, down to the latter end of the eleventh century, are Arabic numerals employed; and the earliest date known on a tombstone is of Elen Cook, in the church at Ware, 1454, written according to the ancient manner of dividing 8 to make 4—thus $1^{\text{ȣ}}5^{\text{ȣ}}$. In seals only one example has been found anterior to the sixteenth century, which bears the date $1^{\text{ȣ}}8^{\text{ȣ}}$ (1484).§ There is an urn of Edward the Sixth's, in which the Roman and Arabic numerals are blended, MDX47, for 1547. The first English book which bears

* Mr. Hasted contends that the date of A.D. 1102 is engraved on a stone window frame of a barn at Preston Hall, in Kent (vol ii. 175). See a valuable paper in the Archæologia, vol. xiii., p. 107 (1168), by the Rev. Samuel Denne, in which Mr. Hasted's opinion is shown to be without foundation. A representation of the real date was shrewdly suspected to be 1533.

† See *ante* p. 29.

‡ Brodie's History of Northamptonshire, vol. i. 582.

§ Archæologia, xiii. 127.; ib. 130.

its date in Arabic numerals was printed at St. Alban's, the Rhetorica Nova Gulielmi de Saona 14ʌ8 (1478). There is a letter of the time of Henry VI. which has in Arabic numerals the date 1459, but there is reason to suspect the date was inserted subsequently to the writing the letter. A calendar, however, exists on vellum, bearing the date of 1ϱʌ2—1472.*

Chaucer, who was born in 1328, and died in 1400, has been frequently quoted † as referring to the introduction of the *newe* or Arabic numerals in a passage of his Dreme, where he describes

THE WODDE.

Shortly it was so ful of bestes,
That though Argus, the noble countour,
Ysate to rekin in his countour,
And rekin with his figures ten;
For by the *figures newe* al ken,
If they be crafty, rekin and nomber,
And tel of every thing the nomber;
Yet should he fail to rekin even
The wonders we met in my sweven.‡

There is in "Record's Arithmetic," the first edition of which was published in 1540, and dedicated to Edward the Sixth, a curious example of the employment of Roman as well as Arabic numerals to exemplify decimal numeration.

P. 17. "A general rule.—Scholar. If I make this number 91359684, at all adventures there are eight places. In the first place is 4, and betokeneth but four; in the second place is 8, and betokeneth ten times 8, that is 80; in the third place is 6, and betokeneth six hundred; in the fourth place 9 is nine thousand; and 5 in the fifth place is XM times five, that is fifty M. So 3 in the sixth place is CM times 3, that is CCCM. Then 1 in the seventh place is one MM; and 9 in the eighth ten thousand thousand times 9, that is XCMM, *i.e.* XC thousand thousand CCCLIX thousand, 684, that is VICLXXXiiij." It is obvious the word million had no popular currency at this period.

Arabic numerals are found in various MSS. written in Italy, bearing the dates of 1212, 1220, and 1228. Among early instances of their use, is a curious record in the handwriting of Petrarch, stating upon a MS. of St. Augustin that it was given him by Boccaccio:—

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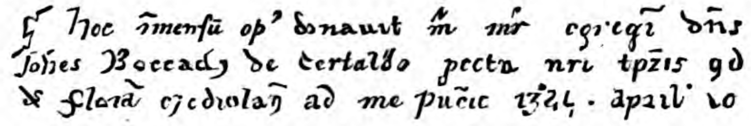
* Archæologia, p. 155. † Ib. 123.

‡ *Id. est*, dream (Danish, "*søvn*").



The figure of 3 resembles that which has come down to our hands; that of 5 has undergone many changes, but was maintained in the above form for several centuries.

The introduction of the Hindoo system of numerals into Arabia and Persia was not accompanied by the invention of new words to represent the higher decimal numbers. A million was called a thousand thousands; a thousand millions, a thousand thousand thousands. The repetition of the smaller decimal sums to represent the greater, has prevailed in languages and countries the most remote from one another. *Taihun-taihund*, ten ten, to mean a hundred, is found in Bishop Ulphilas's Mœso-Gothic Translation of the Evangelists.† So natural is this combination, that exactly the same form of decimal notation is found among a hunting tribe on the northern shores of Lake Superior, who express 100 by *mitana mitenah*, ten ten, and 1000 by *mitana mitenah mitanah*. And the Sapibocones of South America express 10, 100, and 1000 by *tunca*, *tunca tunca*, and *tunca tunca tunca*. In examining the numerals of different nations, similar examples will be found in abundance.

The invention of the cipher was a great step in arithmetical discovery. Why the Greeks, having adopted their letters for numerals, should not have discovered that if α represented 1, β 2, and γ 3, that the three united might represent 123, may be explained by the embarrassment which they must have felt when they had to write 100 and no more, or any number in which a blank occurred; thus they felt the necessity of employing distinct symbols for tens, hundreds, and thousands. The use of marks above or below the letters was used to augment their arithmetical value; but the device was imperfect. The cipher solved every difficulty, and made the nine digits competent to any amount of figures. The word cipher is from an Arabic word, meaning *vacancy* or *nothingness*.

The Arabs employ a dot instead of the cipher; thus 1020 would be written ١٠٢٠. The Spaniards frequently adopt a very

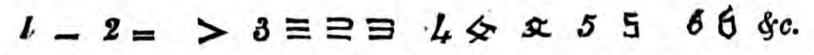
* See Colebrooke's Dissertation, p. 409. Peacock, p. 413.

† Codex Argenteus, preserved at Upsala, in Sweden.

‡ Humboldt "Vue des Cordillères," &c., p. 251. Peacock, 379.

small circle instead of a cipher, and in numbering their streets, particularly in the southern provinces of the Peninsula, a dwarfish cipher often replaces the Arabic dot; thus No. 2°1 is found instead of 201.

There is no end to the fancies which have traced in the Arabic numerals self-expressing symbols.



What is worthy of notice is, that the most ancient forms of the two and three, whether in Egyptian or Sanscrit writing, as well as in ancient Persian, in Thibetan, Mahratta, and other languages, resemble the Arabic numerals, which is not the case as respects any other of the digits.

The *Arabic* numerals were thus written by the Arabs.

١	٢	٣	٤	٥	٦	٧	٨	٩	٠
1	2	3	4	5	6	7	8	9	0

But the letters of the alphabet were among the Arabs, as among the Hebrews and other nations, employed to represent numerals, not in their alphabetical order, but as follows :—

a	b	t	th	g	h	kh	d	j	r	z	s	sh	ss	dd	tt
ا	ب	ت	ث	ج	ح	خ	د	ذ	ر	ز	س	ش	ص	ض	ط
1	2	400	500	3	8	600	4	700	200	7	60	300	90	800	9

tz	kh	kkh	f	kll	k	l	m	n	h	w	y
ظ	ع	غ	ف	ق	ك	ل	م	ن	ه	و	ى
900	70	1000	80	100	20	30	40	50	5	6	10

The Arabic alphabet was probably originally arranged according to the value of the numerals; or rather the numerals followed the order of the letters, as in the Hebrew and the Greek; which would, in fact, restore the Arabic letters to the position they hold in the Hebrew and Greek alphabets.

The use of counters remained long after the Arabic numerals were introduced. Head or mental arithmetic had not made much progress among the people two hundred years ago—so says a master of arithmetic. "The feat with the counters would not only serve those who cannot write and read, but also for them that can do both, but have not at some time their pen or tables ready with them."* So Shakspeare's clown—"Let me see—every shorn wether tods—every tod yields—pounds and odd

* Record's Arithmetic, 1658, p. 179.

shillings—fifteen hundred shorn, what comes the wool to? I cannot do it without counters." *

The works of Cocker have passed into oblivion, but his name and fame are become "household words." The first edition of his "Arithmetick—the Incomparable Art"—as the title-page calls it, was printed 1677. In 1720 (such was its popularity), the work had reached the thirty-seventh edition. Cocker himself appears to have formed a high estimate of his mission, and says complacently: "By the sacred influence of Divine Providence I have been instrumental to the benefit of many;" but Professor De Morgan seems disposed to launch a theory, that Cocker is, after all, the Mrs. Harris of arithmetic—that as far as the book is concerned, he was but "the shadow of a name," and that "John Hawkins, writing master, near St. George's Church, in Southwark," who professed to publish "Cocker's Arithmetic by the author's correct copy," may have himself been the author of the much renowned volume.†

The great and useful change which the Arabic or decimal system introduced, was, to give to the same symbol a different value by altering its position—the figure on the right hand representing the least value—the figure on the left hand the highest, and every figure acquires a ten-fold value by every remove from the digit on the right hand. By this simple and beautiful arrangement, only nine figures were required for the representation of any amount, however great; while, on the less perfect system, great or complicated numbers could only be represented by numerous and complicated figures. With the Arabic signs, the value of any number can be altered and defined, by merely shifting its place. If the simplicity and condensation of the system of Arabic numerals be compared with the complexity and elaborateness of either the Greek or the Roman method, the benefits conferred by their introduction will be most obvious.

In the Greek and Roman schemes, whatever might be the position of the letter representing a numeral, its value would be the same; while, in the Arabic system, its value would be determined by the place in which it stands. Thus while 5 stood alone, it would mean five units—another five added to it would add 5 tens 55, a third 5 hundreds 555, and so forth, the increased value being always ten-fold.

* Winter's Tale, Act iv. Scene 3. † De Morgan's Arith. Books.

CHAPTER III.

DECIMAL SYSTEM EXPLAINED.

To read all the books that have been written on any one topic, and its ramifications, would be a labour far beyond human patience or human industry; and nowhere more than in the field of figures do the embarrassments of superfluity accompany inquiry.

Professor De Morgan estimates, that since the year 1500, no less than 3,000 works on arithmetic have been published in Latin, French, German, Dutch, Italian, and English,* which would give to each of these languages an average of one production a year. In this portion alone of the expanse of human inquiry, how much of ingenuity has been employed—how much of anxious thought and elaborate calculation has been wasted—how little has been saved to the present and the future out of the wrecks and ruins of the past! And yet, instead of indulging in melancholy thoughts over so much of toil and trouble that has passed into oblivion, ought we not rather to rejoice that so little has been lost of that which was really worth preserving?

The decimal system, though found in some shape or other, more or less perfect, in almost every region of the globe, had really no adequate or even convenient mode of sound till the Arabic scheme of notation, with its beautiful simplicity of expression, and its wonderful powers of expansion, supplied wants which must have been constantly felt in every department of arithmetical inquiry.

The popular use of decimal fractions must be attributed to Stevinus,† whose works, originally written in Flemish, were trans-

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* No doubt the first English print on arithmetic is cap. 1 of "The Mirrour of the World, or Thymage of the same," headed, "And after of Arsmetrike, and whereof it proceedeth." Printed by Caxton in 1480.—*De Morgan, Arith. Books*, p. 101.

† Stevins thus describes the decimal power. "*Disme* is a species of arithmetic invented by the progression of tens, consisting in characters of ciphers, by which any number is described, and by

lated into indifferent French by Simon of Bruges, and who adopted the word *disme* as the device or representative of the new system of arithmetic. The English translation of Stevins' work is by Richard Norton (1608), and bears a title which is self-explanatory:—" Disme, the art of tenths, or decimal arithmetic, teaching how to perform all computations whatsoever, by whole numbers without fractions, by the four principles of common arithmetic; namely, addition, subtraction, multiplication, and division; invented by the excellent mathematician Simon Stevin." Dr. Peacock considers Oughtrede, the author of the *Clavis Mathematica* (1631), to have contributed more than any other to the propagation of decimal arithmetic, and that from this date the system may be deemed fully established.

The object of arithmetic is to give definite and correct results from calculations of numbers, and the rules of arithmetic are intended to facilitate these calculations. As regards the simpler processes of addition and subtraction, much may be accomplished by what is sometimes called "head work," the exercise of the mind, unassisted by figures, or what is appropriately denominated *mental arithmetic*; but for the more complicated operations of multiplication and division, which are but addition and substraction on a larger scale, it is not easy to conceive how they can ever have been satisfactorily carried on without the use of decimal divisions; and, even with their aid, what child has not repeated the ancient rhyme with strong sense of its truthfulness?

" Multiplication is my vexation,
Division is twice as bad;
The Rule of Three puzzles me,
And Practice makes me mad."*

In the first efforts of mind, distinct perceptions of numbers do not reach very far; and it is impossible that the ideas can acquire

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which we despatch all calculations of human affairs by whole numbers without fractions." Consult a curious paper of Professor De Morgan's, in the "Companion to the Almanack," for 1851.

* These verses are thus given from a MS. of about the date of 1570, by Mr. Davies.—*Key to Hutton's Course*, p. 17.

" Multiplication is mie vexation,
And Division is quite as bad;
The Golden Rule is my stumbling-stool,
And Practice drives me mad."

distinctness unless by a gradual process—moving step by step from the lower to the higher regions of numerals. The steps of progression afforded by the decimal system are singularly easy. The child who, for the first time, is taught the difference between ten and a hundred, even when told that a hundred is ten times ten, would assuredly get only a vague and loose conception of the greater number until his mind had gone over the ground by adding one ten to another until the process was completed. But if the child had been so far instructed as to get a correct notion of twenty, and were then told that a hundred represented twenty five times repeated, he would probably reach a correct notion of the value of a hundred by a swifter process; and again, if the numbers to fifty were accurately appreciated, and he were taught that two fifties make the hundred, the process of accurate appreciation would be still more rapid. In the same way, a correct idea of the value of a hundred would lead to a true conception of the value of a thousand,* being ten hundreds,—that of a thousand, of a million; but the distinctness of impression would be weakened with every augmentation of the numbers.

It will be seen in the languages of all civilised nations, that a far greater number of words mark the various steps of decimal notation than are found to represent any other arithmetical progression.

In the English language, associated with the idea of *ten*, we have—

Of Saxon roots—ten, tenths, tenfold, tithes, tithing, tithingman, teinds.

Of Norman roots—decimal, decimate, decimation, decime, dime, or disme.

Of Latin roots—December (tenth month or moon), Decemvir decennial.

Of Greek roots—decade, decagon, decalogue.

Of Hundreds. In Saxon—hundred, hundreds (geographical), hundreder.

In Norman, Latin, and Greek—cent, centime, century, centenary, centuple, centurion, centigrade, centesimal, centumviral centipede, centuple.

Of Thousands. In Saxon—thousand, thousandth.

In Norman, Latin, and Greek—mil, mile (1,000 steps), milfoil

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* Egli è maggior fatica a guadagnare il primo migliaio che poi col primo il decimo e il vigesimo.—*Casa. Lettere*, 69.

(a thousand leaves), millennium (a thousand years), millesimal, millennarian, millenest, milleped, millennary, millet (seed of a thousand grains), chiliad.

Ten thousand—myriad.

Million—millionaire.

The decimal progressions are, in most languages, made the resting-place from which start new groupings of words and their associated ideas. The first ten units generally stand separate and alone, and furnish the rests or foundations upon which the whole arithmetical structure is built. From eleven to ninety-nine, every amount is represented by some combination of the units, generally by a euphonious abbreviation, such as thirteen, fourteen, fifteen, instead of three ten, four ten, five ten,—or sixty, seventy, eighty, to represent six tens, seven tens, eight tens, &c. Next, up to nine hundred ninety and nine, hundreds and units are the elements of account, but, the use of higher numbers being less frequent than that of lower, abbreviations are seldom employed. The same rule applies to thousands, myriads, millions, billions, &c., when abbreviations or separate words are only used to represent decimal ideas. It would be obviously most inconvenient to say, ten tens for a hundred, or ten times ten tens, or a hundred tens, for a thousand, and so on. But there are few or no comprehensive or abbreviated terms in any other than decimal multiples; and if there be such, they are of narrow and local signification. Locke says, "In the way we take now to name numbers by millions of millions of millions, it is hard to go beyond eighteen, or, at most, four-and-twenty decimal progressions without confusion." Happily, such enormous quantities are little required in the ordinary concerns of life, but calculations to the twentieth decimal power are needful to determine real astronomical distance.

Dr. Lardner expresses a very natural surprise, that what is called the "device of place," by which all necessity for distinguishing the value of the units by distinct and separate symbols, should have remained so long undiscovered. But the most simple and striking results are frequently the produce of elaborate thought, and one of the highest and noblest exercises of the human intellect is to trace through the entanglements and perplexities of imperfect knowledge some great and pervading element or principle, which brings all disorder into harmony. An easy and intelligible form of decimal expression soon changed the whole system of figures. The process by which the system now universally adopted among civilised nations probably made its way originally, is very intelligibly laid down in the following extract:—*

"Let us imagine a person possessing a clear notion of the decimal method of classifying numbers, being desirous to count a numerous collection of objects by the help of common counters. He will, probably, at first pursue the method practised by the savage tribes of Madagascar.† The objects to be counted being passed before him one by one, he places a counter in a box A for each object that passes; but presently the counters in A become so numerous, and form so confused a heap, that he finds it as difficult to form an idea of their number as he would of the objects themselves which he wishes to count. Being able, however, to form a distinct and clear notion of ten counters, he pauses when he has placed the tenth counter in the box A, and withdraws all the counters from it, placing a single counter in the box B, to denote that ten objects have passed. He then recommences his tale; and, as the objects continue to pass before him, places counters in the box A, and continues to do so until ten more objects have passed, and ten counters are again collected in A: he withdraws this second collection of ten counters from A, and places a second counter in B; signifying thereby that two sets of ten objects have passed. Recommencing a third time, he proceeds in the same way, and, when ten have passed, withdraws the counters from A, and places a third counter in B. He continues in this manner, placing a counter in B, for every ten which he withdraws from A. If the objects to be counted be numerous, he finds, after some time, that the counters would collect in B so as to form a number of which he would still find it impossible to obtain a clear notion. For the same reason, therefore, that he allows no more than ten counters to accumulate in A, he adopts the same expedient with respect to the

* Lardner's Arithmetic, pp. 31-34.

† When the people of that island wish to count a great multitude of objects, such, for example, as the number of men in a large army, they cause the objects to pass in succession through a narrow passage before those whose business it is to count them. For each object that passes they lay down a stone in a certain place; when all the objects to be counted have passed, they then dispose the stones in heaps of ten: they next dispose these heaps in groups, having ten heaps, so as to form hundreds; and in the same way would dispose the groups of hundreds so as to form thousands, until the number of stones has been exhausted.

box B. When ten sets of objects have been counted, he finds that ten counters have collected in B: he withdraws them, and places a single counter in the box C, that counter being the representative of the ten withdrawn from B, each of which is itself the representative of ten withdrawn from A. The single counter in C will thus express the number of objects in ten sets of ten; and such a number, as already explained, is called a hundred. When one hundred objects have passed, there will therefore be only a single counter expressing it placed in the box C. The objects to be counted continuing to pass, the computer proceeds as before, placing counters in the box A, withdrawing them by tens, and signifying the collections withdrawn by placing single counters in B, until ten counters again collect in B; these are withdrawn, and a second counter placed in C. Let us now conceive the three boxes inscribed with the names of the units signified by the counters which they respectively contain. It will be obvious, that by the aid of twenty-seven counters, all numbers under a thousand may be expressed. Thus, nine hundred and ninety-nine would be expressed by placing nine counters in each box; the nine counters in the box C would stand for nine hundreds; those in the box B for nine tens, and those in A for nine original units.

"It will be sufficiently evident that the same method may be continued to any extent. A fourth box, D, inscribed thousands, may be provided, in which a single counter will be placed for every ten counters withdrawn from C; and a fifth, E, inscribed ten thousands, in which a single counter will be placed for every ten withdrawn from D, and so on. Under such circumstances more than nine counters could never collect in any box.

"We have here supposed the counters to be all similar to each other, and not bearing on them any character or mark; but as we have inscribed the several boxes with the names of the order of units which the counters they contain express, there is no reason why the counters themselves may not be inscribed with a character by which a single counter may be made to express any number of units from one to nine. Let us, then, suppose the computer furnished with an assortment of counters, inscribed with the figures 1, 2, 3, 4, 5, 6, 7, 8, 9; when he would express the number of units in each box, instead of placing in it several individual counters, the number of which might not be easily perceived, he places in the box a single counter, inscribed with a character which expresses the number of single counters which would otherwise be placed in the box. Thus, instead of leaving six individual counters in a box, he would place in it a single counter, marked with the character 6; by such an arrangement the number to be expressed would be always evident on inspection, as here exhibited:

F	E	D	C	B	A
4	3	5	7	3	1
Hundreds of Thousands	Tens of Thousands	Thousands	Hundreds	Tens	Units

Four hundred and thirty-five thousand seven hundred and thirty-one.

"Having adopted such a method of reckoning, he would naturally, for convenience, always arrange the several boxes in the same manner, and very speedily the PLACE in which the box stood would indicate to him *the order of the units* which it contains; thus he would be at no loss to remember that the second and third boxes from the right would always contain tens and hundreds, and the like of the others. The formal inscription, *units, tens*, &c., would, therefore, become unnecessary; and since, by the method of inscribing the counters with figures, no more than one counter need be placed in any box, the boxes themselves would be dispensed with, and it would be sufficient to place the counters one beside the other, the PLACE of each counter indicating the rank of units which it signifies. A slight difficulty would, however, occasionally present itself. Suppose that it should so happen that, when the last object to be counted passed, the tenth counter was placed in the box C, according to the system explained, all the counters would be withdrawn from C, and a single counter placed in D, or a counter containing a figure higher by one than that which was placed in it before. When the complete number is expressed, the box C would, in this case, contain no counter. When the boxes are superseded, and the counters alone used, the place of the third counter from the right would be unoccupied, and the number would be expressed by the counters thus:—

(4) (3) (5) ( ) (3) (1)

"The space between the counters inscribed 5 and 3 here shows the absence of the counter which would express hundreds; but in placing the counters, through negligence or otherwise, it might happen that the two counters which should thus be separated by a space might be brought so close together, that in reading the number the space might be overlooked, in which case the counter inscribed 5 would erroneously be supplied to express 5 hundreds. To provide against such an error, let us suppose blank counters to be supplied, and one of these placed in the position which would be occupied by an empty box; the above number would then appear thus:

④ ③ ⑤   ③ ①

and no mistake could possibly ensue.

"The next step in the improvement of this method would be to abandon counters altogether, and immediately to write down the figures which would be inscribed on them if they were used; these figures being written in the same order in which the counters were supposed to be placed. In this case a character would become necessary to signify the place of a blank counter, wherever such a one might occur. The character which would be naturally adopted for this purpose would be 0, and the above number would then be 435031.

"Such is the system of numerical notation, which has obtained in every part of the world an acceptance, the universality of which can only be attributed to its admirable simplicity and efficiency."

The decimal power may be said to lose itself in infinity of addition and multiplication, subtraction and division, by regular gradations of which tens multiplied or divided by tens are the instrument. It starts from a point, and by regular successions of decimal increase rapidly exhausts not only the powers of recording numbers, but even the conception of their immensity. If the attempt be made at a multiplication of progressive decimal quantities, such as by 10—ten by tens, hundreds by hundreds, thousands by thousands, millions by millions, billions by billions, trillions by trillions, and so forth, it will soon be found that the manual and intellectual labour of merely placing the units on paper will exceed all the powers of patient application. But take any other numbers than ten, and continue to multiply the product by itself, such as 9 by 9, 81 by 81, 6561 by 6561, and so forth, and the immense superiority of the decimal over every other scale will be strikingly elucidated. Far more than the telescope has done in exploring what is vast and distant in the regions of space—far more than the microscope has accomplished for exhibiting the adjacent and the minute in the world invisible to mortal eye—the decimal system has effected for arithmetical and astronomical science.

That the powers of figures are limited, whether decimal or not, may indeed be easily demonstrated. Mr. Babbage's calculating machine must be arrested somewhere; and in division, as well as multiplication, we are stopped by those laws of necessity which prevent finite comprehensions from stretching into infinity. For example, no figures will show the square root of 5. And the proof is irresistible, insomuch as that no figure multiplied by itself will make 5. Take the nearest approaches to the square root, and go through the whole nine digits. Suppose you have 2·231—will that, multiplied by itself, make 5·000? Assuredly not; but it will make 4·977,361. Take 2·232—that will not give 5·000; neither will 2·233—nor 2·234—nor any one of the digits up to 2·239, which, multiplied by itself, gives 5·013,121. The square root of 5 is therefore something between 2·236 and 2·237, but it is inaccessible and indefinable by decimal or any other figures; nor am I aware of any system by which the square root of prime numbers could be represented. This indeed is but to say that we lose ourselves in the vast extent of the field of investigation, comprehending all space and all time. However far we are able to pursue inquiry, it must ultimately lead towards the unapproachable. It may be said of all knowledge, that its boundaries are lost in infinity. From infinite wisdom all true science emanates; towards infinite wisdom all true science progresses; and in infinite wisdom all science loses itself.

CHAPTER IV.

ON NUMBERS, WITH ELUCIDATIONS OF DECIMAL DIVISIONS.

In pursuing inquiries into the history of arithmetical science—though the decimal grouping is undoubtedly the most salient point of observation—it is scarcely possible to pass by unnoticed the superstitions which have, in all periods of the world, been connected with particular numbers.* Keeping out of view the decimal distinctions, we find in the Bible remarkable evidence of partiality to particular units. While the number 6 only occurs 123 times; and the number 8 only 56 times; the number 7 is found 413 times. So the number 11 appears 36 times; the number 13 only 17 times; while the number 12 is found in 138 different places.

Independently of its decimal character, the number 10 had a peculiar sanctity in the minds of the Hebrews, especially as associated with the Decalogue; so had the number 40, as representing the period of days passed by Moses with Jehovah on the mount; and that during which the waters of the deluge were poured upon the earth. Seven is one of the most frequently occurring numbers, from having a somewhat indefinite meaning. Seven was employed vaguely to represent an uncertain but not a large number of persons or things. In the very earliest of the Biblical records we find, "If Cain shall be avenged seven fold, truly Lamech seventy and seven" (Genesis iv. 24). And in the book of Job, "In seven troubles (*i.e.* many troubles) no evil shall touch thee" (Job. v. 19). Again, out of many examples in the Apocrypha, "A man's mind is sometimes wont to tell him more than seven watchmen that sit above in a high tower." "How often shall my brother sin against me, and I forgive him until seven times?" (meaning, should I often do so?); and the answer is, "I

* Scaliger will have the word number to be derived from the Greek νεμειν (to distribute), and insists that νομος (law) means that each shall be protected in the property he possesses, or that is distributed to him.

say unto thee, not until seven times, but until seventy times seven" (Matt. xviii. 21), meaning, times innumerable; or, rather, that to forgiveness there should be no bounds.

Independently of its frequent use as an undefined number, *seven* had a holy and mysterious meaning, associated as it was in the minds of the Hebrews with the day on which Jehovah rested from the work of Creation; the seventh month was deemed more sacred than the other months; the seventh year was one of Sabbatical rest; and seven times seven years introduced the year of jubilee (Levit. xxv. 9, 10).

The Book of Revelation presents remarkable evidence of the attachment of the Jews to particular numbers, among which 4, 7, 12, 24, and 144, are the most prominent:—

Four beasts, *four* angels, *four* wings, *four* corners, *four* winds.*

Seven churches, *seven* golden candlesticks, *seven* stars, *seven* spirits of God, *seven* lamps, *seven* horns, *seven* eyes, *seven* angels, *seven* seals, *seven* trumpets, *seven* thunders, *seven* heads, *seven* vials, *seven* mountains, *seven* kings, *seven* thousand slain, *seven* plagues.

Forty and two months $= 6 \times 7$; 1260 days $= 30 \times 6 \times 7$; xi. 3, xii. 6.

Ten days of tribulation, *ten* hours, *ten* crowns.

Twelve tribes, *twelve* gates, *twelve* stars, *twelve* foundations, *twelve* apostles, *twelve* pearls, *twelve* fruits.

Twenty-four seats, *twenty-four* elders. 2×12.

Twelve times twelve, 144 cubits; 144,000 of all the tribes, vii. 4, of the redeemed, xiv. 1, 3.

A thousand years.

Twelve thousand of each of the twelve tribes.

Two hundred thousand thousand horsemen.

Ten thousand times ten thousand and thousands of thousands of angels.

A superstitious reverence has been attached among many nations to the number *seven*, even down to our own time. A seventh son, when there has been no interruption of daughters,

* Some of the Fathers give strange reasons for favouring certain numbers: "There must be four Gospels and no more, from the four winds and the four corners of the earth," says St. Irenæus; and St. Augustin's reasons for the choice of the twelve Apostles is, that the Gospel was to be preached in the four corners of the world in the name of the Trinity,—"and three times four," says he, "make twelve." —See *Brand's Pop. Ant.*, vol. iii. p. 268. Ed. 1849.

has been supposed to possess supernatural powers to heal certain diseases; and the seventh son of the seventh son, powers still more transcendent.*

It was a curious fancy of the ancients, that

"God loves uneven numbers;" †

and the same still exists in the popular mind. Good women, says Grove, held it indispensable that a hen should sit upon an odd number of eggs. All salutes are given in an odd number; and in many ancient medical prescriptions, in the taking pills, purgations, or bleedings, even numbers are ordered to be avoided. From this favourable opinion the number 13 is excluded; which is attributed by some writers to the presence of 13 persons at the Paschal supper, when the treachery of Judas was proclaimed.

The number 12, however, must be excepted from the general dislike to even numbers. It has been an object of partiality among many nations. A *dozen* is a favorite quantity in barter; and a gross, or 12 × 12, is of frequent use among the inhabitants of the South. The Scandinavians employed the word *tolpæd* to make 12 of 10 and 120 of 100. *C C vietra tolpæd*, is 240 years; and in our own language the *long* hundred implies six score.

In examining the affinities between the numerals of the great Indo-European family of languages, it will be seen that in the number *one* there is less of resemblance than in any other of the nine digits. Bopp very naturally supposes that the first numeral was in many cases only a representative of some noun or pronoun and thence was probably scarcely regarded as a numeral at all. Reckoning would in fact begin with 2, the second digit, and in that the resemblance runs throughout the whole group of idioms; and the same resemblance may be generally followed in all the units up to ten, and from ten up to a hundred, for which number many of the languages adopted independent words, not traceable to a Sanskrit, or, indeed, any other source.

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* For many curious elucidations of these superstitions, see Brand's "Popular Antiquities," Vol. iii. p. 265–8. Ed. 1849.

† "Numero Deus impare gaudet." Virgil, viii. Eclogue. — My readers may amuse themselves, while we are on the subject of uneven numbers, by unravelling the puzzle which William Leybourn gives in his "Pleasure with Profit," A.D. 1694. "What are the four odd numbers which added together make twenty?"—Quoted by De Morgan in *Arithmetical Books*, p. 54.

The first ten figures are called *units*, from the Latin *unus* or *one;* or digits, from *digitus* or *digiti*, the fingers; and in most languages these ten figures form the first group, and have separate and distinct names. The multiplication by tens or by combinations of tens is the ordinary mode of progression up to the highest groups of figures,—from hundreds, which are tens of tens, to thousands, which are tens of hundreds, and to millions, which are thousands of thousands.

In the first groups of ten, from eleven to twenty, an irregularity is frequently found, especially in the European languages. We do not say one ten, two ten, for eleven and twelve, as we say thirteen (three ten), fourteen (four ten). But even with this exception, the English numerals proceed with great regularity up to one hundred; and, as regards the seemingly irregular eleven and twelve, both words are associated with this symbol of ten, and mean leave one, and leave two: *i. e.*, one and two to be added to the preceding ten. The process of the etymology may be easily traced through the Anglo-Saxon*endleofan* (one leave), through *einlif*, to the German *eilf*, and the English eleven: so in twelve—two leave, *zwolif*—*zwölf* in German—to twelve English. Twenty is a favourite resting-place. The word *score*, which implies a stoppage when the amount was *scored* or recorded, has a strong hold of the popular mind, and is of frequent occurrence in English talk.

"Score me up for the lyingest knave in Christendom."
Taming of Shrew, 2.

And besides many other examples—

"And thou shalt have more
Than two tens to a score."
Lear, 1. iv.

Two score, three score, three score and ten, four score, four score and ten, are quite as familiarly used as forty, sixty, seventy, eighty, and ninety.

So in the French language, though *septante*, *octante*, and *nonante*, are undoubtedly excellent French words, and to be found in classical authorities, the words *soixante dix* (sixty and ten) for seventy, *quatre vingt* (four twenties) for eighty, and *quatre vingt dix* (four twenties and ten) for ninety, are almost invariably employed to represent these numbers.

Many other languages present peculiarities in the transition from ten to thirteen. In the old Sclavonic, the form is *yedinyi na* *desyaty*, for eleven (literally the first over ten); *vtoryi na desyaty*, for twelve (being the second over ten); in both cases the ordinal form is employed; but from thirteen upwards the cardinal form is used, as *chetyri na desyaty* (fourteen), being four over ten.

In the French, the irregularity is referable to a simple abbreviation of the Latin form, *undecim, onze; duodecim, douze*, where the termination *ze* may be deemed a mere shortening of *decem* for the sake of euphony.

The Sanskrit preserves perfect symmetry from eleven to eighteen, and the Thibetan from eleven to nineteen. In Sanskrit, the word dasa, *ten*, follows, in Thibetan it precedes, the unit.

	Sanscrit.		*Thibetan.*	
11	Eka das'a	one ten	Chu cheic	ten one
12	Dva das'a	two ten	Chu gnea	ten two
13	Triyo das'a	three ten	Chu soom	ten three
14	Chatur das'a	four ten	Chu zea	ten four
15	Pancha das'a	five ten	Chu gna	ten five
16	Sho das'a	six ten	Chu tru	ten six
17	Sapta das'a	seven ten	Chu toon	ten seven
18	Ashta das'a	eight ten	Chu ghe	ten eight
19	Unavinsati	one (from) twenty	Chu goo	ten nine
20	Vinsati	twenty	Gnea chu tumba	two ten

Ovid gives a variety of reasons for holding the number ten in especial honour, the most obvious of which is, that everybody is accustomed to count with his ten fingers.*

It is a favourite number with poets, and is crowded into one of Shakspeare's Sonnets thus:—

"If ten times happier, be it ten for one;
Ten times thyself were happier than thou art,
If ten of thine ten times refigured thee."

Shakspeare's Sonnets, vi.

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* "Annus erat decimum cum Luna repleverat orbem
Hic numerus magno tunc in honore fuit;
Seu quia tot digiti, per quos numerare solemus
Seu quia bis quino fœmina mense parit,
Seu quod ab usque decem numero crescente venitur
Principium spatiis sumitur inde novis."

Ovid, Fasti, lib. iii. 124.

The tenth wave* was held in ancient times to be the most violent and perilous. Ovid says :—

"The wave, of all most dangerous near the shore,
Behind the ninth it rolls, the eleventh before." †

While few of the numeral nouns serve as roots to verbs, to *tithe*, to *teind*, to *decuple*, to *decimate*, have found their way into dictionaries, and into the language of the people.

Decimation is used in a variety of senses, from the earliest times. Herodotus speaks (vii. 132) of the assembled Greeks who compelled their opponents to pay the tenth part of their property (Δεκατεῦσαι), *i.e.*, they *decimated* them—which some commentators have supposed to mean that they put every tenth man to death.

Humboldt ‡ remarks, that in the Toltec languages, spoken by the inhabitants of Central America, the year consisted of 18 months of 20 days each (with five supplementary days), many of which have monosyllabic names, unlike the dialects which prevail in America, and he points out a remarkable resemblance between the word Votan, for the third day, Odin's or Wodan's, or Wedn's-day—the twenty names being those of ancient chiefs. Vodan, according to the traditions of Central America, was a chief who, having escaped in a canoe from a great deluge, was the renewer of the human race. It has even been thought that the Odin of the West is identical with one of the Buddhas of the East, whose name in India is given to the third day of the week.§ These affinities open the door to curious speculations and inquiries.

Grouping by *sixties* is an ancient mode of division among the Hindus. Their *savan* (or natural day), which is the time between two consecutive sun-risings, is subdivided into 60 *Dhatas*, of 60 *vinadikus*, of 60 *vipalas*.

Their *Taura* (or solar day), the time during which the sun describes one degree of the ecliptic, and which, therefore, varies in length, is divided into 60 *dandas*, or *kalas*, of 60 *vikalas*. The *nakshatra*, or true sidereal day—equal throughout the year—

* Fluctus decumanus.

† "Qui venit hic fluctus, fluctus supereminet omnes
Posterior nono est, undecimoque prior."

‡ Letter to Dr. Ahrendt, dated Potsdam, July 22, 1853.

§ See Stephens's Thesaurus, i. p. 937.

is again divided into 60 *gharas*, each being 60 *pals* or *vighadias*. The *pal* is again divided into 6 *franas*, or respirations; but the "Surya Siddh'anta" and all astronomical works carry on the sexagesimal division, thus:—

60 kshanas	=	1 lava		
60 lavas	=	1 nimésha		
60 nimeshas	=	1 kastha		
60 kasthas	=	1 atipala		
60 atipalas	=	1 vipala	=	0·4 seconds
60 vipalas	=	1 pala	=	24 seconds
60 palas	=	1 danda	=	24 minutes
60 dandas	=	1 dena	=	1 day and night.
60 denas	=	1 vata or season.		

The year is divided into six seasons of two sidereal months, the succession of which is always the same, but the vicissitudes of climate in these seasons will depend on geographical position.*

Our division of the minute into sixty seconds has thus an Oriental derivation.

The unit of the Hindu system of currency was gold, and the old specimens found might either be 60 or 120 grains in weight, showing an evident connection with the Grecian drachma and didrachma of gold (χρυσος and διχρυσος), and confirming the testimony afforded by the device and symbols of old Hindu coins of a direct descent from their Bactrian prototype.†

Helvegius, as quoted by Junius, has a strange fancy respecting the origin of the word *hundred*, which he says is derived from ἐν τριῶν, *en triōn*, or one in its third place (decimally considered), 1—10—100. The old Gothic term for a hundred was *taihun taihund*, or ten tens. It was superseded by the briefer and more convenient *hund*, which was sufficiently intelligible after the removal of the three syllables that preceded it. Abbreviation of the word merely for the purpose of counting is natural, to save time and trouble. Most of the ten digits are monosyllables in the commercial languages of Europe, and when they are not so in writing, they become so by rapid pronunciation.

The hundredth day after a particular event was deemed oy the ancients the most propitious for application to the gods for aid and guidance.

* "Prinsep's Useful Tables." Calcutta, 1836. Part II., pp. 18, 19."

† Ib.: Part I., p. 15.

When, as related by Herodotus, Crœsus, the king of the Lydians, sent his messengers to consult the oracles, he specially directed that their inquiries should be made exactly on the hundredth day after their departure from Sardis.*

A curious example of the disposition to run into decimal notation may be found in the enumeration of the Persian fleet. Herodotus says it consisted of 1,207 vessels,† of which he gives these details:—

Phœnicians	300
Egyptians	200
Cyprians	150
Cilicians	100
Pamphylians	30
Lycians	50
Dorians	30
Carians	70
Ionians	100
Islanders	17
Æolians	60
Hellespontians	100
	1,207

It is remarkable that the whole are given in round numbers, except the 17 vessels belonging to the islanders, which Diodorus *rounds* to 50. Diodorus adds, that there were 320 Greek vessels, but enumerates only 310. He makes the whole fleet to have consisted of 1,200 ships:—

* The answer of the Delphic oracle, as given in hexameter verse, is amusing enough:—

"The sands and their numbers I know, and the measure I know of the ocean,
The dumb understand I—the silent I hear—and the savour
Of tortoise—hard-shelled, boiled with lamb, in a vessel of brass—to my senses
Is sweet—brass above, brass below must be laid there."

Crœsus sought to conciliate the Delphic god by sacrifices of 3,000 head of cattle of every kind, and enormous offerings of gold and silver.

† Ἑπτα και διηκόσιαι και χίλιαι. vii. 184.

Dorians	40	310
Æolians	40	
Ionians	100	
Hellespontians	80	
Islanders	50	
Egyptians		200
Phœnicians		300
Cilicians		80
Carians		80
Pamphylians		40
Lycians		40
Cyprians		150
		1,200

These discrepancies show the little confidence that is to be placed on numbers as given by historians. Some allowance must be made for errors of copyists or transcribers.

Theocritus reproaches the Greeks for their decatombs and chiliombs; their sacrifices of 100 and 1,000 oxen, upon which Larcher remarks, that the Greek sacrifices were trifling compared to those of the Jews—Solomon's peace-offering, at the dedication of the temple, consisted of 22,000 oxen and 120,000 sheep.*

Aristophanes had an amusing company of thirty thousand Athenians in his comedy of "The Popular Assembly":—

"What citizen, dear master mine,
Has half such happiness as thine?
Midst thirty thousand, thou alone
Hast had no dinner. Happy one!" †

As we approach the higher numbers of figures, all irregularity disappears, and the reason is obvious. The vulgar language, representing the daily and habitual wants of life, is little subjected to scientific rules; but in the more elevated regions, knowledge and science would create the symbols which they alone require. Beyond the lower numbers, little precision is required, and little exactness used in ordinary parlance. Children and uninstructed

* 1 Kings, viii. 63.

† Τις γαρ γενοίτ' ἂν μᾶλλον ὀλβιώτερος
Ὅστις, πολιτῶν πλεῖον ἢ τρισμυρίων
Ὄντων τὸ πλῆθος, οὐ δεδείπνηκας μόνος.
Arist. Concio. v. 1131.

persons frequently talk vaguely of hundreds and thousands and millions, giving way to fanciful expressions, and employing the first word of large figures which occurs. "I will give you a million of kisses," may be heard from the lips of a parent to a child. "A thousand thanks," is a common mode of expressing gratitude even for a trivial favour. "I have done it a hundred times," is often used merely to express the frequency of an action. Had any large numbers been habitually needed in the common intercourse of life, no doubt we should have had some single word to express ten thousand, as the Chinese have the word *wan*, or, a hundred thousand, for which the Hindoos use *lak*. Million would seem to be the augmentation of mil, and to have conveyed the meaning of a larger thousand. *On* is in many languages the sign of aggrandisement:—hombre—hombron (Spanish), a man—a big man; ladro—ladrone (Italian), a thief—a great thief; garçon for garce (French), a boy.

The words billion, trillion, quadrillion, and so forth, are only expansions of the roots two, three, and four, as carried by decimal multiplication into the higher regions of figures. In the Sanskrit, *padma* means thousands of millions; *mahadpadma*, a great padma, is *billions*, or millions of millions.

Herodotus speaks of the army of Xerxes as comprised of 1,700,000 men,*—an incredible amount. Homer almost always avoids specific and defined numbers, generally employing myriad in its indefinite sense.†

There is no end to examples of the use of the higher numbers to convey exaggerated notions of multitude. Berni says, in his Orlando Inamorato, ii. 21, 41—

> "Of services which wait for doing, one
> Is worth a hundred thousand millions done." ‡

Redi, in his Letters, desires his correspondent to give, in his name, to Father Carrara a million of millions of salutations.§

So Shakspeare in the "Winter's Tale"—

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* Ἑβδομήκοντα καὶ ἑκατον μυριαδες, vii. 60.

† Μυριος, Infinitus, immensus, numerus (Lexicon). Example, Iliad, φ. 320.

‡ "Ch'un servigio val piu che s'abbia a fare,
Che cento mile milion di fatti."

§ "Al padre Carrara renda in mio nome un milione di milioni di saluti."—*Lett.* 149.

"*Autolicus.* The loathsomeness of them offends me more than the stripes I have received, which are mighty ones and millions.

"*Clown.* Alas, poor man! a million of beatings may come to a great matter." Act IV. sc. 2.

And in Julius Cæsar—

"*Oct.* And some that smile have in their hearts, I fear, millions of mischief." Act IV. sc. 2.

Again, in the "Two Gentlemen of Verona"—

"*Val.* Madam and mistress, a thousand good morrows.
Speed. I give you good even, here 's a million of manners,
Sir Valentine, and servant to you two thousand."

"Within thine eyes sat twenty thousand deaths;
In thy hands clutched, as many millions;—in
Thy lying tongue both numbers."

Again, in his 115th Sonnet—

"Time whose million'd accidents
Creep in 'twixt vows, and change decrees of kings."

The million is sometimes used as the Greek, ὁι πολλοι (*oi polloi*), the many, the mob, the multitude. So in Hamlet—

"The play, I remember, praised not the million."

Dante has, I believe, no higher number than congregated thousands—

"Thousands on thousands pass into the moat." *

"More than a thousand leagues its splendours show." †

Spencer has—

"So fair, and thousand thousand times more fair
She seem'd, when she presented was to sight."

The Latins, having no word of *number* conveying the idea of multitude, invariably employed some superlative noun.

Tacitus speaks of a populous city as "numerosissima civitas."

The Italians, and several other nations, have a class of numerals, such as *diecena*, *centenaia*, *migliaio*, &c., which must be deemed rather approximative than precise. They accommodate themselves well to poetical phraseology.

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* "Dintorno al fosso vanno a mille a mille."—*Inferno*, xii. 73.

† "Che refulgeva più di mille milia."—*Para.*, 26.

Dante has—

> "And over thousands of enkindled lamps,
> I saw a sun which far outshone them all." *

And Berni—

> "And Agricano to the combat then,
> Led two-and-twenty hundred thousand men." †

A similar form of numeration existed among the Greeks. It is reported of Thyas, the king of the Paphlagonians, that he had a hundred varieties served at his repasts; and so, where we have Herodotus translated by "he made rich presents," the words literally mean, "he presented him with ten things of each kind." ‡

"And is nobody here but we two? Yes, said the monk, there are thousands!" §

"Which conditions were not by tens but by hundreds." ‖

No higher term than that of *million* has ever obtained currency in England. A thousand millions, a million millions, are used in preference to billions or trillions—words whose real meanings have often been inaccurately laid down. The French have introduced the word *milliard*, meaning a thousand millions. The yearly expenditure of France is habitually spoken of as a milliard and a half; that is to say, 1,500,000,000 francs, or about sixty million pounds sterling. The French represent myriad and billion to be synonymous; but English writers generally consider *billion* to represent a million millions, a trillion a million billions, and a quadrillion a million trillions, and so on; each denomination representing a million times the denomination preceding. Thus

2,567,894,237,168,456,306,123,720

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* "Vedi io sopra migliaia di lucerne,
Un sol che tutte quante l'accendia."—*Paradiso*, 23.

† "Venti due centenaia di migliaia
Di conbattante avessero Agricano."—*Orl. In.* i. 10, 30.

‡ Ἑκατον παντα παρατιθεσθαι, which Larcher says ought to be translated *omnia centena*,—or, une centaine de tout. Ἐδωρήσατο πᾶσι δέκα. Her. iv. 88.

§ "Non v' è egli più persone che noi due? Disse il monaco:
Si, a migliaia." *Boccacio, Nov.* xxviii. 21.

‖ "I quali patti erano a centenaia e non a diecine."
Lett. di Benv. Cellini, 47.

would represent 2 quadrillions, 567,894 trillions, 237,168 billions, 456,306 millions, 123 thousands 720. But the words have little or no practical value; for though such groups of figures may be employed for the purposes of astronomical or arithmetical calculation, they never can be associated with the ordinary and every day business of life, which alone can give currency to new forms of speech.

Independently of decimal divisions, most languages have non-decimal quantities or words, denoting either specific or approximative quantities. Dozen, in English, is the Norman form for twelve—*duodecim* or *douzaine;* and a gross may probably, in its original meaning, have represented a large dozen—*grosse douzaine.* The Scotch have *threave,* which, though generally meaning two dozen, or 24, sometimes denotes a multitude, as in Ramsay:—

> "In came visitants a *threave,*
> To entertain them she maun leave
> The looking-glass." II. 463.

Upon the mysteries of numbers volumes without end have been written. Few are ignorant of the manner in which, by earnest Protestants, the number of the beast (666) has been made to apply to Rome, to the errors of the papacy, and to a variety of individual popes; to different forms of heresies, and to the heresiarch Luther especially, by equally zealous Catholics. Erudition and imagination have revealed wonders concealed under the mysterious *three,** and the scarcely less distinguished *seven.*† One eloquent author,‡ on the title-page of his work on "The Secrets of Numbers," calls them "pleasing to read, profitable to understand, opening themselves to the capacities of both learned and unlearned—being no other than a key to lead men to any doctrinal knowledge whatsoever."

One of the most familiar illustrations of the power of progressive numbers is found in the answer which the inventor of the game of chess is said to have given to the prince who asked what reward would satisfy him for his great discovery—"One grain of wheat," said he, "for the first square on the board, two for the second, and so to proceed doubling to 64, the whole number of squares." Lucas de Burgo had the patience to solve the question, and gives as the number of grains

* See Lucas de Burgo, as quoted by Dr. Peacock, p. 424–5.

† See Heptalogium Virgilii Salzburgensis.

‡ William Ingpen, Gent., London, 1624.

18,446,744,073,709,551,616.*

He carries on the estimate by the Perugian measure, and, calculating that 100 boat-loads would fill a warehouse, 100 warehouses a castle, he computes that somewhat more than 209,022 castles would be necessary to hold the wheat which the ingenious chess inventor suggested as his becoming recompense. Now, supposing, instead of a dual, there had been a decimal progression, what numbers could have recorded the result, and what time would have been occupied in the record?

It would be rather amusing to trace through the regions of fancy the various methods by which the ideas of infinity are associated with the functions of numbers. The graces and glories of the Virgin are given by Gaspar Scott, in his "Magia Universalis Naturæ et Artis," as exactly exhibited by the 256th power of 2, viz.:—

115,792,089,237,316,195,423,570,985,008,687,907,853,269,984,665,640, 564,039,457,584,007,913,129,639,936.†

Others solved the same problem by writing down, in every possible way, the hexameter verses which might be made by the transposition of the letters in the following line:—

"Tot tibi sunt dotes, Virgini, quot sidera cœlo."

"Thy graces, O Virgin, are told when the stars of the heaven are numbered."

* This is the correct 64th power of 2, but the true answer is the 63rd power of 2; viz., 9,223,372,036,854,775,808.

† De Morgan's "Arithmetical Books," p. 45.

CHAPTER V.

ADVANTAGES OF A DECIMAL SYSTEM AS COMPARED WITH THE EXISTING USAGES.

To the value of the decimal system in coins and accountancy in the United States of America, Mr. Jefferson has left this emphatic testimony:—

"The experiment made by Congress in 1786, by declaring that there should be one currency of accounts and payment through the United States, and that its parts and multiples should be in a decimal ratio, has obtained such general approbation both at home and abroad, that nothing seems wanting but the actual coinage to banish the discordant pounds, shillings, pence, and farthings of the different states, and to establish in their stead the new denominations."*

The decimal system is, in fact, a method of easy and regular progression, by which correct ideas of small numbers enable us to attain accurate notions of large ones. Unless we proceed from stage to stage, from group to group of numerals, our associations become very vague and shadowy. If we take any other than the decimal form of enumeration, we shall soon find great difficulty in reaching the higher amounts, and the additions and multiplications become intricate and perplexing. A child that should be called upon to proceed by the lowest form of multiplication, say by two, would soon find its progress arrested: $2\times2=4$, $2\times4=8$, $2\times8=16$, and so forth; and still sooner arrested if the progression were the multiplication of numerals into themselves, as $2\times2=4$, $4\times4=16$, $16\times16=256$: but with the aid of decimals,† and in proceeding from tens

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* Report on Money, Weights, and Measures, by Jefferson, Secretary of State, 1790.

† The decimal power is thus spoken of in a complimentary recommendation of Noah Bridge's "Vulgar Arithmetic" (1653).

"Melitides, who ne'er could thrive
In computation beyond five,
May now in 's noddle millions hive."

to hundreds, and hundreds to thousands, the greatest facilities will be found both for the exact estimate and the intelligible expression of large amounts.

The simplest form of exhibiting the decimal system of coins and accounts to the mind is probably to represent it as getting rid of all the complications of *compound* addition, subtraction, multiplication, and division, and reducing all calculations to those simple rules, which are the first lessons learnt of the arithmetical art. When nothing but a decimal process is used, the greatest possible amount of simplicity will be attained. Any boy who has now to add up a sum in pounds, shillings, pence, and farthings, learns that when he has reached the column of pounds his principal difficulties are got over. The farthings perplex him because they are divided by 4; but that is a less difficult operation than the division of the pence by 12; the division of the shillings by 20 is perhaps the easiest task of the three, inasmuch as 20 has something of a decimal element, being comprised of two tens; but the sum goes on glibly when on adding up the pounds there is no division at all, but merely the carrying on the number of tens from column to column, with the very distinct impression, that every column to the right is one-tenth, and every column to the left ten times the value of the adjacent column.

The contrasted mode of working a decimal and non-decimal system is exhibited in a very simple form, as follows:—

£	*s.*	*d.*
1,234	5	6½
89	10	3¾
467	12	9¼

The operation performed by the existing system is thus effected:—

Farthings added make 6, which, divided by four, leaves 2, and 1 to be carried forward to the pence column;

4) 6

1—2 2 farthings

Pence added, make 19, which, divided by 12, leaves 7, and 1 to be carried forward to the shilling column;

12) 19

1—7 7 pence

Shillings make 28, which, divided by 20, leaves 8, and 1 to be carried forward to the pounds column,

20) 28
1—8 8 shillings

Pounds 1791, no division, but the superior unit carried on to the next column £1791 8 7½

Decimally.

£1,234 · 277	·0863
89 · 515	·0250
467 · 638	·5416
£1,791 · 430	.6529

But if the farthing were decimalised, and made $\frac{1}{1000}$, instead of $\frac{1}{960}$th of a pound sterling, the account would stand thus :—

£1,234 · 277
89 · 515
467 · 637
£1,791 · 429

The whole operation being one of simple addition.

Of the inconvenience of the existing system, as regards the bullion transactions of the Bank of England, no stronger evidence can be desired than that given to the Parliamentary Committee by Mr. Thomson Hankey, the late Governor. Mr. Hankey says:—

"During the time I held the office of Governor of the Bank of England my attention was particularly called to the subject, in consequence of what appeared to me to be the extremely complicated system of keeping accounts with respect to all transactions in the purchase or sale of bullion at the Bank of England. I found, on examining into the system or mode of keeping such accounts, or of making such calculations, that there were three elements which entered into the consideration ; the first was the weight, which was calculated in troy pounds and ounces, of which there were twelve to the pound, pennyweights, of which there are twenty to the ounce, and grains, of which there are twenty-four to the pennyweight. The second element was the quality of the gold, which was subdivided by carats, a carat meaning the 24th part of any quality of gold ; the carat was again subdivided into eight. The third element was pounds, shillings, pence, and farthings. A more complicated system, and one more fraught with incidents to error, can hardly be conceived ; it requires, in fact, an extremely expert calculator to make even any ordinary calculations of the kind ; so much so, that I do not believe that any

THOMSON HANKEY, ESQ., M.P.

merchants or ordinary dealers ever make the calculations themselves; they employ brokers who transact the business for them, and these brokers use a voluminous series of tables by which they arrive at the results of the calculations. This appeared to me to be so extremely inconvenient a system, and so extremely difficult for myself to learn, that I was anxious to see whether I could not, for my own private purposes, make calculations by a system of decimal tables, and I found that by using the decimal ounce, and discarding altogether the pound troy, a very much more simple mode of calculation could be arrived at; and it was after much consideration on the subject that the Bank of England determined to take advantage of the anomalous state of the law respecting the pound troy, and respecting troy weights generally, to discard altogether the use, from all other calculations, of the pound troy. They discarded it out of the Bank altogether; they made use of the ounce troy, multiplying larger quantities by the multiples of the ounce, and a smaller quantity by a decimal subdivision of the ounce; and on that principle a set of tables was framed, which have been in use since that time. Though I believe in the first instance some little prejudices existed on the subject, yet those who were interested in such calculations found that they were much more simple than any they had hitherto used, and within almost a few months they came into such general use that I believe all dealers in bullion in London have adopted that system. I should mention that dealers in bullion are a peculiar class, confined to a small number of merchants in London and their clerks, and are of a very intelligent character; and therefore the difficulty of persuading them to adopt a system which seemed so evidently calculated to save trouble, and is an improvement on the former system, was not very great. I think it has now been adopted generally, and that nobody would think of proposing any return to the former system.

"Having removed, therefore, one of those conflicting elements out of the way, the calculations now really only have reference to the fineness of quality, and to the pounds, shillings, and pence. If we could simplify that calculation by adopting decimal coinage with regard to pounds, shillings, and pence, I have no doubt that all calculations in bullion, which called my particular attention to the subject, would be again extremely simplified. It was with that view that I first paid attention to the subject, and I have arrived at the conclusion that all calculations regarding bullion transactions would be extremely simplified by an adoption of a decimal system of coinage. A decimal system undoubtedly saves labour, and it attains greater accuracy. I should say that there is in all the calculations a great saving of figures, and there is also a saving in the mere recording of the weight of bullion. In recording one hundred bars of gold, there would be a saving of more than forty figures; and the weight would be recorded to the minuteness of something less than half a grain, whilst, by the old mode, it could only be recorded by the grain."

Mr. Wm. Miller, of the Bank of England, one of the witnesses before the Parliamentary Committee, has kindly furnished the following striking exemplification, contrasting the simplicity of decimal calculations with the elaborate operations of a non-decimal system, which will illustrate Mr. T. Hankey's evidence.

"The assayer imagines all gold to consist of 24 parts, or carats, as he calls them; each carat he subdivides into 4 parts, which he calls grains (which, however, have no relation to the grain of weight), and each grain into 8 parts. Thus he defines the quantity of gold by degrees, each of which is the 768th part of the whole.

"The report of the quality is made, not in relation to fine gold, but to standard gold, as so many carats, or grains, or eighths of grains, better or worse than standard.

"Standard gold consists of 22 parts, or carats, of fine gold, and 2 carats of alloy.

"When the quality of a bar of gold has been ascertained, the next question is, what its weight would be, supposing it were converted into standard by the addition, or elimination of alloy.

"For example:—We will suppose the assay report to be "2 carats better," which would be equal to fine gold. To bring the mass to standard, it is clear that to every 22 elements of its weight, there must be 2 elements of alloy added.

"The statement, therefore, of the question as to the amount of standard gold in a mass of gold better, would be—

$$\text{As } 22 : 22 + \left.\begin{smallmatrix}\text{the rate}\\ \text{better}\end{smallmatrix}\right\} :: \text{actual weight} : \text{standard.}$$

In the case of gold worse, the converse would hold—

$$\text{As } 22 : 22 - \left.\begin{smallmatrix}\text{the rate}\\ \text{worse}\end{smallmatrix}\right\} :: \text{actual weight} : \text{standard.}$$

"The question is simple enough, but the working is very tedious, on account of the incongruity of the terms. First we have the weight, in pounds, ounces, pennyweights, and grains; we have next the quality, in carats, grains, and eighths of grains. And, lastly, we have the money value, in pounds, shillings, and pence. None of these terms will work together arithmetically; they have, consequently, to be reduced into their lowest elements, and, when the calculation has been made, to be reproduced.

"The following examples show the working under the old system, supposing the whole operation to be set down; the same under the present system, in which the weight is expressed decimally; and the same supposing a decimal currency existed, and that the quantity of standard gold were altered from 11-12ths to 9-10ths fine; that is to say, that it were the same as the standard gold of France, Holland, the United States, and several other countries.

"EXAMPLE I.

"What is the value of a bar of gold weighing 79 lbs. 7 oz. 17 dwts. 12 grs., reported by the assayer to be 5 carats 3 grains and 7-8ths worse, and what is the weight in standard?

	Carats.		Carats. Cts. Grs.		lbs. oz. dwts. grs.
As	22	:	22 — 5 $3\frac{7}{8}$	: :	79 7 17 12
	4		5 $3\frac{7}{8}$		12
	88		16 $0\frac{1}{8}$		955
	8		4		20
	704		64		19117 : :
			8		24
			513		76480
					38234
					458820
					513
					1376460
					458820
					2294100

704) 235374660 (334339
2112
2417
2112
3054
2816
2386
2112
2746
2112
6340
6336
4

"The above operation gives the standard weight in grains, which have to be reduced to pounds, ounces, pennyweights, and grains.

Grains.
24 { 3) 334339
× 8) 111446 : 1
2,0) 1393,0 : 19
12) 696 : 10 : 19
lb 58 : 0 : 10 : 19
Answer as to weight in standard gold.

"Then comes the question of value at the Mint price of £3 17s. 10½d. per ounce.

Oz. Grains. £ s. d.
As 1 : 334339 : : 3 17 10½
20 20
20 77
24 12
80 934
40 4
480 3738
334339
33642
11214
11214
14952
11214
11214
480) 1249759182 (2603664
960
2897
2880
1759
1440
3191
2880
3118
2880
2382
1920
46

Farthings.
4) 2603664
12) 650916
2,0) 5424,3
£2712 3s. 0d.—Answer as to value.

"EXAMPLE II.

"The following shows the working of the same question under the present system, in which the weight is expressed decimally.

"What is the standard weight of a bar of gold weighing 955·875 ounces, at 5 carats $3\frac{7}{8}$ grains worse, and what is its value?

Carats.	Carats.	Cts. Grs.	Ounces.
As 22 :	22 —	5 $3\frac{7}{8}$: :	955·875
4	5 $3\frac{7}{8}$		513
88	16 $0\frac{1}{8}$		2867625
8	4		955875
			4779375
704	64		
	8		704) 490363875 ($696539\frac{419}{704}$.—Answer [in Ounce Standard.
			4224
	513		

```
704 ) 490363875 ( 696539 419/704.—Answer
      4224                [in Ounce Standard.
      ----
       6796
       6336
       ----
        4603
        4224
        ----
         3798
         3520
         ----
          2787
          2112
          ----
           6755
           6336
           ----
            419
```

Value at £3 17s. $10\frac{1}{2}$d. per ounce:—

		696·540
		3
15 0	$= \frac{1}{4}$	2089·620
2 6	$= \frac{1}{8}$	522·405
3	$= \frac{1}{10}$	87·067
$1\frac{1}{2}$	$= \frac{1}{2}$	8·706
		4·353
Answer as to value.—		£2712·151
		20
		3·020

"In this operation it will be seen that the two reductions are avoided, and the value is ascertained by the rule of practice, as in this case the whole working can be set down by that rule.

"EXAMPLE III.

"The following is the operation, supposing all the elements of the calculation were in decimals, and that standard gold consisted of $\frac{9}{10}$ths fine gold, which would make the Mint price £3 16s. $5\frac{1}{2}$d., or thereabouts, or expressed as it would be in decimals, £3·823 (three pounds and eight hundred and twenty-three mils). The question would, therefore, have to be asked in somewhat different terms.

"What would a bar of gold weighing 955·875 oz., reported by the assayer as 667·96 oz. fine, yield in ounces standard, and what would be its value?

[In working such questions as these, the abbreviated form of multiplication, as taught in all the school books, would be used, which consists in reversing the multiplier, and beginning to multiply with each figure of the multiplier that figure in the multiplicand which stands directly above it; by this means all useless figures are got rid of.]

According to the previous formula—

```
As 900 : 667·96 : : 955875
                     69766—rate reversed.
                   -------
                   5735250
                    573525
                     66910
                      8602
                       573
                   -------
             900 ) 6384860
                   -------
        Answer—     709430 ounces standard.
                      3283—price reversed.
                   -------
                   2128290
                    567544
                     14188
                      2128
                   -------
        Answer—£2712·150—value.
```

Nothing could be more simple than such a working; and were the supposed changes really made, it could be shortened yet more, because the quality would never be reported to five figures."

General Pasley gives us an example of the diminished labour of calculating the following ironmonger's account:—Value of 215 tons 17 cwt. 3 qrs. 9 lbs. of cast-iron, at 9*l.* 11*s.* 6½*d.* per ton; reckoned by the common mode, it takes 208 figures; reckoned decimally, 66 figures—a saving of more than two-thirds.*

In illustration of the advantage of a decimal mode of accountancy, take an example given by Professor De Morgan. "If 16*l.* 10*s.* 2½*d.* yield 23*l.* 1*s.* 11¼*d.*, what will 146*l.* 3*s.* 2¾*d.* yield? The ordinary mode of doing it by those who are not expert at the rule of practice, the way which is taught in schools, has not a figure less than the following:—

```
 £  s.  d.       £  s.  d.         £   s.  d.
16 10  2½       23  1  11¼        146  3  2¾
  20              20                 20
 ----            ----              -----
 330             461                2923
  12              12                  12
 ----            ----              -----
 3962            5543               35078
    4               4                   4
 -----           -----             ------
 15850           22173             140315
                                    22173
                                   ------
                                   420945
                                  982205
                                 140315
                                280630
                               280630
                               ----------
                 15850 ) 3111204495 ( 196290
                         15850          49072 — 2
                         ------          4089 — 4
                         152620           204 — 9
                         142650
                         ------     Answer.—£204 9s. 4½d.,
                           99704       and ½ a farthing.
                           95100
                           -----
                           46044
                           31700
                           ------
                           143449
                           142650
                           ------
                             7995
```

"208 figures, as in General Pasley's statement.

* Evidence, pp. 26, 27.

"In order to compare this with the result of the proposed decimal improvement coinage, we are to remember that our present system, which turns the student away from ordinary decimal integer arithmetic before he is master of it, prevents him from practising useful abbreviations. The system, which would soon be taught, would give the following mode of working, in which the trouble is increased, by taking the tenths and hundredths of farthings. If we had begun with the new system, instead of representing the old, these fractions of farthings would be avoided.

```
16·51041        23.09687        146·16145
                                  7869032
                                ---------
                                292322900
                                 43848435
                                  1315453
                                    87697
                                    11693
                                     1023
                                ---------
                     1651041 ) 337587201 ( 204·469
                                  737900
                                   77484     £204 9s. 4¾d.
                                   11442
                                    1536
"118 figures.                         50
```

"But let the pound be divided, as is proposed, into 1,000 units, and the operation will be thus exhibited :—

If 16·511 yield 23·097, what will 146·162 yield?

```
   16511 — 23097      146162
                       79032
                     -------
                     2923240
                      438486
                       13154
                        1023
                     -------
             16511 ) 3375903 ( 204·464
                       73703
1 ... 208 figures.      7659
2 ... 118  do.          1055
3 ...  76  do.            64              76 figures."*
```

* "Companion to Almanac for 1848," pp. 11, 12.

PROFESSOR DE MORGAN.

As contrasted with the ordinary mode of calculation, here is a saving of 132 figures, or nearly two-thirds of the whole, as contrasted with a decimal system applied to the existing currency, and the saving would be, as above exhibited, of 42 figures. It is true that the latter calculations are much assisted by abbreviated forms; but the use of such abbreviations is decidedly connected with, and will immediately follow, the introduction of a decimal system; for, as Professor De Morgan says :—

"The only reason why those abridgments, which save about half the trouble of multiplication and division, are not now in common use, is simply that the paramount necessity of practising our present money system prevents young calculators from having time to learn them, or opportunity to use them. The want of them is a consequence of our present system; the introduction of them would follow the new one."

Another example from Professor De Morgan :—How much in the pound is 43*l.* 17s. 4¾d. per cent.? The common operation is—

```
        £.         £. s.  d.          £.
As     100    :    43 17  4¾  :  :    1
                   20
                  ----
                  877
                   12
                 -----
                10528
                    4
                -----
           4 ) 42115
               -----
          12 ) 105-1
               -----
                 8-9       Answer 8s. 9¼d.
```

Here are 42 figures; but, written in decimals, the question is answered by the figures themselves. The amount is 43·869*l.*, the percentage obviously 438=8s. 9¼d.*

And a further instance is given by Professor Airy to the Parliamentary Committee, who, in answer to the question whether the decimal system of coinage would not give great facilities in the way of calculating interest and discount, replies—"Every calculation of that sort would be made very much easier. But I may mention, that even calculations of the smallest kind would be very

* Ibid. p. 13.

much easier; for instance, a few days ago I was looking at a gas stove, and I inquired how much it burned; I was told seven cubic feet in an hour. My gas cost me 4s. per 1,000 feet—how am I to calculate the hourly cost? I found the easiest way was to turn it into decimals, and to do it by mils; 4s. gives 200 mils, I multiply that by seven feet, and the result is $1\frac{4}{10}$ mil per hour. I am not a very bad calculator, and yet it would take me several times as long to do it by pence and farthings."

And being asked for instances that have occurred in which the change to the decimal system has been fruitful of great advantages; in astronomy for instance, the Professor states, that the great centesimal change proposed by the French *savans* at the end of the last century he has had occasion to use very extensively, and its value is very great indeed; and he adds, that it would be the means of a very great saving of labour to contractors and builders, and others.*

Professor De Morgan is entitled to be heard with attention, as he speaks with authority on the advantages and assistance which the introduction of a decimal monetary system will bring to the education of the people.

"Has any one of our readers (he asks) ever taken the pains to form an idea how much of the time actually spent in education in Great Britain and Ireland, is spent in overcoming the disadvantage of our present system of coinage? We say coinage, because by far the greater part of practice in commercial arithmetic is devoted to pounds, shillings, and pence. We believe that five per cent. is under the mark, taking in all classes; we believe that in purely commercial schools it is a great deal more; but that in all together, from Oxford and Cambridge down to the lowest village school, more than five per cent., more than one-twentieth of the whole time passed in every kind of learning and practising, is lost by the having two systems of arithmetic to learn—the common decimal and the monetary. We put down arithmetic—looking at the mass of places in which only reading, writing, and ciphering are taught—as more than 20 per cent. (we cannot say how much more) of the whole; and we estimate the dead loss of time which arises out of our monetary system, as one quarter at least of that 20 per cent. We speak of time only: were we to compare what is done—as to efficiency, as to sound result produced—

* Evidence, p. 36.

we should say much more. But suppose it five per cent.—and we think we could maintain this statistically—or go lower, suppose it three per cent., and what is the result? Three hours out of every hundred spent in education are employed in mere consequence of a system which is in itself, and without reference to the trouble of learning it, a positive disadvantage. It would be well to abolish this system, even though it saved nothing in teaching; and, besides this, we turn every 97 hours of useful school work into 100. Add to this the relief given by the abolition of the worst part of the drudgery of learning computation, which lies in this, that there is a lower deep beneath the lowest. As soon as the unfortunate schoolboy has mastered the four rules, there is a weary recommencement of his toil.

"In all the earlier rules of arithmetic, there is nothing which appears to apply. The most ordinary questions of everyday life seem to be beyond the power of addition, subtraction, multiplication, and division of ordinary numbers. And so they are; because the money, weights, and measures, are all numbered on other systems. If the change were made in the money only, an immense power of application would be immediately given. The addition and subtraction of common units would give that of money; by common multiplication and division the total price of integers, or the price of one from the total price, would be found."*

Such is the liability to error under a non-decimal system, that Mr. Miller stated to the Committee, how on one occasion, when he sent for five superior clerks to work out arithmetically the value of an ingot of gold in the Bullion-office of the Bank of England, *five* different results were produced. Mr. Miller is of opinion, that the use of decimal arithmetic, independently of the greater security for accuracy, would enable the Bank of England to dispense with one clerk in twelve.†

Professor Airy says, that the existing system brings with it "very great liability to error, and it costs a great deal of labour. I might say, that the labour is doubled in all cases; by which I mean, that in multiplying there are two mental operations to be performed where one would suffice. For instance, suppose I multiply 9 pence by 7; 7 times 9 makes 63, that is one operation in the mind: but then there is another operation, to convert that 63 into

* Ibid. pp. 15, 16.

† Minutes of Evidence, p. 120.

5*s*. 3*d*.; and although in that case the numbers are related in a simple way, yet in many they are related in such a complicated way that they present no similar features at all. For instance, if I had to multiply 7 pence by 5, it would be 35—that is one operation; but then the mind has another operation to perform, to convert the 35 into 2s. 11d. without any common figure in the calculation.

"The difficulty of dividing under the existing scale is greater than the difficulty of multiplying. Supposing you have to divide 3*l*. 15*s*. 6*d*. by four; in the first place, although the 3*l*. is divisible in itself by 4, you do not treat it in that way, for you have to convert the 3*l*. into 60*s*., and add that to the 15*s*., making 75; and then, again, you have to multiply the remainder from the 75, and convert that into pence, before you proceed to the next division."*

To the immense advantages growing out of the introduction of a decimal system, Sir John Herschel gives this valuable testimony:—"I should say that, the decimal system being once introduced, the rules of 'Compound Arithmetic,' 'Reduction,' and 'Practice,' would no longer require to be taught in schools. The relief thus afforded, both to the teacher and scholar, would be immense. The four essential rules of arithmetic would be better acquired, and the drudgery spared, and the time saved for the acquisition of real knowledge would tell upon the education of every individual in every class of society. Even the 'Ready Reckoner' would be dispensed with, or its place supplied by a general multiplication table of comparatively small extent, and possibly a table of logarithms might occasionally be seen where now such a thing is never dreamt of. All statistical, revenue, and general commercial computations would be facilitated, and the acquisition of clear views of the mutual relations of prices, imports and exports, duties, taxes, &c., very greatly so, by disencumbering the elements of computation of the infinite complexity of denominations under which they are now presented. The introduction of the decimal system would get rid also of the whole of that complexity which consists in what we call Rule of Three, sums of complicated denominations. In these calculations an immensity of labour would be saved, and a great deal of clerkship in the adding up of columns; and the quantities of mistakes that arise with those who are not from their youth up accustomed to that work, is very great."†

* Minutes of Evidence, p. 58. † Ibid, pp. 55, 56.

SIR JOHN HERSCHEL.

Professor De Morgan has long been one of the most zealous and efficient labourers in the decimal field. His valuable contributions on the subject in the Companion to the Almanac,* are well worthy of attention. In the first he lays particular stress on the value of logarithmal tables, applied not alone to mathematical computations, but to the purposes of commerce and the ordinary business of life; and he points out that a decimal coinage, useful as it must be in every other respect, would be of inestimable value if it caused the attention of people in general to be directed to the subject of decimal fractions. He recommends that system of decimal coinage and account which has been since sanctioned by the unanimous approval of the Committee of the House of Commons, viz., the division of the pound sterling into a thousand parts. This scheme indeed, admirable for its simplicity,—for its little interference with the existing currency,—and for the amount of approval which it has elicited alike from men of science, teachers, merchants, and tradesmen, has also had the sanction of the Commission of Weights and Measures, who, though speaking somewhat timidly and hesitatively about the introduction of a universal decimal system, have no doubts as to its desirableness as regards the currency. They say :—

"The first point which has called for our especial notice, is the general question of the decimal scale. In introducing this subject we beg to invite the attention of the Government to the advantage and the facility of establishing in this country a decimal system of coinage. In our opinion, no single change which it is in the power of a government to effect in our monetary system would be felt by all classes as equally beneficial with this, when the temporary inconvenience attending the change had passed away. The facility consists in the ease of interposing between the sovereign or pound, and the shillings, a new coin equivalent to two shillings, to be called by a distinct name; of considering the farthing, which now passes as the 960th part of a pound, as the 1000th part of that unit; of establishing a coin of value equal to the 100th part of a pound; and of circulating, besides these principal members of a decimal coinage, other coins of value having a simple relation to them, including coins of the same value as the present shilling and sixpence. We do not feel ourselves at liberty to enter farther into this subject; but we have felt it

* For 1841, 1848, and 1853.

imperative on us to advert to it, because no circumstance whatever would contribute so much to a decimal scale in weights and measures in those respects in which it is really useful, as the establishment of a decimal coinage."

Whatever may be the inconvenience suffered by the present generation,—trained as it has been to meet and in some respects to overcome the difficulties and complications connected with the existing system,—there can be no doubt that the coming and all future generations will be greatly benefited by the changes proposed; they will be trained, with an immense saving of time and trouble, to the use of a simple and uniform, instead of a perplexing and varied system of accountancy. And, understood and adopted, it will be a matter of wonder that old habits and usages should have retained their hold so long; our hesitations and delays will seem inexplicable to our better instructed descendants. As written accounts superseded the cutting of tally-sticks,—as the Arabic replaced the Roman numerals,—so will the decimal scale supplant the various and singular modes which have been adopted in commercial and monetary transactions, and which represent not the knowledge, but the ignorance,—not the improvements, but the caprices,—not the philosophical results, but the accidental usages of departed experience.*

Professor De Morgan sums up some of the advantages of the change as follows:—

"1. All computations would be performed by the same rules as in the arithmetic of whole numbers.

"2. An extended multiplication table would be a better interest table than any which has yet been constructed.

"3. The application of logarithms would be materially facilitated, and would become universal, as also that of the sliding rule.

"4. The number of good commercial computers would soon be many times greater than at present.

"5. All decimal tables, as those of compound interest, &c., would be popular tables, instead of being mathematical mysteries.

"6. The old coinage would be reduced to the new by the simple

* All the witnesses examined by the Parliamentary Committee concur in opinion as to the inconvenience of the present system, and the advantages of a change to decimal divisions. Much of the evidence of Mr. Bennoch is so sound and practical that I have thought it desirable to preserve it in the Appendix.

rule given at the beginning of this article. Thus any person would see at once, after a moderate degree of practice in that rule, that £14 17s. 9½d. (old coinage), is £14, 8 royals (dimes), 8 groats (cents), 9 farthings (mils) of the new coinage—at least within a farthing; this would be written £14·889. Again £23·614 of the new coinage, or £23, 6 royals (dimes), 1 groat (cents) 4 farthings (mils), would be seen by the same rule to be £23 12s. 3½d. (old coinage).

"7. When the decimal coinage came to be completely established, the introduction of a decimal system of weights and measures would be very much facilitated, and its advantages would be *seen*."*

And in his evidence before the Committee of the House of Commons, Professor De Morgan says:—

"I am of opinion that considerably more than half of the trouble of money calculations would be saved (by a decimal system). An advantage connected with that would be, that the school arithmetic would make boys ready in business, which they are not now; for with their imperfect learning of the decimal system, and their halting between two systems, most men of business will tell you that boys do not come from school very well prepared in business arithmetic. I have heard of a banker who, when asked what a boy who was to enter his bank should do at school to prepare himself in arithmetic, answered, 'For goodness' sake, let him do nothing; don't trouble yourself about him, and when he comes to us we will teach him what he has to do. If he can add up pounds, shillings, and pence, that is the only thing we can hope for from school-teaching.'"

And again: "I think that, taking all the schools in the country, commercial as well as classical, and considering in how many of them reading, writing, and arithmetic form the great mass of what is taught, I am not putting it too high when I say that arithmetic forms the fifth part, in time, of all the primary education given in the country, that is, 20 per cent. of all the primary education. I think that is under the mark. I am sure I am putting the evils of the present system rather low when I say that they cause one-fourth of that time to be uselessly employed, that is to say, 1-20th part of all the time spent in primary education in this country I consider to be thrown away by the present system of coinage, weights, and measures."†

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* "Companion to Almanack for 1841, p. 20.

† Minutes of Evidence, p. 66.

The question of the decimal point is one of some interest. The decimal point is that which, as Professor De Morgan remarks, "is to be employed not merely as a rest in a process to be useful in pointing out afterwards how another process is to come in, or language is to be applied, but making it the final and permanent indication, as well as the way of pointing out where the integers end and the fractions begin, as of the manner in which that distinction modifies operation."* So in its application to English accounts the decimal point must be placed where the pounds sterling terminate, and the fractional parts of the pound begin. Every figure placed to the left of the decimal point represents pounds sterling,—every figure to the right, some decimal portion of the pound sterling. There have been divers ways of marking the point of division. Stevin used one dash for decimal units, two for decimal tenths, three for decimal hundredths, thus—2146 $8'2''5'''$. Napier uses a comma in his quotient as a rest, thus—2146,825, but presents his answer in the same form as Stevin. Briggs, whose arithmetic was published in 1624, leaves a space between the integer and the fractions, and draws a line under the decimals, thus—2146 $\underline{825}$. In 1623, Johnson, in his "Arithmatick," employed this rude form of notation—2146 | $\overset{1}{8}\overset{2}{2}\overset{3}{5}$. Oughtrede adopted both the vertical and sub-horizontal separators, thus—2146$\lfloor\underline{825}$. Gunter, though he sometimes employs Briggs' underline, seems to have abandoned it for the simple point, 2146·825, which has maintained its ground to the present day. It may be worth considering whether a more marked division than a simple point, such for example as a perpendicular or vertical line might not be advantageously adopted. In ruled account books the division, would be already provided either by a double line or a line of different colour; but as there may be some danger of confounding the decimal point with the comma used in the tripartite division of the integer, 2,146·825, a more marked distinction than a simple dot might be adopted by those to whom the decimal formula are not familiar. A sloping line has been suggested, thus—2,146 / 825, and it has also been proposed to introduce the letter £ between the pound sterling and its decimal parts, thus—2,146£825. The probability is, however, that the point or full stop will be generally employed, and supersede all other modes of separating the integer from its parts.

I cannot more appropriately conclude this chapter than with

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* Arithmetical Books, Introd. xxiii. and xxiv.

WILLIAM BROWN, ESQ., M.P.

the following extracts from the printed Report of the Select Committee appointed "to take into consideration, and report to the House of Commons on the practicability and advantages, or otherwise, that would arise from adopting a Decimal System of Coinage:"—

"The question being one which, from its peculiar character, and the importance of the principles involved in it, required to be examined with much care, it has been the object of the committee to obtain evidence of as varied a character as possible from witnesses whose opinions may carry due weight with them, as respects not only the theoretical but the practical bearings of the subject. Amongst them will be found the representatives of the scientific opinion of the country in relation to a system of coinage based upon the decimal principle, together with others who, from their social position, their business occupations, or their interests in the question, have been led to examine into the practical inconveniences attaching to the existing system of coinage, and to seek for practical means of remedying them.

"All the witnesses examined by the committee concur in the opinion that great advantages attach to a decimal system, as compared with the present system of calculation; and the only points on which any difference of opinion was expressed by them relate to the precise basis which should be adopted, and the practical measures to be employed for introducing the decimal system, so as to produce the least amount of temporary inconvenience, and the smallest extent of unwillingness to encounter the change on the part of the classes who are the most likely to be affected by it.

"With regard to the inconveniences of the existing system, the evidence is clear and decided. That system is shown to entail a vast amount of unnecessary labour, and great liability to error, to render accounts needlessly complicated, to confuse questions of foreign exchanges, and to be otherwise inconvenient.

"On the other hand, the concurrent testimony of the various witnesses is to the effect that the adoption of a decimal system would lead to greater accuracy, would simplify accounts, would greatly diminish the labour of calculations (to the extent of one-half, and in some cases four-fifths, according to Professor De Morgan, who has made the question his especial study), and, by facilitating the comparison between the coinage of this country and other countries that have adopted the decimal system, would tend to the convenience of all those who are engaged in exchange operations, of travellers, and others. An important benefit would be derived in several departments of the public service, and in every branch of industry, from the economy of skilled labour which would result from the proposed change; at the same time that the education of the people generally would be much facilitated by the introduction into our schools of a system so directly calculated to render easy the acquirement of arithmetic.

"A further evidence of the value of a decimal system is to be found in the fact of its very general adoption in the different countries of the world, not only in the case of money, but also as respects weights and measures. The committee are not aware of any instance in which a country, after adopting the decimal system, has abandoned it. The tendency, on the contrary, has invariably been in the direction of a further adoption of the system, the most recent instance being that of Portugal, where the mode of reckoning has long been based on the decimal system, and where a decree has been published within the last few months, providing for the introduction of the French decimal metrical system of weights and measures. Dr. Bowring explained to your committee the decimal system that obtains in the vast empire of China, and produced an instrument, a description of *abacus*, there called the 'Swan Pan.' That instrument shows the ease with which a decimal system may be applied, and the great advantages which it confers, as is, in fact, practically proved by the extraordinary facility with which Chinese boys make any arithmetical calculations.

"Even in this country, where the decimal system is not supposed to exist, the committee have ascertained that it is already practically adopted to a certain extent. The late Governor of the Bank of England has informed the committee that it has been found advisable in that establishment to employ a decimal system of weights in their purchases and sales of bullion, instead of the old system of troy pounds, ounces, pennyweights, and grains; and that great advantage has resulted from the change, and Parliament in the present session has passed an act to legalise the new weights. The Master of the Mint has also announced the intention of introducing the use of those weights at the Mint as soon as possible. Professor De Morgan mentions that many teachers, as well as himself, always use the decimal system in actual teaching, by giving their pupils a short rule for transposing the common money calculations into the decimal form, and then, when the answer is obtained, re-transferring them to pounds, shillings, and pence. The great waste of time entailed by its being necessary to perform these operations of transfer and re-transfer, in addition to the calculation itself, is obvious; and yet the advantage of the decimal system is found to be so great, that, for the sake of employing it, it is worth while to incur the extra labour of those operations.

"With regard to the other and more difficult part of the question referred to them, namely, the practicability of introducing the decimal system, it appears to the committee that the obstacles are two-fold in their nature. The first arises from the difficulty which is always found to exist in inducing the mass of the population to depart from standards with which they are familiar, and from modes of calculation to the defects of which usage has reconciled them. The second obstacle arises from the necessity of re-arranging the terms of all pecuniary obligations, depending either on legal enactment or private contract, expressed in those coins which, in the event of a change in our monetary system, would cease to have legal currency. This second obstacle, although apparently the most practical and the most serious in its nature, is probably not so important in actual fact as the other, owing to its more tangible character, and the opportunity which it therefore presents of considering and grappling with its details. But an obstacle of so undefined a nature as a vague popular feeling, based upon habit and association, and not upon reason, cannot be dealt with on any general and abstract principles, and the committee therefore purposely abstain from seeking to fetter the discretion of the Executive on that part of the subject.

"The committee have endeavoured to ascertain the probable feeling of the public, especially of the working-classes, in reference to the proposed change; first by examining witnesses who may be considered to be well acquainted with their feelings; and, secondly, by means of the analogy to be drawn from previous changes of a somewhat similar character. As respects the first point, several witnesses who have very extensive dealings with the poor, and some of whom are accustomed to take as many as 1,000 farthings per week over the counter, have expressed their opinion that if the farthing were altered from its present value (the $\frac{1}{960}$th part of the pound sterling) to the $\frac{1}{1000}$th part of the pound, in accordance with the decimal subdivision, no prejudice would be raised against this slight decrease of four per cent. in the value of the farthing, provided they were made to understand that they could, on the other hand, get 25 of the new coin for sixpence where they now get 24. All the traders examined also stated, as the result of their experience, that competition invariably causes the quantities of the articles sold to adjust themselves without difficulty to the value of the money received for them.

"The Committee have also taken evidence as to the difficulty experienced on occasions when the coinage of any country has been changed, and would especially refer to the cases of the United States and of Ireland. In the former country the old system of pounds, shillings, and pence has been entirely superseded by the decimal system of dollars and cents, and no inconvenience appears to have attended the change. The principal difficulty with which the Committee have now to contend will be the substitution, in lieu of the penny, of a new copper coin, hereafter described, of which the present shilling will contain ten only instead of twelve. In the case of Ireland, where thirteen Irish pence make one English shilling, for which twelve English pence were substituted, a prejudice was originally felt on the part of the poorer classes, in consequence of their believing that as they only got twelve pence for a shilling where they formerly received thirteen, they sustained a loss of a penny in every shilling. They soon found from experience, however, that the injury was imaginary.

"The other difficulties to which the Committee have referred, viz., those of a practical character, arising from the necessity of a re-adjustment of a large number of existing contracts and obligations based upon the present system of coinage, are not, in their opinion, insuperable; but the precise point of view from which to consider them must, of course, depend in some degree on the exact system which may be adopted.

"The first question to be decided is, what shall be the unit of the new system of coinage; and the Committee have no hesitation in recommending the present pound sterling. Considering that the pound is the present standard, and therefore associated with all our ideas of money value, and that it is the basis on which all our exchange transactions with the whole world rests, it appears to the Committee that any alteration of it would lead to infinite complication and embarrassment in our commercial dealings; in addition to which it fortunately happens, that its retention would afford the means of introducing the decimal system with the minimum of change. Its tenth part already exists in the shape of the florin or two-shilling piece, while an alteration of four per cent. in the present farthing will serve to convert that coin into the lowest step of the decimal scale which it is necessary to represent by means of an actual coin, viz., the thousandth part of a pound. To this lowest denomination the Committee purpose, in order to mark its relation to the unit of value, to give the name of mil. The addition of a coin to be called a cent, of the value of ten mils, and equal to the hundredth part of the pound, or the tenth part of the florin, would serve to complete the list of coins necessary to represent the moneys of account, which would accordingly be pounds, florins, cents, and mils.

"Other proposals, having in view the adoption of a different unit, have been brought under the notice of the committee. Of these, the one recommending the retention of the present farthing as the basis of a new system of coinage, leaving its relation to the existing penny untouched, presents the greatest amount of advantage. The large number of payments which are now expressed in pence would remain unaltered, and a great portion of those daily transactions in which the mass of the population are engaged, would be unaffected by the change; but when it is considered that the adoption of that alternative would, by adding 10d. to the value of the present pound, and a halfpenny to that of the shilling, necessitate the withdrawal of the whole of the present gold coinage, and nearly the whole of the silver, and involve the alteration of the terms of all contracts and obligations expressed in coin of either of the latter metals, the committee would not feel themselves warranted in recommending the adoption of such a proposal.

"The committee, therefore, are now in a position to resume the consideration of the practical difficulties in their way, and of the means by which those difficulties may be most readily overcome. The most important obstacles are those connected with the re-adjustment of obligations expressed in the penny (including its multiplies and sub-multiples), by receipts in which coin various portions of the public revenue are in great part raised, such as postage, newspaper, and receipt stamps, as well as many duties of customs; in addition to the class of cases in which private interests are concerned, such as railway, bridge, ferry, and road tolls. To take an illustration, it is obvious that, if instead of charging a toll of one penny or four farthings, as at present, the nearest equivalent toll under the decimal system, viz., one of four mils, were substituted, the change would involve a loss to the receiver of the toll of four per cent.; while, on the other hand, raising the toll to five mils would involve a loss to the payer of 20 per cent. The payment is now the $\frac{1}{240}$th part of a pound, and on the first of the foregoing suppositions it would be reduced to the $\frac{1}{250}$th; on the latter, it would be raised to the $\frac{1}{200}$th. In the case of all cumulative and gross payments, that difficulty will not be felt, and may be disregarded; as the amount involved in the change, being always less than a mil in each case, is then inappreciably small in comparison with the total sum.

"The case of the penny newspaper stamps presents no difficulty, as they are always sold to the newspapers in considerable quantities, and might be charged at the rate of 12 for 50 mils (the equivalent of the shilling), instead of one penny each as at present, the two rates of charge being identical.

"The payment of the troops may be easily arranged in a similar manner, for although they are nominally paid at the rate of so many pence per day, the full pay of every man is drawn in advance each month, and any difference between the sum received by him each day under the decimal system, and that received under the present system, could be adjusted at the monthly clearance, which takes place even at present, for the purpose of settling any small balance.

"The cases in which the payment of the penny is made in separate and isolated, instead of cumulative sums, present greater difficulty.

"The charges payable to the public revenue for duties and stamps, are very generally expressed in pence, or fractions of a penny. Assuming that at the period fixed for the alteration of the coinage, no grounds should exist for an alteration of those charges, the object to be attained will be to secure the levy of an equal amount of revenue in the aggregate, without so far altering existing charges as to create public dissatisfaction, and without needlessly complicating the proceedings of the Revenue Departments. The committee are disposed to believe that these objects may be attained by such slight modifications of existing payments as will enable the payments for duties and stamps to be expressed by a whole number of mils, the loss upon any one head of revenue being compensated by the gain upon some other.

"The case of the penny postage is the most important, and requires a special reference to be made to it. Various witnesses who have been examined on this subject, including Mr. Rowland Hill, have expressed an opinion that considerable discontent would be occasioned by any addition to the present rate, such as the adoption of a charge of 5 mils, whatever might be the benefit to the Exchequer, and they have proposed that the alternative should be adopted of substituting a rate of 4 mils. But the committee feel that, in arriving at a decision on this subject, it is necessary not to forget that, supposing the number of letters transmitted through the post to remain unaltered, the adoption of a charge of 4 mils would involve a loss of revenue estimated at £100,000. Whether such a loss would be actually sustained must depend on whether or no the trifling diminution of charge on each letter would lead to increased correspondence, in accordance with the law that is found to prevail in the case of more extensive reductions. On the other hand, it is admitted that, apart from the fiscal and other practical considerations involved in the alteration of a duty which was reduced to its present rate of one penny in compliance with a popular demand, the establishment of a rate of 5 mils would be convenient, as representing an aliquot part of the coins of a higher denomination in the proposed decimal scale, and that that rate would probably have been adopted had a decimal system of coinage been in existence at the time when a uniform postage was established. The Committee apprehend that it must remain with Parliament to decide, upon the consideration of the respective advantages and disadvantages of the two rates as above indicated, whether the postage rate to be adopted under a decimal system shall be four or five mils.

"The new penny receipt stamp is subject to the same observations.

The committee would only observe, with reference to it, that they have no experience to guide them as to the probable receipts under it, as compared with the receipts under the much higher rates that have hitherto existed.

"As respects those customs and other duties which are now levied at so much per lb., and which are the only cases of the kind that would be sensibly affected by the change to a decimal system, the committee are of opinion that all difficulty would be removed by charging those duties in future by the 100 lbs.

"The chief remaining difficulty relates to charges payable to companies or private individuals, fixed by Act of Parliament at sums expressed in pence or fractions of a penny. Of this class are mileage charges received by railway companies, and tolls on roads, bridges, and ferries. Various suggestions as to the means of regulating these charges, should a decimal system be adopted, have been made to the committee, especially one whereby compensation to the owners of such tolls for the loss they would incur by the ultimate reduction in the charges, should be provided by sanctioning a small increase in those charges for a limited period.

"It remains for the committee to consider the question of the coins to be employed under the decimal system of coinage, and the means of introducing that system.

"As respects the coins, it will be necessary to withdraw from circulation certain of the coins at present in use, and to substitute in their place certain other coins, having reference to the decimal scale, before the decimal system can be considered as fully developed. The committee contemplate the retention under any circumstances of the present sovereign (1,000 mils), half-sovereign (500 mils), florin (100 mils), and shilling (50 mils, or 5 cents). The present sixpence, under the denomination of 25 mils, might be retained, and the crown, or piece of 250 mils, of which few are in circulation, need not be withdrawn. On the other hand, it will be desirable to withdraw the half-crown, and the threepenny and fourpenny pieces, which are inconsistent with the decimal scale.

"With regard to the coins not in actual existence at present, but which it will be necessary eventually to introduce, it appears to the committee that copper coins of 1, 2, and 5 mils, and silver coins of 20 and 10 mils, will be required, to which should be added such others as experience may show to be desirable. It is important, however, to bear in mind, that the smaller the number of the coins with which it is practicable to effect purchases and exchanges, the better.

"The committee feel that a certain period of preparation, destined to facilitate the transition from the present to the new system, is indispensable. During such a transition period, various measures should be adopted with a view to prepare the way for ulterior changes, and to create in the public mind a desire for their completion. Several of the proceedings on the part of Her Majesty's Mint, which would ultimately become necessary, might be adopted at the present time without introducing any elements inconsistent with the existing system of coinage and accounts. The committee believe that no unnecessary delay should prevent the full introduction of the decimal system, and they recommend that the necessary preparatory measures should be entered on at the Royal Mint as soon as possible.

"As respects the means to be employed for preparing the public for the introduction of the new system, the committee would refer to the very valuable and detailed evidence on the point given by the Master of the Mint, the Astronomer Royal, Professor De Morgan, and General Pasley. The committee recommend that all the silver coins hereafter coined should have their value in mils marked upon them, in order that the public might, at the earliest possible period, associate the idea of that system with their different pecuniary transactions. They further recommend, that all the copper coins that may be issued under the decimal system should also have their value in mils similarly marked on them. They think that it would familiarise the public with the new system of account, if some of the papers submitted to parliament, and most generally referred to, were exhibited in the decimal as well as the ordinary form.

"Supposing the decimal system to be introduced into this country, the question of its introduction into the British colonies naturally presents itself. That no indisposition is felt on the part of the colonial legislatures to entertain the question, may be inferred by the fact, that the legislature of Canada has just established a decimal currency in that country.

"The attention of the committee has been incidentally directed, in the course of their inquiries, to the advantage in applying the decimal system to weights and measures as well as to coinage. This being a question not embraced in their order of reference, the committee do not feel themselves to be in a position to do more than express their sense of the importance of further inquiry into that interesting subject.

"In conclusion, the committee, having well weighed the comparative merits of the existing system of coinage and the decimal system, and the obstacles which must necessarily be met with in passing from one to the other, desire to repeat their decided opinion of the superior advantages of the decimal system, and to record their conviction that the obstacles referred to are not of such a nature as to create any doubt of the expediency of introducing that system, so soon as the requisite preparations shall have been made for the purpose, by means of cautious but decisive action on the part of the government.

"The committee consider the present moment especially adapted for introducing the decimal system, in consequence of the prosperous state of the whole community, including those classes which would be more immediately affected by the change, and they feel the importance of not allowing such an opportunity to be lost.

"They believe that the necessary inconvenience attending a transition state will be far more than compensated by the great and permanent benefits which the change will confer upon the public of this country, and of which the advantages will be participated in to a still greater extent by future generations.

"1 *August*, 1853."

CHAPTER VI.

BRITISH SYSTEM OF COINS, WEIGHTS, AND MEASURES, AND PROPOSED MONETARY CHANGES.

NOTHING can be more striking than the contrast between the uniformity, precision, and significancy in the French system of coins, weights, and measures, and the irregularity, vagueness, and confusion of the English system. Not only England, however, but almost every other European country, excepting France and Belgium (which has adopted the French system), presents some evidence of incongruities and absurdities in monetary and metrical designation, the original growth of ignorance and imperfect means of calculation; but they have been allowed by habit and indolence to continue unreformed. The following extracts from Mr. John Quincy Adams' Report to Congress are full of instruction:—

"In every system of weights and measures, ancient or modern, with which we are acquainted, until the new system of France, the poverty and imperfection of language has entangled the subject in a maze of inextricable confusion. The original names of all the units of weights and measures have been improper applications of the substances from which they were derived. Thus, the foot, the palm, the span, the digit, the thumb, and the nail, have been, as measures, improperly so called for the several parts of the human body, with the length of which they correspond. Instead of a specific name, the measure usurped that of the standard from which it was taken. Had the foot-rule been unalterable, the convenience of its improper appellation might have been slight. But in the lapse of ages, and the revolutions of empires, the foot-measure has been everywhere retained, but infinitely varied in its extent. Every nation of modern Europe has a foot-measure, no two of which are the same. The English foot, indeed, was adopted and established in Russia by Peter the Great; but the original Russian foot was not the same. The Hebrew shekel and maneh, the Greek mina, and the Roman pondo, were weights—the general name weight improperly applied to the specific unit of weight. The Latin word libra, still more improperly, was borrowed from the balance in which it was employed: libra was the balance, and at the same time the pound-weight. The terms weight and balance were thus generic terms, without specific meaning. They signified any weight in the balance, and varied according to the varying gravities of the specific standard unit at different times and in different countries. When, by the debasement of the coins, they ceased to be identical with the weights, they still retained their names. The pound sterling retains its name many centuries after it has ceased to exist as a weight; and after having, as money, lost more than two-thirds of its substance. We have discarded it, indeed, from our vocabulary; but it is still the unit of moneys of account in England. The livre tournois of France, after still greater degeneracy, continued until the late Revolution, and has only been laid aside for the new system. The ounce, the drachm, and the grain, are specific names, indefinitely applied as indefinite parts of an indefinite whole. The English pound avoirdupois is heavier than the pound troy; but the ounce avoirdupois is lighter than the ounce troy. The weights and measures of all the old systems present the perpetual paradox of a whole not equal to all its parts. Even numbers lose the definite character which is essential to their nature. A dozen become sixteen, twenty-eight signify twenty-five, one hundred and twelve mean a hundred.

"The indiscriminate application of the same generic term to different specific things, and the misapplication of one specific term to another specific thing, universally pervade all the old systems, and are the inexhaustible fountains of diversity, confusion, and fraud. In the vocabulary of the French system there is one specific, definite, significant word, to denote the limit of lineal measure; one for superficial, and one for solid measure; one for the unit of measures of capacity, and for the units of weights. The word is exclusively appropriated to the thing, and the thing to the word. The metre is a definite measure of length; it is nothing else. It cannot be a measure of one length in one country, and of another length in another. The gramme is a specific weight, and the litre a vessel of specific cubic contents, containing a specific weight of water. The multiples of these units are denoted by prefixing to them syllables derived from the Greek language, significant of their increase in decimal proportions. Thus, ten metres form a deca-metre; ten grammes, a deca-gramme; ten litres, a deca-litre. The subdivisions, or decimal fractions of the unit, are equally significant in their denominations, the prefixed syllables being derived from the Latin language. The deci-metre is a tenth part of a metre; the deci-gramme, the tenth part of a gramme; the deci-litre, the tenth part of a litre. Thus, in continued multiplication, the hecto-metre is a hundred, the kilo-metre a thousand, and the myria-metre ten thousand metres; while, in continued division, the centi-metre is the hundredth, and the milli-metre the thousandth part of the metre.

"The same prefixed syllables apply equally to the multiples and divisions of the weight, and of all the other measures. Four of the prefixes for multiplication, and three for division, are all that the system requires. These twelve words, with the franc, the decime, and the centime, of the coins, contain the whole system of French metrology, and a complete language of weights, measures, and money."*

"In the English system, every weight and measure is divided by different, and seemingly arbitrary numbers; the foot into twelve inches; the inch, by law, into three barleycorns,—in practice, sometimes into halves, quarters, and eighths, sometimes into decimal parts, and sometimes into twelve lines; the pound avoirdupois into sixteen ounces, and the pound troy into twelve,—so that while the pound avoirdupois is heavier, its ounce is lighter than those of the troy weight. The ton, in the English system, is both a weight and a measure. As a measure, it is divided into four quarters, the quarter into eight bushels, the bushel into four pecks, &c. As a weight, it is divided into twenty hundreds, of 112 pounds, or 2,240 pounds avoirdupois. The gallon is divided into four quarts, the quart into two pints, and the pint into four gills.

"In the French system, decimal divisions were prescribed by law exclusively. The binary division was allowed, as being compatible with it; but all others were rigorously excluded,—no thirds, no fourths, no sixths, no eighths, or twelfths. But this part of the system has been abandoned, and they are now allowed all the ancient varieties of multiplication and division, which are still further complicated by the decimal proportions of the law. The nomenclature of the English system is full of confusion and absurdity, chiefly arising from the use of the same names to signify

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* Adams' Report, pp. 87, 88.

different things; the term pound to signify two different weights, a money of account, and a coin; the gallon and quart to signify three different measures; and other improper denominations, constantly opening avenues to fraud.

"The French nomenclature possesses uniformity in perfection, every word expressing the unit weight or measure which it represents, or the particular multiple or division of it. No two words express the same thing; no two things are signified by the same word."*

"The application of the new metrology to the moneys and coins of France, has been made with considerable success; not, however, with so much of the principle of uniformity as might have been expected, had it originally formed a part of the same project (the reform of weights and measures). But the reformation of the coins was separately pursued, as it has been with us; and as the subject is of great complication, it naturally followed, that from the separate construction of two intricate systems, the adaptation of each to the other was less correct than it would have been had all the combinations of both been included in the formation of one great masterpiece of machinery. It is to be regretted that, in the formation of a system of weights and measures, while such extreme importance was attached to the discovery and assumption of a national standard of long-measure as the link of connection between them all, so little consideration was given to that primitive link of connection between them, which had existed in the identity of weights and of silver coins, and of which France, as well as every other nation in Europe, could still perceive the ruins in her monetary system then existing. Her livre tournois, like the pound sterling, was a degeneracy, and a much greater one, from a pound-weight of silver; but it had scarcely a seventieth part of its original value. It was divided into twenty sols or shillings; and the sol was of twelve deniers or pence. It had become a mere money of account; but the ecu, a crown, was a silver coin of six livres, nearly equivalent to an ounce in weight, and there were half-crowns, and other subdivisions of it, being coins of one-fourth, one-fifth, one-eighth, and one-tenth of the crown. There were also coins of gold, of copper, and of mixed metal called billon, in the ordinary calculations of exchange. Shortly after the adoption of the provisional or temporary metre

* Adams' Report, p. 73.

and kilogramme, a law of 16th Vendemaire 2 (7th October 1793), prescribed that the principal unit, both of gold and of silver coins, should be of the weight of ten grammes. The proportional value of gold to silver was retained, as it had long before been established in France, at $15\frac{1}{2}$ for one. The alloy of both coins was fixed at one-tenth; and the silver franc of that coinage would have been worth about thirty-eight cents, and the gold franc a little short of six dollars. The law was never carried into execution. It was superseded by one of the 15th August 1794 (28 Thermidor 3), which reduced the silver franc to five grammes; and it was not until after a law of 7 Germinal 11 (28th March 1803) that gold pieces of twenty and forty francs were coined, at 155 of the former to the kilogramme.

"In the new system, the name of livre, or pound, as applied to money or coins, was discarded; but the *franc* was made the unit both of coins and moneys of account.

"The franc was a name which had before been in common use as a synonymous denomination of the livre. The new franc was of intrinsic value $\frac{1}{80}$ more than the livre. The franc is decimally divided into decimes of $\frac{1}{10}$, centimes of $\frac{1}{100}$, and millimes of $\frac{1}{1000}$ of the unit; but the smallest copper coin in common use is of five centimes, equivalent to about one of the United States cents. The silver coins are of one-fourth, one-half, one and two francs, and of five francs; the gold pieces, of twenty and forty francs. The proportional value of copper to silver is of one to forty, and that of billon to silver of one to four; so that the kilogramme should weigh 5 francs of copper coin, 50 of the billon, 200 of the silver, and 3,100 of the gold coins; and the decime of billon should weigh precisely two grammes. The allowances, known by the name of remedy for errors in the weight and purity of the coins, are of $\frac{2}{100}$ upon copper, which is only for excess: those upon the weight of billon are of $\frac{14}{1000}$; upon silver, $\frac{20}{1000}$ for one-quarter francs, $\frac{14}{1000}$ for one-half francs, and of $\frac{10}{1000}$, or one per cent., on one and two-franc pieces, and of $\frac{5}{1000}$ for five-franc pieces: that of the gold coin is of $\frac{4}{1000}$:—all, excepting the copper, allowances either for excess or deficiency. But the practice of the Mint never transgresses in excess; and the deficiency is always nearly the whole allowed by law. The remedy of alloy is of $\frac{7}{1000}$, either of excess or defect, for billon; of $\frac{3}{1000}$ for silver; and of $\frac{1}{2000}$ for gold. It is said that the actual purity of the coins, both of gold and silver, is within $\frac{1}{1000}$ less than the standard.

"The conveniences of this system are:—

"First, The establishment of the same proportion of alloy to both gold and silver coins, and that proportion decimal.

"Secondly, The established proportions of value between gold and silver, mixed metal, and copper coins.

"Thirdly, The adaptation of all the coins to the weights, in such manner as to be checks upon, and tests of each other. Thus the decime of billon should weigh two grammes; the franc of silver, five; the two-franc piece of silver, and the five-centime piece of copper, each ten; and the five-franc piece, fifty. The allowances of remedy disturb partially these proportions. These are practices continued in all the European mints, after the reasons upon which they were originally founded have in a great measure ceased. In the imperfection of the art, the mixture of the metals used in coining, and the striking of the coins, could not be effected with entire accuracy. There would be some variety in the mixture of metals made at different times, though in the same intended proportions, and in different pieces of coin, though struck by the same process, and from the same die. But the art of coining metals has now attained a perfection, that such allowances have become, if not altogether, in a great measure unnecessary. Our laws make none for the deficiencies of weight; and they consider every deficiency of purity as an error, for which the officers of the mint shall be excused only in case of its being within $\frac{1}{144}$ part, or about $\frac{7}{1000}$,—for if it should exceed that, they are disqualified from holding their offices. Where the penalty is so severe, it is proper that the allowance should be large; but, as obligatory duty upon the officers of the mint, an allowance of $\frac{1}{1000}$ would be amply sufficient for each single piece, and no allowance should be made upon the average."*

The account of the introduction of the decimal system of coinage into the United States of America, is thus given by Mr. Quincy Adams:—

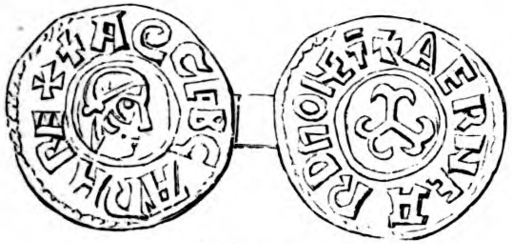
"At the close of our war for independence, we found ourselves with four English words,—pound, shilling, penny, and farthing, to signify all our moneys of account. But, though English words, they were not English things. They were nowhere sterling; and scarcely in any two States of the Union were they representatives of the same sums. It was a Babel of confusion by the

* Report, pp. 62—64.

use of four words. In our new system of coinage we set them aside. We took the Spanish piece of eight, which had always been the coin most current among us, and to which we had given a name of our own,—a dollar.* Introducing the principle of decimal divisions, we said, a tenth part of our dollar shall be called a dime, a hundredth part a cent, and a thousandth part a mille. Like the French, we took all these new denominations from the Latin language; but, instead of prefixing them as syllables to the generic term dollar, we reduced them to monosyllables, and made each of them significant by itself, without reference to the unit of which they were fractional parts. The French themselves, in the application of their system to their coins, have followed our example; and, assuming the *franc* for their unit, call its tenth part a *decime*, and its hundredth a *centime*. It is now nearly thirty years since our new moneys of account, our coins, and our mint, have been established. The dollar, under its new stamp, has preserved its name and circulation. The cent has become tolerably familiarised to the tongue, wherever it has been made, by circulation, familiar to the hand. But the dime having been seldom, and the mille never, presented in their material images to the people, have remained so utterly unknown, that now, when the recent coinage of dimes is alluded to in our public journals, if their name is mentioned, it is always with an explanatory definition, to inform the reader that they are ten-cent pieces; and some of them which have found their way over the mountains, by the generous hospitality of the country, have been received for more than they were worth, and have passed for an eighth, instead of a tenth part of a dollar. Even now, at the end of thirty years, ask a tradesman or shopkeeper in any of our cities what is a dime or a mille, and the chances are four in five that he will not understand your question. But go to New York and offer in payment the Spanish coin, the unit of the Spanish piece of eight, and the shop or marketman will take it for a shilling. Carry it to Boston or Richmond, and you shall be told it is not a shilling, but ninepence. Bring it to Philadelphia, Baltimore, or the city of Washington, and you shall find it recognised for an eleven-penny bit; and if you ask how that can be, you shall learn that, the dollar being of ninety pence, the eighth part of it is

* *Dollar;* from *Thaler* (German), or *Tallaro* (Italian). The Spanish name is *Duro,* meaning *hard.*

COINS OF ENGLAND.—PLATE I.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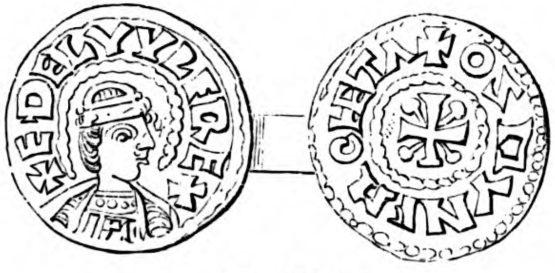
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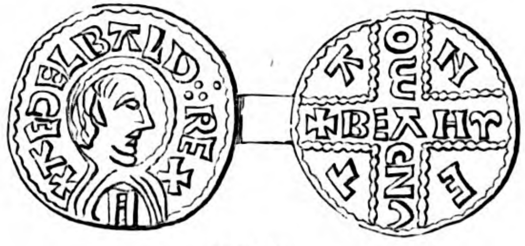
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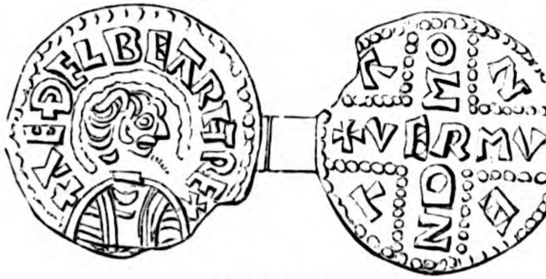
AETHELSTAN.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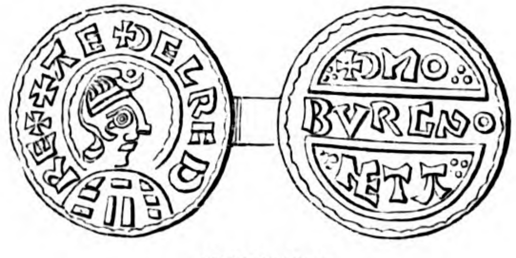
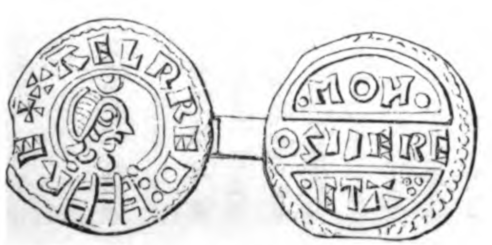

AETHELRED I.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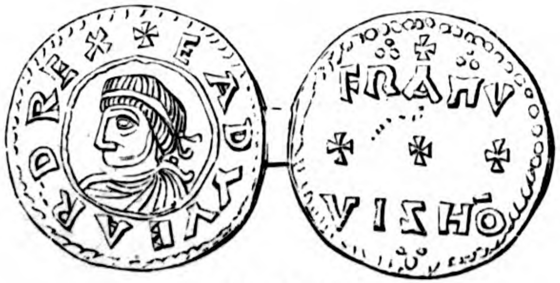
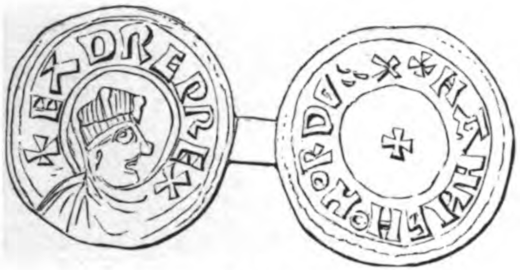

EADWEARD.


EADMUND.

COINS OF ENGLAND.—PLATE II.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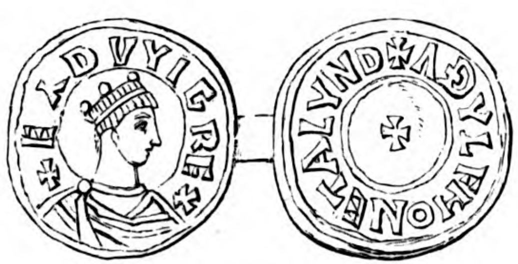
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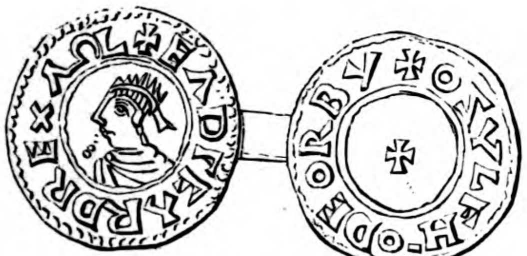
EADGAR.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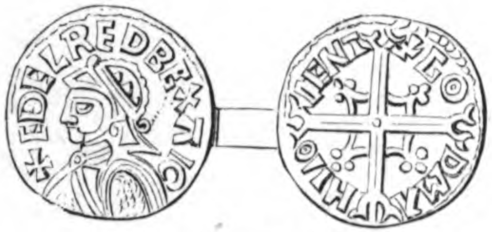
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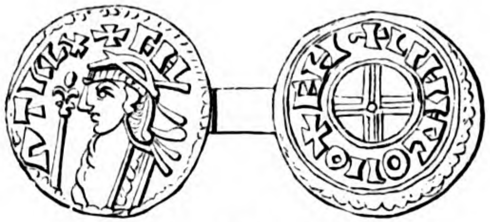
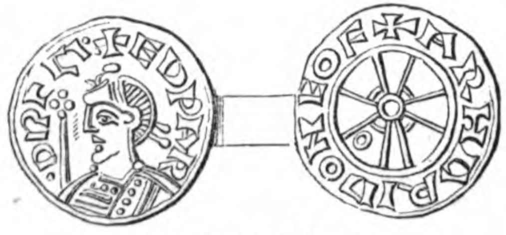

CNUT.


HAROLD I.


HARTHACNUT.

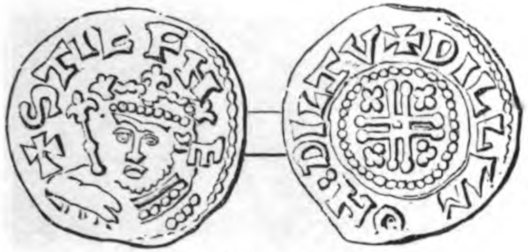

EADWARD THE CONFESSOR.

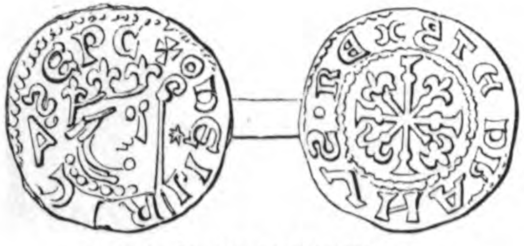
COINS OF ENGLAND.—PLATE III.

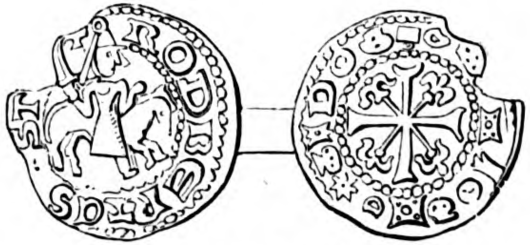

HAROLD II.

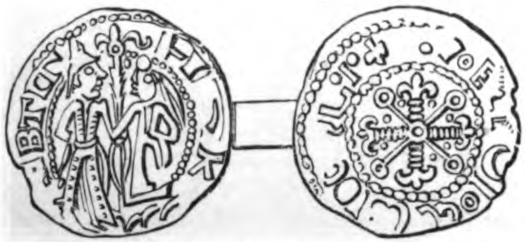

WILLIAM I. AND II.


HENRY I.

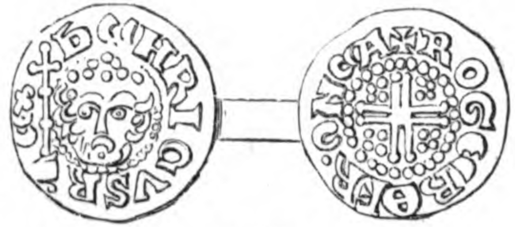

STEPHEN.


HENRY, BISHOP OF WINCHESTER.

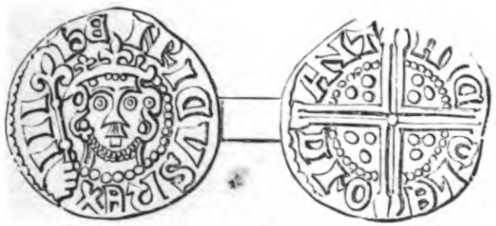

ROBERT OF GLOUCESTER.


STEPHEN AND MATILDA.

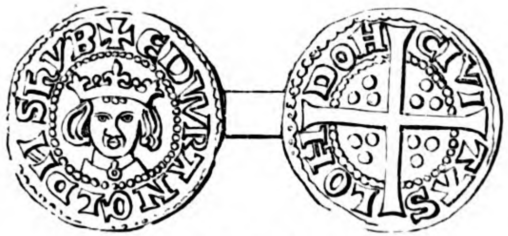

WILLIAM, SON OF STEPHEN.


HENRY II.

COINS OF ENGLAND.—PLATE IV.

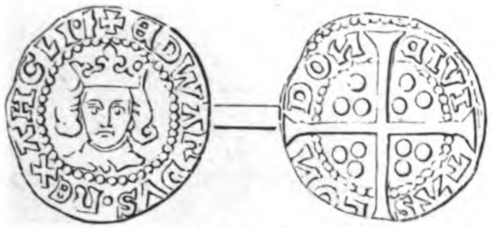


HENRY III.

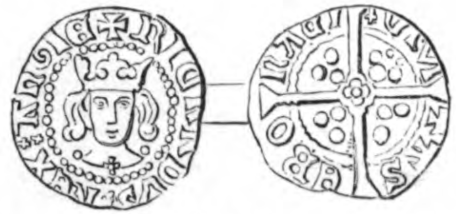


EDWARD I.

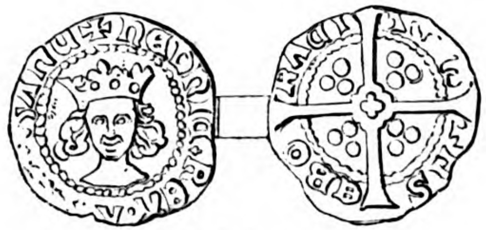
EDWARD II.



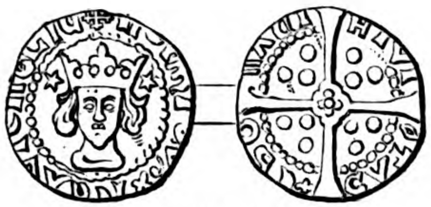
EDWARD III.



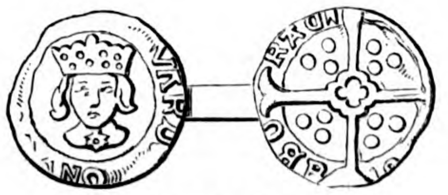
RICHARD II.



HENRY IV.



HENRY VI.



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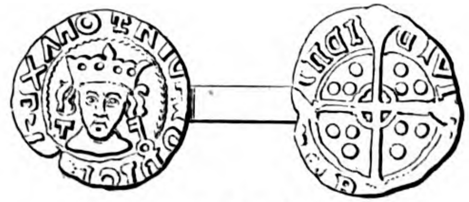
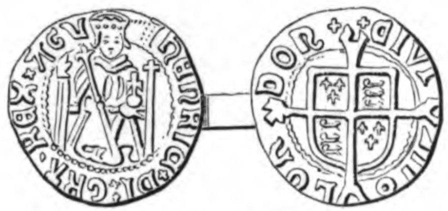
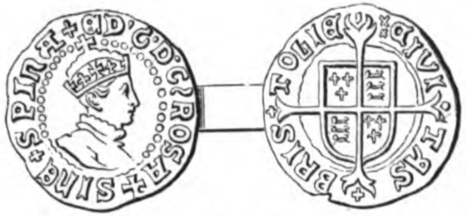


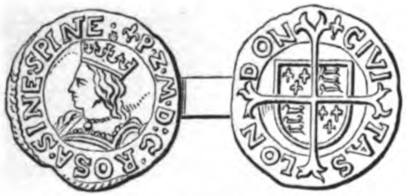
RICHARD III.

COINS OF ENGLAND.—Plate V.

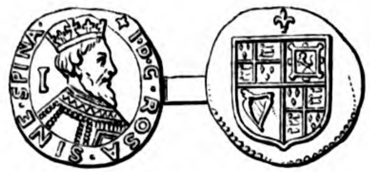

HENRY VII.


HENRY VIII.

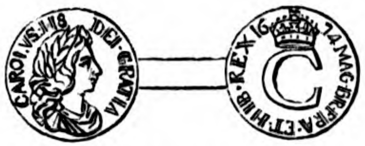

EDWARD VI.


MARY.


ELIZABETH.


JAMES I.


CHARLES I.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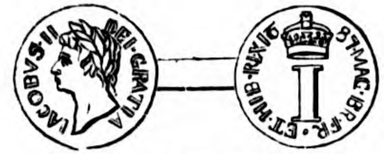
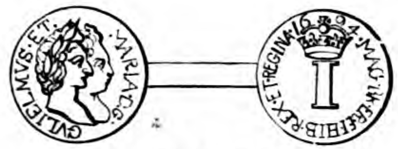
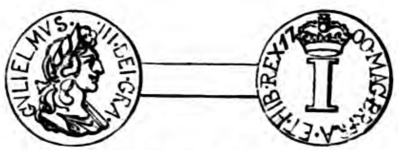

JAMES II.

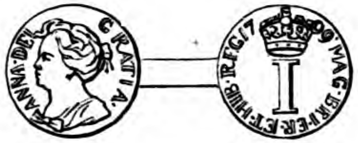
COINS OF ENGLAND.—Plate VI.



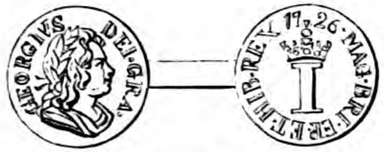
WILLIAM AND MARY.



WILLIAM III.



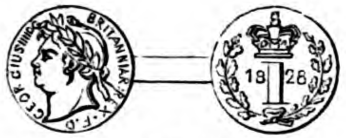
ANNE.



GEORGE I.

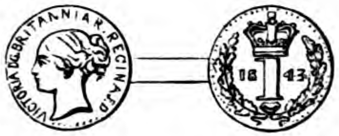
GEORGE II.

GEORGE III.



GEORGE IV.

WILLIAM IV.



VICTORIA.

nearer to eleven than to any other number; and, pursuing still further the arithmetic of popular denominations, you will find that half eleven is five, or, at least, that half the eleven-penny bit is the five-penny bit, which five-penny bit at Richmond shrinks to fourpence halfpenny, and at New York swells to sixpence. And thus we have English denominations most absurdly and diversely applied to Spanish coins; while our own lawfully established dime and mille remain, to the great mass of the people, among the hidden mysteries of political economy—State secrets."*

"The key-stone to the whole fabric of the ancient English system of weights, introduced in the year 1266, was the weight of the silver penny sterling. This penny was the two hundred and fortieth part of the tower pound, the sterling or easterling pound, which had been used at the mint for centuries before the conquest, and which continued to be used for the coinage of money till the eighteenth year of Henry the Eighth, 1527, when the troy pound was substituted in its stead. The tower or easterling pound weighed three-quarters of an ounce troy less than the troy pound, and was consequently in the proportion to it of 15 to 16. Its penny, or two hundred and fortieth part, weighed therefore $22\frac{1}{2}$ grains troy; and that was the weight of the thirty-two kernels of wheat from the middle of the ear, which, according to the statute of 1266, had been taken to form the standard measure of wheat for the whole realm of England. It is also to be remembered, that the eight twelve-ounce pounds of wheat, which made the gallon of wine, produced a measure which contained nearly ten of the same pounds of wine. The commercial pound, by which wine and most other articles were weighed, was then of fifteen ounces. This is apparent from the treatise of weights and measures of 1304, which repeats the composition of measures declared in the statute of 1266, with a variation of expressions, entirely decisive of its meaning. It says, that 'by the ordinance of the whole realm of England, the measure of the king was made,—that is to say, that the penny called sterling, round, and without clipping, shall weigh thirty-two grains of wheat in the middle of the ear: and the ounce shall weigh twenty pence; and twelve ounces make the London pound; and eight pounds of weight make a gallon; and eight gallons make the London bushel.' It then proceeds to enumerate a multitude of other

* Adams' Report, pp. 55, 56.

articles, sold by weight or by numbers, such as lead, wool, cheese, spices, hides, and various kinds of fish; and, after mentioning nominal hundreds, consisting of 108, and 120, finally adds, 'It is to be known that every pound of money and of medicines consists only of twenty shillings weight; but the pound of all other things consists of twenty-five shillings. The ounce of medicines consists of twenty pence, and the pound contains twelve ounces; but, in other things, the pound contains fifteen ounces;—and, in both cases, the ounce is of the weight of twenty pence."*

General Pasley makes the following remarks on the identity or close resemblance between the ancient monetary system of England and that prevailing on the Continent:—

"The system of money established towards the close of the eighth century by Charlemagne, was not only used in France, Italy, and those parts of Germany which composed the dominions of that great monarch, but was also adopted in Britain and in the Christian part of Spain. All payments were estimated in reference to the libra, or pound-weight of silver, which was divided into twenty soldi, or shillings, and each shilling into twelve denarii, or pennies. These were the divisions of the pound of money; but, for other purposes, the same pound was divided into twelve ounces, according to the system of the pound sterling of England,† the pound of Scottish money, the livre

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* J. Q. Adams' Report to Congress on Weights and Measures."—Washington, 1821, pp. 25, 26.

† In England the term "sterling," originally "easterling," and in France the synonymous term "esterlin," were used to denote the twentieth part of the ounce, also called "penny" in England, and "denier," from denarius, in France. This term, whilst it became entirely obsolete in France, was by degrees applied not only to the penny, but to the pound in England; and recently it has been used to denote the standard money of this country, in contradistinction to foreign or colonial money. For the use of this term in France, see Paucton's elaborate Treatise on Metrology, published in Paris in 1780, who observes, after stating the royal or legal system of weights prevailing in France, that the then French pound (livre de marc) was anciently divided into 320 esterlins. Hence the pound of Charlemagne, of 12 ounces, must have been divided into 240 esterlins, and the common ounce of both those pounds must have been divided into 20 esterlins. See the 5th edition of Turner's History of the Anglo-Saxons, vol. 2, appendix II.

of France, the libra of Spain, and the lira of some of the States of Italy, all of which were originally equal, or nearly so: and the marc, likewise common to all those countries, denoted a weight of eight ounces, being two-thirds of the above pound. Amongst the Anglo-Saxons, and for some time after the Norman conquest, it appears that there were only two coins in England, the most important although the smallest of which was the silver penny, which was not only the penny-coin, but the penny-weight of those times, being exactly the two hundred and fortieth part of the pound-weight of silver. The second silver coin alluded to was equal to the fifth part of the shilling; but the shilling itself was not a coin, but a weight, and as such, it appears to have been applied to the weighing of bread as well as of money. The beneficial and simple system of absolute identity between weight and silver money, which thus prevailed over a great part of Europe, was not permanent. The standard pound of commerce, which in all probability was originally only twelve ounces, increased to fifteen ounces amongst the Anglo-Saxons, and to sixteen in France and Scotland, and eventually in England also; whilst the local or market pounds in many parts of England and of Scotland, and I have no doubt in other parts of Europe also, increased to a much greater magnitude. I have not been able to discover at what period the commercial pound of France, called livre de marc, and consisting of two marcs, or of 16 ounces, came into general use; but it finally supplanted the pound of twelve ounces entirely, having been adopted by the French physicians in place of an apothecary's weight similar to ours, after the middle of the eighteenth century, when it was considered the only legal weight in France, excepting that, by a curious arrangement, silk was weighed by a pound of fifteen ounces similar to that of the Anglo-

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In the Assize of Bread and Ale, published in the collection of the Statutes of the Realm, and marked of uncertain date, but supposed to have been a statute of the 5th of Henry the Third, it is declared, that "when a quarter of wheat is sold for eighteenpence, then wastel bread of a farthing, white and well-baked, shall weigh four pounds ten shillings and eightpence;" and thus it proceeds, giving a progressive scale of prices of wheat, and fixing the assize in proportion, until wheat shall rise to twenty shillings the quarter, when it is declared that the weight of the farthing loaf shall be six shillings and ninepence three farthings.

Saxons. The aliquot parts of the French livre de marc were rather incongruous, the denier, the carat, &c., being used for money, which were not used for other purposes; but, as applied to the wholesale and even to the retail dealings of commerce, the French system of standard weights, before the revolution, possessed great advantages over those of England. It had only one ounce and one pound; and the multiples of the latter were the most convenient that could have been desired, namely, the 'quintal,' or hundredweight of 100 pounds, and the 'millier,' or thousandweight of 1,000 pounds." *

Of an attempt made by the French government during the revolution to introduce a decimal system of weights and measures, Mr. J. Q. Adams gives the following account:—

"In the year 1790, the present Prince de Talleyrand, then Bishop of Autun, distributed among the members of the Constituent Assembly of France, a proposal founded upon the excessive diversity and confusion of the weights and measures then prevailing all over that country, for the reformation of the system, or rather for the foundation of a new one upon the principle of a single and universal standard. After referring to the two objects which had previously been suggested by Huyghens and Picard,—the pendulum and the proportional part of the circumference of the earth,—he concluded by giving the preference to the former, and presented the project of a decree:—First, that exact copies of all the different weights and elementary measures used in every town of France, should be obtained and sent to Paris: Secondly, that the National Assembly should write a letter to the British parliament, requesting their concurrence with France in the adoption of a natural standard for weights and measures,—for which purpose, commissioners in equal numbers from the French Academy of Sciences and the British Royal Society, chosen by those learned bodies respectively, should meet at the most suitable place, and ascertain the length of the pendulum at the 45th degree of latitude, and from it, an invariable standard for all measures and weights: Thirdly, that after the accomplishment, with all due solemnity, of this operation, the French Academy of Sciences should fix with precision the tables of proportion between

* "Observations on the Expediency and Practicability of Simplifying and Improving the Measures, Weights, and Money," &c., 8vo, 1834.

the new standards and the weights and measures previously used in the various parts of France; and that every town should be supplied with exact copies of the new standards, and with tables of comparison between them and those of which they were to supply the place. This decree, somewhat modified, was adopted by the Assembly, and, on the 22nd of August 1790, sanctioned by Louis the Sixteenth. Instead of writing to the British Parliament themselves, the Assembly requested the king to write to the king of Great Britain, inviting him to propose to the parliament the formation of a joint commission of members of the Royal Society and of the Academy of Sciences, to ascertain the natural standard in the length of the pendulum. Whether the forms of the British constitution, the temper of political animosity then subsisting between the two countries, or the convulsions and wars which soon afterwards ensued, prevented the acceptance and execution of this proposal, it is deeply to be lamented that it was not carried into effect. Had the example once been set, of a concerted pursuit of the great common object of uniformity of weights and measures, by two of the mightiest and most enlightened nations upon earth, the prospects of ultimate success would have been greatly multiplied. By no other means can the uniformity, with reference to the persons using the same system, be expected to prevail beyond the limits of each separate nation. Perhaps when the spirit which urges to the improvement of the social condition of man shall have made farther progress against the passions with which it is bound, and by which it is trammelled, then may be the time for reviving and extending that generous and truly benevolent proposal of the Constituent National Assembly of France, and to call for a concert of civilised nations to establish one uniform system of weights and measures for them all. The idea of associating the interests and the learning of other nations in this great effort for common improvement, was not confined to the proposal for obtaining the concurrent agency of Great Britain. Spain, Italy, the Netherlands, Denmark, and Switzerland, were actually represented in the proceedings of the Academy of Sciences to accomplish the purposes of the National Assembly. But, in the first instance, a committee of the Academy of Sciences, consisting of five of the ablest members of the academy and most eminent mathematicians of Europe, Borda, Lagrange, Laplace, Monge, and Condorcet, were chosen, under the decree of the Assembly, to report to that body upon the selection of the natural standard, and other principles proper for the accomplishment of the object. Their report to the Academy was made on the 19th of March 1791, and immediately transmitted to the National Assembly, by whose orders it was printed. The committee, after examining the projects of a natural standard, the pendulum beating seconds, a quarter of the equator, and a quarter of the meridian, had, on full deliberation, and with great accuracy of judgment, preferred the last; and proposed, that its ten millionth part should be taken as the standard unit of linear measure; that, as a second standard of comparison with it, the pendulum vibrating seconds at the 45th degree of latitude should be assumed; and that the weight of distilled water at the point of freezing, measured by a cubical vessel in decimal proportion to the linear standard, should determine the standard of weights and of vessels of capacity."*

In reference to the proposal of a consultation with foreign nations for a general reform of the existing systems of weights and measures, a measure which hopeful philanthropy may now anticipate at no very remote period, Mr. Adams says:—

"Although it is respectfully proposed that Congress should immediately sanction this consultation, and that it should commence, in the first instance, with Great Britain and France, it is not expected that it will be attended with immediate success. Ardent as the pursuit of uniformity has been for ages in England, the idea of extending it beyond the British dominion has hitherto received but little countenance there. The operation of changes of opinion there, is slow; the aversion to all innovations, deep. More than two hundred years had elapsed from the Gregorian reformation of the calendar, before it was adopted in England. It is to this day still rejected throughout the Russian Empire. It is not even intended to propose the adoption by ourselves of the French metrology for the present. The reasons have been given for believing that the time is not matured for this reformation. Much less is it supposed advisable to propose its adoption to any other nation. But in consulting them, it will be proper to let them understand, that the design and motive of opening the communication is, to promote the final establishment of a system of weights and measures, to be common to all civilised nations."†

On the application of a decimal system to thermometers, Mr Adams says:—

J. Q. Adams' Report, pp. 49, 50. † Report, p. 92.

"The divisions of the barometer had always been marked in inches and lines. The application to it of the decimetre, its multiples and divisions, had for observation and calculation the usual conveniences of the decimal arithmetic. The graduation of the thermometer had always been arbitrary and various in different countries. The principle of the instrument was everywhere the same,—that of marking the changes of heat and cold in the atmosphere, by the expansion and contraction which they produced upon mercury or alcohol. The range of temperature between boiling and freezing water was usually taken for the term of graduation; but by some it was graduated downwards from heat to cold, and by others, upwards from cold to heat. By some the range between the terminating points was divided into 80, 100, 150, or 212 degrees. One put the freezing, and another the boiling point at 0. Reaumur's thermometer, used in France, began with 0 for the freezing point, and placed the boiling point at 80. Fahrenheit's, commonly used in England, and in this country, has the freezing point at 32, and the boiling point at 212. The centigrade thermometer, adopted by the new system, begins with the freezing point at 0, and places the boiling point at 100: its graduation, therefore, is decimal, and its degrees are to those of Reaumur as five to four, and to those of Fahrenheit as five to nine."*

The immense preponderance of evidence before the Parliamentary Committee is in favour of the retention of the pound sterling as the unit or integer of account, and for its division into a thousand parts. And the reasons are obvious.

The pound sterling is one of the best known and most ancient moneys of account. From the time of the Conquest down to the time of Edward I., it represented one pound of standard silver, weighing 12 ounces troy, so that the value and weight of the shilling was then exactly the twentieth part of a pound of silver, and the penny the twelfth part of the shilling. Successive acts of legislation lowered the value to the present standard, which has been finally fixed, by what is called Peel's Act, at £3 17s. 10½d. per troy ounce of gold.

There is an almost universal desire that, while the pound sterling should be kept as the basis of our accountancy, its name and value should remain unchanged as the unit of the cur-

* Report, p. 62.

rency and accounts of the nation, and no proposal for its decimalisation is so reasonable as that which suggested that it shall in future be divided into one thousand instead of nine hundred and sixty parts. In 1838, Mr. J. Parry, in a paper read before the Numismatical Society, advocated the adoption of this system of decimal division, which indeed affects the copper coinage alone, and which will be only felt by the people as giving to them 50 of the new farthings, or mils, to the shilling, instead of 48 as at present, and 25 to the sixpence instead of 24.

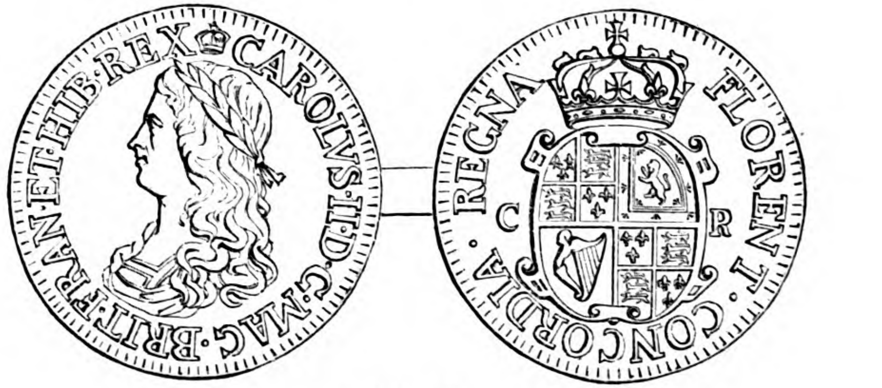
The pound sterling had ceased to be represented in the coinage from the reign of Charles II. till the year 1816; for though the guinea first coined by Charles II., in 1675, was intended to represent 20 shillings, it constantly fluctuated in value, and was fixed, in 1717, by Sir Isaac Newton, then master of the Mint, at 21 shillings, at which value it continued till it was superseded by the sovereign. The pound sterling, in the time of Elizabeth, had weighed 7 dwts. and 4 grains. It was reduced in the time of James I., first to 6 dwts. and $10\frac{3}{4}$ grains, and next to 5 dwts. and $20\frac{1}{2}$ grains. In the time of Charles II., when its value was raised, it weighed only 5 dwts. and $9\frac{1}{2}$ grains. Such had been the gradual growth in the value of gold as compared with silver, that the proportionate value of the two metals was, in the 43rd of Elizabeth's reign, of fine gold to fine silver, 10·905; in the beginning of James I.'s reign, 12·109; in the 15th of Charles II., 13·485; and, as established in the 3rd year of George I., 15·209. It is well worthy of note, that the enormous production of gold in California, Australia, and other parts of the world, has hitherto affected the relative value of gold and silver much less than had been anticipated. The greater portability of gold will always recommend it as a preferable instrument of exchange; and the displacement of silver from circulation by the greater influx of gold, leads to a diminished demand for silver, which has served to counteract the influence which the greater importation of gold would otherwise have exercised upon its market value. It is well known, that no one can be compelled to receive as a legal tender more than forty shillings in silver; and it has been contended by some high authorities, such as Locke and Harris, that there would be convenience in our adopting silver instead of gold, by making it a legal tender to any amount; but, as Lord Liverpool says, with much good sense,—"In rich countries, where great and

COINS OF ENGLAND.—Plate VII.

ELIZABETH.

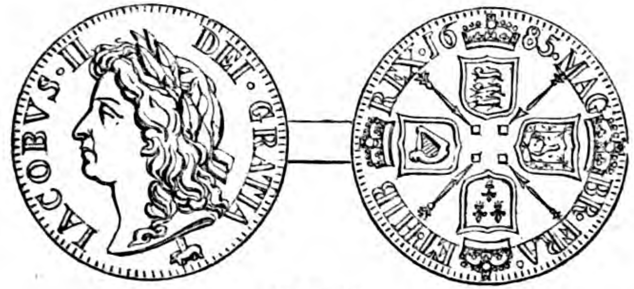
JAMES I.

CHARLES I.

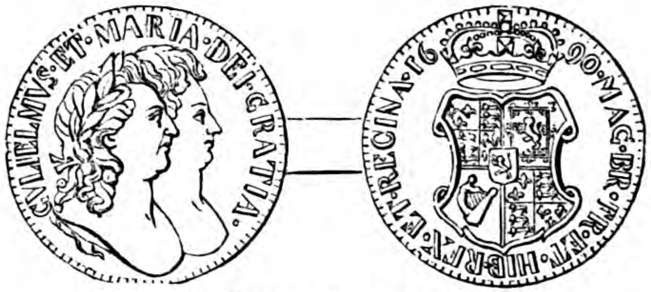


CHARLES II.

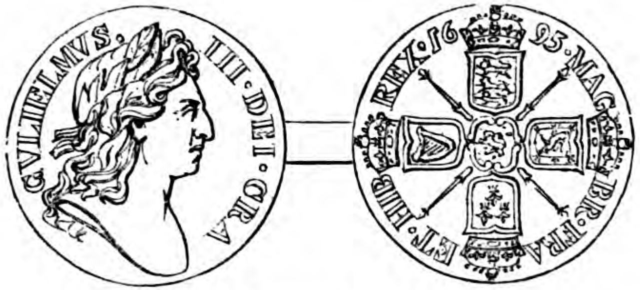
COINS OF ENGLAND.—Plate VIII.



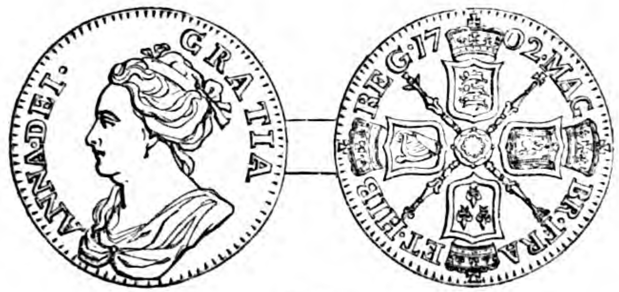
JAMES II.



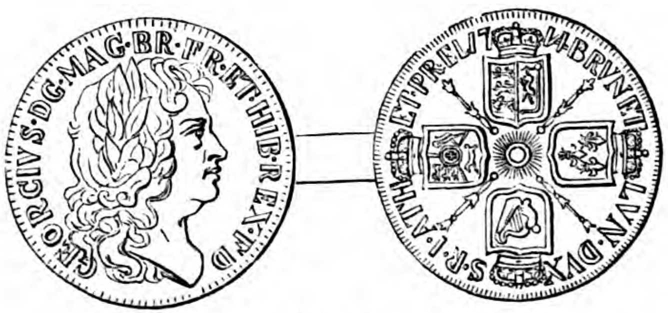
WILLIAM AND MARY.



WILLIAM III.



ANNE.



GEORGE I.

COINS OF ENGLAND.—PLATE IX.

GEORGE II.

GEORGE III.

GEORGE IV.

WILLIAM IV.

VICTORIA.

extensive commerce is carried on, gold is the most proper metal to be employed as the measure of property and instrument of commerce. And, in such countries, gold will in practice become so, with the general consent of the people, not only without the support of law, but in spite of any law that may be enacted to the contrary." It would be utterly impossible to conduct the daily trading affairs of the metropolis by the medium of silver coins alone. In the Bank of France there are great numbers of *facteurs* and assistants employed solely in weighing and counting the silver coins which pass through that establishment. In England, the vexations and delays attendant upon legalising silver currency beyond a moderate amount, would be absolutely intolerable. Even gold becomes nearly unmanageable in large transactions; and, but for the facilities of checks upon bankers, bank notes for the larger amounts, and the assistance which the clearing house gives for settling all balances between the Bank of England and the bankers, and between the bankers themselves, the vast operations of exchange in London could hardly be got through.

The name originally given to the guinea was the *unit*,—a very convenient designation, as it then represented the real *unit*, or integer of English coinage and account.* It took the name of guinea in consequence of the large supply of gold which was furnished to the Mint, by the Royal African Company, from the Guinea coast. From the time of its introduction to the great re-coinage of silver money in 1717, the guinea fluctuated in value, as against English silver coins, from 30*s.* to 21*s.*, at which last value it continued in circulation till superseded by the coinage of sovereigns in the reign of George III.

The *pound* sterling is of all coins and integers of accountancy perhaps the most extensively, not to say universally, known. It is the groundwork of our exchanges with all trading nations, and its value could not be changed without intolerable inconvenience and perturbation of commercial relations. It has the recommendation of a higher antiquity, a larger uninterrupted possession of the field of commerce, than any other unit of exchange. The name pound (*pondus*, Latin), with its synonyme *libra*, has the strongest hold upon the languages and associations of the trading

* The dollar of the United States bears on its edge, "One Dollar or Unit—Hundred Cents."

world. The word *libra*, as used by the Latins, means equally a weighing machine, and a *weight* (pound); the ascertaining which being the most common object of the scale, probably gave its name to the machine itself, as it is clear the existence of specific weights must have preceded the use of the instruments, in fixing and regulating those weights. Generally, the *libra* represented the pound-weight either of gold, silver, or other metal. The pound of pure silver, whose primitive value may be considered as representing nearly four times its nominal value of our present currency, has in various parts of the world been subject to a succession of depreciations, either by altering the size of the coins which represented its value, or adulterating the metal of which they are composed. Thus the pound sterling represents 20*s.*; the lira Toscana, $7\frac{1}{3}$*d.*; the Genovese, about 8*d.*; the livre Tournois, about $9\frac{1}{2}$*d.*; while the lira Reggiana was only $3\frac{3}{4}$*d.*, and the lira Modenese only two-thirds of that of Reggio; the livre of Venice only $2\frac{1}{4}$*d.*

Sir John Herschel's detailed reasons for the adoption of the pound sterling as the unit of account, are unanswerable :—

"I think we must adopt the pound sterling.

"There are four other systems which have been proposed. There is, first, the Ducat system, which takes the half pound as its unit. I call it the Ducat system; some speak of Royals—some of Victorias; it is no matter, provided only it is not called a pound, for if you call it a pound, all manner of objections apply to it.

"This has some very taking points. It preserves the shilling as the silver unit—the poor man's unit, as it has been called: it requires only doubling to change pounds into ducats. It would admit of a copper coin to represent its tenth part—a copper cent, which is a real advantage.

"On the other hand, it has, in my opinion, fatal objections. It would double the numerical announcement of debts, taxes, liabilities of all kinds, rents, and prices; but what is of more real consequence, and is in my mind unanswerable, is, that the bulk of our gold circulation cannot possibly consist of ten-shilling pieces. It is impossible to coin enough of them in a given time to meet emergencies. Now the bulk of your gold coinage must consist of your gold unit. It would never do to have the one great element of all our reckonings thinly scattered among larger pieces, as our half sovereigns are now among the sovereigns. It would be, in short, a mere money of account.

PROFESSOR AIRY.

"Next comes the Florin system, which would reckon all in florins and cents of florins. This makes the pound a natural decimal multiple;—and so far good. But it assumes a silver monetary standard, whereas, for good or for evil, for better or for worse, we are married to a gold one. I do not mean to say a silver standard would not be better; I believe it would: and I believe a binary standard—half silver, half gold, at the option of either party to insist on—would be better than either; but gold is our standard of value, and we are lashed on to it, and must be carried along with it, toss as it may.

"Then comes the Shilling system. It has no one point to recommend it but its copper dime. The sovereign must be called a twenty-shilling piece; the penny must be demonetised; and we are landed in a system having no relation to any other in Europe, or elsewhere.

"The Penny system is a little better. It would give us a franc not very far from the French, and a pound of 200 pence, which was the old Saxon pound of Ethelbert. I took occasion not very long ago to suggest this for a Canadian pound; but it is quite visionary as applied to England.

"So, I conclude, we must stick to the pound. It is a national institution ingrained into all our notions, and I hold it impossible to oust it. The true office of the ten-shilling piece is to break the sovereign, and lessen the amount of silver necessary to be kept up."*

If additional reasons were required to show the desirableness of retaining the pound sterling as the integer, those given by Professor Airy would be irresistible:—

"I can scarcely conceive it possible, except by the most violent and offensive measures, to change the principal money of account from its present value of the pound sterling. Every estimation of large, and even of very moderate sums, is formed by the pound. I do not attach great importance to such things as the national debt, or the rental of the country; but the price and rental of private estates, the salaries of offices, the annual wages of servants, down to those of the lowest female servant—in larger matters, the expense of constructing a railway or sailing a ship;—all are estimated by pounds. An alteration of the value of the pound would unhinge every estimate and every contract in England. I

* Minutes of Evidence, p. 90.

say advisedly every contract, for the shilling is inseparably connected with the pound; and every real contract which is not ostensibly made by the pound, is made by the shilling. To this class belong an infinity of shop purchases, and an infinity of weekly wages of workmen, occasional servants, and the like. If pence enter into these matters, it is merely as aliquot parts of the shilling, which can be supplied quite as well by the decimal division of the pound.

"No important contract whatever, between man and man, is so made as to depend for its amount on the exact value of the penny. It is true that a Liverpool merchant may sell cotton per pound, or a Suffolk farmer may sell clover seed per pound, at prices below one shilling per pound, and therefore expressed on the existing system by pence. But he sells, not a single pound, but tons, and therefore the pence serve the purpose simply of subordinate parts of a shilling, and are expelled from the account before it is brought to the state of payment. The same would be done if any other scale of copper coinage below the shilling, as that of decimals from the pound, were in common use.

"Many small articles in the retail trade are sold by the penny; balls of string, apples and oranges, seats in an omnibus, and the like. The principle of adjustment here, is a struggle between the desire of selling many, and the desire of making a large profit on each article. The adjustment is a very rough one, and will be made as easily on one scale as on another. It possesses no sort of permanence, being altered from hour to hour.

"In a word, I may say that every habitual estimate, and every long, or permanent, or important contract, depends on the pound. The things which depend on the penny are insignificant, even to the lowest classes."*

To the pound sterling, indeed, the most distinct and definite ideas attach—whether on small or large amounts. Mention a pound, five pounds, ten pounds, fifty pounds, a hundred pounds, a thousand pounds, ten thousand pounds, and your meaning is comprehended by everybody. But those who would make farthings, pence, or shillings, the integer or basis of account,—and each denomination has had its advocates,—forget that to speak of a hundred, or a thousand farthings, pence, or shillings, is to convey only a vague idea of value to the mind of the hearer. It should

* Minutes of Evidence, p. 30.

be remembered, that all the machinery of compound calculation is but an instrument for converting the smaller into the larger denomination,—farthings into pence, to assist their being rendered into shillings, and from shillings into pounds. The relations of the lower denominations to a pound sterling, and in so far as a single pound sterling is concerned, may be intelligible enough; but beyond a pound they become complicated and entangled to the common understanding. And even within the range, it may be doubted if a majority of the labouring classes could answer off hand, and without the process of a mental calculation, how many pence go to a pound, or, still less, how many farthings!

An exact representation of the new proposed system of keeping account in decimals, the pound sterling being the integer, may be seen in an old English book, by Richard Witt, published in 1613 and called "Arithmetical Questions, &c. &c., Briefly Resolved by means of certain Breviats;" of which Professor De Morgan says,—

"Decimal fractions are really used; the tables being constructed for ten millions of pounds, seven figures have to be cut off, and the reduction to shillings and pence, with a temporary decimal separation, is introduced when wanted. For instance, when the quarterly table of amounts of interest at ten per cent. is used for three years, the principal being £100, (page 99), in the table stands 137,266,429, which, multiplied by 100, and seven places cut off, gives the first line of the following citation:—

THE WORK.

Facit	£	1,372	66,429
	sh.	13	2,858
	d.	3	4,296

Giving £1372 13*s.* 3*d.* for the answer. And the tables are expressly stated to consist of numerators, with 100 for a denominator." *

In the division decimal next to the pound I should have been glad to have seen the word *dime* employed instead of *florin*, to designate the tenth of a pound. The word *disme* (decime) is that by which the idea of a decimal system was first popularised, and ushered in (as it deserved to be) with a loud trumpeting forth of the miraculous value of the system—giving light from smoke,

* A reprint of this work, by T. Fisher, London, 1634, duodecimo, is in the Royal Society's Library.

born of a Divine Author, and worthy of being celebrated with a golden voice, in a hundred tongues, to a hundred ears, "and through all ages in perpetual praise."*

There is an English translation by Richard Norton, 1608, the title of which is "Disme, the Art of Tenths," or Decimal Arithmetike, invented by the excellent mathematician Simon Stevin.†

Dismes are frequently mentioned with reference to our revenues in the early records of the Exchequer. They are sometimes called Tallage of Tenths, and the tolls or duties paid by merchants were also called dismes.‡

The objection to the word *florin* is its vagueness of signification, and its conveying no decimal idea whatever. The only florin known to English numismatic history, is a gold piece, of the value of six shillings, coined by Edward III., which soon disappeared from circulation, was adopted by none of his successors, and is rarely found even in large collections. The ancient florin of Italy, and the existing florins of Austria and Holland, represent value by no means corresponding to the tenth of the pound sterling. Though the issue of the florin has been of immense value in introducing and popularising a decimal system, the name of the coin has been obstructive, and is a cause of much confusion in our intercourse with foreign countries. It were much to be wished that the old English word *dime*, now re-established in the United States to represent the tenth of a dollar, should be legislatively sanctioned in this country as the tenth of a pound sterling.

Evelyn says:—"*Florins* were coined in gold, in the reign of Edward III., by certain *Florentine* moneyers who were employed in England."§ From these, no doubt, they took their name. The

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* "Non fumum ex fulgore sed ex fumo dare lucem
Cogitat, ut speciosa dehinc miracula promat.
Sume unum e multis, quid non Decarithmia præstat
Divinum scriptoris opus? cur non ego si vel
Aurea mi vox sit, centum linguæ, oraque centum,
Omni ætate queam laudes persolvere dignas."

Decarithmia La Disme, p. 132. *Iagius Tornus, Philomates*, appended to Gerard's Translation (French) of Stevin's Mathematical Works.

† Dr. Peacock mentions that the early Dutch edition has "De Thiende Leirinde alle Reckeninger," Gouda, 1626. *Tenths*, teaching all reckonings. De Morgan, pp. 26, 27.

‡ Madox's Exchequer, p. 503. § Evelyn on Medals, p. 4.

association of the name of the coin with the country of the coiners having completely passed away, the propriety of again introducing it may well be doubted.

The coin which is now most required to complete the instruments of decimal currency, is the piece which is to represent 10 mils ($2\frac{2}{5}d.$ of the existing currency), or one hundredth part of the pound sterling. The name of *cent*, being monosyllabic, intelligible, and descriptive, will probably be adopted without much hesitation. I am not of opinion that either the *dime* or *cent* will become coins of account, though of the greatest importance for facilitating the settlement of all trading transactions, and for spreading a knowledge of the decimal currency. The cent should be a silver coin—it would not be perceptibly smaller than the silver 3*d.* If made of copper, it would be too unwieldy to be popular. The experiment of coining copper twopences was made in the reign of George III.; but they found no acceptance from the subject, and soon ceased to circulate. It has been proposed that the cent should be of mixed metal,—which is objectionable, from the great facilities which would be given to fraud and adulteration, which flourish in all countries where coins of great alloy are in vogue.

There has been an expression of contradictory views as to the convenience or inconvenience of the mil, or thousandth part of a pound, as the smallest coin of accountancy or of exchange. Some are of opinion that it is unnecessarily small, and have grounded that opinion upon the fact, that the farthing, whose value is somewhat greater than the mil, is almost wholly excluded from the present system of accountancy, and that no banker or merchant has a column in his books for any sum less than a penny. Others maintain that the mil will not be a sufficiently small element of account, and that where articles such as cotton are sold by the pound, and the subdivision of the penny into sixteenths is become a commercial usage, the mil will be too large a coin for the convenience of merchants. When a decimal system of coinage and accounts shall have been established, there can be little doubt of its being followed by decimal weights and measures, and their combination will lead to a reconstruction of all the operations of commerce. Cotton, instead of being sold at so many pence and subdivisions of a penny per lb., will be contracted for at so many mils per 100lb.,—not only making the transaction one of easy calculation, but allowing a much more minute valuation of the commodity. Meanwhile, as the farthing has been found sufficiently small for all purposes of currency, and, in fact, is seldom demanded, the mil, whose value is less than a farthing, may be accepted as sufficiently minute for the common purposes of life. The attempts to introduce a smaller coin, whether in the shape of half or quarter farthings, have, though made on more than one occasion, met with no encouragement. Moreover, though the division of a farthing is sometimes employed in accounts, the coin is very rarely, seldom or ever, required for the purposes of payment. All things considered, the mil will be found neither too large nor too small for the *minimum* coin;—but if, for any purposes of minute accountancy, a lesser element is required, another column representing the tenth of a mil, or the ten thousandth part of a pound sterling, may be employed in harmony with, and subserviency to, the decimal system which it is proposed to establish.

Whatever be the coins in circulation, there is no reason that any other denominations should be used in accountancy than pound and mil. The Americans have eagles and dimes, but in accounts they only employ dollars and cents. The French have Napoleons and deniers, but they only use francs and centimes in their book-keeping. In Russia, though they have sundry coins in gold, platinum, and copper, yet accounts are always kept in rubles and copecks;* so in Holland, notwithstanding their ducats, crowns, and stivers, yet guilders and cents form the sole accountancy. In China, candereens and mace, being the decimal divisions of the ounce, are constantly used in conversation, but they do not figure in their accountancy. There would be considerable convenience from the introduction into common parlance of the words cents and dimes, as representing the decimal parts of the pound sterling; but they need no more be money of account than the groat or the guinea. The florin or dime being a new coin, could not be paid without some name or other, and the coin of ten mils, which is needful to complete the decimal series, will be probably called a cent, though there is no reason it should be specially designated in the columns of account books.

Whatever be the form in which *accounts* are kept, whether only in two divisions, £1, 525 mils, the pound sterling and the mil; or in three £1, *5d.* *25m.*, the pound, the dime (florin), and the mil; or in four—£1, *5d.* *2c.* *5m.*, *i. e.*, the pound, the dime, the cent, and

* A copeck is the one-hundredth part of a ruble.

the mil;—the *principal coins* will each represent a multiple or a division of 10 as regards the adjacent column—*i. e.*, the *cent* will be 10 mils, the *dime* 10 cents, the *pound* 10 dimes; or, in other words, the pound will be a thousand *mils*, or 100 *cents*, or 10 *dimes;* the dime will be 10 *cents*, or 100 *mils;* the cent will be 10 *mils*. These will be the sole *moneys of account*, though the *auxiliary coins* in circulation may represent, as they would probably do, 1,000 mils and 500 mils in gold, 100 mils (the dime), 50 mils (the half dime), and 25 mils (the quarter dime) in silver, and 1 and 2 or 5 mils in copper; the cent, or new coin of 10 mils, whose value would be $2\frac{2}{5}$*d.* of our present money, would be the only novelty; but it would at the same time be the great instrument of popular education and initiation into the decimal scale, and the demand of the new coin would probably grow with a perception of its usefulness. As regards books of accounts, there is no reason why the ruling for £ *s. d.* should not serve for pound and mils,—thus, £1 | 10 | 6 would be written 1 | 5 | 25.

We cannot dismiss this part of the subject without some reference to those familiar coins, shillings, pence, and farthings, which will cease to be coins of account when a decimal system is legalised. The shilling, no doubt, will retain its name, and perhaps its popularity, and, as throwing no impediment in the way of the new accountancy, may probably be issued from the Mint for generations to come. And as habit has so strong a hold on the mental associations, and the language of a people does not suddenly or easily accommodate itself to change, or submit to the law which legislative authority may impose, it is likely that the mil, notwithstanding its altered value, will be called a farthing, two mils a halfpenny, and four mils a penny, for many a long year. And the evil will not be great, for though decimal names would be invaluable allies in giving currency to a decimal system, they are not a necessary part of such a system, and their introduction must be of slow progress. When J. Quincy Adams wrote his interesting report, the word *dime*, though coined on every piece representing the tenth of a dollar, had little hold upon the public mind, and had not incorporated itself with the popular idiom. I am assured that a great change has already taken place in the United States, and that the education of two generations has succeeded in giving to the word *dime* the stamp of general acceptation. Names once familiar to English ears have passed into oblivion with the objects they betokened; roses, spurs, laurels, marks, harps, riders, nobles, angels, guineas, groats, testoons, mites, and a multitude of similar designations, are now only to be found in records of departed time, familiar though they once were as household words, and forgotten now, except in tales and tradition, as though they had never been.

Down to the time of Edward the First, the pound of silver (troy 12 ounces), containing 11 oz. 2 dwts. of fine metal, was coined into 240 pennies, or 20 shillings. The weight of the silver coinage was diminished by a succession of reductions down to 1816, when the pound troy was coined into 62 shillings. From that period to the present, the pound is coined into 66 shillings, so that the augmentation upon the primitive value amounts to 330 per cent. The additional 4 shillings represent the seignorage which the sovereign appropriates on the coinage of silver. Yet more extraordinary than this depreciation are the changes upon Scotch coinage. The pound of gold represented, in the reign of Robert II. (1371), £17 12*s*. Scotch: in the time of Charles I. (1633), £492 Scots were coined from the same weight—an augmentation of nearly 2,800 per cent., or, in other words, that the pound Scots in the 17th century had only one twenty-eighth part of its intrinsic value in the 14th.

The shilling, schilling, or skilling, called escalin in some parts of the Netherlands, represents twelve pennies or pfennings. The soue, sol, soldo, or suldo, which is its equivalent in southern languages, is also divided into twelve denarii, dineros, or deniers. It is worthy of notice, that though the depreciation of the coinage of England from its primitive value, as represented by its ancient names, amounts to more than two-thirds, the depreciation (with the exception of China, where the *cash* still represents about 50 per cent. of its original value, viz., the thousandth part of the tael or ounce of pure silver) is far less in England than in other parts of the world,—the shilling of France being about one-half of a penny; that of Italy one-third of a penny.

Shillings, though constantly spoken of as the twentieth part of the pound sterling, were first coined by Henry VII., in the eighteenth year of his reign, when the front face was laid aside in our coinage, and the profile substituted. Henry VIII. and Edward VI. partially resumed the front face; but from the time of Mary the profile portrait has continued in use, generally shifting from right to left on the advent of a new sovereign.

There is in a curious old book—a big and heavy book printed in the year 1600*—a versified description of the aliquot parts of a shilling :—

"A farthing first findes forty-eight,
An halfpenny hopes for twenty-four,
Three farthings seeks out sixteen straight,
A peny puls a dozen lower;
Dicke Dandiprat drewe eight out deade;
Twopence tooke six, and went his way;
Tom Trip-and-goe with four is fled,
But Goodman Grote on three doth stay;
A testime only two doth take:
Moe parts a shilling cannot make."

The author, Thomas Hylles, who calls himself in his title-page "A Well-wisher to the Mathematicals," must have been a facetious pedagogue.

The penny is a sort of continuation of the Roman *denarius*, which has penetrated into Oriental language as *dinar*, *denier* (French), *danaro* (Italian), *dinero* (Spanish), *dinpeiro* (Portuguese), having in the three last and several other languages become the representative of the general idea of money or monetary value. Penny, penning, pfennig, though the initials are changed, preserve enough of the original root to render it probable they have been derived from the same source. The letter *d* is frequently rejected or modified in words derived from the Latin; and, pronounced as we pronounce it, did not exist in Greek at all. It is a letter wanting in many alphabets, such as Finnish and its ramifications, and cannot be clearly uttered by any of the Celtic race.

There are few coins, if any, of which so long, so uninterrupted, and so interesting a series, exists as the English penny. Representations of pennies from the Anglo-Saxon period will be found in the accompanying illustrations. They not only exhibit the diminishing intrinsic value of our silver currency, but are illustrative of the state of art at different epochs of our history.

The Roman denarius, a coin which continued current for more than six centuries, down to the time of Constantine I., was originally a *decimal* coin representing ten asses. After the last Punic war its value was varied to sixteen asses: Augustus reduced its value to twelve, but it mounted again to sixteen, though it frequently bore the worth of ten.

* De Morgan, "Arithmetical Books," p. 31.

The *denier* of France remained, through many changes, an integral part of the monetary system of France, down to the introduction of the decimal francs and centimes. The denier, like the penny, was the two-hundred-and-fortieth part of the livre or pound. In the time of Charlemagne it weighed from 28 to 30 grains. Charles the Bold raised it to 32 grains. It fell by successive adulterations down to 6½ grains in the time of St. Louis (1226). The small copper coins of France, which were superseded by the decimal coinage, represented various values—from 2 up to 36 deniers.

The copper penny was first introduced in the reign of George III. Its utility is very doubtful. It is inconvenient from its size and weight. Copper twopences, still more huge and ungainly, were also issued in the same reign. They are now seldom seen—never as currency, and rarely even as curiosities.

Farthings, or fourthings, no doubt had their name from the habit of cutting pennies into four parts,—a usual practice in the Anglo-Saxon times. Pennies cut accurately into *halves* (halfpennies), and *fourths* (farthings), are constantly found among Anglo-Saxon coins. In the Anglo-Saxon version of the Gospels, *fourthling* is twice used.—(Matt. v. 26, Luke xxi. 2.)

A simple mode of ascertaining the number of farthings in any amount of pounds sterling, is to multiply by 1,000, and deduct 4 per cent. from the quotient. This operation is now frequently practised, and saves much labour. Persons receiving large amounts in copper currency, instead of undertaking the operose toil of adding up the number of farthings and pence, and then going through the various divisions of 4 for the farthings, 12 for the pence, and 20 for the shillings, would find it an easier task to consider the shilling as representing 50 farthings instead of 48, and the pound sterling 1,000 instead of 960.

	£	s.	d.		
Thus	1,206	10	6	in Decimals would be	1,206,525
	20			Deduct 4 per cent.	48,261
	24,130				1,158,264
	12				
	289,566				
	4				
	1,158,264				

A saving of 11 out of 30 figures, or rather more than a third.

A curious and instructive Table was laid before Parliament, by Mr. Kirkman, showing the number of customers which were served in Liverpool, at a popular tea and grocery establishment, during a day, the number of articles bought, the money expended,—the average purchases not exceeding $2\frac{1}{2}d.$ Mr. Kirkman stated that he thought there would be no difficulty in reconciling the working classes to a decimal system, and that it would soon recommend itself; he believed that a coin lower than a mil would not be desirable. This Table is given on the next page.

Of our current silver coins the most obstructive to a decimal accountancy are the half-crown, the fourpence, and the threepence, pieces which, however they may facilitate payments, are connected with complications and loss of time even in our existing mode of keeping accounts. Association has given to the half-crown a tolerably distinct value in the mind even of the least instructed, who know that eight of them make a pound sterling; but there are multitudes among the people who, if asked how many threepences or fourpences go to a pound sterling, would be unable to answer. And, as regards the present plan of book-keeping, every odd number of half-crowns requires two figures at least to record them, and necessitates the employment of two columns, and the division of the pence column by 12 to be carried on to the shilling; so in all cases except where four or fours is the multiple of the *3d.*, or three and threes of the *4d.*, two columns would have to be used. In decimal enumeration the halfcrown would be represented by three figures, 125, a very inconvenient number; and though the multiplication of even quantities of half-crowns would assume a decimal form, the retention of the half-crown, from its resemblance in value to the dime or florin, is undesirable. As regards the *4d.*, which represents decimally 16 mils, and the *3d.* 12 mils, these sums would be inconvenient in accounts, and ought undoubtedly to be superseded by a new coin of the value of 10 mils, which coin would become indeed the principal source of popular instruction in the introduction of a decimal system; and its relative value to the mil, to the dime (or florin), and to the pound sterling, being once fairly established in the public mind, every difficulty growing out of ancient prejudices and usages would speedily pass away.

STATEMENT of One Day's Transactions at a Shop in the Tea and General Grocery Trade, in a low part of Liverpool.

Articles.	Customers.	Price paid.
	s.	d.
1	0	0½
1	0	1
1	0	1¼
1	0	1½
1	0	2
3	0	4
2	0	8½
2	0	3½
1	0	0¼
1	0	1
3	0	7½
1	0	2
2	0	2½
1	0	1½
1	0	4¾
1	0	4½
1	0	4
1	1	3
1	0	1½
1	0	4
2	0	2¾
1	0	2½
2	0	2¼
3	0	1¾
2	0	1½
1	0	2
3	0	2¼
4	0	3
2	0	1¼
2	0	1
2	0	1½
1	0	0½
1	0	0¾
2	0	1½
2	0	2½
2	0	3¼
1	0	1
4	0	3¼
2	0	1¼
3	0	2¾
2	0	1¼
4	0	2¾
5	0	4½
80	43	9/9

Articles.	Customers.	Price paid.
	s.	d.
1	0	1½
1	0	2
1	0	1½
1	0	1½
2	0	1¾
1	0	4½
1	0	2
1	0	1¼
1	0	3
1	0	2½
1	0	3
1	0	1½
1	0	3
1	0	1½
1	0	3
2	1	1½
1	0	1
1	0	1¼
2	0	3
1	0	1½
1	0	2½
2	0	3¼
3	0	1½
3	0	2¼
1	0	2
2	0	1¼
1	0	1
1	0	0½
2	0	1¼
1	0	0¾
1	0	0¾
2	0	2½
2	0	2
4	0	3¼
1	0	1¼
2	0	3½
6	0	10¼
3	0	2
4	0	2½
2	0	1¾
1	0	0¾
68	41	8/4

Articles.	Customers.	Price paid.
	s.	d.
1	0	4½
1	0	0½
1	0	3
1	0	1
2	0	1¾
1	0	4
2	0	7
1	0	1½
2	0	3
3	0	10
3	0	4
1	0	5
2	0	3½
1	0	3
1	0	1
2	0	1¼
3	1	0
1	0	3½
2	0	2½
1	0	3
1	0	3½
2	0	2¼
2	0	3¾
4	0	1
4	0	1¾
4	0	2½
4	0	4
2	0	6
3	0	8
2	0	7½
1	0	6
2	0	2½
1	0	1¼
2	0	3½
1	0	4½
1	0	2
3	1	1½
6	1	7½
2	0	6
3	0	4½
1	0	2
2	0	2¼
1	0	1¾
1	0	1½
1	0	1¼
2	0	1
3	0	2¼
5	0	3¼
2	0	3½
1	0	4
2	0	2¼
1	0	1¼
1	0	0½
1	0	0½
1	0	2
1	0	0¾
96	56	9/-½

Articles.	Customers.	Price paid.
	s.	d.
1	0	1½
1	0	1½
2	0	3
1	0	1
1	0	2½
1	0	2
1	0	7½
2	0	1¾
1	0	2
2	0	9
1	0	4
1	0	3
2	0	3½
1	0	2½
2	0	4
2	0	2
2	0	2
2	0	2
1	0	0½
1	0	6
1	0	3½
6	1	5½
2	1	5
1	0	9
4	0	3
2	0	3¾
1	0	3
1	0	3
1	1	0
1	0	0½
1	0	1½
1	0	0½
1	0	3
1	0	1½
1	0	5
1	0	5
1	0	3
2	0	4
1	0	6
2	0	1¼
1	0	3
2	0	3
2	0	3¼
1	0	0½
1	0	0¾
1	0	1½
1	0	1½
1	0	2½
1	0	1½
3	0	2
2	0	2
2	0	2¾
3	0	2¼
2	0	1½
4	0	6
3	0	6½
2	0	2½
1	0	1½
93	58	17/5

Articles.	Customers.	Price paid.
	s.	d.
3	0	2
1	0	4
2	0	6
1	0	3
1	0	2
2	0	8
1	0	3½
1	0	1½
3	1	4
4	1	2
1	0	6
2	0	2
1	0	1½
2	0	1½
4	0	5½
3	0	2½
6	1	8
2	0	2
2	0	1½
2	0	1
2	0	1¾
4	0	5
3	0	2½
1	0	1½
2	0	1½
1	0	0½
2	0	4
1	0	0½
1	0	0½
2	0	3½
4	0	6
2	0	6
1	0	1
1	0	1½
2	0	2½
2	0	2½
2	0	1¾
1	0	2½
3	0	2½
4	0	3½
2	0	1¼
4	0	2½
3	0	2½
3	0	3
1	0	0½
1	0	7
2	0	8¾
1	0	2½
1	0	2
2	0	2
2	0	1¾
1	0	1¾
1	0	2
1	0	2½
2	0	4
3	0	3½
2	0	1½
117	57	17/

Articles.	Customers.	Price paid.
	s.	d.
2	1	0½
1	0	3
2	0	4½
1	0	4
2	0	3
2	0	3½
4	0	3½
1	0	1
2	0	1½
2	0	2
1	0	2
1	0	2
1	0	1½
3	0	2
2	0	3
3	0	3
4	0	2½
1	0	2½
1	0	2½
1	0	0½
2	0	2½
1	0	1½
3	0	4
1	0	2
1	0	3½
2	0	2½
1	0	1
1	0	1½
1	0	1
2	0	3¼
4	0	7
2	0	4½
6	3	1
2	0	1
3	0	2½
2	0	1
2	0	1¼
2	0	1½
4	0	9
3	0	3½
2	0	6
4	0	6¾
2	0	4
3	0	2½
1	0	7
4	0	3½
3	0	2
1	0	2
1	0	2
2	0	3½
1	0	1½
2	0	4
1	0	3½
0	3	6½
8	0	2
2	0	3½
2	0	4
122	57	20/11¾

Articles.	Customers.	Price paid.
	s.	d.
3	0	5
2	0	2
2	0	2
2	0	4½
1	0	0½
2	0	1
2	0	1½
1	0	1½
1	0	1
1	0	0½
1	0	1½
1	0	0½
1	0	1
2	0	1½
1	0	1
1	0	0¼
2	0	0¾
1	0	2
1	0	2
1	0	1½
3	0	2½
2	0	1¼
1	0	1½
2	0	0½
1	0	3½
2	0	2
2	0	4
1	0	1½
2	0	1½
1	0	1
2	0	3
1	0	1½
2	0	2½
3	0	4¾
4	0	2½
3	0	3¼
3	1	0
2	0	6¼
3	0	2¼
4	0	8½
2	0	2
1	0	2
2	0	2¾
3	0	4½
4	0	3
5	0	8¼
3	0	2½
1	0	1
2	0	2¼
1	0	0¼
1	0	0½
3	0	2½
4	0	3
2	0	2½
107	54	11/-½

CHAPTER VII.

PROGRESS OF PUBLIC ACCOUNTANCY IN ENGLAND.

It is by no means irrelevant to the subject of the present volume to refer to the progress made in public accountancy from the rude system which prevailed in the Anglo-Saxon and Norman periods of our history. The introduction of a decimal system will—next to the employment of the English language, Arabic numerals, and book-keeping by double entry—be the most important step towards facilitating the records and insuring the accuracy of all accounts of income and expenditure.

Book-keeping by double entry, or by what is called the Italian method, and which has become now the almost universal system of bankers and merchants, was one of the natural improvements growing out of the use of the Arabic numbers, the introduction of which so facilitated all the operations of exchange. It was only in 1832 that the Commission of Public Accounts recommended its universal employment by the various departments of receipt and expenditure. Under the direction of Sir Henry Parnell, the expenditure of the army and the navy service was subjected to a sound and mercantile system of record and control; and the complete success of the experiment in these great departments has prepared the way for a general reform of the public accountancy. The period is now at hand in which the payment of the gross revenue into the Exchequer will lay the foundation of great additional securities for the investment or appropriation to the public service of all sums raised by the taxation of the people.

The Exchequer is one of the most ancient institutions in this country. It was the place of receipt and payment of the royal revenues. The antique forms which existed before the Conquest were preserved down to the time of William the Fourth, and the Exchequer still exists as a constitutional control upon the public accountants, its administration having been greatly reformed, and the cost of the establishment much reduced. It is still charged, as of old, with a general supervision of the application of the public money, and is bound to see that the revenues are appropriated as directed by Acts of Parliament. The Bank of England is now the principal receiver of the State revenues, but it pays no warrants issued by the Treasury, or by any department of Government, until the Exchequer has reported that such warrants are sanctioned by legislative authority. Some account of the Exchequer, and of the mode formerly in use for receiving and paying the public moneys, will serve to illustrate the great improvement which has taken place in the system of national accountancy; and it may excite astonishment to learn, that the rude and barbarous forms employed in days of arithmetical ignorance should have been maintained even down to the present generation.

The ancient Exchequer* of England was similar to that of the Normans, and is supposed to have been introduced by the Conqueror, as no mention is made of an Exchequer in times preceding the Conquest; but soon after that event it is frequently mentioned by historians and in records.† The great officers who presided at the Exchequer were all, or most of them, new, that is, had different functions from those of the great officers of the king's court or palace in the English or Anglo-Saxon times.‡

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* It is said to have been called the Exchequer, from the chequered cloth, resembling a chess-board, which covered the table, and on which, when the accounts were made up, the sums were marked and scored with counters.

In the ancient "Dialogue concerning the Exchequer," Book I., chap. i., written probably in the time of Henry II., the Exchequer is described as "a square board, of about ten feet in length and five in breadth, fixed up in the shape of a table, for people to sit round, with a border of about four inches high all round it, to prevent anything falling off, and a cloth, bought in Easter term, marked with black squares, distant from each other about a foot or a span, laid upon the Upper Exchequer, and was like a chess-board. In the squares, counters were regularly placed."

And the "Dialogue" farther states that the cashier carried his coffer of silver from the Under to the Upper Exchequer, to be examined by weight and combustion; therefore the offices of Weigher and Melter seem rather to belong to the Upper Exchequer.—See "Dialogue," Book I., chap. iii. and chap. vi., under the heads "Cashier" and "Melter."

† Madox (folio), 120, 121.

‡ Ib. 127. Williams' "Ancient Exchequer of England," p. 1.

When the Exchequer was held at Westminster, there were two principal rooms for the barons to sit in; one was called *Scaccarium*, or *Scaccarium Baronum*—it was so called in the times of Henry II. and III.; the other was called *Thalamus*, or *Thalamus Baronum*, a sort of council chamber.* Sometimes the greater Scaccarium was called *Scaccarium in Solio*, the throne-like Exchequer. The barons had also certain chambers in the King's Palace or Exchequer; but whether for lodgings or for other purposes, does not appear.† It is stated in the "Dialogue of the Exchequer," Book I., chap. vii., that the Usher of the Upper Exchequer not only took care of the door of the apartment in which the Exchequer was kept, but had also the care of the Council Chamber, which was situated near the apartments of the Exchequer. The barons met there when any doubtful matter was proposed to them at the Exchequer which they chose to debate apart; but their chief reason for retiring thither was, that they might not hinder the accounts from being proceeded with. If any doubtful question arose it was referred to them.‡

When any money was to be paid into the Exchequer by the sheriff or other person, the proper place was at the *Receipt* or *Lower Exchequer*, at the office of the Tellers, where it was entered in a book; this entry was immediately transcribed on a slip of parchment called a bill or tellers' bill, and thrown down a pipe into the Tally Court, where a Tally§ was struck or levied. A

* Coke, in his 4th Inst., p. 112, says, that "about the end of Edward I. this Court was new built, and, therefore, in 2 Edward III. it was called the New Exchequer. Four score and one persons (whereof the Abbot of Westminster and forty-eight of his monks were part) brake into the Receipt, and robbed therefrom £100,000. This occasioned the new building of both parts of the Exchequer, the old being ancient and weak."

† Madox, 129—131. ‡ Williams, pp. 1, 2.

§ The system of recording events, especially numbers, by cutting notches in wood—as the tallies of the Exchequer were cut—is one of very general practice where the art of writing is little cultivated or unknown. Barrow, in his "Travels in South Africa," says of the Kaffirs, "Their only chronology is kept by the moon, and is registered by notches in pieces of wood. It seldom extends beyond one generation till the old series is cancelled, and some great event, as the death of a favourite chief, or the gaining of a victory, serves for a new era."—i. p. 218.

tally was a stick (generally of hazel) prepared by an officer called the Tally Cutter, or Cutter of the Tallies; on the tally notches were cut, indicating the sum in the Teller's Bill, a large notch for M (or £1,000), a smaller notch for C (or £100), a smaller still for X (or £10), and so on for pounds, shillings, and pence. The Clerk of the Pells entered the bill with the teller's name, in order to charge him therewith—this is called the "Pell of Receipt:" in addition to which, the tally writer, who was afterwards Auditor of Receipt, also wrote the sum on two sides of it, then it was cleft from the head to the shaft through the notches, one part of which was called a tally, the other a counter-tally (or tally and foil); one of the parts was retained by the Chamberlains, the other part was given to the party paying in the money, and was his discharge for that amount in the Exchequer of Account when joined by the Joiners, whose business it was to fetch away the foils from the Chamberlains' chest when parties claimed allowance on their tallies; and the bill was filed by the auditor, who also entered the same, by which he saw what every teller received, and made certificate thereof to the Lord Treasurer.*

Four volumes have been printed of the earliest records of the public accounts, from parchments in the custody of the Record Commission. The earliest of these is of the second year of Henry the First. Then follow the rolls of the second, third, and fourth years of Henry the Second. They extend in almost unbroken continuity from the twelfth to the nineteenth century. They consist of a number of Rotulets (Rotulæ) fastened together at the head. The Rotulets are each formed of two membranes—the width is fourteen inches. The writing is in the large square character. The membranes are for the most part written on the front and dorse.†

As a specimen of the manner in which the early public accounts were kept, I have taken a copy of a portion of the first parchment skin, being one of the documents called the great Rolls of the Pipe, of the first year of the reign of Richard the First (1189-90):—

HONOR WILLI DE VESCI.

Nicholas de Morewich redd comp de ccc 7 q^{a}t xx 7 VII li VIII s 7 II, d. de firma Honoris Willi de Vesci. In thro cc 7 XLII li 7 v s 7 vi d.

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* Gilbert, 137, 138.

† Hunter's "Great Rolls of the Pipe," 8vo. 1844.

Et in Elem const 7 Decim p maneria in denar x li 7 VII s 7 IIII d. Et p blado Prebendarioȝ appliato h anno VI li 7 II s.

And so on. The rolls proceed to give in detail the manner in which the whole sum of £327 8s. 2d. was expended, less the £242 5s. 6d. paid into the Treasury. At the foot of each account are the words

In thro librauit.	Et quiet' est.
Paid into the Treasury.	And he is discharged.

The following is an account of the receipts of public revenues for one lordship, as collected by Nicholas de Morewich, on the Pipe Roll, bearing the date of the first year of Richard the First, and of the manner in which the receipts were expended or paid into the Exchequer.* The second and third columns are translations and explanations of the Latin account :—

CHARGE.

Extract from a Pipe Roll, 1 Ric. I.	*Explanation.*	*Charge.*	*Discharge.*
Honor Willi de Vesci.	Honor of William de Vesci.		
		£. s. d.	£. s. d.
Nichols de Morewich redd comp de ccc 7 q^a^t xx. 7 VII li. 7 VIII s. 7 II d. de firma Honoris Willi de Vesci.	Nicholas de Morewich renders his account of 300 and 4 score and 7 pounds 8 shillings and 2 pence for the farm of the Honor of William de Vesci.	387 8 2	

DISCHARGE.

In thro cc 7 XLII li 7 V s. 7 VI d.	Paid into the Treasury 242*l.* 5*s.* 6*d.*	...	242 5 6
Et in Elem Const 7 Decim p maneria in denar x li 7 VII s. IIII d.	Also paid the settled alms and tythes on account of the manors; in money, 10*l.* 7*s.* 4*d.*	...	10 7 4
Et p blado Prebendarioȝ, appliato h anno VI li 7 II s.	Also for the corn of the Prebends, appraised at 6*l.* 2*s.*	...	6 2 0

* Williams, pp. 66, 67.

Et Monialib' de Gisnes, II s 7 VI d in redditu salis, q hnt p annu.	Also for the nuns of Guisnes, for their annual rent of salt, 2*s*. 6*d*.	...	0 2 6
Et p pannis xx frm Prebendar 7 II Inclusar LXXIV s.	Also for clothes for 20 friars and 2 recluses, 74*s*.	...	3 14 0
Et in Quiet tre Ric. falconar qa ht anno q° servit de ministio suo VI s. 7 VIII d. qa h anno seruiuit.	Also for quittance of the land of Richard the Falconer, who served his own office, 6*s*. 8*d*., which he is allowed when he so serves.	...	0 6 8
Et in manio de Malton LI li 7 XVII s 7 X d. de qib3, Galfr Haget deb3 responde.	Also for the manor of Melton, 51*l*. 17*s*. 10*d*., which Geffery Haget ought to answer.	...	51 17 10
Et in defalta reddit' militu p Warda de Alnewick, XXXVIII s 7 XI d.	Also in default of the rents of the Knights of the Ward of Alnwick 38*s*. 11*d*.	...	1 18 11
Et in defalta reddit' tre de Burden qamat' Alani Goher disronau ĩ curia ẽe dotẽ suã XXX s.	Also in default of the land of Burden, which the mother of Alan Goher proved in court to be her dower.	...	1 10 0
Et in libat 1 Caplli residntis in Cast de Alnewick XXX s 7 V d.	Also in livery of one chaplain resident in Alnwick Castle, 30*s*. 5*d*.	...	1 10 5
Et in libat Eustach de Vesci H'edis ei' d Willi de anno integro LIIII li 7 XV s. set q' lib3 die III s. p br. ℞.	Also in livery of Eustace, the heir of the said William, for one year, 54*l*. 15*s*., at the rate of 3*s*. per day, by the King's Writ.	...	54 15 0
Et deb XII li 7 XVIII s. Id redd comp de eod debito.	And he oweth 12*l*. 18*s*., and afterwards rendered account of the same.	...	...

In thro IX li. Et deb LXXVIII s.	Paid into the Treasury, 9*l.*; and then owed 78*s.*	. . .	9	0	0
Id redd comp de eod debito.	And afterwards rendered account of said debt.	. . .			
In thro libavit.	Paid it into the Treasury, 78*s.*	. . .	3	18	0
Et quiet' est.	...And he is quit. ...	. . .	387	8	2

Some curious accounts of the usages of other days, in reference to the Exchequer, have been preserved.

Coke, in his 4th Inst., p. 104, states, that the Lord Treasurer of England was appointed by the delivery of a white staff, but that in former times he was appointed by having delivered to him "the keys (golden keys) of the Treasury; when treasure failed, the white staff served him to rest upon, or to drive away importunate suitors; but, as Treasurer of the Exchequer, he was appointed by Letters Patent." It may here be observed, that the Secretary of State is appointed by the delivery of the signet, but he has also Letters Patent, under which he receives his salary, but no one will say he holds two offices.

However, in process of time he was called Lord High Treasurer and Treasurer of the Exchequer. The following quotation from the "Black Book" of the Exchequer* will show the great ceremony observed on the Earl of Godolphin taking possession of his office a century and a half ago.

"Monday, the 11th day of May 1702, the Right Hon. Sydney Lord Godolphin having had the staff of Lord Treasurer delivered to him by Queen Anne on Sunday the 10th instant, on the 11th he came, about the hour of ten in the morning, to the house of Lord Halifax, the Auditor of the Receipt of the Exchequer, where he was attended by many Earls, Barons, Privy Councillors, the King's Attorney and Solicitor-General, and other persons of quality; they being assembled in the two great rooms, were

* The "Black Book" is so called from its binding. It contains divers authentic entries, chiefly relating to the Receipt of the Exchequer, such as oaths of office, admissions of officers, &c. In it is entered, also, a celebrated treatise on the ancient constitution and practice of the Exchequer, called "Dialogus de Scaccario;" and various other entries and memoranda, from an early period to 1755.

treated with chocolate, &c., by the said Lord Halifax. The proceedings began from thence; a great number of gentlemen in swords and coats, pell mell, the Clerks of the Treasury, Auditors of the Exchequer, Secretaries, Officers, &c., and amongst them the officers of the Exchequer, having no gowns (who should have marched in their proper places if they had had gowns); then the Usher of the Exchequer in his gown, the Clerk of the Pells, Clerk and Tally-writers' Clerk in gowns, the Tally-cutter, the Deputy Clerk of the Pells, the two Deputy Chamberlains, the Marshal of the Exchequer, the auditors, viz., the Lord Halifax, on the right hand of Mr. Lowndes, the Secretary to the Lord Treasurer, Lord Treasurer's Sergeant-at-Mace, the Lord Treasurer; on his right and left, and behind, several Lords, as the Lord President of the Council, Lord Privy Seal, &c., all pell mell. Thus they proceeded along the Inner Court up the great stairs of the Exchequer in the corner of the Palace-yard, by the Tally-court, down the stone-steps into Westminster Hall, by the Common Pleas bar—when my Lord Treasurer made his obeisance to the Judges of that Bench—so up towards the Chancery bar; and about the middle of the Hall made two obeisances, one to the Lord Keeper, sitting in the Court of Chancery, the other to the Court of Queen's Bench, whence they proceeded up the Hall into the Court of Chancery, the officers filing off at the bottom of the steps, except the Marshal of the Exchequer, and the Sergeant-at-Mace, with the Lords, where he took the oaths to the Queen; after which he came back, with the Lord Keeper on his right-hand, and the said officers before him, by the Common Pleas bar, where they both made their reverences to the Judges, so up the stone-stairs into the Exchequer. The Barons being sat, my Lord Keeper went into the Court, placing himself on the right of the Lord Chief Baron; the Lord Treasurer was by the Marshal, and his own sergeant conducted to the outside of the bar, with the Sergeant-at-Mace on his left, when my Lord Keeper made a neat speech, signifying his Lordship's great abilities—that he had two offices, that of Lord High Treasurer by delivery of the staff, and that of Treasurer of the Exchequer by patent; after which my Lord's patent was read by one of the clerks of the King's Remembrancer's office. Then his Lordship was conducted into the Court, where was a cushion provided, on which he knelt whilst the oaths of his respective offices were administered to him by the Lord Keeper. After which he was conducted to his place on the left of the Lord Keeper, and his patent delivered to him by the Lord Keeper; which done, the Lord Keeper departed the Court, and the Lord Treasurer sat to hear motions some little time, after which he departed the Court, when he should have taken possession of the King's Remembrancer's Office, Treasurer's Remembrancer, Pipe, and other the offices on that side of the Exchequer, before he walked thence; but he was conducted in the same order, accompanied to the Tally Court, where were placed cushions for him in the middle thereof, and two for the Chamberlains on each side of the block, the two Deputy-Chamberberlains in each corner, the Lord Halifax, Tally-writer, and his clerks on the right-hand, below the senior Deputy Chamberlain; the Deputy Clerk of the Pells and his clerk below the junior Deputy Chamberlain; then the Usher of the Exchequer just within the door, and the Tally-cutter without the Court; the Chancellor of the Exchequer on the Lord Treasurer's left; several Dukes and Earls round the Court, the Barons of the Exchequer on the outside of the bar, with the Attorney and Solicitor-General. When all were come in, a bill was thrown down from the tellers' offices, a tally prepared, writ on, struck, and examined by the proper officers; then his Lordship withdrew thence, after having had the great keys of the Treasury presented to him by the Auditor, and he delivered them to him again; then he went into the Auditors', Pells', and Tellers' Offices, and viewed the cash in the last of them, the Barons of the Exchequer, Attorney and Solicitor-General, with the Dukes, Earls, &c., attending him to each office. After which he went back again to the other side of the Exchequer, to take possession of the several offices there, which he should have done before he came to the receipt side; and after retired to his house," &c.

The intervention of the Exchequer in matters of coinage is thus described:—

"The trial or assay of money is technically called the Trial of the Pix, from the box in which the coins selected for that purpose are contained. In Ruding's 'Annals of the Coinage,' it is stated that the modern practice is for the Master of the Mint to present a memorial, praying for the trial of the pix; upon which the Chancellor of the Exchequer moves the Sovereign in Council, who commands the trial to be holden. The members of the Privy Council are accordingly summoned. A precept is likewise directed by the Lord Chancellor to the Wardens of the Goldsmiths' Company, to nominate a competent number of sufficient and able freemen of their company, skilful to judge of and to present the defaults of the coins, to be of the jury. This number is usually twenty-five, of which the Assay Master of the Company is one.

"No coin whatever is issued from the Mint until a portion of it has been assayed by the Queen's Assayer. When that process has been gone through, one coin of each denomination is placed in what is called 'the Pix,' meaning box, chest, or casket; when so deposited, this box is sealed with three seals, and secured with three locks, the keys being separately kept by the Master of the Mint, the Chancellor of the Exchequer, and the Queen's Assayer; the pieces of coins so secured are given to the jury to assay and compare with the trial plates, which are kept in the ancient Treasury in the Chapel of Edward the Confessor, in the cloisters of Westminster Abbey, the keys of which, and of the box in which the trial plates are deposited, are now in the custody of the Comptroller of the Exchequer and the Lords of the Treasury."

It is, indeed, scarcely credible, that the perplexing and entangled manner of keeping accounts by the Roman numerals, in the same barbarous style which was practised before the Norman Conquest, was maintained at the Exchequer almost down to the present day; and the introduction of the English language and the Arabic numerals was successfully resisted by no less a personage than Lord Granville, on the ground, that if the barbarous usages of our ancestors were reformed, it would be difficult to understand the accounts, and the records of departed time; and hence he argued for the necessity of perpetuating a system of complication, confusion, and imperfection, not on the common plea of the superior wisdom of our ancestors, but in full acknowledgment and appreciation of the ignorance which was originally instituted and had continued to reign triumphant among the Exchequer records.

In addition to the strange and absurd system of Exchequer book-keeping, *tallies* continued to be used down to the year 1782. It was only in the year 1831 that the Committee on Public Accounts, of which I was the Secretary, recommended the utter and immediate abolition of the ancient system, and the adoption of the Arabic numerals and the English language. It was in consequence of this change that, in the year 1839, the tallies were ordered to be burnt, a conflagration which led to the destruction of both Houses of Parliament—the Exchequer in which the tallies were kept having formed a part of the ancient edifice of St. Stephen's. Far more serious consequences than were ever anticipated were thus produced by the introduction of the new and improved system of accountancy at the Exchequer. To it we owe those splendid edifices which are now the seats of British legislation, and in their grandeur and beauty we may find some consolation for having been, as one of the principal authors of the Exchequer Report, the unintentional incendiary of that old sanctuary whose eloquent words and legislative influence have so often agitated and ameliorated the world. May a grander pile accomplish even loftier destinies!

Many of the ancient forms and usages of the Exchequer are preserved even to our own time, and afford various illustrations of the habits of our forefathers. The following is an account of a tenure custom, as it was observed in the present year, in connection with the presentation of the Sheriffs in the Court of Exchequer. The chopping the sticks and counting the six horse-shoes and sixty-one hob-nails have probably reference to amounts due to the Crown on account of the tenures in question:—

"The Lord Mayor, accompanied by several members of the Court of Aldermen, the Sheriffs, Under Sheriffs, and other corporate officers, then proceeded in state from Guildhall, viâ Cheapside, Ludgate-hill, and Bridge-street, taking water at Blackfriars-Bridge, and proceeding in the city barge to Westminster, where they were met by the High Constable of that important city.

"On their entering the court, which was much crowded, a number of ladies being present, the Cursitor Baron took his seat on the bench. The Baron wore his scarlet robes, as did also the Sheriffs and Recorder their scarlet robes, as also the Lord Mayor, with his collar of SS.

"The Lord Mayor and Sheriffs, and other civic functionaries, having taken their position within the bar,—

"The Recorder, addressing the Cursitor Baron, then related Mr. Sheriff Wire's personal history and civic position, together with the connection of Mr. Wallis with the City.

"The Cursitor Baron having referred to the ceremonial as having existed for several hundred years, concluded by signifying the approbation of her Majesty to the appointments the citizens had made; and by wishing health and strength to the Sheriffs to discharge their onerous duties.

"The Recorder then read the warrant of attorney from the new Sheriffs to receive and execute all writs, &c., and prayed that it might be recorded.

"The Queen's Remembrancer read the warrant, which the learned Baron ordered to be recorded.

"The Recorder also read the warrant for the late Sheriffs to account, as also the Under-Sheriffs, they having placed in their stead Mr. G. K. Potter and Mr. Thomas Cleobury; and this terminated the ceremony of the Sheriffs' presentation.

"Proclamation was then made by the Crier of the Court for the service, as follows:—

"'Oyez! Oyez! Oyez!

"'Tenants and occupiers of a piece of waste ground called "The Moors," in the county of Salop, come forth and do your service, upon pain and peril that shall fall thereon!'

"Alderman Moon, as the senior Alderman below the chair, then cut one faggot (small twigs) with a hatchet, and another with a bill-hook.

"The Crier then made a proclamation:—

"'Oyez! Oyez! Oyez!

"'Tenants and occupiers of a certain tenement called 'The Forge,' in the parish of St. Clement Danes, in the county of Middlesex, come forth and do your service!'

"Alderman Moon then counted certain horse-shoes and hob-nails, and was questioned by the Queen's Remembrancer thus:— 'How many have you?' 'Six shoes.' Then the Alderman counted the nails:—'How many have you?' 'Sixty-one nails—good number.'

"The Recorder having invited the Cursitor Baron to dinner at the London Tavern, the civic cortége returned."

Mr. Nichols, in the "Gentleman's Magazine" for October 1804, vol. lxiv., p. 965, describes the custom as performed in that year, and adds this explanation:—"The ceremony on this occasion, in the Court of Exchequer, which vulgar error supposed to be an unmeaning farce, is solemn and impressive; nor have the new Sheriffs the least connection either with chopping of sticks or counting of hob-nails. The tenants of a manor in Shropshire are directed to come forth and do their suit and service; on which the senior Alderman below the chair steps forward and chops a single stick, in token of its having been customary for the tenants of that manor to supply their lord with fuel. The owners of a forge in the parish of St. Clement (which formerly belonged to the City, and stood in the high road from the Temple to Westminster, but now no longer exists) are then called forth to do their suit and service; when an officer of the court, in the presence of the senior Alderman, produces six horse-shoes and sixty-one hob-nails, which he counts over in form before the Cursitor Baron, who, on this particular occasion, is the immediate representative of the Sovereign."

Mr. Sheriff Hoare, in the journal of his Shrievalty, 1640-41, in his own handwriting, says:—"The senior Alderman present cut one twig in two and bent another, and the officers of the court counted six horse-shoes and hob-nails. This formality, it is said, is passed through each year, by way of suit and service for the citizens holding some tenements in St. Clement Danes, as also some other lands;—but *where they are situated no one knows, nor doth the City receive any rents or profits thereby*."

The Court of Exchequer, be it observed, is the legal court of accounts; and, moreover, pursuant to the charter 32 Henry III., the high officers of the City are, on their appointment, to be presented to the Sovereign, or, in the absence of Majesty, to the Sovereign's Justices or Barons of the Royal Exchequer.

So many references to the Exchequer are to be found in Shakspeare, that some have supposed he must have been a clerk in that office. The process of examining the public accounts is recorded in one of his sonnets:—

> "She may *detain*, but still not keep her treasure.
> The *audit*, though *delayed*, *answered* must be:
> And her *quietus* is to *render* this."
>
> SONNET CXXVI.

There is the stoppage of the public money—the delay in passing the account till certain answers are obtained to justify the audit—and the rendering the correct account is followed by the *quietus*, exactly as was practised in the Exchequer Court:—

> "For she hath no *exchequer* now but his."
>
> SONNET LXVII.

> "To make their *audit* at your Highness' pleasure."
>
> MACBETH.

Again,

> "What acceptable *audit* canst thou have?"
>
> SONNET IV.

Again,

"Called to that *audit* by advis'd respects."
SONNET XLIX.

"Nor need I *tallies* thy dear love to score."
SONNET CXXII.

"When he himself might his *quietus* make
With a bare bodkin." HAMLET, ACT III.

"Some younger brother would have thanked me,
And given my *quietus*." GAMESTER, ACT V.

"It were a sin to disquiet him, since he carries his *quietus est* with him." CLETUS' WHIMSIES, p. 166.

CHAPTER VIII.

NUMERALS OF DIFFERENT NATIONS.

It would be quite impossible—even were the present occasion a fit opportunity—to explore, still less to exhaust, those vast fields of investigation which are open to any one who seeks to trace, through the infinite variety of language and symbols, the modes adopted by different nations for communicating ideas of numbers and quantities. I have thought it might not be wholly without amusement or instruction if I selected some of the most prominent and characteristic peculiarities which present themselves in various parts of the inhabited globe; and without encumbering these pages with redundant and superfluous matter, it appeared not undesirable to connect and preserve in them some materials which might prove of more general and diffusive interest than would seem directly connected with an inquiry into the history and advantages of a decimal system. There is, however, more of association and affinity between the various branches of human knowledge, than the careless or the thoughtless inquirer may imagine. The multifarious developments of progress and civilisation are closely allied to each other; and though it can hardly be expected that many will concern themselves in the discussion of all the topics upon which this volume touches, it may be hoped that, to some readers at least, they will recommend themselves, and be suggestive of pleasing and useful objects of research.

Man is born with, and carries about him, instruments of notation, and weighing, and measuring, which serve for the common or everyday purposes of life. Most of these have passed into habitual language in the various idioms of the world, representing numbers, quantities, and proportions, with more or less accuracy, but generally with considerable approximation to the truth.*

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* Sir J. E. Tennent has given us the following memorandum illustrative of the remark in the text:—

"As an illustration of the expedients resorted to by the Singhalese to describe measures of distance in the absence of any standard or terms by which to define it, I may mention to you, that in my travels through

In India, *gôvista*, or the cries of a cow— *i. e.*, the distance at which the lowing of a cow can be heard—is equal to two *kes*, or 8,000 cubits. A *gôshpada*, cow's foot, is a measure representing what the impression of a cow's foot will hold.

The classification of numerals or decimal multiplications, or a progression in tenfold proportions, would naturally grow from the employment of the fingers as counting instruments, and is to be traced to the remotest records of history, and over a vast extent of the inhabited world, both in the words and the symbols employed. Every step in the lower gradations enables us to form clearer conceptions of the higher. Proceeding from ten units to ten times ten, we immediately perceive the value of a hundred,—which being thoroughly understood, another multiplication by ten helps us accurately to estimate a thousand, and so onward. The numeration by twenties has equally its foundation in nature, every human being having not only ten fingers, but ten toes; and it will be found that a *vicenary* scale is employed, not only in connection with, but sometimes, as by the ancient Mexicans, separately from, the decimal progression.

Examples will also be discovered of a quinary scale, or reckoning by fives, in the spoken languages of many rude tribes, as in written signs for numerals. Some ancient nations adopted a new series of characters at the quinary stage, as I, V, X among the Latins, and ⟍ ⟍ by the inhabitants of Palmyra. A *binary* system, or counting by twos, presents its own explanation in the many combinations of pairs which the human frame presents,—such as two eyes, two ears, two nostrils, two arms, two legs; but a multiplication by two increases the power of numbers too slowly to be available for the higher purposes of arithmetical calculation.

Humboldt has very properly remarked, that if we consider the source of the various numerals, we shall find everywhere a great resemblance in the nature of their developments. The

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the more unfrequented portions of Ceylon, I constantly heard, in reply to my inquiries as to short distances, that I was within "*a dog's cry*" of it,—or that it was still "a *hoo*" off, or a loud hoo, as the case might be,—a *hoo* meaning the sound a man's voice exerted to the utmost in shouting that sonorous monosyllable, and thus denoting *the distance* at which it could be heard. The *dog's cry*, in the same manner, meant a shorter distance, or such as a bark of a dog could extend over."

last is generally only a wider extension of the first. Thus, if, as in many branches of the Malayan stem, the number 5 is represented by (lima) the hand (5 fingers), it might be anticipated that for the number 2, words meaning wings, arms, eyes, and so on, would be employed. Of such symbols no doubt many have been forgotten, and will be no more restored to use. Nations appear soon to have discovered that a variety of signs for the same number was not only a superfluity but an inconvenience, and likely to lead to misunderstandings. Hence synonymes for the same numbers growing out of the same language, are of rare occurrence, though some examples are to be found in the dialects of the southern seas. Nations alive to the powers of language must, long before trained to form an accurate estimate of numbers, have felt the desirableness of establishing clear notions, and of fixing a general standard,—and the more this feeling prevailed, the less would be the desire to retain in the names of the numerals the primitive idea of its value, and thus, as the original meaning became less and less discernible, the words would be rendered by merely conventional sounds."

The word *stone*, for 14lb. in English, is no longer associated with its vague and normal meaning, which undoubtedly was the weight of a stone, of a generally understood size, in a particular locality. Some of the associations of definite numbers with undefined ideas, are remarkable. Out of the Sanskrit root *yu*,—meaning gathering together, or union,—come *pra-yuta* and *ni-yuta*, which express equally a hundred thousand and a million,—while *a yuta* which means "detaching" or "disuniting," is used for ten thousand, a decimal division of the larger number.

Though the richness and precision of a language in arithmetical terms is undoubtedly an evidence of the civilisation and advancement of the people employing them, such richness cannot always be referred to as a standard of civilisation, or accepted in itself alone as all-sufficient proof of superior intellectual cultivation. One language, for example, possessing high capabilities for expressing high numerals, may continue little changed where those who speak it have been declining in the scale of civilisation;—another language, wanting such facilities of expression, may be spoken by an advancing nation, and not easily lend itself to the introduction of novel terms. This is not alone the case with respect to numerals; for, as regards languages generally, there are many which, "neither in the perfectness of their grammar, nor even in their copiousness, appear to have any certain relation to the state of civilisation of the people by whom they are spoken."* There existed in France, for instance, from the reign of Louis XIV., quite a passion for preserving what was called the purity, or, to speak more truthfully, for cherishing the poverty, of the language by the repudiation of all novelties in words. Necessity has broken down many barriers. Improvements in science, especially in the field of modern investigation and discovery, have compelled the introduction of many terms for which no representative could be found in the dictionary. Thus, in spite of repudiation and hostile criticism, new words become nationalised. The English language affords a noble example of still progressive advances in richness and efficiency. Its ever-increasing vocabulary, representing and adapting itself to all the demands of growing civilisation, fit it admirably for the great mission it has to accomplish as the instrument of the widest intercourse, and thus the mightiest ally of the interests of peace, commerce, and happiness, through the most populous regions of the world.

No portion of the field of language presents more curious results, both of affinity† and dissimilarity, than do the various numerals. It may be generally said, that the least civilised races have almost invariably taken the names for the higher numbers from the more civilised with whom they have come into communication. Thus the words mil and million have found their way into a great variety of idioms, between which words for numerals of lower value there is not the least affinity. The word *lak* is of very extensive use in the regions of Eastern Asia, generally meaning 100,000, but sometimes, as in Sumatra, implying only 10,000,—and in the Newar district of Nepaul, *laksee* means a million. The words of high numeral value in Sanskrit are found in many languages, associated with decimal notation indeed, but with very different value in several other idioms. The Chinese word *wan* (10,000), which is found in almost all the dialects of that vast empire, is employed, with slight variation, *iwuan*, to denote 1,000 in Manchuria. *Alp*, which represents 1,000 in several of the

* Peacock, p. 377.

† The numeral 3 is exactly the same (*tri*) in the Sanscrit, Erse, Welsh, Armoric, and Cornish languages. A close resemblance to the word may be traced through most of the European, and many of the Asiatic tongues.

languages of the nations bordering on the Nile, means 10,000 in the Amharic, being a language of close affinity.* As we proceed into the higher ranges of figures, our notions become less and less distinct. The English word *myriad* presents to many minds an undefined or erroneous idea of its value.

The Spaniards have adopted a singular word for million,—*cuento*,—a tale, a story, a fiction. It is not found as a numeral anterior to the introduction of the Arabic system of notation. The Portuguese have the word *conto*, with a similar meaning, also of modern introduction.

Though the ceremonial forms of language generally only influence phrases of courtesy, and are principally exhibited by a greater elaboration of words, there are some languages where the same words for numerals cannot (without offence) be applied to superiors, as to equals. Among the Javanese, *ja* or *siji* is the word for *one;* but in the language of ceremony, it is needful to add *tungil*;—and *one* becomes *satungil* meaning *one* standing by itself. Though the common word for ten is *puluh*, in addressing a superior, *doso*, a numeral of Sanskrit derivation, must be employed.

There are not wanting poetical forms of expression even in the dry regions of arithmetical figures. Some of the tribes of South America, instead of inquiring, "How many years have you lived?" ask, "How often has the algarroba blossomed since your birth?" Some reckon by the phases of the moon, and the numerals of some are reputed to be described by the names of flowers, whose petals represent the number in question. The lotus plant was, in consequence of its fruitfulness, deemed the symbol of millions; while the centifolium represented hundreds, and the *cinquefoil* fives. The ancient Egyptian character for 1,000 is a lotus leaf in its stalk, which is supposed to denote, that the fruit of the lotus bears thousands of seeds.† Among the Abipones, five is denoted by a word which signifies an animal's hide, which has spots of five colours upon it. So some of the Brazilian Indians call the months by names of native fruits; and others designate them by words implying the return of the various seasons. In Thibet, the word is the same for year and leaf (spring). Indians, on their

* Peacock, pp. 376-7.

† Champollion Gramm. Egypt. i., p. 230. See also Humboldt, "Verschiedenheit des menschlichen Sprach-baues," p. 437.

travels, speak of the twenty-four hours, or days, as *rests:* instead of saying, "I shall be three days absent," they say, "I shall rest three times before I return." Among the Arabs, a common mode of denoting a mile, is so far that you cannot distinguish a man from a woman. Hussein Khan, in reporting his victories, said, "I have destroyed more enemies with my own hand, than there are hairs on my beard,"—and his beard was distinguished for its size.*

There is considerable affinity between the Sanskrit and Persian, the Greek and Roman numerals,—with their derivations, such as the Romaic, French, Italian, Spanish, Portuguese, Romance, the Catalan, and Wallachian;—between these, and all the branches of Gothic and Scandinavian roots—such as High and Low Dutch, Anglo-Saxon and Frisian, Icelandic, Swedish, and Danish—between these, again, and the ancient Sclavonic, with its descendants, the Russian, Polish, Servian, Bohemian, Illyrian, Hydriote,—with the Celtic varieties, such as Gaelic, Erse, Welsh, Armorican, Manx, and Cornish.†

The resemblance which exists between the numerals and a few other words in this great body of languages, has led many writers to the hasty conclusion, that all languages descend from one primitive or common language—once universal—and from which the whole human family have derived their various idioms—changed, modified, and separated, by the progress of time.

But it may be laid down as a general principle, that where no intercourse has existed between nations, no affinity will be traced, either in the words, or the construction, or the general character of their languages; and when any marked analogy exists, it must be received as undoubted evidence of inter-communication.

If any two languages be examined, taken from localities wholly separated from one another, the comparison between them will strike not by any resemblance whatever, but by their extraordinary variety.

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* "Cameron's Travels in Georgia, Circassia," &c., vol. i.

† Dr. Peacock ("Arith.," p. 372) classes the Armenian among the Sclavonic tongues, with which it has no affinity: only two of its numerals—*ut* (8) and *inn* (9)—resemble those of other nations. He also speaks of the Biscayan as a Celtic language, which it is not: only one of its numerals, *sei* (6), bears any likeness to the group above referred to.

Compare, for example, any language spoken in the remoter parts of Eastern Asia with that of any nation of Western Europe, and, neither in its numerals nor in any other word, will be found even an accidental resemblance, with the exception of those earliest utterances of infancy, such as ma-ma, pa-pa, fa-fa, ba-ba, which are generally employed to exhibit the paternal, maternal, or filial relations; and the words, such as ku-ku (cuckoo), by which an animal may be represented by its voice; or words like *hiss* or *roar*, which have an affinity with the sounds they designate. Even the old joke, that the word *sack* was preserved, at the dispersion of the Tower of Babel, in every language, in order that every man might carry away his own property, will not bear examination, as, compared with the number of idioms in which the word is not found, the number of idioms in which it is found are exceedingly small.

Again, if a language be taken from the interior of Africa, and compared with any spoken by the natives of America, or by any of the islanders of the Pacific, no analogy whatever will be found. Only one example is recorded of great resemblance between the numerals of races essentially different, and between whom intercourse can hardly have been supposed ever to have existed, viz., those of the African Mandingoes and an extinct American tribe, the Nanticocks, on the banks of the Chesapeak.* But the evidence of similarity may well be doubted, and the disappearance of the Nanticock nation deprives us of the means of investigation. No such resemblance, or anything like it, is traceable between any of the American-Indian and African languages which we are able to compare with one another.

As far as our knowledge and experience extend, the number of languages spoken is not increased, but diminished, by the progress of time, by intercourse between different races, and by the influence of civilisation. So far from inquiry leading to proofs that the many languages now used are traceable to one or a few sources, we shall find, that the farther we look back to the records or traditions of the past, the greater will be the number of idioms of which traces are discoverable. Conquests, so far from introducing new languages, tend to the absorption of many dialects into one. We have undoubted evidence that in ancient Greece there were many languages, which have wholly disappeared. In

* Barton, as quoted by Dr. Peacock, p. 373.

Italy, a great variety of tongues were spoken, of whose existence we are assured, but of whose characteristics we know nothing. Many languages were spoken in Spain, of which Strabo speaks, and probably only one of them (the Biscayan) has survived to our days. In France, it is but in Britanny we find the remains of a single specimen of the languages spoken in ancient Gaul. In England we have seen the ancient language of Britain driven into the county of Cornwall, and perishing there within the memory of man; while the inroads of the modern English into Ireland, Scotland, Wales, and the Isle of Man, will undoubtedly, in a few generations, wholly extirpate the remains of the ancient Erse, Gaelic, Welsh, and Manx. Just before the French Revolution, not three quarters of a century ago, three-fourths of the population of France spoke various idioms,—the Provençal, the Languedocian, the Gascon, the Walloon, the Bas Breton,—which are already invaded and undermined on every side, and will certainly be supplanted ere long by the literary language of Paris. In Spain, the Catalan, the Valencian, the Gallician, and the Euscara, or Bascuence, are gradually fading before the growing influence of the Castilian tongue. In Germany, Luther's translation of the Bible has generalised the High Dutch dialect, and every generation sees the decay of the multitudinous idioms which have their hold among the least instructed of the Teutonic races. The all but total extinction of the Dutch language in the State of New York, the progress of the English tongue in Canada, in Florida, and Louisiana, are remarkable evidence, most visible to our own senses, of the subjugation of the idioms of minorities to those of greater numbers. The Arabic language—the instrument of Mussulman influence—has not only greatly modified, it has in many cases wholly superseded, other languages; and, with the Arabic language, Arabic numerals, and a system of decimal notation, have been very widely spread. The Malays, more adventurous and active than most of the tribes of the Indian Archipelago, have made their language the instrument of intercourse through the vast tropical regions with which they have had intercourse. No man can estimate how many languages have been utterly extirpated by the conquests of the Spanish and Portuguese races in the southern countries of America, and by the Anglo-Saxon conquerors in those of the north.

The more barbarous the country—the less the communications between the people—the greater will be the variety of languages spoken. We have no accurate knowledge of the multitudinous idioms used in the various regions of Australia; but we know that every separate tribe had an idiom of its own. In the same district of Paraguay, in South America, no less than thirty languages were spoken. On the coast of California, in an extent of 500 miles, seventeen varied tongues were used.* We possess a catalogue of more than 150 other languages on that continent, and the list is very imperfect.

In a small district on the western coast of Africa, we have the numerals of thirty-one languages; and, on the eastern coast, between Mozambique and Abyssinia, we have those of fifteen.† It is not always easy to draw the lines of distinction between dialects and languages. Some would contend for placing Dutch and German, Danish and Swedish, Spanish and Portuguese, in the same category; others would draw the lines of separation between English and Lowland Scotch,—between the idioms of Yorkshire, Devonshire, and Northumberland; but it may be stated with tolerable certainty, that there are about 3,000 languages in the world so distinct and separate, that in no two of them could an ordinary conversation be carried on by persons who had not been accustomed to the use of both.

I have ventured upon these observations of a somewhat general bearing, before tracing some of the peculiar characteristics languages as connected with their various modes of reckoning.

We are told that there are tribes of Indians in Brazil who reckon by the joints of the finger, and whose numerals do not go beyond three. Beyond this, they always use a word signifying *many*.‡ Some of the African languages are also reported to be wholly deficient in the means of defining any high numbers, except by general terms.‖ In America, the tribe of the Purys has the three numerals—1 *omi*, 2 *curisi*, and 3 *prica*, or *many*. There is a point of fine observation in Dickens' "Haunted Man," where he speaks of the poor savage boy—"The chemist laid a few shillings, one by one, in his extended hand; to count them was beyond the boy's knowledge; but he said 'One' every time, and avariciously looked at each as it was given, and at the

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* Dobritzhoffer's "Abipones," and Humboldt on New Spain; quoted by Dr. Peacock, p. 372.

† Bowdich's "Ashantee," and Salt's "Abyssinia." Peacock, p. 372.

‡ Spix and Martin's Travels, i. p. 387.

‖ Lichtenstein, ii. p. 610.

donor." It is said that in the idiom of the Botucudos there are only two numerals, one meaning *unity*, *mocenam;* the other, *multitude*, *uruhu.* No doubt the power of accurately estimating and correctly expressing any considerable numbers, is one of the most striking evidences of civilisation; and complications of words in the expression of small amounts must be deemed evidence of great intellectual inferiority. The Abipones say *initàra* for 1, *inoakà* 2; but for three they use *inoaka yik aimi*, or two and more, that is, with an addition.*

Crantz, in speaking of the numeration of the Greenlanders, says it is so imperfect, that they have difficulty in getting beyond the number of their fingers, which they always employ in reckoning: 1 is called *attausek*, 2 *arlaek*, 3 *pingajuah*, 4 *sissamat*, and 5 *tellimat.* When they have reached this point, they begin by the fingers of the other hand, and call 6 *arbennek;* but they then repeat for 7, 8, 9, and 10, the words employed before for 2, 3, 4, and 5. They call 11 *arkanget*, and 16 *arbarsanget*, counting their toes as they count their fingers; and for 20 they say *innuk*, a man, meaning all the fingers and toes of a man. For 100, some go so far as to say 5 men; but generally numbers above 20 are held to be uncountable. In the same way, the inhabitants of Nootka Sound repeat the same words when they reckon above 5. The example of the Abipones is a fair picture of what takes place among almost all uncivilised nations, and such as I have often witnessed in my intercourse with them. Ask an Abipone "How many?" and if the number be small, he will raise as many fingers as denote the number, and only exclaim "Leyer iri—Look!" but if the number be five, he will say "Hanamegen!" the fingers of one hand; if 10, "Lanámrehegem," the fingers of both hands; if 20, "Lanámirhegem cat gracherhaka anamichirihegem," the fingers and toes of both hands and feet. But between the 5, the 10, and the 20, he will probably attempt no definition. If the Abipones have to describe a number of horses, they will point out the space they would occupy standing side by side. When a quantity in question is very great, they will take up a handful of grass, or of sand, and shew it, as exhibiting an innumerable amount. But their notions of number are always vague and inaccurate; and in reporting amounts, they are never to be trusted.†

* Balbi's Ethnographical Atlas, Nos. 497 and 501.

† Dobritzhoffer, ii., p. 202-3.

Sometimes, when the number exceeds three, an Abipone will lift up his finger and shout "Pop!" many; or "Chic legyekalipi," cannot count them; and where only ten soldiers were drawn out in a line, the crowds shouted "Voaliripi," very many men; "Latenk naueretape!" multitudes are come. In translating the ten commandments, the missionaries found it necessary to use after the word first, or foremost—and yet another—and yet another; for the tenth they employed the terms, latest or hindmost.* Even the Chinese, who are very precise in matters of accounts, employ very loose terms in general conversation: they say "several tens," "several hundreds," "several thousands:" they neither have themselves, nor do they convey to others, any clear notions of number or quantity.

Another American tribe, the Guaranos, are unable to proceed beyond the number 4: they have for 1 *petey*, 2 *mokoy*, 3 *inbohassi*, 4 *irundy;* but they reach the number 8 by repetition—*mokoy-mokoy*, being another form for 4; *inbohassihassi*, 3 and 3 = 6; *irundy-rundy*, 4 and 4 = 8. Beyond this they call numbers *ndipapahabi*, meaning "not to be counted." The missionaries, however, tried to introduce the Spanish numerals up to 1000. They report, that the Guaranos learnt music, drawing, and painting; but that, after all the trouble taken in teaching them figures, nobody could trust a Guarano in his report as to numbers, his ideas being always vague and confused.† They used, according to some authorities, *inbo* or *po-petei*, one hand for 5; *po-mokoy*, two hands for 10; *inbo-mbiabu*, hand-foot, for 20.‡

Among the aboriginal Brazilians there existed the same infirmity as to calculation. Their dialect stopped at three: 1 was *ojepe*, 2 *mocoi*, 3 *moçapyr*, which have a remarkable resemblance to the Guarano dialect. They also called five *ambô*, the word for hand. The Portuguese priests assisted them with Portuguese words, and introduced decimal divisions. They learnt to employ *dez* for 10, *ojepe papaçâba*, meaning "one enumeration or counting," for 100; *dez papaçâba*, 10 countings, = 1000. For 5 they were in the habit of lifting up their hands and saying "Ojepé xé po," like my hand; for 10, "Xe po," my hands, lifting both hands; for 20, "Xe po, xe pi," my hands, my feet. For 13 they

* Dobritzhoffer, p. 204.

† Balbi, p. 490.

‡ Hervas' Arith., p. 16.

say "Xe po, moçapir cembyra," literally, my hands and three more.

The description of the manner of reckoning among the Tarahumara Indians (Quadalajara), resembles much that which has been just described. "When they reckon, the Tarahumaras are careless about words, but employ their fingers, toes, and joints of their fingers, to designate numbers. For 10 they exclaim "Mäcoek," and exhibit their two hands with the fingers separated; for 20 they strike their ten fingers against their two feet; for 4 they show the three joints of the forefinger, and one joint of the second finger; for 12 they bend in the thumb; — and thus the joints of the four fingers exhibit the desired number." They sometimes employ grains of maize, small stones, or cut notches in sticks, and they have the following words for their numerals:—1 *pile*, 2 *ocà*, 3 *bricà*, 4 *naguoca* (a repetition of 2), 5 *mariki*, 6 *pusaniki*, 7 *kichao*, 8 *ossanaguoc* (2 fours), 9 *kimacoe* (1 from 10), 10 *macoe*,—and are said to possess a decimal progression, though seldom used in conversation.*

"The people on the Orinoco," says Gilj,† "have numerals, but avoid using them. If they wish to convey an idea of great numbers—as, for example, 'I saw multitudes of turtles,' or a 'great many armed Caribs,'—they pull about the hairs of their head, and put on a look of stupefaction." On the Maranham river, La Condamine says, "The arithmetic of the Jamei does not go beyond the number three; and however incredible it may appear, other South American natives exhibit the same incompetency, and have ònly learnt higher numerals, with European words, from the Catholic missionaries." The intricate combinations for conveying ideas even of simple units, as exhibited in the Orinocan dialects, easily explain their unwillingness to use such lengthened and elaborate terms:—1 is *tevinitpe;* 2, *ac-ciachè;* 3, *ac-ciluòve;* 4, *ac-ciachèmnène* or *ac-ciachère-pene*, 'two-twos;' 5, *amgnaitone*, which means a full hand; 6, *itaconò amgna-ponà tevinitpe*, or 'one from the other hand;' and so on up to 9. For 10, *amgnà aceponàre*, that is, 'both hands.' For 11 they stretch out both hands, and point to one toe, saying, *puitta-ponà tevinitpe*, which is, 'one from the foot;' 16 is *itacono puitta ponà teventpe*, 'one from the other foot;' 20, *tevin itòto*, 'one man,' meaning ten fingers and ten toes;

* P. M. Steffel, as quoted by Murr, i., p. 369. Ib. 349.

† Chap. xxvii. book ii. p. 332.

21, *itaconó itòto jamgnar-bonà tevinitpe*, 'one taken from another, man;' 40, *acciachè itato*, 'two men;' 100 being 'five men.'"*

The Manipuri Indian numerals are—1, *papeta*; 2, *avanume*; 3, *apechivà*; 4, *apechipachi* (*i. e.*, 3 and 1); 5, *papeta capiti* (*i. e.*, one hand); 6, *papeta janà paaria capiti purena*, 'take one from the other hand;' 10, *apa numerri capiti*, 'two hands.' But this nation does not employ the same numerals for different objects. They sometimes modify the noun:—1 day is *mapuchia pècumi*; 2 days *apucunume*; 3 days, *apèche-pucū*. The ex-missionary G. M. Forneri says of the Jaruris—"They have only five numerals—1, *caneamè*; 2, *gnoeni*; 3, *tarani*; 4, *chevvenì*; 5, *cani-iccīmò*, which last, as it signifies a hand, can scarcely be deemed a numeral; for 6, 7, &c., they say one, two, &c., from the other hand; for 10, *jorà-iccibo*, 'all two hands;' 15, a foot; 16, one from the other foot, 20, a man; and beyond 20, they make heaps of grain of 20 each,† but do not employ words."

Lichtenstein speaks of the difficulty of obtaining from some of the African races any words for numbers, or other symbols than the exhibition of their fingers. From the Bechuanos, he reports, he could not learn the words for either 5 or 10. Van der Kemp, who lived long among some of the tribes, says he could never ascertain the word for 8. But it is worthy of remark, that though it is quite impossible to obtain from a Kaffir any expression which defines such numbers as 11, 12, and so on, they will take charge of a large flock of sheep or oxen, and, with absolute certainty, detect the loss of any one,—such is the power of habit. The arithmetical faculty being never called into action, remains inert and dormant, while that of observation or recollection being in daily exercise, is alert and active. Of the Botocudoes we are told that they have two numerals: they use *moke-nam* for one, *hentiatá* for two, *urrehu* for more or many; to express other numbers, they apply to their fingers and their toes for aid.‡

Marks of decimal notation are found among nations and languages the most rude and imperfect. The Huron tongue is so poor as to have no adjective, no abstract noun, no active verb: it can express no negation without an absolute change of the word; and yet it possesses a numeral language sufficiently regular,

* Gilj, *passim*. † Hist. de l'Orin.: iii., ch. xlviii.

‡ Prince of Neuwied's Travels, ii. part viii. p. 41.

the name for 10 being *assou*—for 100, *egyo tiwoissan*—and for 1000, *assou attevoignavoy*. Among the tribes of Upper Canada, the Indians of the Delaware, the ancient inhabitants of Virginia, and the neighbourhood of New York, and most of the tribes of Central North America, numeral systems equally complete are to be found.*

A common mode among rude people, whose powers of language are feeble, is to adopt a quinary system, making the number five the starting point for the higher digits. There are, however, cases in which 5 + 1 being used for 6, and 6 + 1 for 7, new words or new combinations are found for the numbers 8 and 9. In the Ende language, 5 is *lima;* 6, *limasa*, or 5 + 1; 7, *limazua*, 5 + 2; 8, *ruabutu*, 2 × 4; 9, *trâsa;* 10, *sabulu*. The forms by which the numbers above five are expressed, are various and capricious. Among the inhabitants of New Caledonia, every numeral from 1 to 10 begins with the syllable *pa;* but 6 *pànimgha*, 7 *pànim-roo*, 8 *pànim-ghin*, and 9 *pànim-bai*, are made by adding 1, 2, 3, and 4, to 5, and 10 is *parooneek*, or 2 × 5. In the Tanna, the word five is dropped, and 6, 7, 8, and 9, are represented by *ma-riddee* more one; *ma-carroo*, more two; *ma-kahàr*, more three; and *ma-kafà*, more four; while ten is expressed by *karirrom-karirrom*, meaning five, five. The Koriaks of Kamtschatka, and several of the tribes of Eastern Asia, make the numerals from 6 to 9 by combinations of five with the lower figures from 1 to 4, but they have almost all an independent word for 10; and there are many examples where the words for 8 and 9 are complicated, those for 10 are simple. Among the Greenlanders, the same words are used for 2 and 7—*arlaek*, 3 and 8—*pingajuah*, 4 and 9—*sissamat*, and 5 and 10—*tellimat*, the sole distinction being, that when the lower numbers are meant, the left hand is raised, and when the higher, the right hand.† The same words are employed for 12 and 17 as for 2 and 7—for 13 and 18 as for 3 and 8—for 14 and 19 as for 4 and 9; but in order to distinguish this, they point first to the toes of the left, and then of the right foot. There is a variation between the numbers—1 *attausek*, 6 *arbennek*, 11 *arkangit*, and 16 *arbasangik*, each serving to show the beginning of a new series of fives. For 20, the word *innuk*, or man (ten toes and ten fingers), is used; for 40, *innuk arlaek*, men two;

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* Peacock, p. 379.

† Peacock, p. 386. Crantz's Greenland, vol. i., p. 208.

but beyond twenty they hesitate in using any other term than words implying that the number is not to be counted. Humboldt gives similar examples among the South American races.*

The Esquimaux are less advanced than the Greenlanders. They use the fingers of the left hand with facility for reckoning up to five, but in employing the right hand, they generally make some mistake before they reach seven, and beyond nine they hold up both hands. If 15 or 20 are required, they point to the hand or hands of another person, but do not refer to their own feet. When they are perplexed with any number beyond 10, they generally say *oonōoktoot*, which means something undefined.

There are many native tribes, not only on the American continent, but descended from the ancient inhabitants of the West Indian islands, whose numerals only extend to 4, and who use their fingers alone—having no words in their language to express higher amounts. One of the races of Paraguay calls 4 *geyenk uate*, meaning the foot of the emu, which has four claws; and 5 *necuhalek*, which is the name of a skin remarkable for having five distinct colours. The poverty of language is often remarkably exhibited in the want of special words for numerals. In the Caribbean, where the words for fingers and toes mean "the children of the hands and of the feet," the phrase for 10 is *chon oucabo raim*, or "all the children of the hands." The Achaguas on the Orinoco, call 5 *abacaje*, "the fingers of one hand;" 10, *tucha macaje*, "all the fingers;" 20, *abacaytacay*, "all the fingers and toes;" 40, *incha matacacay*, "two men's fingers and toes." The Zamucoes call 5 "the hand finished;" 6, "one of the other hand;" 10, "the two hands finished;" 11, "foot one;" 20, "feet finished."† Many of the natives of Australia have only the three first numerals, and either raise their hands to express a greater number than three, or use a phrase meaning multitude. Among the ancients, it was a joke against a stupid fellow that it took him infinite pains to reckon up to five; and in the well-known passage of Aristotle, before referred to,‡ in which, after saying that almost all nations, barbarous and civilised, used the decimal

* Vues des Cordillères, p. 253. Peacock, p. 586.

† Vues des Cordillères, p. 253. Peacock, 390.

‡ Μόνοι δὲ ἀριθμοῦσι τῶν Θρακῶν γένος τὶ εἰς τέτταρα, διὰ τὸ, ὥσπερ τὰ παιδία, μὴ δυνάσθαι μνημονεύειν ἐπιπολὺ, μηδὲ χρῆσιν μηδένὸς εἶναι πολλοῦ ἀυτοῖς.

notation, he excepts a tribe of Thrace, declaring they could not count beyond 4.

Though words, as instruments of counting the high numbers, are often wanting among rude nations, a decenary or decimal system is often adopted when other auxiliaries than words are employed. The Guaranoes calculate by heaps of maize of twenty grains each, and mingle 2, 3, 4, or more heaps, when they mean to denote 40, 60, 80, and so forth,—the excess of the scores being expressed by the usual numbers. In Sumatra, the natives make a knot on a string to represent 100,—and we are told, that, in reckoning money, every tenth, and sometimes every hundredth piece is set aside. In reporting numbers of men or of horses, the Abipones marked out the space which they supposed the numbers would stand upon. Humboldt says he never met with a native Indian who, if asked his age, would not answer indifferently 16 or 60,—not always from the want of numerals, but from the very indistinct associations of numbers with words. Thus, as Dr. Peacock remarks, we have generally great reason to distrust the authority which gives to particular words a definite numeral interpretation, especially in the higher figures.*

The works of Humboldt throw much light upon several of the languages, both modern and ancient, of the central parts of the continent of America. The Aztecs, or ancient Mexicans, appear to have possessed the most complete system of vicenary numerals both in words and signs. Up to 20 the numbers were represented by dots. A small flag represented 20, which, if divided by two cross lines and half coloured, represented half twenty, or 10; and, if three quarters coloured, 15. The square of 20 (400) was represented by a feather, because grains of gold enclosed in a quill were used as money,—or a sign for purposes of exchange. A figure of a sack indicated the cube of 20 (8,000), and bore the name of *xiquipilli*, which was given to a kind of purse that contained 8,000 grains of cocoa. These symbols were repeated twice, thrice, and to denote multiples by 2, 3, and grouped together,—both the common symbols to denote any compound number. The first nine digits were—

1	2	3	4	5	6	7	8	9
ce	ome	jei	nahui	macuilli	chicuace	chicome	chicuei	chiculmahui
					5+1	5+2	5+3	5+4

* Marsden's Sumatra, p. 192. Peacock, pp. 390, 391.

In which a new quinary modification will be seen in the use of the prefix chi. The third form from 10 upwards—

10	11	12	13
matlactli	matlactli oz ce	matlactli omome	matlactli oz jei
	10+1	10+2	10+3

At 20 a new form of notation began.

20	30	100
pohualli	cem pohualli oz matlactli	macuilli-pohualli
or	one 20+10	5×20*
cem-pohualli.		

The fingers being universally used as calculating instruments, decimal notation was the result. When ten had been counted, it was necessary to begin the reckoning anew, in order to employ them for higher numbers. There are few languages in the world in which a word is not to be found for *ten*, but there are many languages in which words for all the units between one and ten are not to be discovered. I remember, when I was at Kandy, the capital of Ceylon, I met with a Veddah—one of the aboriginal race of that island, who represent the lowest stage of human civilisation. They build themselves no houses, but live like beasts in caves, or monkeys among the trees of forests seldom or never explored by cultivated man. They do not dress their food, nor cover any part of their bodies with garments. The man I conversed with had been convicted of murder; but as it was found utterly impossible to associate with his answer any idea of guilt or responsibility, the judge very properly objected to subject him to the rigour of the law, and, instead of being executed, he was condemned to perpetual imprisonment. He was not able to reckon up to *five*,—but the word for hands was associated with the ten fingers upon the hands, though for any number between 4 and 9 he had no word in his language.†

* Vues des Cordillères, pp. 241 and 251. Peacock 388.

† Sir J. Emerson Tennent, whose diligent inquiries into all subjects connected with Ceylon give much value to his communication, informs me that—

"The Veddahs are a race of harmless savages, who inhabit the forests in one of the eastern districts of Ceylon, between the mountains of Ouva and the sea. Their origin and history are unknown; but they are probably a remnant of the aborigines driven into their

Among some of the American Indians there are distinct words for the ten digits—then compound words from eleven to twenty ;

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wilds many centuries ago by the Malabar invaders of the island, and, from some unaccountable cause, they have never returned to civilised life. They live by hunting, and are expert in the use of the bow. They lodge in caves, under the shelter of over-hanging rocks, and frequently sleep in the trees out of the reach of the bears and other wild animals. Fruits, roots, and grain they consume when they can procure them ; but they subsist chiefly on birds, fish, honey, and the products of the chase. They dry deer's flesh and carry it for barter to the confines of the inhabited country, whither some of the travelling Moors resort with clothes, axes, and arrow-heads, to be exchanged for dried meat, ivory, and bees-wax. In these transactions the wild Veddahs are rarely seen by the strangers ; in the night they deposit what they have to offer in barter, and intimate, by established signals, the description of articles which they require in exchange, and which, being left the following evening at the appointed place, are carried away before sunrise.

"Their language contains some words so similar to the more ancient Singhalese, that the civilised natives are enabled to communicate with them, though with difficulty; but Mr. Mercer, who held for some years an official appointment in the vicinity of their forests, told me that not only is the language of the Veddahs almost unintelligible to the Singhalese generally, but so imperfect in itself, that much of their communication with each other is conveyed by signs, grimaces, and guttural sounds, which bear scarcely a resemblance to articulate words.

"This race are unable to count beyond the first few numerals. A Veddah who had been found guilty of murder, is now undergoing a long imprisonment in the gaol at Colombo, where he learned to count his own fingers ; but he has never been able to advance further, and seems bewildered by the unaccustomed idea of any numbers beyond.

"Mr. Atherton, the Government agent at Batticaloa, was employed by the Government to induce these untamed creatures to become located in villages, and betake themselves to cultivating the ground ; and he has to a great extent succeeded in several instances. He verified to me the statement of their incapacity to comprehend the smallest combination of numbers ; and I remember, in illustration of this, that he mentioned to me an instance in which he had given twelve arrows to a Veddah to be divided between himself and two others ; but so helpless was he that, after spreading them out on the ground, he failed in every attempt to reduce them to three equal portions."

a new series begins at 400, and another at 8,000. In Yucatan * the numerals are—1, *hun;* 2, *ca;* 3, *ox;* 4, *can;* 5, *ho;* 6, *uac;* 7, *uuc;* 8, *uaxac;* 9, *bolou;* 10, *lahun;* 20, *hun kal;* 400, *hun bak;* 8,000, *hun pic;* 100 is expressed by five times twenty, *ho-kal;* 1,000 by twice four hundred, plus ten times twenty, or by 200 from 1,200, *lahu-y-ox-bak.* The Mexican hieroglyphics are in accordance with the numeration of the spoken language. They have distinct characters for the numerals 1, 20, 400, and 8,000, and these are sufficient to express any number. The unit is represented by a small circle, 20 by a standard shaped as a parallelogram, 400 by a feather, and 8,000 by a purse supposed to contain so many grains of cocoa. Although the number of units from 1 to 19 is

generally represented by so many small circles, yet in the same manner as they had uncompounded names for the numerals 5, 10, and 15, they had also an abbreviated and direct way of representing their numerals. This consisted in dividing the parallelogram or hieroglyphic for twenty, into four squares, which, according as they were coloured, represented either 5, 10, or 15. It seems also that they occasionally represented the numeral 200 by half a feather. The year 1854 would be thus expressed:—

The mode of counting by 20, 400, and 8,000, had a practical influence. Bernal Diaz, when speaking of the Indian armies, counts them by so many *xiquipillis*, or bodies of 8,000 men. It is not improbable that they were divided into battalions of 400 men each—these again subdivided into squads of 20 men—and that the hieroglyphic of 20 represented originally the banner or standard of each such squad. A load (cargo) of dresses, cloaks, &c., consisted of twenty such articles.†

The decimal and vigesimal divisions are found in many and completely distinct languages, as points round which varieties of expression are grouped to convey the ideas of num-

* Gallatin, cited in Pott, Zählmethode, &c., p. 93.

† Gallatin.

bers adjacent to those divisions. In Anglo-Saxon, when the numerals reach towards 100, its adjacency is pointed out, and *hund seofortig* is 70, *hund eahtatig* is 80, *hund nigontig* 90. *Tyn* (10) is from the verb *tynan*, to inclose, meaning the number that can be inclosed by the fingers. "Forty stripes less one" is the biblical form for 39. In the Malay, *sambīlan*, meaning "one taken" (from ten), signifies 9, while 99 is expressed by *kōvang asa sa-rātus*, "wanting one of a hundred." In Danish, 30 and 40, *tredive* and *fyrretive*, are 3 and 4 times 10. Twenty is the frequent index to greater amounts, as 60 and 80; *tre sinds tyve*, *fir sinds tyve*, 3 times 20, and 4 times 20; while 50, 70, and 90, *halv tre sinds tyve*, *halv fier sinds tyve*, *halv fem sinds tyve*, mean half the third, fourth, and fifth 20. So in Icelandic, *halft fiorda hun-drada*, half four hundred, means 350; *halft fertugr*, half the fourth ten, 35; *halft sextogr*, half six ten, is 55. The form of stopping an expression midway, as it were, existed among the Greeks,* as it does among the Germans, Scandinavians, and even among the Scotch, who frequently, instead of saying it is half-past 9, or half-past 10 o'clock, say it is half 10, or half 11. The Laplanders, whose numerals do not go beyond 100, say for 11, *auft nubbe lokkai*, 1 to the second 10; for 23, *golm goaalmad lokkai*, 3 to the third 10, and so forth. The Finlanders, for 14, use words signifying "the 4 in the second 10." †

In the long series of English numerals, there is only one break in the simple process of *decimal* notation, and that is, in the numbers *eleven* and *twelve*. The first nine units have distinct and separate words—then comes the decimal ten, which, with the units, the sole exception being that of eleven and twelve, the meaning of which is *leave one* and *leave two* (with 10), or rather, *one leave* or *two leave*, from the Gothic *ainlif* and *tvolif*, ‡ go up to one hundred, thence to thousands, millions, billions, and so onwards by multiplications, which even go beyond the powers of

* Ἕβδομον ἡμιτάλαντον—seventh half-talent = $6\frac{1}{2}$ talents.

† The irregular formation of these numerals may be traced through the different Gothic dialects. For eleven the ancient German had in the genitive *einlif*, and in the dative *einlivein;* the old Saxon had *êleven;* the Anglo-Saxon *endlufan;* the Swedish has *ellofva;* the Danish *elleve;* the German *eilf* or *elf;*—the Gothic word for twelve was thus declined—*tvalif* nom., *tvalibi* gen., *tvalibim* dat.; Anglo-Saxon *tvelf*, dat. *tvelfum*. Swedish, *tolf;* Danish, *tolv;* German, *zwôlf*.

‡ Peacock, p. 381.

record and of conception. The vigesimal form is sometimes used, and maintains its hold possibly, more than for any other reason, from its having been adopted in the English translation of the Scriptures, and especially as occurring in some of the most frequently quoted texts of the Bible—as, for example, "The days of our years are three-score years and ten; and if by reason of strength they be fourscore years, yet is their strength labour and sorrow."*

Like the Latin, many languages preserve the genders in the first two or three digits. The Lithuanian and the Lettish have the masculine and feminine forms up to the number 9, but with several breaks. In the Lettish, all the units except *three*, represent the masculine and feminine genders.

In the ancient Gothic, several of the numerals have genders, and some of them are declinable:—

1 mas. *áins;* fem. *áina;* neut. *áin, áinata.*
2 „ *tvái;* „ *tvôs;* „ *tva.*
3 „ *threis;* „ *thrijôs;* „ *thrija.*
4 no. ac. *fidvôr;* dat. *fidvôrim.*
5 *fimf.*
6 *saihs.*
7 *sibun.*
8 *ahtáu.*
9 no. ac. *niun;* gen. *niuné.*
10 *taíhun.*
11 *áinlif.*
12 no. ac. *tvalif;* dat. *tvalibim;* gen. *tvalibê.*
14 *fidvortaihun.*
15 no. ac. *fimftaihun;* dat. *fimftaíhunim.*
20 *tvái-tigjus* (two decades); dat. *tváim-tigum.*
30 *thrins-tiguns.*
100 *taihun—taihund* (10×10).
1,000 *thûsundi.*
10,000 *taihun thusundjos.*

On the declension of numerals, Grimm says:—"The number *one* in all idioms of Gothic origin is regularly declined as an adjective of the first declension:—

Gothic—*áins, aina, áinata (áin).*
Old German—*einêr, einu, einaz.*

* Psalm xc., 10.

Old Saxon—*ên, én, ên.*
Anglo Saxon—*ân, ân, ân.*
Old Frisian—*ên, ên, en.*
Old Norse—*einn, eìn, eitt;* gen. *eins, einnar, eins.*
Middle High German—*einer, einiu, einez.*
Middle Dutch—*ên, ên, ên.*
Middle English—*âne, âne, âne.*
Modern German—*einer, eine, eines.*
Modern English—*one.*
Swedish—*ên, ên, ëtt.*
Danish—*ên, ên, ët.**

For *two*:—

Gothic—n. d. a. *tvái tvôs, tva; tváim, tváim, tváim; tvans, tvôs, tva,* in the adjectival form. In John viii. 17, *tvaddjê* occurs in the genitive form; and in Luke ix. 3, *tveihnôs,* for *tvos,* in the accusative feminine.

The Anglo-Saxon had *tvêgn* mas., and *tvâ* fem. and neuter. The numeral was also declined, gen. *tvêga* and *tvêgra,* dat. *tvâm; tvig* is also found in the accusative. In the German anciently, *zwene* or *zween, zwo* and *zweï.* We had formerly in English, as will be found in the common version, *twain* as well as two. The Germans, like ourselves, now only employ one form, *zwei,* the neuter; but the masculine, feminine, and neuter will be found in Luther's Bible, *zween Ebräische männer,* Exod. ii. 13—"*zwo* werden mahlen auf der Mühle," Matt. xxiv. 31, where the adjunct women is not even introduced. (See also Matt. xviii. 8, 9, &c.) The Gothic, Anglo-Saxon, and ancient German, had inflections to 3, and several of the lower numerals; but in all the modern descendants of the Gothic root, whether in the Teutonic or Scandinavian branches, no inflection is now retained, except in the numerals 1 and 2, and in the *two* in the Swedish language alone;—so much has simplicity of expression progressed with civilisation.

The old northern word *her,* or army, is used for 100; *en flocke,* a *flock,* means 4 persons; *folk* (a crowd of), people, is a word for 40. *Morgen* (morning), a common measure for land in German country, meant the quantity that could be ploughed before mid-day.

The Welsh language has some peculiarities. From 11 to 15, the numerals proceed regularly:—11, *unarddeg,* 1 + 10; 12,

* Deutsche Grammatik, p. 760.

deuarddeg, 2 + 10; 13, *triarddeg*, 3 + 10; 14, *pedwarddeg*, 4 + 10; 15, *pymtheg;* but from 16 to 19, the elements are 15 and an added unit; 16 is *unarbymtheg*, 15 + 1; 17, *dauarbymtheg*, 2 + 15; 18, *triarbymtheg*, 3 + 15; 19, *pedwararbymtheg*, 4 + 15. From 20 upwards we count to every succeeding score, instead of by tens—that is, we express the same numerals as to the first 20, adding after each the words *ar ugain*, or "over twenty," as *unarbymtheg ar ugain*, 1 + 15 + 20 for 36.* It is remarkable that the Welsh numerals were decimally carried into very large amounts—100, *cant;* 1,000, *mil;* 10,000, *myrdd;* 100,000, *rhiallu;* 1,000,000, *myrddiwn*. The Bas Breton has some characteristic peculiarities in the formation of words expressing numerals:—18 is *tri-ouech*, = 3 × 6; 50, *hanter kant*, or half a hundred. Like the French, they count by twenties up to 80, and so from 80 to 100, using for 70, *dek ha tri ugent* (= 10 + 3 × 20); for 71, 11 + 3 × 22; for 80, 4 × 20; for 90, 10 + 4 × 20. In Erse and Gaelic, 31 is 11 over 20. Both languages preserve the vigesimal form: thus 40 = 2 × 20; 50 = 10 + 2 × 20; 60 = 3 × 20; 70 = 3 × 20 + 10.

The numerals of the various Celtic dialects have all a decimal character, but resemble the Phœnician and some other oriental tongues in proceeding by twenties as far as 100, and not beyond that amount. Thus in—

Welsh.		Erse.	Gaelic.	
1	un	aon	aon.	
5	pump	cuig	còig	
10	deg	deic	deich	
11	unarzeg	aondeag	aondeug	1+10
15	pymtheg 5+10	cuig deag 5+10	cùig-deug 5+10	
16	unarbymtheg	seact-deag 6+10	sia-deug 6+10	
20	ugain	fitce	fichead.	
30	deg ar ugain	deic ar fichead	deich thar fichead 10+20	
100	cant	cead	coig fichid or ciad.	5×20
1000	mil	mile	mile or deichceud	10×100

* Pughe's Welsh Grammar, p. 108.

The Welsh is characterised by making the number 15 a point of departure for 5; 16 begins a new numeration; 17 is *deu ar bymtheg*, 2 over 15; 38 is *tri ar pymtheg ar ugain*, 3 over 15 over 20. 59 *pedwar ar pymtheg ar deugain*, 4 over 15 over 2 twenties.

It is by no means my intention to present anything like a general catalogue of the numerals known to be employed in the various languages of the world. Though the materials towards a complete collection are augmenting from year to year, there yet remain many millions of the human family with whose means of communication we are but little acquainted; and the selections I have made from the languages of Asia, Africa, America, and Polynesia, are rather intended to awaken than to satisfy curiosity, and to exhibit, in various shapes, their peculiarities—especially with reference to the decimal system, to which allusion has been so frequently made in the course of our inquiries. They will serve to show how universal are the same elements of thought, which find an infinitely varied expression in words. These general resemblances of mental operations,—these wonderful differences in forms of speech,—are alike marvellous and mysterious. Could the multitudinous human races employ only *one* language, how vast would seem the distance between them and the brute creation! but, furnished by the common Creator with powers to communicate in ten thousand modes of speech, these plastic organs of utterance—so subservient to the necessities and the enjoyments of existence—seem to remove us farther and farther from the inferior animals. And yet philanthropy cannot but breathe the prayer, that the distinction of languages may be gradually obliterated, and man become everywhere intelligible to his fellow man. Such seems, indeed, the tendency of things. One *written* language (the Chinese) is understood by more than one-third of the inhabitants of the globe. One *spoken* language (our own) is making its way, on the wings of commercial enterprise, from one region to another, and is becoming more and more the instrument of mercantile communication. Hundreds of idioms are dying away, absorbed in the influence of tongues, which are the principal depositories of the literature, the sciences, the progress, of an inquiring and advancing age. In Europe, no literary record anterior to the Christian era represents the language of, or would be intelligible to, any portion of the European people. Languages seem to perish like the races which have disappeared on the ad-

NUMERALS IN VARIOUS LANGUAGES.

	Sanskrit.	Persian.	Arabic.	Welsh.	Erse.	Greek.	Latin.	Russian.	Polish.	Hindostan.	Kurds.	Pehleir.
1	aika	yika	ahad	un	aon	eis, mia, en	unus, a, um	odin	ieden	ek	jek	jek
2	dwa, dwau	du	ithnan	dau, dwy	da, do	duo, doio	duo, duœ	dva, dve	dva	du	du	du
3	tri	seh	thalathat	tri, tair	tri	treis, trees, tra	tres, tria	tri	trzy	tri	seh	se
4	chatur	chehaur	arbaa	pedwar, pedair	keathair	{ pissyres, pessyris, tettara }	quatuor, petor	chetyre	tchtery	char	ciahr	chahar
5	pancha	penj	khamsah	pump	kuig	pempe, pente	quinque	pyat	pients	panch	penc	pandj
6	shash	shesh	settah	chwech	se	hex	sex	shest	shesz	cheh	scese	sese
7	saptan	heft	sabaah	saith	secht	hepta	septem	sem	siedm	sat	ahft	haft
8	ashta	hesht	themanieh	wyth	ocht	okto	octo	osm, vosem	osm	ath	ahst	asht
9	navan	nuh	tisaeh	naw	noi	ennea	novem	devyat	dzieviens	nau	nah	no
10	dashan	deh	ashraah	deg	deich	deka	decem	desyat	dziessiens	des	deih	deh

NUMERALS IN VARIOUS LANGUAGES (*continued*).

	Anglo Saxon.	Icelandic.	Danish.	Swedish.	Old High German.	German.	Dutch.	Mæsogothic.	Frisian.	Tyrol.
1	an	einn	een	en	ein	ein	een	ains, aina, ain	ien	ans
2	twa, twegen	tvau	to	tva	zue	zwei	twee	twai, twos	twa	zwa
3	threo, thry	thrju	tre	tre	dri	drei	drie	thrins	trie	drai
4	feower	fiorir	fire	fyra	fiuar	vier	vier	fidwor	fjouwr	virhi
5	fif	fimm	fem	fem	vinfe	funf	vijf	fimf	fyf	finfi
6	six	sex	sex	sex	sehs	sechs	zes	saihs	seks	segsi
7	seofen	sio	syv	sju	sibun	sieben	zeven	sibun	san	simmi
8	eahta	atta	aatte	otta	ahto	acht	acht	ahtau	acht	ochti
9	negon	niu	ni	nio	niguni	neun	negen	niun	njuegen	naini
70	tyn	tiu	ti	tio	tehan	zehn	teen	taihun	tjen	zehni.

The Asian monosyllabic languages, which are principally to be sought in China and neighbouring countries, present in their numerals some remarkable resemblances and differences.

	Mandarin.	Kwanchow.	Canton.	Kiangshan.	Chenchew.	Japan.	Cochin-China.	Siam.	Passe.	Pe y.	Ava.
1	yih	i	jat, jek	jat, ja	it, ddjit, ddjeq.	iz	mot, nhit	ning	ning	leng	t'it
2	urh	ol, ny	y	gy	ngi, shi, no	ne	doi, hay, nhi	song	song	song	nhit
3	san	san	lam	sam	sa	san	ba, tam	sam	sam	san	sum
4	sz	szü	si	sy	sq	sy	sau, luk	sy	sy	sy	leh
5	woo	u nga	ing, ong	ong, nong	ngu, gou	go	bai, that	cha	cha	ha	ngah
6	leu	lu, lieu	lok	lok	lag	rok	tam, bat	hok	chok	uu	kiok
7	tsih	zi	zat	tzat	chit	siz	chin	cdjed	ddjed	chi	kunit
8	pa	pa	pat	bat	pe	faz	muoei	dhap, ped	ped	pje	shit
9	keu	kieu	kou	gau	kav, kau	kou	bori, tu	tau	kau	kao	koh
10	she	shi	shap, shat	sap	chap	sion	nam, lam	kib	sib	sib	ta-zah
100	pei	pe	pak	ba	pe	yak	tlam	soi	loi	pak	tara
1000	sien	zian	zin	tzin	chan, chian	sen	nghin	lthien ppan	fan	ling	zong

As. Pol., p. 378-9.

vancing cycles of time,—but, like the vestiges of these races, are full of instruction to successive generations.

The specimens, then, which follow of the numerals of various nations, have been selected from those presenting many points for comparison and contrast. It would be a vain attempt to trace the origin either of all the primitive roots, or the various modifications to which they have been subjected; but the text will present many curious materials for investigation and inquiry, the development of which would be inappropriate here.

The Thibet numerals are frequently cited as presenting an example of the simplest structure, and exhibiting the nearest approach to arithmetical notation by local value.*

1 cheic	..	11 chucheic	10+1.	21 gnea cheic.
2 gnea	..	12 chugnea	10+2.	22 gnea gnea.
3 soom	..	13 chusum	10+3.	23 gnea soom.
4 zea	..	14 chuzea	10+4.	24 gnea zea.
5 gna	..	15 chugna	10+5.	25 gnea gna.
6 tru	..	16 chutru	10+6.	26 gnea tru.
7 toon	..	17 chutoon	10+7.	27 gnea toon.
8 ghe	..	18 chughe	10+8.	28 gnea ghe.
9 goo	..	19 chugoo	10+9.	29 gnea goo.
10 chutumbha		20 gnea chutumbha	2×10.	

The groups of the first ten numerals (or digits) on pages 153 and 154, present many curious points of contrast and comparison.

Chinese Tartary.	Corea.	Formoza.
1 yga	1 ho-djün, ho-tun	1 tat saat
2 lianga	2 fu-pu	2 rauha
3 ssanga	3 sai	3 tauro
4 siggæ	4 nai	4 hpat
5 ugæ	5 ta-shu	5 rima or hand
6 lugæ	6 ji-shu	6 nnum
7 szugæ	7 ji-kü	7 pytto
8 baya	8 jĭ-ta	8 kauyphpa
9 dshugæ	9 ja-hao	9 matauda
10 shy	10 jĕ	10 kytti
11 shy-ygæ		
12 shy-lianga		
20 ul-shy	20 shu-nui	
30 sung-shy	30 shi-hau	
40 sig-shy	40 ma-jü	
50 ug-shy	50 shün	
60 lug-shy	60 ji-shun	

* Peacock, p. 373. See Turner's Embassy to Thibet, p. 321. Cf. Klaproth's Asia Polyglotta, p. 352.

Chinese Tartary.	Corea.	Formoza.
70 tzy-shy	70 ji-tuon	
80 bay-shy	80 ji-tun	
90 dschi-shy	90 ja-shün	
100 ibai	100 jun	100 kautaughau
1000 iwuan*	1000 zian (chinese)	1000 katanuaun †
	10000 wan (ditto)	

Some of the Caucasian numerals are very complicated. The Taguarish for 20 is *caedz;* for 90, *daec aemae tzuppaerucaedzuj* (10+80); for 100, *fondzucaedzy:* for 1000, *daec fondzucaedzy*, 10×100. The Circassian numerals are simple, and monosyllabic up to 10—*se* 1, *tu* 2, *she* 3, *ptle* 4, *chu* 5, *chi* 6, *ble* 7, *ga* 8, *bgu* 9, *pshe* 10, *sheh* 100, *min* 1000.

The Ostiak numerals present curious combinations:—

1 chusem.
2 ynem.
3 dogom.
4 syjem.
5 chajem.
6 ahjem, or chajem-chüsem—5 and 1.
7 ohnem, or chajem-ynem—5 and 2.
8 chajem-dogom, 5 and 3, or ynem boche chojem—2 from 10.
9 chajem-sysem, 5 and 4, or chusem boche chojem—1 from 10.
10 chojum.
11 chusem chojum—1 and 10.
18 ynem boche ägem—2 from 20.
20 ägem.
30 domga-sha.
40 soluk-sha.
41 soluk-sha an chogda.
50 cholepky-sha.
60 aha-chojum—6 tens.
70 ohna-chojum—7 tens.
80 ynem boche chojem chojum—2 from 10 times 10.
90 chusem boche chojem chojum—1 from 10 times 10.
100 kyshash, or ky.
1000 chojem kyshash—10 times 100.‡

Of the Oedh-Ostiaks (Sable-Ostiaks), who are also called Denka, Klaproth, repeating Messerschnudts,§ says that many of

* The roots of all these words are Chinese.
† Asia Polyglotta, pp. 340, 380.
‡ Asia Polyglotta, p. 171.
§ Messerschnudt's "Tagebuch," 9th July, 1723.

them could only reckon up to five, and that on reaching that number they began with one till they again reached five.

The different tribes of the Jenisei have the following numerals:—

	Inbazk.	Pumpokolsk.	Abassen.	Kotten.	Ariner.
1	chusem, chusam	chuta	hautu, hucha	hocha	khusei
2	unem, ynam	hineang	ince, una	inja	kina
3	dongeen, dongan	donga	tonga toga	tonga	tjonga
4	siém, siam	ziang	sheggiang, shega	chega	shaja
5	gagem, kagjam	cheilang	geijang kega	kega	khala
6	ages, agam	aggiang	geiluddgang, gelucha	kelucha	ogga
7	onse, erham	onjang	geiliniang, kelina	kelina	unnja
8	unem-boisem chogem (2 from 10)	hun basi ang (2 from 10)	geiltangiang, kattaga	chetonga	kina-manchau
9	chusem boisem chogem (1 from 10)	chuta-jamos chaijang (1 from 10)	goddjibunagiang	huchabunaga	khusamanchau
10	chogem, kogom	chaijang	hagiang, chaha	haga	khoa
11	chusem-ogem-chogem (1 and 10)		hagaluddjiang, aga-hucha	hagal hucha	khoa khusa
12	unem-ogem-chem (2 and 10)		hagaliniang, hahal-toga	hagal inja	khoa kina
20	ekse		intuku, untugu	intuku	khinthjung
30	dongbes		toontuku, tontaguo	tontuku	tjongthjungg
40	sjakpas, siem-chogem (4 tens)		shektugu, sheitagu	cheisuku	shaithjung
50	gagem chogem		geeigtuku keitago	keituku	khalthjung
60	ages-chogem		geilustuku, kelustai	kelushtin	oggthjung
70	onse-chogem		geilintuku kelientago	kelintuku	unthjung
80	ekse boisam-kise		geiltontuku, keltontago	cheltontuku	kinamanchauthjung
90	chogem baisem-kise		hagashibunalchintashu	huchabunagatuku	khusamanchanthjung
100	kise, kiha	utamsa	kuchumnai-tagu alshin-tamshu altumbamchu	alchin-tamshi	jus (Turkish)
200	un-kise		inpalchin-tamshu, una-paldamzia	inpalchintamshi	kin jus (Do.)
1000	cho-kise koga-kcha	cha-utamsa	hagti alchintamshu	hagpalchentamshi	kho jus (Do.)

(*As. Pol.* p. 191.)

EASTERN RUSSIA.

	Kamtschatka.	Tarakai.	Jeso.
1	syhnap	shnepf	sonezb, zinezf
2	dupk	tup	zuzb, zuzf
3	räph	repf	rezb, rezp
4	yhnäp	inipf	inezb, ynezf
5	āhsik	asheki, ashikinipf	asaraneeof, assikine
6	chguæhu	juwambi	juiwanbe, ywam
7	aruæhu	aruwambi	aruambe, aruwam
8	dūhpyhs	tubishambi	zujemambe, zubsam
9	syhnähpyhs	shnebishambi	sinesambe, sinobsam
10	upyhs	wambi	fambe, wambe *

	Motorish.	Koibalish.
1	om	unem
2	kydy	syda
3	nagor	nagor
4	deite	tade
5	shumblia	sumula
6	muktun	muktuk
7	kübe	s'eigbe
8	knydeite	syetade
9	togos	togos
10	tchiun	bet
11	tchiun 'op	bedop
12	tchiun-gide	besyda
15	tchium sumblia	betmuktut
20	kydy tchiun	sydybet
30	nagor-tchiun	nagorba
50	shumblia-tchiun	ilich
100	tchius	dsoon †

TUNGUS NUMERALS.

1	mukonn.
2	djuhr.
3	ilann.
4	degenn.
5	tona.
6	nunun.
7	naddan.
8	djapkull.
9	ijogjin.

* Asia Polyglotta, pp. 314-15. † *Ibid.*, p. 159.

10 djann.
11 mukonn-dje—one ten.
12 djuhr-dje—two ten.
20 djuhr-jarr—two tens.
30 ilann-jarr—three tens.
40 degenn-jarr—four tens.
100 nemadje.
200 djur-nemadje.
1000 djann-nemadge—ten hundred.*

As in many of the African languages, so in the Kurile islands of Japan, and on the coast of Kamtschatka, numbers are formed by deduction from the decimal points.†

Various are the inventions by which the decimal points are made subservient to the purposes of numerals. The Knisteneaux, in order to count up to 20, add to the first 9 digits a word signifying "with," as *peyac* 1, *peyac osap* 11; for 21 they say, *nishew mitenah peyac osap*, or $2 \times 10 + 1$. So the Malays add *blas*, and the Javanese *talas*, meaning *complete*, to the lowest numerals, in order to reach from 11 to 19. They have also several words with special meaning for some of the higher numbers, such as *samas*, one piece of gold meaning 400,—and *domas*, two pieces of gold meaning 800,‡—names originally associated, no doubt, with specific values.

Send.	Armenian.	Georgian.	Mingrelian.	Suanian.
1 oim	mi	erti	arti	eshgu
2 besh, bee	jergu	ori	djin	jeru
3 teshro, se	jerjek	sami	sumi	semi
4 chetwere	chors	ot'chi	ot'chi	wortshtcho
5 pianche	hink	chut'i	chuti	wochushi
6 chshuesh	wjez	ekwsi	apchshui	usgwa
7 hapti	jeotu	shwidi	shgwit'i	ishgurd
8 ashte	ut	rwa	ruo	ara
9 neo	nen	zchra	chchoro	chchara
10 des	dasn	ati	lirti	jesht
100 sete		ase	oshi	asher §

MONGOLIAN NUMERALS.

Mongols beyond Walls of China.	Chalcha Mongols.	Burietish.	Olotish Dsungaria.	Olotish on the Volga.
1 nige	nege	nege	xege	negen
2 gojer	chour	koir	chojur	chojur
3 churban	gurba	gurban	gurba	gurban

* As. Pol., p. 286.
† Peacock, p. 380.
‡ Peacock, p. 381.
§ As. Pol., pp. 74, 107, 122.

	Mongols beyond Walls of China.	Chalcha Mongols.	Burietish.	Olotish. Dsungaria.	Olotish on the Volga.
4	durban	durba	derbyn	dorbo	dorbon
5	tabun	tabu	tabun	tabu	tabun
6	dserchochan (dsirohn)	asurga	ddjergon	surga	surgan
7	dolochun (dolohn)	dolo	dolon	dolo	dolon
8	naiman	naima	najaman	naima	naiman
9	jisun, dsisun	jusu	jihun	jesu	jesum
10	arban	arban	arban	arba	arban
20	chosin	chori	koryn	chorin	chorin
30	chuchin	quchi	quchin	quchin	quchin
40	duchin	duchi	duchin	duchin	dochin
50	tabin	tabi	tabin	tabin	tabin
60	dsiran	ddjava	ddjiron	ddjiva	ddjira
70	dalan	dala	dalan	dalan	dalan
80	najan	naje, naja	najan	naija	naijan
90	javan	jire	jirin	jeren	jeren
100	dsachun (dsun)	dso	dson	dzo	suhn
1000	nungchan	rainggamjangga	minggan	minggan	minggan *

The following groups of numerals are employed in the various islands of the Indian Archipelago :—

	Kayan.	Malayan.	Javanese.	Buges.
1	ji	sa		sedi
2	duo	duwa		duwa
3	tulo	talu		tölu
4	pat	ampat	pat	öpak
5	lima	lima		lima
6	anam	anam	nam	önöng
7	turyu	tuju		pitu
8	saya	dalapan	wolu	aruwa
9	pitan	sambilan	sanga	asera
10	pulo	puluh	puluh	söpulo
11	puloji	sablas	sawalas	söpulo sedi
20			rongpuluh	
30		talupuluh		
100		ratus		siratu
1000		{ riwu / ribu }		sisöbu
10,000		laksa		silasa
100,000		kâti		saköti

* As. Pol., p. 284.

Kayan—Borneo	20	duwa puluh	kong puluh
	30	tiga puluh	tahing puluh
	40	ampat puluh	pat puluh
	50	lima puluh	limans puluh
	60	anam puluh	nam puluh
	70	tujuh puluh	pitung puluh
	80	dalopan puluh	wolung puluh
	90	sambilan puluh	sangang puluh
	100	ratus	atus

	Kisa.	Manatoto.	Timuri.	Rotti.	Sava.	Ende.	Mangavai.
1	ita ida	nehi	aida	aisa	aisa	asa	sa
2	ror	erūa	rūa	dūa	nūa	rūa	sūa
3	kal	etalu	tolo	talu	tanu	talu	talu
4	ahka	chäat	hāat	hāa	hah	wutu	pa
5	lima	lema	lema	lema	lema	lema	lema
6	nain	näen	nāen	nāen	naen	lema sa*	ana
7	iko	hetu	hetu	petu	hetu	lema-rua†	petu
8	ah	walu	walu	talu	panu	rua butu‡	alo
9	hi	sīoh	sīoh	sīoh	sīoh	turaasa	sioh
10	wali	nulu	rulu	hulu	bo	buru, bulu	puluh
11	Ita-wali-ita 1 × 10 + 1						
20	waroh					bulu rua §	sūa puluh‖
21	waroh ita						
30	wali kal						
100	raho	atus	atus	natun	natun	nasu	ratuh
1000	riun					rewu	rewu

	Tambora.	Sambawa.	Tamati (Temali).	Serang.	Tagala.	Bisaya.
1	sēena	satu	rimoi	takura	isa	isa, isara
2	kalāe	dūa	remo diti	dua	dalava	duha
3	nih	tiga	rāangi	tolu	tatlu	tulu
4	kude-in	ampat	raha	pat	apat	upat
5	kukl-in	lima	roma toha	lim	lima	lima
6	bata-in	anam	rava	onan	anim	anum, unum
7	kumba	tuju	tomdi	titura	petu	petu
8	koneho	dalapan	tofkangi	dalapanti	valu	valu
9	lali	sambden	siyu	sambilante	siyam	sīam
10	saroni	pulu	yagi	putusa	pulu	pulu
20	sisarone	duapulu	yagi romdide	dua pulu		
100	simari	atus	ratu	utun	dāan	gatus
1000			ribu	rihune	libu	livu
10,000					laksa	laksa
100,000					yuta	yuta

The Burmese numerals are :—

1	2	3	4	5	6	7	8	9	10
ta	wheet	thoun	he	nga	khyouk	khwon	sheet	ko	tshay

* 5 ÷ 1 † 5 + 2 ‡ 2 × 4 § 10 × 2 ‖ 2 × 10

They employ a sort of decimal accountancy, and pay all precious metals (like the Chinese) by weight.

moo mal hkwe kyatatikas
1000 = 400 = 200 = 100 = 1 priktha or vissom.

The purity of gold is expressed by *moos* or tenths; 10 *moos* and *shay moo* being esteemed pure gold.*

POLYNESIAN NUMERALS.

	Marquesa.	Sandwich Islands.	Fiji.	Tonga.	Maori.
1	tahi	kahi	düa	taha	tahi
2	uä	lüa	rua	ua	rüa
3	toru tu	kolu	tulu	kulu	toru
4	ha, aha	ha, aha	va	fa	wa
5	fima	lima	lima	nina	rima
6	ono	ono	ono	ono	omo
7	hitu	hiku	pitu	fitu	witu
8	vau	valu	walu	valu	waru
9	iva	iva	tiva	iva	iwa
10	ono hüu	umi	tini	ulu	tekan
100	uäta	uuta	hanvaan	aü	raïe
1000	mano	mano	handolu	afe	mano

	Caroline.	Tuham.	Pelew.	Malagasi.
1	tot	asaha	tong	trai
2	ru	agüa	oru	rüa
3	tal, iol	tulu	othai	telu
4	tan	tod-fud	o'ang	efatra
5	lim, nim, lib	lima	aïn	dimi
6	hol	gurum	malong	enina
7	fiz, fuz	fiti	oweth	fitu
8	wal, wan	güalu	tai	volu
9	tihu	sigua	eten	sivi
10	seg, sik, sig	manud	makoth	fulu
100	sia pugu	gatus	20 olo-yuk	11 iraiki ambinifulu
1000	senses zele	s'alan	30 ok-a-thai	12 ru ambinifulu
			40 ok-a-waugh	20 rua fulu
			50 ok im	100 zatu
			60 ok gollan	1000 arion
			70 ok-a-weth	10,000 alina
			80 ok tai	100,000 ketsi
			90 ok a tui	
			100 mak a dart	

* Prinsep's Useful Tables, p. 30-31.

One of the most extraordinary numeral forms is that of the Hawaian, where the unity is represented by *kauna*, or *four;* but instead of being multiplied by itself, it is multiplied by 10, and the different grades are thus represented :—

4 integers	=	1 kauna	=	4
10 kauna	=	1 kanaha	=	40
10 kanaha	=	1 lau	=	400
10 lau	=	1 mano	=	4,000
10 mano	=	1 kini	=	40,000
10 kini	=	1 lehu	=	400,000*

The Arabic cardinal numerals are simple and declinable as masculine and feminine nouns from 1 to 10;—from 3 to 10 they may be employed either as adjectives or as numerals;—from 11 to 99 they are indeclinable, but are distinguishable into the masculine and feminine genders. The word for 100 is feminine, —that for 1,000 is masculine.†

The Arabs have introduced the names of the higher digits into several of the languages of Africa. In Darfour, the numerals are:—1, *dik;* 2, *au;* 3, *ihs;* 4, *ongall;* 5, *ôs;* 6, *ôszandik*, (*i. e.*, 5 and 1); 7, *szebbe;* 8, *tmäni;* 9, *nattise;* 10, *uêje*—where 7 to 9 are Arabic words; but their notation is decimal, 20 *uêng-au* (10×2;) 100, *firi*; 1,000, *firi-nga-uieh*—100×10.

The Oceanic languages, which have no words in common with those of any of the great continents, have the same quinary and decimal character which is found so generally diffused.

In the *Ende* or *Flores*, the numerals are :—1, *sa*; 2, *zua*; 3, *telu*: 4, *wutu;* 5, *lima* (hand); 6, *lima-sa* (hand and 1); 7, *lima-zua* 5+2; 8, *rua butu*, 2×4; 9, *trasa;* 10, *sabulu.*‡

The Australian dialect spoken in the neighbourhood of Sydney:—1, *wagle;* 2, *bola;* 3, *broui;* 4, *karga;* 5, *blaourè;* 6, *blaourè-wagle;* 5+1; 7, *blaourè bola;* 5+2; 8, *blaourè broui*, 5+3; 9, *blaoure-karga* (5+4).

The Tanna:—1, *retti;* 2, *carru;* 3, *kăhar*; 4, *kefa;* 5, *karirrom;*

* Chamisso Hawaian Language, p. 57.

† De Sacy, Grammaire Arabe, i. 418, ii. 313.

‡ Forster, p. 254, quoted by Balbi.

6, *me-riddi*; (5+1;) 7, *me-carru*; (5+2;) 8, *me-kahār*, (5+3;) 9, *me kefa*, 5+4; 10, *karirrom-karirrom*, 5+5.*

In New Caledonia:—1, *paraì*; 2, *parù*; 3, *parghen*; 4, *parbaì*; 5, *panìm*; 6, *panimghi*; 7, *panimru*; 8, *panimghen*; 9, *panimbai*; 10, *parunik*.

In this language, no doubt, the word *pa* prefixed to all the digits is a word denoting a numeral. The numbers from 6 to 9 are all combinations of 5 with the lower units. The association of a prefix to words denoting numerals, obtains among many of the tribes in the Pacific;—*wa* is adopted by several†:—1, *wanaet*; 2, *wadu*; 3, *wakien*; 4, *wabay*; 5, *wanaim*; 6, *wanaim guic paignique*; 7, *wanaimdu*; 8, *wanaimgaiene*; 9 *wanaimbait*; 10, *wadouninc*.

The Iddah, a language spoken at the confluence of the Tshad and the Niger, has a system of numeration perfect in its decimal character—

1	nya		23	ogu eta	20+3
2	edji		24	ogu ele	20+4 and so forth
3	eta		30	ogwela	10×3
4	ele		40	ogweali	10×4
5	elu		50	ogwelu	10×5
6	efa		60	ogwefa	10×6
7	eba		70	ogweba	10×7
8	edjo		80	ogweja	10×8
9	ela		90	ogweala	10×9
10	egua		100	ijeje abbreviated	
11	egua 'nka	10+1	101	ijeje maya	
12	egua edji	10+2	102	ijeje medji	
13	egua eta	10+3	103	ijeje meta	
14	egua eli	10+4	104	ijeje mele	
15	egua elu	10+5	105	ijeje melu	
16	egua efa	10+6	106	ijeje mefa	
17	egua ebia	10+7	107	ijeje meba	
18	egua edja	10+8	200	guake maya	
19	egua ela	10+9	300	guake meta	
20	dogu ogu	10+10	400	guake meli	
21	ogu ngka	abbreviated 20+1	500	guake melu	
22	ogu edji	do. 20+2	1000	itshha madji	

There has been lately published a collection of the numerals,

* Cook's Third Voyage, ii., p. 364; and Balbi's Eth., 432. (Pott, 47.)
† Balbi, p, 275.

from 1 to 10, of no less than 388 dialects and languages of Africa, and of these very many have separate words for 1 to 5, and combinations of 5 with 1, 2, 3, and 4, to represent 6, 7, 8, and 9, but most have a simple word for 10. For example:—*

The Felata (Soudan)—

1	2	3	4	5
go	diddie	tattie	ni	jowie
6	7	8	9	10
sowiego	sowadie	sowatuttie	sowanie	sapo

The Felaps (Senegambia)—

1	2	3	4	5
enori	kukaba	sisaji	sibakir	futuk
6	7	8	9	10
futuk enori	futuk kukabo	futuk sisaji	futuk sibakir	sibankoni

The Ballorn (near Sierra Leone)—

1	2	3	4	5
bul	ting	ra	nenol	mun
6	7	8	9	10
meinbul	meinting	meinra	memnehol	naung

Benin (Bight of Benin)—

1	2	3	4	5
bo	bi	la	nin	tang
6	7	8	9	10
tahu	tabi	tala	tenii	te

Igberra (on the Niger)—

1	2	3	4	5
anya	ebba	eta	enna	jokki
6	7	8	9	10
sokkiloanya	jokkirebba	jokkireta	jokkireuna	ikkewah

Bongo (Gaboon)—

1	2	3	4	5
uoto	baba	balali	banai	batan
6	7	8	9	10
batan a nota	batan a baba	batan a bala	batan a banai	dium

Otam (Cross river)—

1	2	3	4	5
yoka moa	beba	beraru	bini	bittan
6	7	8	9	10
bitan ari yo	bitan ari beba	bitan ari raru	bitan ari bini	isaka

* Specimens of Dialects, &c., by John Clark : Green, 1489.

Several other African languages exhibit examples of decimal notation. The Dankali has,

1	2	3	4	5	6	7	8
eneki	lāmei	siddēhu	ferēï	konōö	lekēï	mel hein	bahhāra

9	10	11
sagalla	tabana	tabbankeeneki

and so up to twenty, which is *labbátana;* 30, *soddōmo*—3×10; 31, *soddonki eneki;* 50, *kontomo,* 5 × 10; 100, *bōl;* 1000, *tubban a bōl,* 10×100.*

The Galla numerals† are also decimally arranged:—

1	2	3	4	5	6	7	8	9
tok	lama	sadi	afur	shani	tsha	torba	sadeti	sagall

10	11	12
kudana	kudatok	kudalama, &c.

20 is *diktama,* 2×10; 100, dibba; 1,000, kūma.

The Dongola numerals, in the Sennâr kingdom, have a similar character:—

1	2	3	4	5	6	7	8	9
uérij	ówi	túskij	kémmisk	dik	gorîk	kólodá	iddúge	üskodk

10	11	12	20	50	100
dümming	dümmindôek	dümmindoe	arrígk	îr-îk	ímmelwek

1000
dónnalwék ‡

The pursuit of the decimal elements through the languages of the world, would occupy volumes. Though, as we have seen, there are examples in which the quinary power is the limit to calculation, yet *ten,* and additions or multiplications of tens, may be deemed the almost universally recognised arithmetical instrument. But there are many examples which might be added to those already given, where the word for ten is only the duplication of the word for five. There are several of the African languages in which there are separate and distinct words for the numerals up to 6; the numerals 7, 8, and 9, are combinations of 5 and 2,

* Isenberg's Small Vocabulary of the Dankali language. Salt's Voyage to Abyssinia, Appendix xii. (Pott, 106-7.)

† Krapf's Imperfect Outline of the Elements of the Galla Languages. (Pott, 106.)

‡ Vater's Proben, p. 247. Balbi, N. 209, 210.

5 and 3, and 5 and 4, as those used by the Manna people:—1, *kidding*; 2, *fidding*; 3, *sarra*; 4, *nani*; 5, *soolo*; 6, *seni*; 7, *soolo mo fidding*; 8, *soolo ma sarra*; 9, *soolo ma nani*; 10, *nuff*. The Buntookoos have five monosyllables for the first five digits, while the following five are made up by combinations of the first: 1, *tah*; 2, *noo*; 3, *sah*; 4, *nah*; 5, *taw*; 6, *torata*; 7, *toorifeenoo*; 8, *toorifeessa*; 9, *toorifeena*; 10, *nopnoo*.

Some of the African languages have simple words for the numerals up to 6, but have combinations of 5 and 2, 5 and 3, 5 and 4, for 7, 8, and 9, with a simple word for 10.

The Susu:—

1	2	3	4	5	6	7	8	9	10
kiring	firing	sukung	nāni	suli	seni	suli firing	suli masakung	suli manāni	fu.

The Mozambique has the combination of $5+1$, $5+2$, for 6 and 7, but has simple words for the remaining digits.

1	2	3	4	5	6	7	8 (5+3)	9	10
moosa	pili	thára	ssesse	thana	thanamoasa	thanapili	thana ssesse	looko	mino komili ssesse.

Many of the African languages make their numeral resting-place at 5, and start from thence with new combinations. The numerals of Lagoa Bay are:—

1 chiugea	6 tanou na chengeva	5 and 1
2 se-berry	7 tanou na tree-beere	5 and 2
3 ni-rarou	8 tauou ni raron	5 and 3
4 moo-nau	9 tanou na maunau	5 and 4
5 thanou	10 koumau	

20 ma-koumau ma-bdere 10 by 2
30 ma-koumau ma-varou 10 by 3*

So in the Mozambique:—

1 moosa	6 thana moasa	5 and 1
2 pili	7 thana pili	6 and 2
3 thara, ba-tatu	8 thana ssesse	
4 ssesse, me sana	9 looko	
5 thana	10 mino komili ssesse	

* "White's Journal," 1800, p. 72, quoted by Balbi, Atlas Ethno., No. 287.

Among the Feloops, as given by Mungo Park :—

1 enory	6 footuck enory	5 and 1
2 sickaba or cookaba	7 footuck cookaba	5 and 2
3 sisajee	8 footuck sisajee	5 and 3
4 sibakir	9 footuck sibakir	5 and 4
5 footuck	10 sibankonyem	

The Ratongga* exhibits some very remarkable caprices :—

1 yoko 2 beba 3 biraru
4 binni 5 betta
6 betta nadi yoko (5+1)
7 ossi yoko bin tsambi (8—1)
8 iwambi
9 issiokomancondaru (10—1)
10 doridaru

The forms of the Luda† numerals are various :—

1 aquiripo	6 aquesiato
2 aquawe	7 aque se aur (5+2)
3 aquaton	8 aque se anto (5+3)
4 aqueni	9 aque se eni (5+4)
5 aquato	10 aqua owe, *i. e.*, 2 numbers

in which the word *aqua* obviously means a numerical substantive.

The numerals of the Jolofs present more irregularities than those of almost any other rude people. They are found in Durand's "Voyage au Senegal" (Paris, 1807, vol. ii. p. 360), and are as follows :—

Bene - - - - - - -	1	
Gnare - - - - - - -	2	
Gnete - - - - - - -	3	
Gnanette - - - - - - -	4	
Gnirome - - - - - - -	5	
Gnirome bene - - - - - -	6	= 5 + 1
Gnirome gnare - - - - - -	7	= 5 + 2
Gnirome gnete - - - - - -	8	= 5 + 3
Gnirome gnanette - - - - -	9	= 5 + 4
Foucq - - - - - - -	10	
Foucq ac bene - - - - - -	11	= 10 + 1
Foucq ac gnare - - - - - -	12	= 10 + 2
Foucq ac gnete - - - - - -	13	= 10 + 3
Foucq ac gnanette - - - - -	14	= 10 + 4
Foucq ac gnirome - - - - -	15	= 10 + 5
Foucq ac gnirome bene - - - -	16	= 10 + 5 + 1
Foucq ac gnirome gnare - - - -	17	= 10 + 5 + 2
Foucq ac gnirome gnete - - - -	18	= 10 + 5 + 3
Foucq ac gnirome gnanette - - -	19	= 10 + 5 + 4

* Bagoon River. † Dahomy.

Gnare foucq	20	$= 2 \times 10$
Gnare foucq ac bene, &c., &c.	21	$= 2 \times 10 + 1$
Gnete foucq	30	$= 3 \times 10$
Gnanette foucq	40	$= 4 \times 10$
Gnirome foucq	50	$= 5 \times 10$
Gnirome bene foucq	60	$= (5 + 1) \times 10$
Gnirome gnare foucq	70	$= (5 + 2) \times 10$
Gnirome gnete foucq	80	$= (5 + 3) \times 10$
Gnirome gnanette foucq	90	$= (5 + 4) \times 10$
Temere	100	
Gnare temere	200	
Gnete temere	300	
Gnanette temere	400	* *Sic. in orig.* But is appa-
Gnirome temere	500	rently a mistake for
Gnirome temere ac gnirome bene*	600	Gnirome bene temere
Gnirome temere ac gnirome gnare	700	Gnirome gnare temere
Gnirome temere ac gnirome gnete	800	Gnirome gnete temere
Gnirome temere ac gnirome gnanette	900	Gnirome gnanette temere
Gunee	1000	
Gnare gunee	2000	
Gnete gunee	3000	
Gnanette gunee	4000	† *Sic. in orig.* Is probably
Gnirome gunee	5000	a mistake for
Gnirome gunee ac gnirome bene†	6000	Gnirome bene gunee
Gnirome gunee ac gnirome gnare	7000	Gnirome gnare gunee
Gnirome gunee ac gnirome gnete	8000	Gnirome gnete gunee
Gnirome gunee ac gnirome gnanette	9000	Gnirome gnanette gunee
Foucq gunee	10000	
Gnare foucq gunee	20000	
Gnete foucq gunee	30000	
Gnanette foucq gunee	40000	‡ *Sic. in orig.* Probably a
Gnirome foucq gunee	50000	mistake for
Gnirome foucq gunee ac gnirome bene‡	60000	Gnirome bene foucq gunee
Gnirome foucq gunee ac gnirome gnare	70000	Gnirome gnare foucq gunee
Gnirome foucq gunee ac gnirome gnete	80000	Gnirome gnete foucq gunee
Gnirome foucq gunee ac gnirome gnanette	90000	Gnirome gnanette foucq
Temere gunee	100000	gunee

Colonel Thompson, who was one of the earliest governors of Sierra Leone, says of the Jolofs:—"They are not a rude race, as would be implied, if they could at this day only count five by the help of their fingers. Though if they were unable, they would be only what the Greeks were in the time of Proteus, if, indeed, any body knows when that was. But the Jolofs are the most advanced of all the African races, as distinct from mixture with the Arabs. Their language is held to be very melodious and competent to all purposes. In proof of which, the European ladies who find their way to the Senegal and Goree, learn to talk Jolof as in India they learn Hindostanee. It is remarkable that the Jolofs, though the handsomest race in Africa, are the blackest; and the name Jolof, I understand, means *black*."

The system of notation employed by the ancient Peruvians, at least as represented by the collection of *Quipos*, or knot-records, as described in the Westminster Review, was *ternary*, or by gradations of *threes*. "On examining the numerical system of knot-writing it is evident that what algebraists call the local value is *three*. For example, *one* is typified by the simplest of all possible knots, as what a sempstress makes on a thread previous to taking the first stitch; *two* is expressed by putting the end through once more, before drawing tight, as a sempstress does when it is desired to increase the magnitude of the knot; and *three* is expressed by performing the same operation an additional time. *Four* assumes a new combination, for it is expressed by a loop of the simplest kind, such as is made in nautical language, by taking a bend in the bight of the rope; and *five* is expressed by the same kind of loop, with an additional twist in the clinch or part where the whole is drawn tight; and *six* has another twist still; *seven* is another kind of loop, which is manifestly different from *four*, though it would probably puzzle a forecastle man to define the difference in words; *eight* is the same with the addition of another twist in the clinch, and *nine* with yet another. *Ten* is no loop at all, but a portentous kind of a knot, such as might be made in a cat o' nine tails, when the object was to kill; *eleven* is the same with an additional twist in the clinch; and *twelve* with another. *Thirteen* is the same kind of knot as ten, only with a loop sprouting out on one side; and *fourteen* and *fifteen* distinguish themselves by their twists, as before. In this manner the system goes on to a hundred, exhibiting a new knot at every third numeral, and expressing the two next by additions at the clinch. The knots become exceedingly complicated and artificial, but they invariably adhere to the *ternary* system described."*

Mr. Gallatin represents, however, "that the arithmetic of the Peruvians and of the Araucanians is purely decimal."† Different writers give different numerals, many of which appear to be rather quinary than decimal. Several of the digits are polysyllabic: 10 is tunca, 100 is pataca (the Spanish for dollar); and 1000, quaranca.

Yarica says, "The Indians employ threads of cotton which they call *quippos*, and they show the numbers by knots of different forms, exhibiting in various distances from *units* and *tens*, and so

* Westminster Rev., vol. xi. 1829, p. 246.

† American Ethnol. Soc. i. p. 49 (Pott, 73).

upwards; and they give to the thread the color which is connected with the thing they desire to show. In every province there are persons who are charged to preserve by these records the memory of public events, which are called *Quippos Camaios;* and there are public edifices filled with these threads, which he who has charge of them can readily explain, though they belong to ages antecedent to his time." *

The Guaranies, who are said never to count beyond thirty, employ combinations of the first four numbers, and of the words for hands and feet to reach that number; 1, *petey;* 2, *mocoi;* 3, *mbohapi;* 4, *irundi;* 5, *irundi hae nirai,*—four and another, or *ace popetei,* one hand; 6, *ace popetei hae petei abe,* a hand and one besides; 9, *ace popetei hae irundi abe,* a hand and four besides; 10, *ace pomocoi,* two hands; 20 *mbo mbi abe,* hands and feet besides; 30 *mbo mbi hae promocoi abe,* hands, feet, and two hands besides.

The Zamucos have the following numerals:—1, *chomara;* 2, *gar;* 3, *gaddive;* 4, *gahagani;* 5, *chuena yiminaete,* finished hand; 6, *chomarahi,* one of the other; 7, *garihi,* two of the other; 10, *chuena yimanadie,* finished two hands; 11, *chomara yiritie,* one of a foot; 20 *chuena yiriddie,* finished feet. Beyond 20 the Zamucos use the word *unaha,* many; if the number greatly exceed twenty, they use *unahapuz,* the superlative of many. But they communicate an idea of growing greatness of numbers by elongating the sound of the second vowel thus—*ana-a-a-a-a-hapuz.* But they assist their calculations by grains of rice, stones, or seeds; and having placed of these the number required, they point to them and say, "*choetie,*" like this.†

It was in vain, says one of the historians of America,‡ that the Jesuit talked to the negro of angels without number—millions upon millions—like stars in the heavens, like leaves on the trees, like sands on the shore; the words made not the slightest impression. There was no association between such figures and the grains of maize which the negroes employ for counting; but when he said there were more angels than maize-corns in a *fanega* (a large Spanish measure), the negro's attention was awakened into wonder, and the preacher's meaning was thoroughly understood.

La Condamine states, that the American Yancos who inhabit

* Historia del Peru, vol. iii. pp. 5, 6.

† Dr. Peacock, p. 479. ‡ Gilj. vol. iii., p. 305.

the banks of the river Amazon, cannot, in consequence of the complex character of their language, count beyond three, which they call *poettarrarorincoaroac*. Five is a not unfrequent limit to numeration among barbarous people.

The Maipuri, on the Orinoco, call 1 *papìta; 5, pdpitaerri capiti* —*i. e.*, one only hand; 6 *papita yana pauria capiti purena*—*i. e.*, "one of the other hand we take." But though so cumbrous a mode of numeration is employed for counting human beings, other numerals are used for other animals, and others still for inanimate objects,—a distinction found also among the Japanese. The Yaruroes call 5 *canniicchimo*, "one hand alone;" 10, *yoaicchibo*, "all the hands;" 15, *canitaomo*, "one foot alone;" 20, *canipumè*, "one man."

The manner of exhibiting the fingers varies among different nations. The Ottomacos, to express *three*, join the thumb, the fore and middle finger of the right hand, and close the other two fingers; the Tamanacos, the little, the ring, and the middle finger, and close the forefinger and the thumb; the Maipuros raise the fore, the middle, and the ring fingers, and close the thumb and the little finger.

With a vast variety of words, the same mode of employing the fingers, hands, and feet, may be traced in the numerals of many of the American tribes. Some of the more remarkable characteristics of the American languages are worthy of note. The Luli of Paraguay, while they call 6 four with two, *lokep moilè tamop*,— 8, four with four, *lokep moilè lokep*,—9, four with four one, *lokep moilè lokep alapea;* — say for 11, all the fingers of hand with one, *is yaoum moilè alopea;* and for 30, all the fingers of hand and foot, with all the fingers of hand, *is elu yaoum moilè isyaoum*. For 40, a Luli raises his open hands to his shoulders, bends his head to his feet, and says, *tamop*—two or twice. For 60 he employs the same action, saying *tamlip*, three or thrice; and he expresses 100 in a similar way by exclaiming, *lokep moilè alapea*, four with one—*i. e.*, five or five times. The Mocobi numerals used by a tribe on the Paranâ river, a branch of the Rio de la Plata, use their hands and feet; but their spoken numerals present no higher combinations than 4:—1 *iniateda;* 2, *inabaca;* 3, *inabocaocaini*, 2 more: 4, *inibacao-cainibao* 2+2, or *natolatata;* 5, *inibacaocainiba iniateda*, 2+2+1, or *natolatata iniateda*, 4+1; 6, *natolatata inabaca*, 4+2; 7, *natolatata inibacao-caino*, 4+2+more; 8, *natolatata natolata*. The Guaicurus do not go beyond 2 in their numeral combinations:—1, *uninitegui*; 2, *iniguata*; 3, *iniguata dugana*, 2+more; 4, *iniguata driniguata*; 2+2. For all numbers above 4 they employ the *oguidi*, meaning *many*. One stage lower is presented by the numerals of the Betoi on the Orinoco:—1, *edojojoi*; 2, *edoi*, *i.e.*, another; 3, *ibutu*, *i.e.*, beyond; 4, *ibutu edojojoi*, beyond one; 5, *rumocoso* hand.* From these rude and imperfect fragments to the amazing decimal powers as exhibited in the calculations of astronomy, is like a transition from thick darkness into infinite light,—from a murky prison into boundless space; and we are actually tempted to inquire, whether a Newton meditating on the banks of the Thames, and an American wandering by the shores of the Orinoco, can be made of the same materials,—can be brethren of the same great family! The interest attached to these investigations is far greater than that of a mere inquiry into the different modes of notation,—it stretches into the vast ethnological field of races and their histories—of languages and their formation — of civilisation and its multifarious exhibitions — of human contrivances and human necessities—of ability to conceive, and aptitude to communicate instruction—of climate—of production—of habits—of isolation and of intercourse. How nations greatly advanced in many of the arts of life have made so little progress in those of arithmetic,—how others to whom the mysteries of figures have been revealed and developed should have remained uninitiated into so many other departments of science and philosophy—how instruction and ignorance—how backwardness and movement have been so strangely blended;—these are topics for curious speculation and research!

As a curious specimen of polysyllabic numerals, I give the units of the Timuacana language:—†

1 minecotamano	5 namaruama	9 napekecheketama
2 naiuchamima	6 namarecama	10 natumama.
3 nahapumima	7 napikichama	
4 nacheketamima	8 napikinahuma	

No doubt the *na*, which in this language is found in all the units except the first, denotes a numeral. It seems as if, to some extent, one numeral served as a stepping-stone to the following:—In the 7, 8, and 9, *napiki*, or *napeke*, are found, as is *mima* in 2, 3,

* Hervas, quoted by Dr. Peacock, pp. 479, 480.

† Balbi Eth., N. 785. (Pott, 66.)

and 4; *nama* commences both 5 and 6; and *ama* is the termination of 5, 6, 7, 9, and 10.

Of the semi-civilised nations of Mexico, Yucatan, and Central America, Gallatin says:—"It is remarkable that these tribes had, for the numerals under 20, only four uncompounded names—*pil* 1, *ajte* 2, *puguantzam* 4, and *juyopamany* 5. Even the numeral 3 is *ajti c pil* (2+1.) The other numerals are compounded in a variety of ways:—6 is (2+1+2;) *ajti c pil ajti;* 8 is (4×2;) 10 is 5×2; 11 is 5×2+1; 12 is 4×3; 15 is 5×3; and, for compounding the numerals 18 and 19, they have borrowed the Mexican word *chicuas*, 6:—thus 19 is *chicuas ajti c pil co pil*, or 6×(2+1)+1."*

In the Ounalaska language, the numerals 1 to 4 and 6 to 9 have a remarkable resemblance to one another:—1, *atoken;* 6, *atoon;* 2, *arlok;* 7, *oolloon;* 3, *kankoo;* 8, *kancheen;* 4 and 9 are absolutely identical, *seecheen*, and can only have been distinguishable by referring to the same finger on different hands; 5 is *chaan*, synonymous with *chianh* (hand).†

So in the Koljush tribes:‡—1, *tleek;* 2, *tech;* 3, *neztke;* 4, *tachun;* 5, *ketschtschin;* 6, *tletuschu;* 7, *tachuteuschu;* 8, *nesketuschu;* 9, *kusckok;* 10, *tschinkat.* In this and cognate languages, the numeral five is the word for hand, and the numeral one resembles the word for finger.

In the island of Santa Barbara, the numerals 5, 6, and 7, are formed by prefixes to 1, 2, and 3:—

1 pacà	3 maseja	5 ytipaca	7 ytimasage	9 upax
2 excò	4 scumu	6 ytixco	8 malahua	10 kerxco§

Humboldt gives the numerals of the Eslene tribes, showing that the word for 5 is composed of 1 and 4, and that 6, 7, 8, and 9, are but compounds or amplifications of 1, 2, 3, and 4:—

1 pek	3 julep.	5 pamajala	7 julajualanai	9 jamajusjualanai
2 ulhai	4 jamajus	6 pegualanai	8 julepjualanai	10 tomoila‖

And Duponceau shows that similar constructions are found among

* Transactions of the American Eth. Soc., i., p. 49. (Pott, 69.)

† See Cook's Voyages, iv., p. 539. (Pott, 61.)

‡ Krusenstern, p. 55. (Pott, 66.)

§ Balbi, p. 829. (Pott, 63.)

‖ Essai. Pol. sur le Royaume de la Nouvelle Espagne, p. 322.

the North American nations.* The Alconquins have—1, *ciutte* and 6, *ciutas ;* 2, *nissa ;* 7, *nissas.*

He farther remarks, that though in many of the North American languages the numerals have simple words up to 5, they frequently present new combinations from 6 upwards—such as 5 and 1 for 6, 5 and 2 for 7, 5 and 3 for 8, and 10 less 1 for 9. It is observable, that though in the spoken Latin language no such association of ideas is traceable, yet it is found in the written numerals of Rome,—as vi., vii., viii., and ix., and in no other ancient symbols.†

The Muyscas in New Granada, Humboldt informs us, say for 11, *quicha ata,* foot one ; 12, *quicha bosa,* foot two ; 13, *quicha mica,* foot three; and they use the foot for numbering when they have exhausted the hands. 20 is foot ten, or *gueta,* meaning a small house or barn—probably with reference to the store-house in which the maize is collected, whose grains they are in the habit of using for calculation. They say a house and ten for 30, two houses or twice twenty for 40, four houses or four times twenty for 80. So the Celts; and some of the Roman-derived dialects—as the French, *quatre vingt,* and even *quinze vingt,*‡ for 300 ; *six vingt, sept vingt,* and *huit vingt,* are sometimes employed for 120, 140, and 160. "The poor-house (work-house) in Paris is called 'les Quinze Vingt.'" In the Bas Breton the words *pemzek-ugent,* 15 × 20, and *tri-chant,* 3 × 100, are equally employed for 300.§

Two forms of numerals are sometimes found even among semi-civilised races. "The Otomis expressed the numeral 100 by the words *Cytta tæ,* which means 5 × 20; but they had also a distinct, apparently uncompounded word, *nthebe,* for the same numeral; their word for 1,000 was *ratta nthebe,* 10 × 100, but they had also an uncompounded word, *mao.*"||

The Caribs of Essequibo, according to Biet, for 5 show a hand, for ten the two hands, for twenty the feet and hands. The word for five is *winee etanee,* a hand; for 20, *owee carena,* or, a person. The numerals 6, 7, 8, and 9, are made by adding the

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* Système Gramm. des Langues de quelques Nations Indiennes de l'Amerique, du Nord. Paris, 1838.

† Duponceau, p. 59. See also Humboldt in Crelle's Mathematical Journal, 1829, p. 211.

‡ Gallatin, p. 53. § Pott, p. 88. || Gallatin, p. 53.

word *puimapo* to the numerals, for 1 *oween*, 2 *oko*, 3 *oroowa*, and 4 *oko baimea*. So in the Cavaiban Island they add the word *laoyagone*, 5, to *aban* 1, *biama* 2, and *eleoua* 3, thus making 6, 7, and 8.*

The Arrawakis add the word *timan* in the same manner to the four first units, and so convert them into the four last.† It is remarkable, however, that *puimapo* among the Caribs, and *timan* among the Arrawakis, do not represent 5, which number is *wineetanee* and *abbatokabbe* in these languages;—so strange are the caprices and irregularities which have led to the formation of the words in most ordinary use.

It has been observed, that the tribes of South America possess much more perfect systems of numeration than those of the north. Few of the nations of Northern America have a decimal system,—and without this, or some other means of grouping numbers, the powers of language fail, and the higher numerals are represented by a phraseology so lengthy and entangled, as to embarrass and overcome the means of utterance. Humboldt gives the system of the ancient Peruvians, which exceeds in extent and simplicity anything to be found in the Greek or Roman vocabulary:—

10	chunca.	10,000	chunca huaranca.	10×100.
100	pachac.	100,000	pacha huaranca.	100×1000.
1,000	huaranca.	1,000,000	hunu.‡	

The numerals of the Cayababi, a tribe on the banks of the Mamore river, exhibit some remarkable forms of quinary and decimal combinations. *Arue* is the word for hand, and, being appended to 1, 2, 3, and 4, make 6, 7, 8, and 9; 10 is hand hand; 100, hand four times repeated—a multiplication of 10 by itself; and 1,000, a multiplication of 100 by 10.

1	carata	10	bururuche	
2	mitia	11	bururuche-caratorogicne.	10+1
3	curapa	12	bururuche-mitiarogicne	
4	chadda	19	bururuche-chaddarirobogicne	
5	maidaru	20	mitiaburuche.	2×10
6	caratarirobo	30	curapabururuche.	3×10
7	mitiarirobo	100	buruche-buruche.	10×10.
8	curaparirobo	1,000	buruche-pene bururuche.	10×100§
9	chaddarirobo.			

* Rüdiger, p. 129. † Balbi, No. 585.
‡ "Vues des Cordillères," p. 252. Peacock, p. 379. § Ibid, p. 478.

Dr. Peacock quotes from Hervas the following numerals from the ancient languages of Peru and Chili:—

	Quichua.	Araucana.	Aimarra.	Sapibocona.
1	huc	kine	mai	pebbi
2	iscai	epu	paya	bbeta
3	kimsa	kula	kimsa	kimisa
4	tahua	meli	pusi	pusi
5	pichca	kechu	pisca	pissica
6	socta	kayu	sogta	succuta
7	canchis	relghi	pacalco	pacalucu
8	passac	pura	kimsacalco 3+5	kimisacalucu
9	iscon	ailla	pusicalco 4+5	pusucalucu
10	chunca	mari	tunca	tunca
11	chunca huc niyoc 10+1	marikine 10+1	tunca mayani 10+1	tunca peapebbi 10+1
12	chunca iscai niyoc 10+2	mari epu 10+2	tunca payani 10+2	tunca peabbeta 10+2
20	iscai chunca 2×10	epu mari 2×10	paya tunca 2×10	bbeta tunca 2×10
30	kimsa chunca 3×10	kula mari 3×10	kimsa tunca 3×10	kimisa tunca 3×10
40	tahua chunca 4×10	meli mari 4×10	pusi tunca 5×10	pusi tunca 4×10
100	pachac	pataca	pataca	tunca tunca 10×10
1,000	huaranca	huaranca	huaranca	tunca tunca tunca 10×10×10*
1,000,000	hunu			

All these represent decimal notation; the resemblances and the differences are equally remarkable. In the three last, the terms for 100 and 1,000 are the same, exhibiting a similarity in the higher numbers which is not traceable in the lower.

Another group of numerals is furnished by Hervas, viz.:—the Aztec, or ancient Mexican, the Yucatan, and Coran (Nueva Galicia).

* Peacock, p. 478, from Hervas.

Aztec.		Yucatan.		Coran.
1	ce	hunppel	or yax	ceäut
2	ome	cappel	„ ca	hualpoa
3	yei	oxppel	„ yox	huaeia
4	nahui	camppel	„ cantzel	moâcoa
5	macuili (maitl, hand)	hoppel	„ ho	amxuoi
6	chicuace 5+2	uacppel	„ uac	acevi
7	chicome 5+2	uncppel	„ uuc	ahuapoa
8	chicuei 5+3	uaxacppel	„ uaxac	ahuaeica
9	chicunahui 5+4	bolonppel	„ bolon	amoacua
10	matlactli	lahunppel	„ lahun	tamoamata (moamati, hand)
11	matlactli-oce 10+1	huncahunppel 1+10		tamoamata apon ceäut 10+1
12	matlactli omome 10+2	lahca 2+10		tamoamata apon hualpa 10+2
15	chax tòli	holhunte 5+10		
16	chaxtòli-occe 15+1			
20	cempohuàli	kal or hunkal		ceitevi, *i. e.*, one man
30	cempohuali-i-pan matlactli 20+10			ceitevi poan tamoamata 20×10
40	ompohuàli	cakal 2×20		huahcatevi 2×20
60	epohuàli	oxkal 3×20		huaeicatevi 3×20
100	macuilpohuàli 5×20	hokal 5×20		anxütevi 5×20
200	matlacpohuàli 10×20	lahunkal 10×20		tamoamatatevi 10×20
400	cen-tzontli			ceite vitevi, 20 men
800	ontzontli (hairs of the head)			
8000	ce-xikipili	hunpic, or pic		

A fanciful spirit seems to have possessed some of the Indian nations in the formation of their numerals. The tribe which occupied Bogota, for 1 used ata, meaning water, . . .

2	bosa	a field
3	mica	changeable
4	muyhica	tempest clouds
5	hisca	repose
6	ta	harvest
7	cahupqua	deaf
8	sahuzu	a tail
9	aca	(unknown)
10	tibchica	bright moon*

In this there has been an attempt to associate the numerals either with changes of the heavenly bodies, or the labours of the field, and the objects of worship, but little light has been thrown on the matter. After the number 10 the *quicha* is introduced, meaning *foot*. *Quicha ata*, or foot +1, meaning 11; 20 has two terms—*quicha ubchica*, 10+10, or *gueta*, meaning *hours;* 40, guebosa, 2 hours.

* Peacock, 388, 478.

FRENCH COINS.

FRENCH GOLD COINS.

FRENCH SILVER COINS.

FRENCH COPPER COINS.

CHAPTER IX.

DECIMAL CURRENCY AS ESTABLISHED IN OTHER COUNTRIES.

THE nations which have adopted the decimal system are, France, Holland, Sardinia, Naples, Rome, Modena, Greece, Belgium, Switzerland (in part), Lombardy, Tuscany, Spain, Poland, Japan, China, Russia, Zollverein (metrical in weights and measures), Portugal, Brazil, New Granada, Chili, Mexico, Columbia.

The foundations of the French system of weights and measures and of coinage as dependent upon them, are purely scientific, and not subject to arbitrary change. The standard of measures was the dimension of the earth—*i.e.* the distance from the equator to the pole, which, being divided into 10,000,000 parts, gave the *metre* = 39·371 inches; which, being subjected to decimal multiplications and divisions, establish all the legal measures of length of France. For the standard of weights, a cube of pure water, at the temperature of melting ice, measuring in each direction the hundredth part of this *metre* (called a centimeter), gave a weight which was named a *gramme*, whose decimal subdivisions and multiplications are the standard of all authorised weights. The gramme is equal to 15·435 troy grains. By a decree of the 28 Thermidor, an iii. (Aug. 19, 1795), the five-franc piece and its divisions were introduced at the rate of 200 francs to the kilogramme—9-10ths fine; and in 1803 the deviations of permitted fineness were limited to $\frac{3}{1000}$ above or below the standard,—so that a coin is not allowed to exceed 903 in fineness, or 897 in alloy.

The object of the various regulations which have determined the coinage in France, was to make every species of coin harmonise with a decimal system, not only as regarded money, but every calculation of weights and measures.

The law of the 7 Germinal, year xi. (28th March, 1803), decided that the currency should consist of—

In gold —Pieces of 40 francs and 20 francs.
„ silver — „ of 5f., 2f., 1f., $\frac{3}{4}$f. = 75c., $\frac{1}{2}$f. = 50c., $\frac{1}{4}$f. = 25.
„ copper — „ of 10c., 5c., 3c., 2c.

It will be seen, however, that many of these coins were rather introduced to facilitate transactions than to represent decimal divisions. In process of time the non-decimal coins have almost wholly disappeared, and the only pieces now issued are—

Gold, of 20 and 10 francs.
Silver, of 5, 2, 1 francs, and 50 and 20 centimes.
Copper and bronze, of 10c., 5c., 2c., and 1c.

The standard in France has a decimal foundation—namely, 1-10th, or 9 parts of pure gold and silver, and 1 of alloy.

In gold, the proportions of pieces of 20 francs to those of 10 francs is 9 to 1.

In silver, the proportions are 1-40th part in the following coins:—

50	in pieces of	2 francs.
120	„	1 franc.
65	„	50 cents.
15	„	20 „
250		

The rest in pieces of 5 francs.

The mint is dependent upon the Ministry of Finance.

The Belgian coins and modes of account generally agree with those of France, though, in some parts, the Dutch currency is maintained.

In Holland, the guilder or florin is the money of account, and is divided into 100 cents—the value of the florin being about twenty pence.

In Geneva the French currency prevails. In Bâle, the Swiss franc, whose value is about 13½d., is divided into 100 raps or cents.

In Lombardy and Vienna, the Austrian lira = 8·13d., is divided into 100 centesimi.

The Neapolitan ducat = 3s. 4d., is divided into 100 grani.

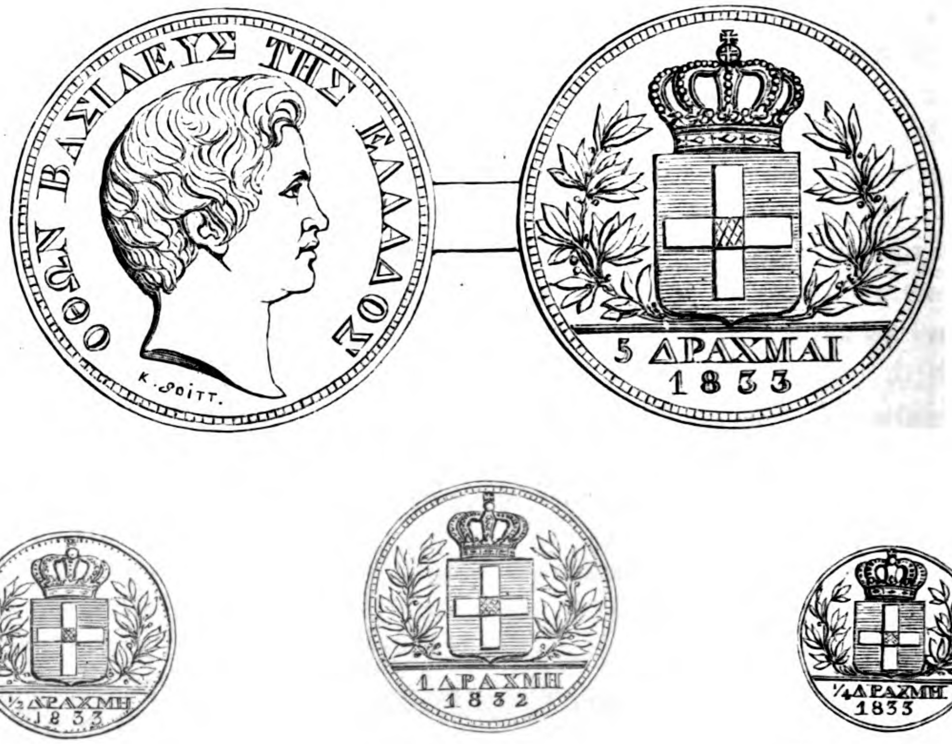
Rome divides the *scudo romano* = 50·5d., into 100 *bajocchi*.

The *lira nuova* of Genoa and Sardinia is equal to the French franc, and is divided into 100 centesimi.

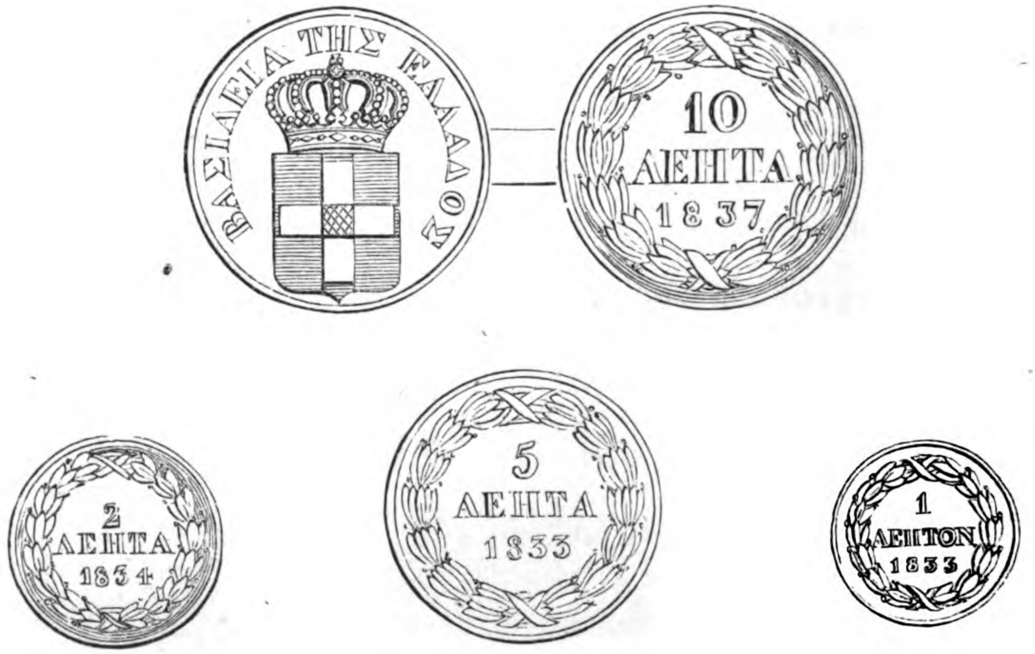
In Tuscany, the *lira toscana*, = 7·82d., is divided into 100 centesimi.

The dollar of Spain, divided into 100 cents, now established by law, is gradually superseding the ancient forms of villon rials, and maravedis.

GREEK COINS.



GREEK SILVER COINS.



GREEK COPPER COINS.

In Portugal and Brazil the milrei is the money of account, and is divided into 1,000 reis.

A project for decimalising the currency of Sweden and Norway has now been prepared by the authorities of these countries; and Austria and Prussia have under consideration a plan for decimalising the currency of Germany.

The decimal coinage and accountancy of Greece are established by a law of the 8th Feb. (O.S.) 1833. The unit is the drachma, which is divided into 100 lepta; and in these two denominations all accounts are kept. The sterling value of the drachma is about 8½d. Six are equal to a Spanish dollar.

The gold coins are of 40 and 20 drachmas;
The silver 5, 1, ½, and ¼ drachmas;
The copper 10, 5, 2, and 1 lepta;

Ten coins in all; which are abundantly adequate to all purposes of currency. As these coins represent the latest application of a decimal system, fac similes are here given.

The Canadas have proposed to adopt the American dollar as the integer of accounts, to be divided into 100 cents, according to the now universal usage of the United States of America, and which has been adopted by all the Central and South American States which were formerly the colonies of Spain.

In China and Japan, an integer of account is the *tael*, or ounce of pure silver. It is divided into 1,000 cash = 100 candereens = 10 mace. The sterling value of the tael is about 78d.

CHAPTER X.

COLONIAL CURRENCY.

In the British colonies, an arbitrary system has been introduced, of keeping all the public accounts in pounds, shillings, and pence sterling. No matter in what coins or currency the transactions of commerce really take place—no matter what may be the usages of merchants, or the habits of the people; in utter disregard to the loss of revenue, to the difficulties of adjusting contracts, and to the innumerable inconveniences which are connected with two systems of accountancy in the same locality, English coins and English denominations have been adopted for all receipts and payments in the public departments. In countries where the pound sterling is unknown to commercial book-keeping, and where its value is subject to perpetual fluctuations, an unchangeable value has been affixed to it by royal proclamation. The errors of legislation may to a great extent be traced to ignorance or miscalculation of the *powers* of legislation,—and no error is more common than the supposition, that the exchangeable value of coins and currency can to any considerable extent be regulated by law. In Hong Kong, for example, her Majesty's orders in Council have proclaimed that a Spanish pillar dollar and a dollar of Mexico shall have the same current value,—in the face of a notorious fact, that the Spanish dollar is habitually received at a premium of from 2 to 10 per cent. above the Mexican. A sovereign is ordered to pass for 4 dollars and 80 cents, though it sometimes (gold not being current in China) will not produce within 8 to 10 per cent. of that value, and, in the ports of China, has been known to be at a discount of more than 20 per cent. The fluctuations of exchange are a necessary result of the fluctuations of supply and demand, and can no more be controlled by laws or ordinances than can the flux or reflux of the tides. A memorable instance of the blindness and impotency of legislation may be found in the resolution of Mr. Vansittart, affirmed by Parliament, that a bank-note and a shilling were equal in value to a guinea. This was but one form of averring that 21 shillings were equal in value to 28!

In legislating with reference to coinage and currency, it ought never to be forgotten that the *intrinsic* value of a coin by no means establishes its *exchangeable* value. The relative values of different metals is notoriously subject to many fluctuations; but, as regards coins of the same metal, habit often gives to coins of a particular mintage an unreal and almost capricious value. The Chinese are accustomed to make their larger payments in Sycee silver, a metal of great purity; and the art of assaying metals is pretty extensively known. Hence the shroffs and money-dealers are quite aware of the fact, that the dollars of the different American States are intrinsically of nearly the same value as the Carolus or pillar dollar of Spain. Yet, in every one of the trading ports of China, the Spanish dollar invariably passes at a considerable premium, sometimes as high as 10 per cent. upon the dollars of other countries; and frequently, though the dollar of Spain has only 910 parts of 1,000 of pure metal, it is of equal value in weight to the Sycee silver, which averages 980 parts of pure metal to the 1,000.

In 1825, the British Government determined to introduce British currency into all the colonies. The effects have been thus described:—

"On the introduction of British silver coins into the colonies, instructions were given to the officers of the commissariat to grant bills upon her Majesty's treasury, at the rate of £100 for £103 (afterwards reduced to £101 10s.) of British silver. This measure, it was expected, would secure to the silver the same extrinsic value which it possessed in the mother country, and render it a more useful and convenient instrument of circulation than the degraded coins, or bits of coins, then circulating in the colonies.

"These expectations were not realised. Not only was the concurrent circulation of the Spanish dollar, and the British silver, rendered impossible by the erroneous adaptation to each other of the rates respectively assigned to them, but the free circulation of both was impeded by the high proportionate rate at which the gold coins of Spain were a legal tender." *

* "Currency of British Colonies," pp. 54-5. The simple fact is, that there can be no adaptation of different currencies to one another, which will not be disturbed and overthrown by circumstances wholly beyond the control of legislation; and it would be quite as reasonable to declare by Act of Parliament that so many cwts. of sugar should

In 1838, the arrangements of 1828 were superseded as regards the West India colonies. The 16 dollar piece (Spanish *onza*), generally known as the *doubloon*, was to be received for 64s., the dollar at 4s. 2d. This was deemed a "correct adjustment" of what can never be adjusted. In Jamaica, the legislature adapted the royal proclamation to the currency of their island by declaring that £166 13s. 4d. (Jamaica currency) should represent £100 sterling, or, in other words, that the island currency should become sterling by a deduction of 40 per cent., and the gold and silver coinage of Spain was regulated accordingly.

In Guiana a decimal system was introduced in 1839, the accounts being kept in dollars and cents, which superseded the more ancient Dutch form of guilders, (=20) stivers, (=16) pennings, and it was ordered that 3 guilders should represent 1 dollar currency. But whatever be the real value of the dollar, the public accounts reckon it at 4s. 2d., as in the other colonies.

In the British provinces of North America, though accounts were kept and bargains made in pounds, shillings, and pence, the Spanish dollar was considered the principal measure of exchange, and the basis of money contracts, and it was rated at 4s. 6d., corresponding with the value given to it by Sir Isaac Newton in 1717. But as, in common language, the dollar was divided into five shillings, the nominal par of exchange with England was computed by adding one-ninth to the valuation of the dollar; so that £111$\frac{1}{9}$, or £111 2s. 2$\frac{6}{9}$d. (Halifax money), represented £100 sterling. The division of the dollar into shillings—no doubt to accommodate new moneys to old names—has prevailed in many parts of the world which have been colonised by Englishmen. In New England the dollar is six shillings; in New York, eight shillings; in Pennsylvania, seven shillings and sixpence; in Nova Scotia, five shillings; in Upper Canada the shilling was valued at fourteen pence, and fifteen since 1836; in Lower Canada, it was thirteen pence; in Nova Scotia, fifteen pence. It would seem far more easy to introduce a new value into accounts than a new name into popular language. The sterling value of a dollar being estimated at 4s. 2d., the par of exchange should now be £120 Halifax cur-

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be received in exchange for so many pounds of wool, as to fix the relative values of different coins. The *law* says that the dollar in Hong Kong shall be 4s. 2d.; at the time when I write (October 1853), 5s. 7d. must be given for a dollar.

rency for £100 sterling, or 480 dollars at 4s. 2d. In Lower Canada the guinea had the official value of £1 3s. 4d.; the British crown, 5s. 6d.; the Spanish dollar, 5s. In Upper Canada the British crown was, by an act of 1827, rated at 5s. 9d.; the Spanish and American dollar, at 5s.; and the sovereign, in 1836, was made a legal tender at £1 4s. 4d., and the crown at 6s.; but the dollar was made equal to 4s. 2d. sterling, and to 4s. sterling in English shillings. The effect of this arrangement was of course to drive out the coins to which a high value was given, and replace them by those of a low value. Twenty shillings were worth £1 5s. currency, while the sovereign was represented by 8d. less, or £1 4s. 4d., the par of exchange between Canada and Great Britain. Gold against gold is, in Canada currency, £121 13s. 4d. for £100 sterling: but, for silver against gold, £122 5s. 6d.

The Nova Scotia currency was arranged in 1836 and 1842, by adding one-fourth to the pound sterling, and thus making £125 currency to represent £100 sterling. The dollar was estimated at 5s. 2½d., the crown at 6s. 3d., the doubloon at £4, agreeing with the proclamation of 1838.

In New Brunswick the currency is, in sovereigns, at £1 4s.; United States eagle, £2 10s.; dollars at 5s.; crowns at 6s., and the aliquot parts in proportion. Excepting that the eagle is overvalued—(with reference to the sovereign, it should represent £2 9s. 3d.)—the currency would be convertible into sterling by deducting one-sixth from any given amount.

The Newfoundland currency is not regulated by enactment. The dollar passes for 5s., and as its supposed value is 4s. 4d., the par of exchange is called £115 7s. 8d. per £100 sterling; but as the sterling value of the dollar is over-estimated, bills on England generally bear a premium of 4 to 6 per cent. The shilling fluctuates from 1s. 2d. to 1s. 3d.; but the shifting value of the currency often creates confusion and inconvenience.

The currency in Bermuda previously to the proclamation of 1838, which fixed the value of the doubloon at 64s., and the dollar at 4s. 2d. sterling, was most irregularly provided for. The Legislature decreed that £150 currency should represent £100 sterling; but the colonial treasury, requiring three dollars at 4s. 4d. for every pound sterling, exacted £153 16s. 7d. currency for every £100 sterling; while, among individuals, the shilling was paid at the rate of four to the dollar, so that £100 sterling was represented by

£166 13s. 4d. currency. In 1842, the English currency was established in all accounts, and all existing contracts in the currency of the island were directed to be settled at the rate of £1$\frac{2}{3}$ currency = £1 13s. 4d. per pound sterling.

It will be seen that strange contradictions, anomalies, and absurdities are to be found in the systems of currency of the various British colonies, which must be all attributed to the desire of giving fixity to that which is in its very nature shifting. The perpetual fluctuations of foreign exchanges show that no law can make them stationary. In fact it would be as reasonable to require by legislation that quicksilver should be made into solid bars for the everyday purposes of life, as to decree that the relative values of different objects shall be inexorably maintained.

In the colony of Gibraltar, it has been directed, by an order in Council, dated 23rd March, 1845, that Spanish, Mexican, and South American dollars, shall be legal tenders at 4s. 2d. sterling each; and that the gold doubloons, or 16 dollar pieces, of the same countries, shall pass for £3 6s. 8d. Commercial accounts are kept, and trading operations are carried on, in dollars and cents. The exchange value of the dollar is not, and cannot be fixed by authority, except in the cases of public servants and others, who are not in a position to object to the conditions imposed by the Government. Complaints are frequently and naturally made by soldiers and others of the operation of the currency regulations, which subject a nominally fixed and certain pay to all the fluctuations of a varying exchange.

In Malta, accounts are kept in *scudi*, *tair*, and *grani*—

1 scudi = 12 tair = 240 grani.

But the nominal currency is in pounds, shillings, and pence sterling, the pound being (by proclamation) 12 *scudi*, the shilling 7 tair and 4 grani, the penny 12 grani. As, however, doubloons and dollars form the principal circulating medium in Malta, it was ordered, in 1845, that the Spanish or South American dollar should pass for 4s. 2d., or 30 tair, and the dollar of Sicily for 4s., or 28 tair and 16 grani. The proclamations which regulate the currency are founded on the "intrinsic value" of the coins which are made a legal tender, in forgetfulness or inattention to the fact, that the intrinsic and exchangeable or commercial value are by no means identical, and cannot be made identical by the powers of legislation. The introduction of a decimal system into our currency and accounts will greatly assist the establishment of sound principles of exchange between the mother country and her dependencies. Where there is no currency but British coins, and while all accounts are kept in pounds sterling, there is no difficulty in matters of exchange; but wherever accounts are kept, and commercial transactions carried on, in other than British currency, that currency must fluctuate in exchangeable value, and there ought to be no attempt to give it a false and fictitious import.

Were it only that the relative value of silver and gold is subject to perpetual change, it would be obviously impossible for any country adopting a gold standard to fix an invariable rate of exchange with a country having a silver standard; but there can be no such invariable rate even between countries which have the same standard, inasmuch as the demand for money in a particular place, or at a particular time, may increase or diminish its commercial value, without reference to its intrinsic value.

On the western coast of Africa, accounts in the British possessions are generally kept in pounds, shillings, and pence; but in consequence of a nominal value of 80s. per ounce given to gold dust, which is the principal article used for receipt and payment—which gold dust, when remitted to England, *nets* only about £3 12s. per ounce—the pound sterling is generally at a premium of about $11\frac{1}{9}$ per cent.—in other words, £100 currency, or 25 ounces of gold dust, are given for a bill upon London of £90 sterling. In the Gambia settlement, accounts are kept in current pounds, sterling pounds, or dollars and cents, according to the caprice of the merchant.

In the island of St. Helena, the principal circulation is in doubloons, which are made legal tenders at 64s. sterling, and dollars of Spain, Mexico, and South America, at 4s. 2d. In the year 1843, when these rates were established, the commissariat called in all such money as had previously been current, and paid for them at the established rate.

The currency of the Cape of Good Hope, from the period of its conquest by the British down to 1835, was an inconvertible paper, in which the rix-dollar, whose metallic value is about 4s. sterling, was represented by an exchangeable value of 1s. 6d. This was about the depreciation inherited from the time of the Dutch occupation, when the premium of bills on Holland was 160 per cent. The public accounts are now kept in pounds, shillings, and pence sterling. Some private persons retain the ancient usage of reckoning in rix-dollars, skillings, and stivers, whose values, reduced to British currency, are—

1 Stiver	0s. $0\frac{3}{8}$d.
6 Stivers = 1 Skilling . .	0s. $2\frac{1}{4}$d.
1 Rix-Dollar = 8 Skillings . .	1s. 6d.

Fixed property is sold at auction in guilders, each equal to 6d. sterling.

An order in Council of 1843 established the pound sterling as the money in which the public accounts are to be kept in the Mauritius, and gave to the coins ordinarily circulating in the colony the following values:—

The E. I. C. Gold Mohur . . .	29s. 2d.	$7{\cdot}29\frac{1}{8}$	In Mauritius dollars.
Napoleon of 20 francs	15s. 10d.	$3{\cdot}95\frac{5}{6}$	
Dollars of Spain, Mexico, and South America	4s. 2d.	$1{\cdot}4\frac{1}{6}$	
E. I. Rupees	1s. 10d.	$\cdot45\frac{5}{6}$	
5 Francs	3s. 10d.	$\cdot96\frac{21}{29}$	

But the inconvenience of these fractions has led the population to receive the rupees at the rate of two to the Mauritius dollar, so that its sterling value, in spite of the order in Council, is really 3s. $8\frac{2}{5}$d. instead of 4s. Thus British coins have been practically excluded, and rupees have become the main currency of the island. British coins bear a premium of from 4 to 6 per cent., and are used only in transactions with the British Government.

Down to 1825 the island of Ceylon had a currency of its own, consisting principally of silver rix-dollars, and inconvertible Government paper rix-dollars, which usually circulated at a depreciation of about 10 per cent. Since 1825, the public accounts, by order in Council, are kept in sterling moneys, at 4s. 2d. the Spanish dollar, 2s. the Sicca rupee, and 1s. 10d. the rupee of Madras and Bombay; but in commercial transactions and accounts, the Sicca rupee supersedes the sterling currency, whose value is determined, not by the order in Council, but the more influential laws of supply and demand. Government paper circulates, which is convertible into such coins as have a *legal* value; but the *exchangeable* value, which after all is the only *real* value, as far as receipts and payments are concerned, seldom or never agrees with the proportions fixed by the ordinance, either as regards the proportions which one coin should bear to another, or any coin to the standard pound sterling.

I have referred to Hong Kong as being an example of bad legislation in currency questions. No case more clearly, and, as far as the public service is concerned, more injuriously exhibits the absurdity of attempting to maintain, and the impossibility of maintaining, various coins at a fixed and invariable value, than is displayed in the legislation of the youngest of our colonial possessions—the island of Hong Kong. The order in Council now in operation directs that the public accounts shall be kept in sterling money, but that all money contracts may be legally in gold mohurs, at the rate of 29s. 2d.; in the dollars of Spain, Mexico, and South America, at 4s. 2d.; and in rupees, at the rate of 2s. sterling; and that the currency of England shall circulate in the island at its standard value.

But as the monetary transactions of Hong Kong are small and those of the adjacent continent of China enormous, all the accounts, except those of public functionaries, are kept in Spanish dollars alone.

Neither is gold as a metal, nor the sovereign as a coin, known or negotiable in China, except for the fluctuating value of the gold itself; and in the ports of Spain, at Shanghai for example, the sovereign is sometimes at a discount of 22 per cent.

Though the order in Council declares that the dollars of Spain, Mexico, and South America, shall represent the same value of 4s. 2d. each, there is such a preference given to the Spanish dollar, which is the only coin by which the transactions of foreign commerce are regulated, that it bears a premium varying from 2 to 15 per cent. The exchangeable value of rupees also fluctuates in a similar manner. As English coins are thus depreciated, there would be a loss either to the public service or to public servants to the extent of that depreciation, except that, where money is wanted for transmission to England, the exchange, which is almost invariably higher than the ordinance value, gives to the remitter the difference between the 4s. 2d. and the real rate of the exchange. But the Government loses all the benefits of the greater exchange value of the dollar. It has been stated, that the motive for giving the same legal value to the dollars of different nations, was the expectation that such assimilation of value in coins of the same intrinsic worth would lead to the removal of prejudices from the Chinese mind in favour of a particular coin. The result has proved the utter impotence of such legislation, as the difference between the exchangeable value of the dollars of

Spain and America has never been so great as since the existence of the order in Council which declared their values to be equal. Changes in language are slowly introduced. In the United States of America, we are told, "People are extremely reluctant to change their pounds and bushels, by which they are accustomed not only to measure, but to speak and think. Before our own revolution, we had the cumbrous nomenclature of pounds, shillings, and pence, brought from the mother country; and although advantage was taken of our new political condition to introduce a decimal system of money, it required many years to accustom the people to the alteration. It was common to reduce dollars and cents to shillings and pence before they could be well apprehended."*

But a decimal system of book-keeping has gradually penetrated into most of the British colonies, which the colonial ordinances have been made to subserve. Canada has lately emancipated herself from ancient trammels by adopting the decimalised accountancy of the United States; and there can be no doubt that the example of the mother country, in adopting a decimal system in coins, weights, and measures, would be speedily followed by all her dependent colonies.

* Eckfeld and Dubois, p. 53.

CHAPTER XI.

CHINESE NUMERALS AND THE ABACUS.

The Chinese notation is thus given by Morrison (Dict. p. 466):—

	0	jit	1
十	1	shit	10
百	2	pĭh	100
千	3	tseen	1,000
萬	4	wan	10,000
億	5	yĭh	100,000
兆	6	chaon	1,000,000
京	7	king	10,000,000
垓	8	kai	100,000,000
秭	9	tsze	1,000,000,000
穰	10	jang	10,000,000,000
溝	11	kow	100,000,000,000
澗	12	keen	1,000,000,000,000
正	13	ching	10,000,000,000,000
載	14	toai	100,000,000,000,000
極	15	keit	1,000,000,000,000,000
恆河沙	16	hang ho sa, sands of the Hang river,	10,000,000,000,000,000
阿僧祇	17	o-sang-te,	100,000,000,000,000,000
那由他	18	na yew ta "where is it?"	1,000,000,000,000,000,000
不可思議	19	put ko sze e, "inconceivable,"	10,000,000,000,000,000,000
無量數	20	woo leang so, "infinite number,"	100,000,000,000,000,000,000

He adds, that 321,987,654,321,987,654,321, in European notation, carried, as above, to twenty-one places of figures, would amount to three hundred and twenty-one trillions, nine hundred and eighty-seven thousand six hundred and fifty-four billions, three hundred and twenty-one thousand nine hundred and eighty-seven millions, six hundred and fifty-four thousand three hundred and twenty-one.

Besides the notation 以十進者, advancing decimally as above, some 以萬進 advance by tens of thousands, as 萬萬曰億 ten thousand times ten thousand are called *yĭh*, ten *yĭh* are called *chaon;* and others, 以自乘數進 advance by multiplying every number into itself, or squaring it, as 萬萬曰億 億億曰兆. *Wan wan yue yĭh, yĭh yĭh yue chaon,*—ten thousand times ten thousand are called *yĭh*, or million; a million times a million are called *chaon*, or a billion.

The Chinese have a complicated character to represent a cipher 零, *ling*, all whose purposes are quite as efficiently answered by the dot or small circle of the Arabs.

There is a form of digital decimals among the Chinese, by which they express from the left hand any number up to 100,000. The little finger exhibits the 9 digits, the second finger the tens, the hundreds are shown on the third, thousands on the fourth, and tens of thousands on the thumb. Every joint is reckoned three times, first by passing up the external side, then down the internal middle, and then down on the other side. And Dr. Peacock remarks, that the employment of the other hand might be used to extend much farther this system of numeration, by continuing the progression of decimal figures. This process will be easily understood by making the first joint of the little finger, reckoned from the outside, to represent 1, the second joint 2, the third joint 3; then taking the inside of the finger, the first joint represents 4, the second 5, the third 6; then, beginning again with the third joint outside, it counts for 7, the second joint for 8, and the first joint for 9,—exactly the same process being carried on for the tens with the joints of the ring finger, for the hundreds those of the middle finger, the thousands those of the fore finger, and the ten thousands those of the thumb.

Like most other nations, the Chinese took their standard of measurement from the human body. They have a proverb which says, "The rule for *pun*, *che*, *chĭh*, *tsin*, *chang*, and *jin*,* is taken from the human body." The foundation of the land measure is the *kiver*, or one step. A decimal system is found in

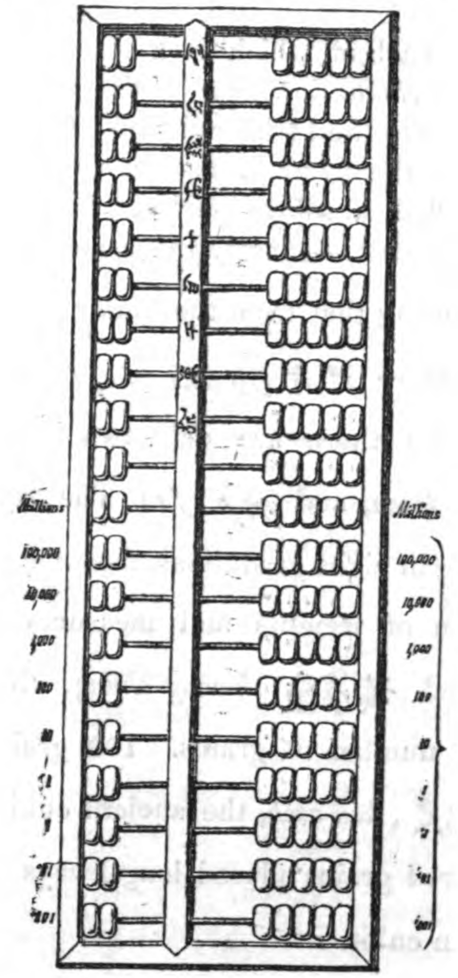
* 咫尺尋常仞 These are various measures of length.

the long measure, each of which is a decuple of the adjacent number. From the *chang* downwards, the measures descend in simple monosyllables to the 14th gradation, after which compound terms are used; at the 22nd gradation, the measure is called *vacancy*,—at the 23rd, absolute purity. Weights descend also from the *leang*, or ounce,—exactly the same signs being used as the measures, excepting that from the *chang* 丈 to the *fun* 分 there are three grades—尺 寸 分 *chih, tsin, fun*,—in the measures, while in the weights there are only two from the 兩, *leang*, to the *fun*, 錢, *tseen*, and 分, *fun*. The dry measure is also decimal, descending in eight gradations, from the *shih* 石, or *stone*.

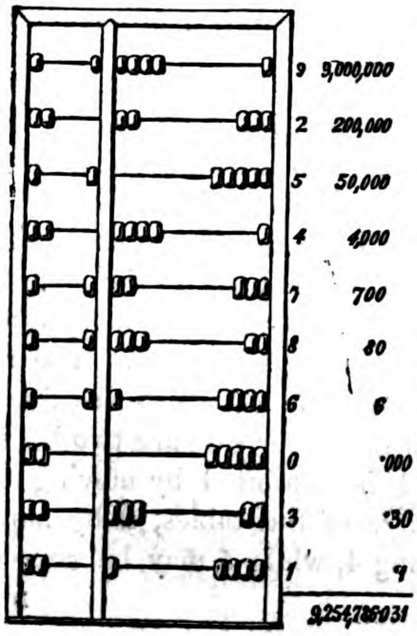
The foundation of weights and measures in China is the musical reed called 黃鐘, *hwang chung*, which was supposed to hold a certain number of grains. 100 grains placed crosswise made the 古尺, *koo chĭh*, the ancient cubit, equal to about 10 inches; a hundred grains placed lengthways make the 今尺, *kin chĭh*, or modern cubit.

The abacus, or *swan pan*, 算盤, which is sometimes called the *soo pan*, 數盤, is the instrument universally employed for account keeping throughout the Chinese dominions and their dependencies. Its value consists in the facilities it affords for decimal calculations. It is a table across which are fastened a succession of equidistant wires, upon which wires move balls,—the balls on every wire representing ten times the amount of the balls upon the wires beneath it,—that is to say, the balls on the lowest wires represent units; those on the next above, tens; the next hundreds, then thousands, then tens of thousands, and so on. The table is divided into two parts, upon one side of which are five balls, each representing one; and on the other side are two balls, each representing 5. The number 1 is exhibited by moving *one* ball from the five towards the centre of the tables, 2 by moving 2, 3 by moving 3, and 4 by moving 4, while 5 may be represented

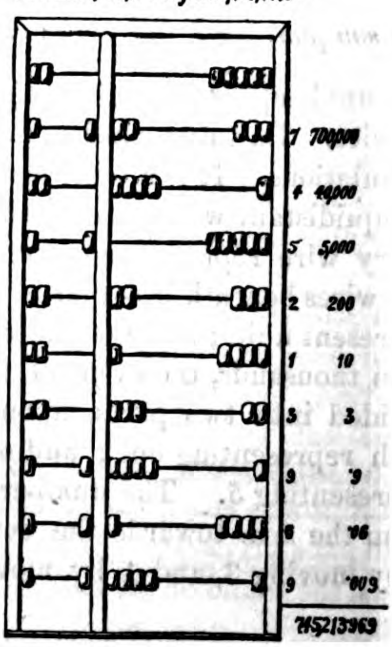
CHINESE ABACUS WITH SUMS WORKED.



Add 9,254,786·031



Subtract 9,254,786·031 from 10,000,000.



either by moving the whole 5 balls from one side, or one ball from the other. To work a sum in addition, whenever the amount reached is 10, a ball is added to the wire above;—so, when the addition exceeds 100, *one* is added to the next wire,—so for 1000 to the next; and so onwards, a multiplication by 10 being always represented.

The word *swan pan* is composed of 竹 (*chuh*), bamboo, whose abbreviation is ⺮ and 弄, or 具 廾, or 卄, being to play.

There is a sentence in Chinese which everybody learns, as we learn the multiplication table:—

十十為百十百為千十千為萬十萬為億十億為兆

Shit shit wei pih,
Shit pih wei trien,
Shit trien wei wan,
Shit wan wei yih,
Shit yih wei chaon.

That is:—

Ten tens are a hundred,
Ten hundreds a thousand,
Ten thousands a wan = 10,000
Ten wans a yih = 100,000
Ten yihs a chaon = 1,000,000

At early morn, one of the first sounds heard in the shops of all the towns and cities of China, is the shaking and cleaning the swan pans preparatory to the business of the day. As, in Christian lands, the sound of the bells calls the worshippers to church—as, in

Mahomedan countries, the voice of the Muezzin from the minarets bidding the devout Mussulmans to prayers—so, in "the middle kingdom," the rattling of the abacus announces that another morning's labours are begun.

With that instrument the Chinese youth has been as familiar as with his hemetrical classic, the first and most popular of his school-books. From it he has received the most correct impressions of the relations of numbers to one another; and he has acquired the habit of moving the balls on the wires of his swan pan with considerable dexterity and rapidity. Wonderful are the ease and accuracy with which all calculations are made and recorded. In my own person I have had to settle a great variety of accounts with various classes of people in China, and I never remember to have detected an error; and in cases where my reckoning has disagreed with that of the Chinese, I have invariably found that their amount was correct, and my own erroneous. In China it might almost be laid down as an axiom, that a mistake in an account is in itself strong evidence of fraudulent intention. I have compared my observations with those of persons of the longest and most extensive experience as to the general correctness of Chinese accountancy, and my opinion has been fully confirmed, that among Chinamen intending to be honest, an error in reckoning is almost unknown.

In the Chinese mind, the proportions and distances between units, tens, hundreds, thousands, tens of thousands, hundreds of thousands, and millions, as well as the decimal division of the unit into a thousand parts, are as clearly presented as to our minds the differences between one unit and another. The decimal scale is like the steps of a ladder, which the Chinese youth is taught to ascend and descend with inconceivable agility. His fingers play with the balls representing the various values of decimal notation, as a practised musician with the keys of a piano. The higher numbers being subjected to exactly the same process as the lower, present equally clear conceptions to his thoughts. According to our system of addition or subtraction, it is absolutely necessary that the work should begin with the units on the right hand, and so proceed through the higher denominations towards the left; but with the abacus the process is carried on merely by adding or subtracting each denomination to or from its own, it being indifferent whether the operation is commenced from the higher or the lower denomination.

The recommendations of the abacus are found in its simplicity, and the rapidity and ease with which calculations are made, and the security it gives to the accuracy of results. Where, as in most cases, two persons are interested in a calculation, there are three ways in which the operation may be performed—either by a simple abacus, where one party moves the balls along the wires, the operation being watched by the eye of the other; or where a double abacus is used, by which the calculations can be simultaneously and separately carried on at the two ends; or where each of the parties has a distinct abacus of his own.

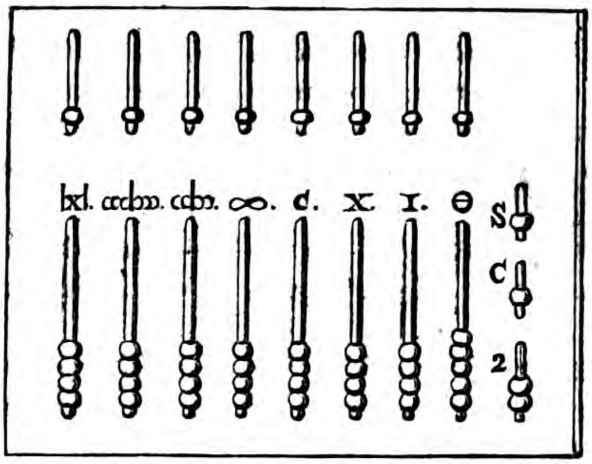
There is generally confidence enough in the person making the calculation, so that a second reckoning is scarcely ever deemed necessary as a check upon the first. The Chinese are trained from their infancy to the greatest agility in the use of their fingers. They are taught to use the chop-sticks, *kwai tsze*, to convey their food to their mouths; and the beautiful specimens of carving in wood and ivory are remarkable evidence of their dexterity, to which the employment of the abacus in the elementary schools essentially contributes.

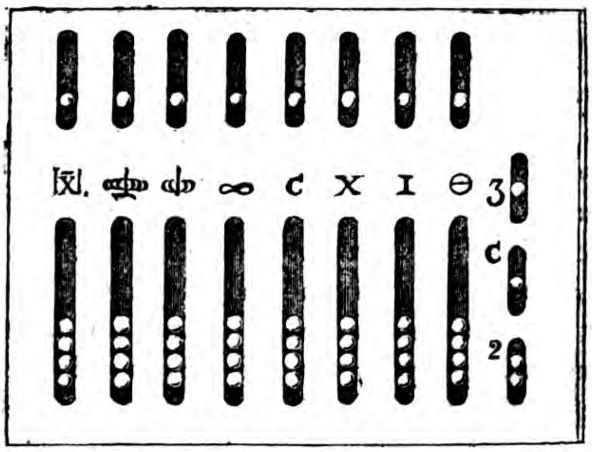
Whenever a servant in China comes to settle accounts with his master, he brings his *swan pan* with him; and I have invariably found, that as rapidly as I had noted down the items of an account, my servant had correctly added up all the amounts. My habit was fortnightly to settle my household accounts; they comprised a great variety of matters, and I never recollect having detected an error in the calculations of my servants. Very frequently, in the multitudinous trifles which formed the items of account, there were differences between my reckonings and those of the Chinese; but I do not recollect any instances in which re-examination did not prove me to have been in error; and I always found the additions made quite as fast as I could run over the figures—in fact, so rapid is the motion of the balls upon the wires in the hands of a dexterous calculator, that the eye cannot follow the movements, and the operations appear rather like triumphs and tricks of legerdemain, than the exercise of a universally acquired habit—so universal, that it would be an opprobium not to possess it.

The *Abacus* is frequently referred to by ancient authors.

Horace speaks of boys going to school with the table and counters suspended on their left arm.*

ROMAN ABACUS.





There is an imperfect *abacus* sometimes used in our schools for teaching the multiplication table. It consists of 12 rods, on each of which are twelve moveable balls. A still simpler *abacus* is employed to teach the numeration table, which has only 6 wires, upon which a number of balls circulate.

An *abacus*, but much less simple and efficient than the Chinese, is described by Dr. Peacock.† Counters were used for the pur-

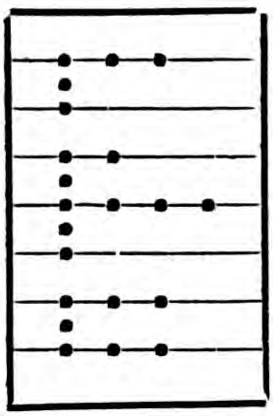
* Quo pueri magnis e centurionibus orti,
Lævo suspensi loculos tabulamque lacerto.
Sat. 1 vi., p. 75.

† Pp. 409-10.

pose of carrying on this process; and as the whole partakes of a decimal character, the explanatory extract is here given at length.

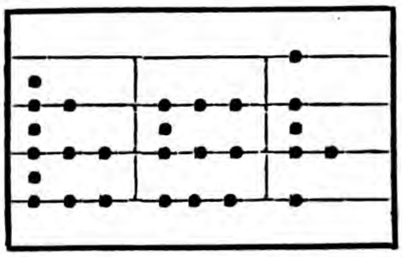
"They commenced by drawing seven lines with a piece of chalk, or other substance, on a table, board, or slate, or by a pen on paper; the counters (which were usually of brass) on the lowest line represented units, on the next tens, and so on as far as a million on the last and uppermost line; a counter placed between two lines was equivalent to five counters on the lower line of the two. Thus the disposition

NOTATION.



of counters in the annexed example represents the number 3,629,638; and it is clearly very easy to increase the number of lines, so as to comprehend any number that might be required to be expressed.

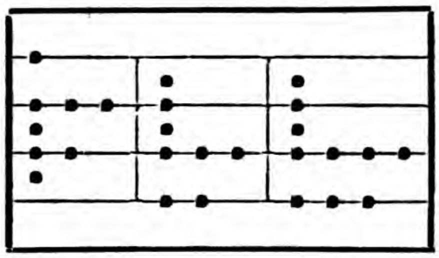
"ADDITION.—Suppose it was required to add together 788 and 383,



express the numbers to be added in the two first columns. The sum of the counters on the lowest line is 6; write, therefore, 1 on that line in the third column; carry one to the first space, which, added to the 1 already there, is equal to 1 on the second line; place a counter there, and add all the counters on that line together, the sum is 7; leave, therefore, two counters on that line together, and pass one to the next space; add the counters on that space together, which are three; leave one there, and place one also on the next line; add all the counters on that line together, the sum is 6. Leave one counter, and pass another to the next space ; add all the counters on that space together, which are 2 ; leave no counter in the space, but pass one to the next, or fourth line ; we thus represent the sum, which is 1,171.

"The principle of this operation is extremely simple; and the process itself, after a little practice, would clearly admit of being performed with great rapidity. In giving a scheme of this operation, we have made use of three columns ; but in practice no more would be required than are sufficient to represent the sums to be added, the counters on each line being removed as the addition proceeds, and being replaced by the counters which are requisite to denote the sum.

"SUBTRACTION.—We shall now proceed to a second example—namely, to subtract 682 from 1,375. Write the numbers in the first



and second columns. The two counters on the last line have none to correspond to them in the minuend; bring down the counter in the first space, and suppose it replaced by 5 counters ; take away two, and three remain on the lowest line of the remainder. Again the three counters on the second line must be subtracted from 7, (bringing down 5); and therefore leaving 4 on the second line of the remainder.

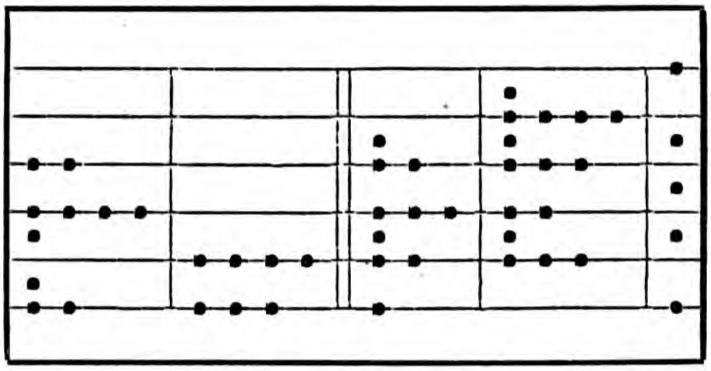
"The counter on the second space has now no counter corresponding with it in the minuend ; remove one counter from the next line, and replace it by two counters in the next inferior space ; there will remain, therefore, one counter for that space in the remainder.

"There is now one counter on the third line to subtract from two in the minuend, and there remains one for the remainder. The counter in the next space has nothing corresponding to it ; and we must, therefore, bring down the counter on the highest line and replace it by two counters in the space below it ; if one counter be subtracted from them, there will remain one, and the whole remainder will be 693.

"Recorde writes the smaller number in the first column, and commences the subtraction with the highest counters ; and very little consideration will show in what manner the operation must be performed, with such a change in the process.

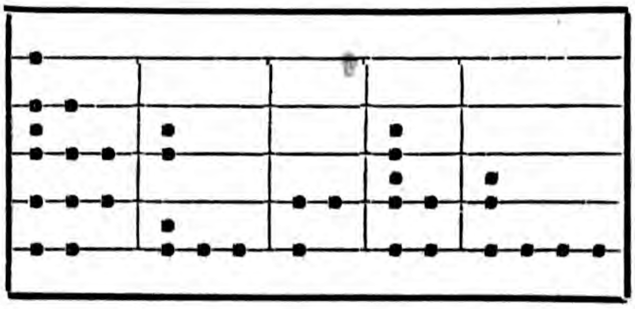
"MULTIPLICATION.—We shall now give an example of multiplication ; and let it be proposed to multiply 2,457 by 43.

"Write the multiplicand in the first column, and the multiplier in the second; multiply first by three, and write the product in the third column, and then by 4 in a superior place, and write the result in the fourth column; add the numbers in these two columns together, and the sum is the product required.



"DIVISION.—We shall conclude with an example of division; and let it be required to divide 12,832 by 608.

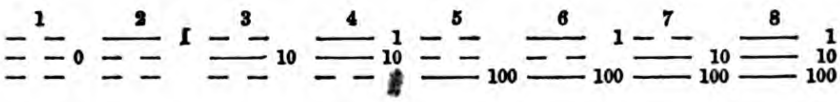
"Write the dividend in the first column, and the divisor in the second, reserving the third for the quotient; then, since 6 is contained twice in 12, in the line above that in which 6 is written, we



may put down 2, in the last line but one in the column for the quotient; multiply 6 by 2, and subtract; there is no remainder; multiply 8 by 2, and subtract 16 from the number expressed by the counters remaining in the dividend in the line above the last; first take one counter from the three in the third line, and two remain; next take 6, which is done by taking 1 from the second line from the bottom, and bringing 1 from the third line, replacing it by 2 in the space below, and then subtracting one of them, thus leaving 67 in the remainder, to be denoted in the second and third lines and the spaces above them; the remaining two counters in the dividend are transferred to the corresponding line in the column for the first remainder; the operation is now repeated, the next figure in the quotient, as 1, being written on the lowest line; it is now merely necessary to subtract the divisor from the first remainder, and we get 64 to the second and last remainder. It is evident that the same process may be repeated to any extent that may be required; and that the complication of the process as exhibited in a *scheme* is much greater than in practice, when the dividend is replaced by the first remainder, and so on successively until the remainder is *zero*, or less than the divisor."

There is an instrument frequently seen in the houses and buildings of China, called the Lines of Fohi, to which mysterious virtues are attached. The broken lines represent *zero*, entire line

units; and it will be seen, that taking the top line to represent digits, the second line ten, and the third hundreds, the result will be that the following numbers will be represented:—



The Jesuits lauded this instrument as containing the elements of all knowledge, and as a part of revelation from the greatest of sovereigns and philosophers, by which all the revolutions of the celestial orbs were to be calculated, and all the mysteries of nature developed and explained. But they do not give us the key to the mystery, or interpret the teachings of the oracle.

CHAPTER XII.

COINS, MEDALS, ETC.

In sending forth a book connected with decimal coinage, it is scarcely fitting to pass over unnoticed that portion of the field of history which is associated with numismatic progress,—a topic in itself of remarkable interest, and boundless variety.

The following are Larcher's observations in his notes to Herodotus, on the moneys of the ancients:—

"'Ασθενέες Χρήμασι—*were not rich in money.* At the time of the siege of Troy, the use of money was unknown to the Greeks. Neither Homer nor Hesiod speak of gold or silver money; they express the value of things by a certain number of sheep or oxen; they indicate the wealth of a man by the number of his flocks, and that of the country by the abundance of its pastures, and the quantity of its metals. In the camp before Troy, trade was carried on in kind, and not in money; the wines of Lemnos were bought with copper, iron, skins, oxen, slaves, &c.—See the Iliad, book vii. verses 473—475.

"Lucan (Pharsal., lib. vi. verse 402) attributes the invention of money to Itonus, king of Thessaly, and son of Deucalion; whilst others ascribe it to Erichthonius, king of Athens, who was said to be the son of Vulcan, and who was brought up by the daughters of Cecrops. Aglaosthenes (in Jul. Pollux, lib. xi. cap. vi., segm. lxxxiii. pp. 1063, 1064) attributes the glory of this invention to the inhabitants of the island of Naxos. The most common opinion is, that Phidon, king of Argos, contemporary with Lycurgus and Iphitus, first brought money into use in the island of Ægina, to afford to the Æginetæ the facility of subsisting by commerce, their island being remarkably barren.—See Strabo, book viii., p. 577. We have at the present day some coins oı this prince, (Sperling, de Nummis non cusis,) which represent on one side the species of buckler called by the Latins 'ancile,' and on the other a small pitcher of grapes, with the word ΦΙΔΟ Plutarch (in Lycurgo) informs us, that Lycurgus, with a totally opposite design, and to alienate the Lacedæmonians from any commerce with strangers, caused to be manufactured a coarse heavy coin, of iron, steeped in vinegar whilst red-hot, in order to render it unfit for any other use. 'He wished,' says Justin, (lib. iii., cap. ii. p. 124,) 'that traffic should be carried on, not with money, but by an exchange of merchandise; Emi singula non pecuniâ, sed compensatione mercium jussit.'

"According to Athenæus (lib. vi., cap. iv.) neither gold nor silver was suffered at Lacedæmon. A certain number of oxen was given to the widow of King Polydorus, who reigned about 130 years after Lycurgus, for the purchase of her house. From the time that Lysander pillaged Athens, the Lacedæmonians began to have money, both of gold and silver; but this was limited to the public transactions, the use of it being forbidden to private individuals, on pain of death. The form of the small money of the Greeks was very remarkable. According to Plutarch (in Lysandro, p. 442) they were small rods or pieces of iron, or copper, called 'obeli,' (spits,) whence the word 'obolus;' and the name of 'dragma' (handful) was given to a piece of money of the value of six oboli, because six of these little rods or bars made a handful. —See Eustathius, in Iliad, p. 102.

"Herodotus (lib. i., § 94) says, that the Lydians were the first who struck coins of gold and silver, and used them in commerce. Zenophanes (in Julius Pollux, lib. ix., cap. vi.) says the same thing. But neither the one nor the other mentions at what precise period this occurred.

"It does not appear that in the time of Crœsus, the Lydians had any regular stamped coin. The treasures of that prince contained only gold and silver in the mass, either dust or ingots;* for Herodotus (lib. vi., § 125) says that Alcmæon, in his ample dress, large shoes, and even in his hair, carried away from the treasury of Crœsus, by permission of that prince, a complete load of gold dust.

"Neither does it appear that, before the time of Darius, the son of Hystaspes, money was in use amongst the Persians. Darius regulated the tribute which he required of his subjects, and the

* This does not amount to any proof, because these princes struck money only as it was needed, and kept their stock of gold bullion. Witness what he says, a few lines lower down, of Darius.

weight in gold and silver was separately melted in earthen pots; the pots were broken afterwards, and the metal cut from the mass as it was wanted."

"Darius caused coins to be struck of the purest gold, which were called Darics. We do not learn that any king had done so before him.—See Herodotus, lib. iv. § 166. Polycritus (in Strabo, book xv., towards the end) and Diodorus Siculus (book xviii.) also assert, that the kings of Persia kept in their palace the produce of the tribute in ingots, coining but very little of it. Xerxes, according to Herodotus (book ix. § 40), left a considerable quantity of gold and silver, both in bars and money, with Mardonius, whom he had commissioned to carry on the war in Greece; so that, from the time of Darius, a vast number of Darics, pieces of money which bore the figure of an archer on the reverse, were seen in that country, as we find from Plutarch, in his Apophthegmata Laconica.

"No ancient coins, either of the Lydians or the Persians, are now extant. The most ancient medals found in the cabinets of the collectors are Greek, and amongst the Greek coins the oldest are of the time of Alexander the Great. We must not, therefore, be surprised that Herodotus should say (book viii., § 137) that neither the people nor even the kings were rich in money in those ancient times; but that their riches consisted in herds, &c. Gold and silver were formerly exceedingly scarce, both in Greece and the adjacent countries. Athenæus (lib. vi. cap. v.) cites Anaximenes of Lampsacus, who says it was only on account of the scarcity of gold that the golden necklace of Eriphyle became so famous in Greece; and that, at that time, a silver cup excited much admiration, as being a remarkable novelty. The same Athenæus informs us, that Philip, king of Macedonia, whenever he retired to rest, put under his pillow a small gold cup that he had, and which he highly esteemed on account of the scarcity of that metal."*

"Before the time of Gyges, king of Lydia, no other metal was seen in the temple of Delphi but copper; and this not in the form of statues or other ornaments, but only in tripods. The Lacedæmonians were obliged to have recourse to Crœsus for the gold of which they made their statue of Apollo on Mount Thornax, as we learn from Herodotus (book i. § 69.) Hiero, king of

* Larcher's Notes on Herodotus, vol. ii. pp. 520-3.

Syracuse, diligently sought for gold to make a statue of Victory, and a tripod for the temple of Delphi: he at length found some at Corinth, in the house of a certain Architeles, who had accumulated it by purchasing it in small quantities, and who, beyond the weight required of him, made the king a present of a handful, in return for which Hiero sent him a vessel laden with corn."*

There is no reason to suppose that the most ancient moneys referred to in the Old Testament were *coins*. As in China to this hour, so probably in the patriarchal times, pieces of gold and silver were weighed. Thus, when Abraham buys the field of Machpelah, we are informed of the proceedings in the bargain. Abraham says to Ephron, "I will give thee money for the field: —take it of me—and I will bury my dead there;" and Ephron answers, "The land is worth four hundred shekels of silver —what is that between us?—take the place, and bury thy dead. So Abraham *weighed* to Ephron the silver—four hundred shekels of silver, as current among merchants."† Though there are among the Nineveh sculptures many representations of tribute bearers, and there can be no doubt that gold and silver almost invariably formed part of the spoils collected by ancient conquerors, there is no record of coined money in the remotest times of authentic history.

There can be little doubt that payments in money by counting, or tale, would soon follow, or even be associated with the meting or weighing the precious metals, whose portableness and value made them the convenient instruments of barter or exchange. The natural process would be the employment of pieces of a similar weight to represent the same value; but if such pieces had no stamped evidence of their being really of the value they represented, no payments would take place without the employment of scales, or some other instruments to be used as a security against fraud or error. It was quite natural that for the public benefit the stamping of the coin should be a function of the highest authorities; hence the right of coining would be assumed by sovereigns, by corporate bodies, or by influential persons, whose effigies, symbol, cipher, name, or other designation or device, would obtain for the coin public appreciation and currency. Long after money ceases to circulate by weight, the name of the

* Bellanger, cited in Larcher's Notes on Herodotus, vol. ii. p. 523.

† Gen. xxiii. 13—16.

weight will be retained, and the divisions of the weight will become the ordinary instruments of exchange. Thus in England the pound weight of sterling silver, which is the base and integer of our accountancy from the Anglo-Saxon times, was divided into 240 pennies,—no larger coin than a penny being in general circulation.

Herodotus speaks of the Lydians as the first people who coined gold and silver—(see Larcher i., 94, 143). Other authorities ascribe the invention of coined money to the inhabitants of Ægina, under Pheidon, king of Argos, 895 years before the Christian era, and give to the Lydians the second rank. Then comes the coins of the Persian kings, beginning with Darius the First, about five centuries before Christ. It has been truly remarked that the coins of ancient nations are among the most interesting and the most valuable of historical records; and it is a matter of regret that metallic and enduring memorials are now confined to medals struck to commemorate some particular event, whose number is very limited, and which obtained little circulation among the multitude. There is no reason why a metallic currency should not be the vehicle, as in times called classical, of much historical instruction. Why should not coins be made the recorders of interesting events? Why should we not preserve, as of old, specimens of beautiful architecture, the originals of which time has not spared? Why not exhibit the progress of scientific discovery—the march of geographical knowledge—the conquests of commerce and civilisation? The Mint of the Augustan Age, has been well called the seat of Roman genius; and why should not the genius of Britain be installed where its works would assuredly be imperishable?*

The Jewish skekel was undoubtedly a weight, and not a coin. For the Medo-Persian coins, called Darics, the highest antiquity is claimed, as traceable to a period antecedent to the Macedonian conquest. It has been suggested that they were stamped upon pieces of metal current as money, inasmuch as the standard weight and value are strictly Grecian, though the devices are clearly Persian, and they are traceable to the middle of the fifth century before Christ, say B. C. 560.†

The earliest coins are almost certainly those which have an

* Consult Addison's Dialogues on the usefulness of ancient medals.

† The perfect reverse is found in the coins of Gelo of Syracuse, B.C. 490.

impression on only one side. "The coins of the first four or five centuries of the art, so far as Greece and her immediate dependencies were concerned, hence present us with various stages from the one or more irregular hollows in place of the reverse, which may have been produced in the process of applying the die to a piece of metal fixed on a pointed surface (and, in some instances, by subsequent deterioration), until these hollows become gradually replaced by the square, which is itself often found sub-divided, and taking a radiated or star-like appearance, (a circumstance which could not have resulted from the mere process of striking, and which was therefore a step towards the purposes of the reverse)."*

"The Roman imperial coins, on the other hand, in addition to their individual characters and interest, possess a general historical interest, in consequence of being, for the most part, struck to commemorate remarkable events. The difficulties of history are, consequently, cleared up by these contemporary records, which are so complete until the time of Constantine, that histories have been compiled from them.

"They form the most authentic data in the Roman annals;—the years of the consular and tribunitian offices held by the emperors, appearing in the front; and, on the reverse, representations of the events whose dates are expressed on the other side.

"The coins of Trajan, Hadrian, and the Antonines, are remarkable for this, and for the accurate data which are thereby supplied to history, by which the mistakes of chroniclers are often corrected. Among the description of events commemorated, are the departure of the emperors on expeditions; their successes and returns; their munificence to provinces wasted by famine; visits to the provinces, and benefits conferred during such visits, &c., as in the case of Hadrian's visit to Britain, A.D. 121.

"Conquered provinces are represented in a pleasing, and often poetical manner, as in the weeping 'Judæa capta' of the coins of Vespasian and Titus; and universal peace is symbolised by the closed temple of Janus, on medals of Nero, with the legend, 'Pace Populo Romano terrâ, marique parta, Janum clusit.'"†

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* Cullismore's Proceedings of Numismatic Society, 1836-7, p. 11.

† See a Commentary on the amphibious and universal character of Janus, as god of the land and sea, maintained by Sir W. Betham;

ANCIENT COINS.—Plate I.

Fig. 1.—Greek.

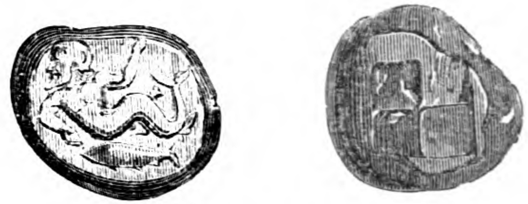

Fig. 2.—Greek.

Fig 3.—Greek.

Fig. 4.—Greek.

Fig. 5.—Persian Daric.

Fig. 6.—Coin of Ægina.

The deaths and consecrations of emperors and empresses are depicted, and their virtues and other attributes beautifully personified. Happiness, hope, abundance, security, piety, modesty, are poetically represented, together with the different countries of the world, and the provinces of the empire.

Even naturalists may derive advantage from the study of these coins—those struck on the occasion of the secular games, as the coins of Philip, representing various animals, some of which appear to be now unknown.

Accurate portraits of persons of historical eminence are represented, so that busts may be referred to their owners by the agency of medals, together with representations of buildings now in ruins, as they originally stood—as triumphal arches, temples, &c.; so that the poet, the painter, the sculptor, and the architect, derive no less advantage from the study than the historian.*

It is remarkable that no reference to coined money is found in Egypt anterior to the times of the Ptolomies, notwithstanding the recorded riches of the Pharaohs and the great cities on the banks of the Nile. The hieroglyphic character for money is a loop.

In earliest times gold had only a decuple value of silver, both among the Romans and the Greeks.† It was stamped generally with the same devices as the silver; and in the coins struck by C. Claudius, Nero, and M. Livius Salinator, it bore the proportion of 12½ to 1.

"The earliest representatives of value," says Mr. John Williams, "appear to have been pieces of the precious metals taken by weight, as bullion at the present day, and circulating as a medium of exchange. After a time an obvious improvement upon this system seems to have been made, as there is evidence to show that the pieces so circulating were of a certain definite weight, and also of an agreed degree of purity. This is evidently hinted at in the accounts of some early transactions, in which we

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or a complete description of these inestimable illustrations of history, chronologically arranged, in Captain Smyth's "Descriptive Catalogue of a Cabinet of Roman Imperial large Brass Medals," and in Mr. Akermann's "Descriptive Catalogue of Rare and Inedited Roman Coins."

* Mr. Williams, in Proceedings of Numismatic Society, 1836-37, pp. 25, 41-42. † Evelyn, p. 7.

read of 'pieces of silver, such as are current with the merchant,' being employed as the medium of exchange. We also find that all the primary denominations of money, such as the shekel, drachma, as libralis, &c., were the names of weights employed by the several people who struck the money known by those appellations. Still, however, much inconvenience must have been felt in the circulation of mere pieces of metal, in consequence of there being no guarantee that the weight and purity of the metal were such as had been thus generally agreed upon; and this necessary security was obtained by the happy expedient of several states or cities issuing pieces of gold or silver, stamped with the known symbols of such states or cities, thus impressing them with their common seal, as it were, and affording the necessary public guarantee that the pieces thus stamped were precisely such as they professed to be.

"This stamping of money appears to have first taken place in Greece, about the sixth or seventh century before the Christian era. The earliest coins are of an irregular globular form, having on one side one or more irregular cavities or indentations. These appear to have been produced by rude projections rising above the surface upon which the piece of metal was laid; and these appear to have been the means by which it was firmly fixed, so as to enable the workman to stamp the upper side with the required symbol, which was evidently done by means of a hollow punch and a heavy hammer. After a time it was found that the desired impression might be produced without the metal being so firmly fixed; and thus we find the indentations gradually getting shallower, until at length a slightly indented square, is all that remains. This, in its turn, gradually gives place to the perfect reverse. At first this consists merely of a small figure, or figures' placed either in the centre of the square (as in an early coin of Syracuse), or in one or more of the divisions of the square as in some of the coins of Ægina. A coin of Gnossus, in Crete, presents us with four deep indentations, placed at a considerable distance from each other, alternating with which are portions of the Cretan Labyrinth, and in the centre is the minotaur, figured as a human figure with the head of a bull. This filling up of the indentations, and substitution of the square, appears to have taken place between the time of the invention of coinage and the reign of Alexander I. of Macedon, B.C. 497 to 454, as we have coins of this monarch having the shallow square, with the name

ANCIENT ROMAN COINS.—Plate II.

Fig. 7.—Roman As.

ANCIENT ROMAN COINS.—Plate III.

Fig. 8.—Semis.

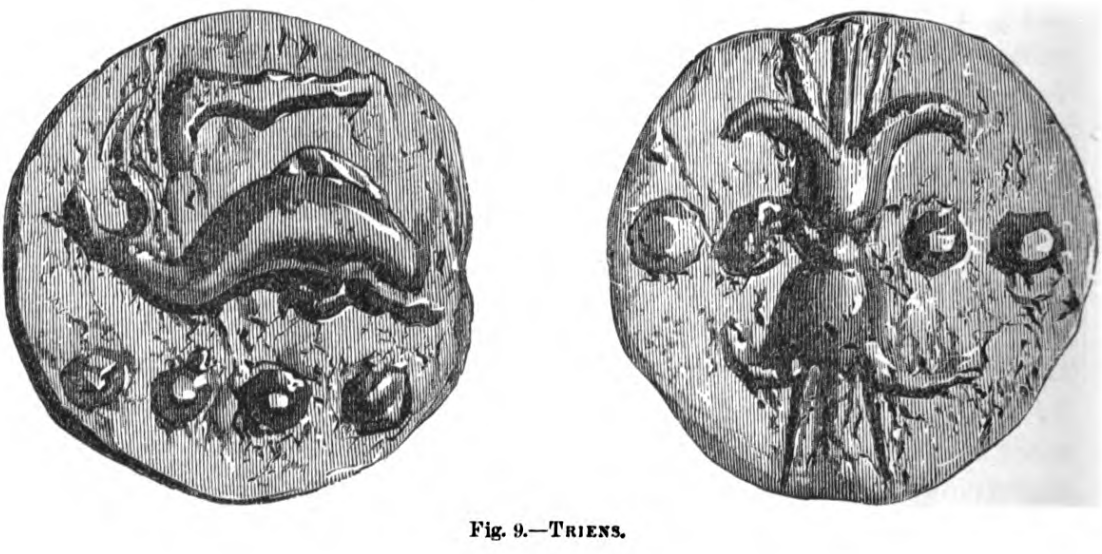

Fig. 9.—Triens.

Fig. 13.—Triens.

'Alexander' surrounding it. The square finally disappears in the reign of Amyntas II., B.C. 397 to 371. From this period the Greek coinage gradually improves in workmanship, until at length they present those beautiful specimens of workmanship which, although they may have been equalled, have certainly never been surpassed, even in modern times.

"The figures 1, 2, 3, 4, represent Greek coins of the earliest kind; 5 is a Persian daric, which has also the irregular hollow, but appears from the workmanship to be of later date; 6 is a coin of Ægina, also of much later date, shewing the indented square, with letters and figures in the divisions of the square.

"The Roman coinage," continues Mr. Williams, "appears to have originated in the *as*, a copper piece weighing twelve ounces. The pieces of the most common occurrence have on their obverse the double head of Janus, and on the reverse the prow of a ship. Others, as in the specimen represented in Fig. 7, have on them the head of Rome and a Bull, with the word Roma. The divisions of the as, were the semis, or half of six ounces, marked S.; the quincunx, or piece of five ounces; the triens, of four; the quadrans, of three; the sextans, of two; and the uncia, of one ounce. These have on them dots or pellets expressing the number of ounces contained in them individually. There were also multiples of the as, as high as the dicussis, or piece of ten ases. The as and its parts originally weighed as much as was expressed upon them; but they gradually decreased in weight, until, at the time of the second Punic war, the as was reduced to only half an ounce. This depreciation in value, and consequently in size, may be exemplified by a comparison of Figs. 9 and 13, representing the triens or piece of four ounces, at different periods. Figs. 11 and 14 show the sextans, and Figs. 12 and 15 the uncia of ancient and more modern times, and thus the as and its parts became of a merely nominal value.

As these heavy pieces must have been very inconvenient in their use before their reduction in weight, silver appears to have been soon substituted for them, and the denarius, or silver piece originally of the value of 10 ases, and afterwards of 16, became the most common representative of value; this piece is frequently marked X. The quinarius, or victoriatus, which was the half of the denarius, and marked V, to show it was of the value of five ases, also occurs. These are represented in Figs. 17 and 18. The sestertius, or fourth of a denarius, equal in value to two and a half ases, was also a silver coin in common use, and formed the general unit of value in speaking of money. Thus a person was said to have died worth so many sesterces, &c. These, perhaps, are the nearest approach to the decimal division among the ancient coins,—there being nothing like it in the valuations of the Greek coins. The former of these, with the exception of the lepton and the tetrobolon, were halves of the next higher denomination; of the latter of these, seven made a chalcos, and one and a-half tetroboloi made a drachma; all the others, to the tetradrachma, increased by doubling. In like manner, the later Roman coins, from the teruncius to the denarius, were increased by doubling the preceding denomination, with the exception of the sestertius, which was of the value of two and a-half ases. In reckoning Hebrew money, 50 shekels made a maneh, and 50 manehs a talent. These last, however, were only nominal coins, and I cannot now refer to the values of the divisions of the shekel (which formed the general currency of the Jewish nation), and consequently am unable to say whether they conform to the decimal system or not."

I shall conclude this chapter by some amusing examples of the manner in which coins and medals have been employed, and in which they serve as curious mirrors of public feeling, and as permanent records of transitory passions.

There is a medal coined in the time of Joseph of Austria, bearing the inscription

"Josephus Imperator regnat amore et timore, facit MDCCV.

(The Emperor Joseph reigns by love and fear—which makes MDCCV.)

On the reverse is a curious cabalistic interpretation, thus given:—

CABBALÆ CLAVIS.

A 1	G 7	N 40	T 100
B 2	H 8	O 50	V 200
C 3	I 9	P 60	W 300
D 4	K 10	Q 70	X 400
E 5	L 20	R 80	Y 500
F 6	M 30	S 90	Z 600

The exergue has—

ANCIENT ROMAN COINS.—PLATE IV.

Fig. 10—QUADRANS.

Fig. 11.—SEXTANS.

Fig. 14.—SEXTANS.

ANCIENT ROMAN COINS.—Plate V.

Fig. 12.—Uncia.

Fig. 15.—Uncia.

Fig. 16.—Sextans.

Fig. 17.—Denarius, or Piece of Ten Ases—Marked X.

Fig. 18.—Quinarius, or Piece of Five Ases—Marked V.

"Sit ineffabilis, sit innumerabilis Austriæ gloria."
(Ineffable and innumerable be Austria's glory.)

I	9	I	9	R	80	A	1	T	100
O	50	M	30	E	5	M	30	I	9
S	90	P	60	G	7	O	50	M	30
E	5	E	5	N	40	R	80	O	50
P	60	R	80	A	1	E	5	R	80
H	8	A	1	T	100	E	5	E	5
U	200	T	100		——	T	100		——
S	90	O	50		233		——		274
	——	R	80				271		271
	512		——						233
			415						415
									512
									——
									1705

The date of the reform of the calendar in 1700, is curiously and variously recorded in many medals of the time.

One has—

"GereChtes Lobopfer Denk MahL."
(The record of merited gratitude.) MDCLL.

Another—

"GeenDerten CaLenDers DenkzahL." DDDCLL.
(In remembrance of the reformation of the Calendar.)

One has—

"Hoert doch, wunder! im Jahr MDCC, wusten de leuthe nicht wie alt sie waren."

(Listen to a wonder! In the year 1700 people did not know how old they were.)

One medal portrays a boy asking an old man his age; and the answer is *Nescio.*

Another has—

"Wo sind wir?"
(Where are we?)

Another—

"Ey was wunder!
MDCC. sind de noch nicht herunter
Wers nicht glaubet lieber herr
Bleibt ein 99 er."

What a wonder!
MDCC. has not knock'd under!
Who won't believe it, my dear sir,
Is a 99-er. (Is a nine and ninetyer.)

There is a medal struck at Ostend, one side of which exhibits a map of the neighbourhood of Helvoetsluys, and the other a battle between the Spaniards and the Flemings at the taking of Ostend, with a Greek inscription—

ΧΡΥΣΕΑ ΧΑΛΚΕΙΩΝ.

"Gold for copper;" * and in Latin this chronogram—

"ItaNe fLanDrIaM LIberas Iber ?" †

The large letters exhibiting the date MDLLIIII.

Another has, to celebrate the peace of 1678:—

"a DoMIno VenIens popVLIs paX Læta refVLget.‡"

Where, as is generally sought to be accomplished, all the numeral letters are fixed on to exhibit the date.

There is a medal of William III. containing the names of all British sovereigns, with the date of their succession to the throne, and that of their deaths, from Egbert A.D. 801, with this inscription in Dutch:—

"These clomb to the throne
With sceptre and crown
But none were more glorious,
And none more victorious,
That ever we heard,
Than William the Third."

At the rupture of the treaty of Ryswyk—

"Auwey! der fried hat shon en loch 1702."
(Alas! there is already a hole in the peace.)

Reverse:—

"Auwey! auwey! auwey! auwey!
Ryswikscher Fried is gar entzwei."
(O woe! O woe! O woe! O woe!
The Ryswyk peace is torn in two.")

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* Iliad vi., 236.

† Is it thus, Spaniard! thou freest Flanders?

‡ Peace, which is the gift of heaven, brings gladness to the people.

APPENDIX.

APPENDIX.

(I.)

THE immense majority of intelligent and thoughtful opinions have been expressed in favour of the decimal system as proposed by the parliamentary committee, which leaves the pound sterling unchanged, as the integer and basis of our currency and accountancy, and divides it simply into one thousand parts. A plan supported by Mr. Theodore Rathbone has, however, found some favour. He would reduce the value of the shilling to tenpence, and make the said *new shilling* to consist of *ten pennies*—the groundwork of a new decimal coinage. I have been favoured with a paper by a gentleman who has given much attention to the subject, and which so completely demolishes Mr. Rathbone's scheme, that I venture to insert it entire.

OBSERVATIONS ON MR. THEODORE RATHBONE'S PAMPHLET ON "DECIMAL COINAGE."

Mr. Rathbone and the committee of the House of Commons are agreed in giving a preference to the decimal system over our present denominations of account. They are agreed also in their estimate of the nature of the problem that has to be solved, in order to introduce that system into our currency; for they both consider it a matter of primary importance to effect the change in such a manner as to create the least possible disturbance in the transition from one system to the other; but they differ as to the means by which this object should be effected.

The committee, adopting the opinion of the witnesses of greatest weight and reputation examined before them, recommend that the unit of account which represents our standard of value, and governs all existing contracts, should be preserved, and that the decimal system should be applied to the subdivisions of the pound sterling. In recommending this course, they have followed the example of the two greatest countries, France and the United States, in which a decimal coinage has been established. In France, owing to an over-valuation of silver by the Mint regulations of the country, the franc superseded the gold coins, and became the standard of value. The currency of France was, therefore, decimalised by dividing the franc into one hundred parts. In the United States, when they were yet colonies of Great Britain, the dollar had been over-valued for circulation, and had superseded all other coins, though the denominations of pounds, shillings, and pence were long retained. In settling the currency of the country, therefore, the dollar, as the practical standard to which all contracts referred, was adopted as the unit of account, and the decimal system was established by subdividing that coin into cents. In Great Britain, after the standard had long oscillated, as in other countries, between gold and silver, the former gained the preference, and the sovereign has been established as the unit. It is proposed, therefore, to decimalise our currency, by subdividing the sovereign into a thousand parts, by a gradation of tenths, viz., sovereigns, florins, cents, and mils.

Mr. Rathbone considers that the system proposed would be "clumsy, inconvenient, and unsound." He objects to the names of the new coins proposed to be introduced, and he dwells upon, and, to some extent, exaggerates the difficulties of issuing money of the new denominations in exchange for that which now circulates. When we bear in mind the ease with which an entirely new silver coinage was put into circulation after the Act of 1816, the partial change which is now contemplated cannot be considered a very formidable operation; and it should be borne in mind that the withdrawal of none of the existing coins would be absolutely necessary, because, previously to the introduction of the proposed decimal system, the silver coins now in circulation could be adjusted to the system by giving them new denominations, and a new value could be given to the copper coins now current, as was done in the case of the pence of Ireland, when the currency of that country was changed. Mr. Rathbone's greatest objection, however, to the proposed scheme is, that it would operate with "extreme injury and injustice to the poorer classes," by sacrificing "*our copper coin—that useful, precious penny*," which, in his imagination, "happily coincides so accurately and harmonises so well with the great features of the foreign decimal systems."

The scheme which he proposes to substitute for that suggested by the committee is based on the penny, and he thinks to accomplish his object without "the sacrifice or alteration of any one existing money of account, but our duodecimal shilling," without actually requiring "the issue of one single new coin," until quite convenient. He characterises his plan as one which "would rapidly and insensibly conduct and initiate ALL CLASSES *into the current ready use, not only of a decimal system, but of the only pure and perfect decimal system of numeration.*"

The system which he adopts as his model is the French system, which he prefers "because it is thoroughly decimal," and his plan is simply to substitute for the shilling a coin of ten pence, which he proposes to call a franc, and to divide the halfpenny into five parts, each, of course, the cent of the franc.

We might ask, whether it is conceivable that the many able, practical men, who have long laboured for the establishment of a decimal system of currency, would not have thrown pence tables, and all legal definitions to the winds, in the management of their own accounts, if so simple an expedient as that proposed by Mr. Rathbone would have worked? But let that pass.

Let us examine his project under its several recommendations.

1stly. That it will preserve to the poor man his penny, as "his landmark and integer."

2ndly. That it is not only thoroughly decimal, but the only pure and perfect decimal system of numeration.

3rdly. That it will establish entire harmony, and instant, easy convertibility as regards all foreign coinage and accounts whatever.

I.—Is it a fact that the penny is the poor man's integer and standard of value? The penny is known to him as the subdivision of the shilling. If it were not so, if his notions of value were confined to pence and halfpence, there would be no advantage to him in attempting to facilitate his computations by giving him a decimal system. It would, under such a supposition, be the same to him whether the penny represented the decimal, duodecimal, or any other fraction of a higher coin. Leave him his integer, and he will be contented. But the poorest labourer has a higher conception of value. His wages or earnings are usually so many shillings a day or week. His rent, likewise, is computed in weekly payments of shillings. His deposits in the savings'-bank are accumulations of shillings. And he knows full well that twenty of those shillings make a pound, though he may not be much used to reckon by pounds. His pence are the change of his shilling. The shilling is in his eyes much what the pound is to the man of wealth; pounds are to him what fifties and hundreds of pounds are to the latter.

It is easy to raise a cry by the confident assumption of a proposition, especially when it is brought forward under the amiable guise of protecting the poor. But the shilling has as many claims, from associations of olden time and from positive utility, as the penny. As it is the greater value to which the lesser must be referred, even by the poor man, it has more pretensions to be considered "his landmark and integer;" and it may be asserted, with at least as much claim to acceptance as the confident assumption in this pamphlet in favour of the penny, that the sacrifice of that "useful, precious" shilling, for the purpose of preserving the pence unchanged, would operate as no boon to the poor man. The subdivision of the shilling may be altered, as it has been altered before, without entailing more than a temporary inconvenience; but take away the shilling, and you deprive the poor man of his practical standard of value. More serious alterations of the value of the penny than that now proposed have been carried out, without much difficulty, in Ireland and the Isle of Man, amongst a people more rude and uninformed than the English. Why should we apprehend such serious difficulty here?

And it may be urged, that an alteration which increases the number of pieces into which a coin is subdivided, will generally operate favourably, rather than otherwise, to the purchaser in retail dealings. In the rude adjustment of prices which must to a certain extent attend the division of commodities into small quantities, the portion sold for a coin of a low denomination must often be overpriced: ordinary weights and measures of value cannot accommodate themselves with exactness to such minute divisions; the seller will take care to be on the safe side, and some articles, not admitting of subdivision, must be sold for the smallest coin in ordinary use, whatever its value may be. A man who buys a halfp'orth of tobacco now, will probably get as much (or so nearly the same quantity as to make the difference hardly perceptible) when there are twenty-five instead of twenty-four halfpence to the shilling, and he will have twelve pence (or forty-eight mils) remaining in his pocket. If eggs are now sold at a halfpenny each, they must still be sold for a halfpenny (or two mills) when the value of the coin is altered, and the purchaser will get twenty-five instead of twenty-four for a shilling. These matters will soon adjust themselves in the huckstering of the market.

II.—But allowing, for the sake of argument, that the one great object is to preserve the penny at its present value for the poor man's benefit, let us see how this great boon is to be accomplished, and how, at the same time, all classes are to obtain the benefit of a pure and perfect decimal system of numeration, "*without the sacrifice or alteration of any one existing money of account, except our duodecimal shilling.*"

It is not easy to understand in what light the French system can be considered more thoroughly decimal than that proposed by the committee. It is the beauty of decimals that they admit of being carried to any amount, in either direction, without a break in the calculation. Decimals of pounds are as thoroughly decimal as decimals of francs. It is a question of convenience where the decimal point should be put to mark the termination of the decimal fractions and the commencement of the unit. The French wisely adopted the franc as their integer, because it accorded with the practical standard of value already in use. The sous, into which the franc or livre was subdivided, were convertible into decimals by extension of their terms, without any alteration of their current value. Circumstances thus afforded the framers of the French system the opportunity, which Mr. Rathbone imagines he has found in our case, of establishing a decimal system of computation without an alteration* of the coins. But, apart from the considerations of practical convenience which presented themselves, there is nothing in the scheme which subdivides the smallest copper coin into five nominal parts, and thereby multiplies the ciphers by which small values

* The trifling alteration which was made in the silver coin was immaterial to the introduction of the system.

are expressed, that in point of principle gives it any special claim for imitation. On the other hand, it is an objection felt by many to the French system, that in large sums it involves an inconvenient number of ciphers, and there can be little doubt that to English apprehensions the expression of sums in pounds sterling, to which we are used, gives a clearer notion of value than the multiplicity of francs. We shall act wisely if, instead of imitating the details of the French system, which is inapplicable to our existing coins, we adopt the principles upon which they acted, and adhere to what we have, so far as it can be made subservient to a thoroughly decimal scale. Examples may be found in which the nominal unit or integer of account has been altered, as in the case of the United States, and in that of our Irish currency, for the purpose of fitting it to the practical standard of value to which contracts referred. Examples may also be found of alterations of coins, as in the case of the abolition of our guinea, in order to fit them to existing denominations of account. But it would be a new thing to set at nought all existing tests, whether of money or account, by which value has been habitually ascertained, in order to substitute a fancied system of perfection, in regard to which it would be difficult to find agreement among any body of men. A change of that character would create such an utter derangement of all existing accounts, and such confusion in adjusting pecuniary engagements, that, great as are the advantages of a decimal system of numeration, the ultimate convenience would be too dearly purchased, if it could only be acquired by a revolution so subversive.

The pound sterling, represented by the gold sovereign, is the measure of value by which every contract in this country, from the highest to the lowest sum, is ascertained. It is incumbent on those who advocate a theoretical change, to show a reason for it. The pound is as susceptible of a thoroughly decimal subdivision as any smaller coin. The subdivision into florins, cents, and mils is not essential to the proposed system: it was suggested with the view of adjusting the scheme to current coins and facilitating its use to persons who are inapt in the decimal mode of computation; but, for calculations, pounds, and their thousandths, would be all that would be required; and, if it were desirable, the decimal scale could be carried to a lower fraction without inconvenience.

But we must bear in mind that Mr. Rathbone promises to effect his object without the alteration of a single coin. Our coins are numerous, but we find at the extremes the penny and the pound, to one or other of which all the intermediate coins refer. If, therefore, we are to obtain a thorough decimal scale without alteration of a single coin, it can only be effected by some scheme which would convert the pound into a decimal multiple of the existing penny, or the penny into a decimal divisor of the pound. Our existing penny is a fractional coin, which represents one-twelfth of a shilling or one-two-hundred-and-fortieth of a pound. Any one acquainted with the common rules of arithmetic can satisfy himself that these fractions cannot be converted into finite decimals, and of course it follows that no process of subdivision or combination can bring out a different result. The problem of converting a recurring into a finite decimal is startling to ordinary apprehensions, yet this is the problem which, if his proposition means anything, Mr. Rathbone undertakes to solve.

Let us look then a little closer into his scheme, and, allowing again for the sake of argument that the French system is the best, let us examine the process by which Mr. Rathbone proposes to adapt it to our existing coins.

When he states, that "the course of proceeding would be simply, as the first great step, to make pounds, francs, and pence, instead of pounds, shillings, and pence," it would appear that the pound is to be retained in this system; but when he proceeds to explain that "in all sums whatever *up* to the pound sterling, the dot dividing, or the column in account separating the two first items—pence and ten pences, tens and hundreds—would present the ordinary figures of account, and at the same time the amount decimally stated in the most pure and perfect form of decimals," a doubt arises as to his treatment of our great "land-mark and integer," the pound. How is it to be brought into the system of account? Is its value to be altered? No. The sovereign is to be excluded from the decimal scale, but retained as the standard of value. "The old pound sterling," Mr. Rathbone says, "would retain its time-honoured useful place in all such large amounts as the national debt and the public accounts, and would be ever at hand and most easily accessible to state all large amounts of figures, &c." But what of smaller amounts of figures? What of rents, salaries, and other innumerable contracts expressed in pounds? How is a system to be worked which goes up to the pound, but does not include it, and yet retains it as a standard of value? But it is to be "at hand," though unseen, behind the scenes. This is verily the play of Hamlet, omitting the character of the Prince of Denmark.

If Mr. Rathbone had not said that he intended his scheme for all classes, it might have been supposed that he contemplated two systems—a decimal one for the poor, who do not want it; a more complicated one for the mercantile classes and accountants, to whom the decimal scale would be more especially beneficial. But no; it is clear that he proposes to substitute, for our present denominations of pounds, shillings, and pence, a scale by which the pound will be divided into twenty-four francs, which latter coins will alone be decimalised. He is even conscious of the defect of his system, for he admits his treatment of the pound, his omission of the Prince of Denmark, to be an "imperfection and irregularity;" and yet, notwithstanding this admission, he has the hardihood to maintain that his plan gives "a pure and perfect decimal system of numeration," and he sets at scorn the scheme of the committee—which is really decimal—and characterises it as "clumsy, inconvenient, and unsound."

III.—But we have yet another promised benefit to consider. We are told that "a vast and overwhelming portion of the civilised world would be at once financially united, as it were," by the adoption of the scheme which is to harmonise with "all foreign coinage and accounts whatever." Let us see. And let us again, for the sake of argument, assume that Mr. Rathbone's quasi decimal scale could be worked in accounts, and, consequently, in calculations relating to the foreign exchanges. First, he conceives that the franc of ten pence would exactly correspond with the French franc, and the half-penny with the French sou of five centimes. He takes the vulgar approximate computation of the franc at ten pence, and adopts it without inquiry or investigation. The weekly quotations of the French exchanges in the City article of *The Times*, which can hardly have escaped the notice of a man so prompt to dissect, might have taught him a better lesson as to the real comparative value of the French franc in relation to our money.

The florin piece of twenty pence will, according to Mr. Rathbone, exactly correspond with the Dutch florin. It cannot be supposed that a man so conversant with the names of coins, and who writes so confidently on the subject, can be ignorant of the laws which regulate their value in exchange. If he had given himself time to reflect, he must have been aware that there can be no real par of exchange between two countries, one of which has a gold and the other a silver standard of value; and that the relative price of the two descriptions of coins will fluctuate according to the production of one or other of the precious metals, and the demand for them, either for coinage or other purposes. Three years ago twenty pence might have been taken fairly as the average and approximate value of the Dutch florin. Now it is much higher.

The same observation applies to the silver dollar. Mr. Rathbone adopts some crude statements from the evidence of General Pasley before the Decimal Coinage Committee, and fixes the value of the dollar immutably at fifty pence. Mexican dollars were sold readily in London the other day at the rate of sixty-one pence the ounce, which gives a value of more than fifty-two pence to each dollar.

He talks of the dollar of the United States, evidently in ignorance of the change which was made in the Mint law of that country in 1834, and which based its currency practically on a gold standard. The gold eagle, or ten dollar piece of the United States, is worth about two pounds one shilling of our money, which gives forty-nine pence and a small fraction to the gold dollar.

There cannot, in truth, be a greater mistake than to suppose that a mere similarity in denominations of account can have the slightest effect upon the calculations of foreign exchanges. Without identity of standards of value the use of common denominations creates confusion instead of affording facility for computations. We have an example of this in our North American Colonies, in all of which our denominations of pounds, shillings, and pence prevail, but in which the pound currency differs from the pound sterling, and differs in each colony from its neighbour. When a sum is mentioned in any colonial account, it is always a matter of calculation to ascertain what value the pound represents.

There are many descriptions of dollars current in the world. The old Spanish pillar dollar, which has a peculiar value in China, and the gold dollar of Spain; the dollar of Mexico, and the South American States, which vary slightly from each other; the gold dollar of the United States, and the silver dollar of those States, which differs from the Spanish and Mexican dollars. There are, besides, the Maria Theresa dollar, the Sicilian dollar, and at least nine dollars of German States, differing from each other in weight and contents, of pure silver. None of the coins above enumerated are identical in value, and confusion is always created when they come into concurrent circulation at the same place. Not one of them coincides at this time in value with that of 50 English pence. What, then, it may be asked, is the dollar with which this vaunted scheme is to harmonise?

Mr. Rathbone has formed high notions of the effect of the example of Great Britain in the proposed regulation of the currency. Other nations, however, have their own ways and their own prejudices. We cannot even effectually control our own Colonies in these matters. Our great dependency of India has established a system of currency of its own, differing entirely from ours. Last year, after the discovery of gold in Australia, the question was raised at the India House, whether or not they should adhere rigidly to their silver standard. It was decided, probably on good grounds, as regards Indian interests, but questionably as regards Imperial interests, to exclude gold from their circulation.

But there is a difficulty to be overcome, independent of national laws, before such an universal system of concord as Mr. Rathbone contemplates could be effectually established—the difficulty of overcoming mercantile habits and prejudices. The tenacity with which merchants will adhere to old formula in calculations of the exchanges, rather than incur the trouble of altering them, is remarkable. The calculations of the exchanges between England and the United States afford a pregnant example of the force of such habits. The two countries have gold standards of well-defined quality. The comparative value of the coins of each is, therefore, easily ascertained, and the par of exchange could be readily fixed on that simple basis; but the Spanish dollar, which was the origin of the North American currency, was valued in the reign of Queen Anne at 4*s.* 6*d.*, and that rate is still adhered to in the calculation of the exchanges. A fictitious valuation is first given to the silver dollar, which is then converted into the gold dollar; and this circuitous operation brings out the par of exchange at the nominal amount of 109 23-40ths per cent. In international transactions it is easier to adhere to an intricate process once learnt, than to adopt a change for the sake of simplicity.

Such is the result of an examination into the propositions contained in this pamphlet, and some surprise may be entertained at the countenance which it has received among the mercantile community of Liverpool. But it has often been observed, that those who take the trouble of thinking for themselves are a very small minority of mankind; and a dashing and sparkling style of writing, which sweeps away, in a summary manner, the opinions of those who have been considered to have claims to respect, is wonderfully captivating. The reader enjoys the work of destruction, without reflecting on the merits of the structure proposed to be substituted. The pamphlet may be considered able, if fluency and vivacity of style can alone constitute force; but fluency is easy, if facts and principles do not stand in the way of the writer, and vivacity is a quality which is commendable only when an author's confidence in his own judgment proves to be well-founded.

(II.)

Mr. F. Bennoch's experience exhibits so satisfactorily the advantages of a decimal system, as contrasted with the present usages, that I have much pleasure in presenting a considerable portion of his evidence before the committee.

Extracts from the Examination of Mr. Francis Bennoch.

What is your opinion of the evils of the present system?—It is, in my judgment, a mass of evils and inconsistencies. It necessitates several processes of different calculations, where one might serve: for instance, here is the cost of a manufactured article, requiring four different calculations, and four different values, before we can arrive at the simple cost of 3*s.* 2¾*d.*; and it is next to impossible, in our present coinage, to give an accurate result; we must have a small fraction on each item left over, which would not be the case with the decimal coinage.

Does the present coinage involve a consumption of more time than if it were arranged decimally?—Infinitely: this cost would occupy five minutes, while in a decimal system it might be done in the fraction of a minute.

How do you propose to effect this, and what alterations in our present coinage would you suggest?—In the first instance we require very few changes. Gold being fixed in price, and circulating at what is considered its intrinsic value, expresses its market price; but silver and copper, being circulated above their value, are in reality merely tokens. There is, in fact, so far as I can understand, no alteration in the relative value of gold and silver contemplated. There would be the same quantity of copper given in exchange for a florin, and the same quantity of silver given for a sovereign, that there is now. The alteration desired is only one of arrangement, to facilitate calculations and exchanges.

What are the real and nominal values of silver and copper?—The value of copper is, I find, to-day, 1*s.* -½*d.* per pound, while it circulates at 1*s.* 4*d.* to 1*s.* 6*d.* per pound; silver is 5*s.* to 5*s.* 1*d.* per ounce, while it circulates at 5*s.* 6*d.* per ounce; there is no fear, therefore, of the copper or silver coin being used for manufacturing purposes, while gold coin is being continually broken up; in fact, watchmakers and others prefer new sovereigns to bullion; they are sure of the purity; they can buy a quarter of an ounce, or sovereign, with 20*s.*, without the trouble of assaying it, and I have been informed, that several thousands are consumed weekly in the district of Clerkenwell.

What are the changes that would be required to make a decimal system work properly?—They are very few. One of the difficulties is, in having our unit of account fixed so high that it requires more coins than under other circumstances might be required. Still there are many reasons for retaining our unit of value or pound as it is now; and with the farthing coined into the 1,000th part of a pound, instead of the 960th, leaving the sovereign and florin as they are, we should only require another coin to render the system nearly perfect.

What do you mean by another coin?—I mean a coin of the value of 10 mils, or tenth of a florin; we should then have the pound, florin, cent, and mil. These four standard coins of account would, I think, be sufficient; to facilitate exchanges, it would be indispensable to have these divided into parts.

How would you divide them?—I would divide, first, the gold into three coins; *i. e.*, the sovereign or 1,000 mils, the half-sovereign or 500 mils, and quarter sovereign or 250 mils; the silver coins I would divide into the florin or 100 mils, half-florin or 50 mils, and quarter-florin or 25 mils; and the cent, or whatever name you adopt, of 10 mils; in copper, I would have a two-mil piece and a one-mil piece; giving nine coins in all.

Is there any great advantage in having so small a number of coins?—I think there are many advantages; in the first place, fewer dies would be required, and consequently there would be less expense; a smaller quantity of metal would be required; and it would be more easily counted, there being less labour in division.

What would be the size of the smallest gold coin?—About the size of a silver fourpenny-piece; and a small gold coin would be very advisable, for several reasons. The recent discoveries of gold are likely to disturb the relative value of gold and silver; and the more you can displace, or rather replace, silver by the introduction of gold, the less inconvenience will be felt; besides, if with one coin of light weight, say 1-16th of an ounce of gold, you can supply the place of five coins of silver, weighing in the aggregate nearly an ounce, the advantage would be immediately felt.

Would there not be an objection on the part of the public to being obliged to carry so small a gold coin in their pockets?—I think there might be some objection at first, but the prejudice would soon be overcome, and the quarter-sovereign would become a favourite; a similar coin is now current in America. They have a gold dollar which is nearly one-fifth less than our 250-mil piece would be; it would weigh nearly 31 grains; and I find that so long ago as the time of Henry the Third, in the year 1257, we had a gold penny, which weighed 45 grains.

Might it not be objected to on the ground that it might be mistaken for a silver coin of a small size, in giving change?—That is one of the evils of any metallic system, and it might as reasonably be assigned as an objection to our present coinage, that the sovereign is sometimes passed for a shilling, and the half-sovereign for sixpence.

Are you of opinion that our gold coinage requires no amendment, beyond the introduction of 250-mil pieces?—None, with the exception that I would advise that every gold coin should have stamped upon it the number of mils it represents, so as to familiarise the public with the two most important parts of our system, and ultimately lead them to look upon mils as the principle of our currency, while pounds should remain as our unit; and it would be a vast improvement could it be arranged to make our sovereign 120 grains instead of 123 grains; it would then be a quarter of an ounce, which would render bullion calculations very easy.

Would you not adopt the mil as the unit?—There are several objections to that; first, the sovereign or pound is our standard measure of value, and now that gold is abundant, it ought not to be changed; secondly, all our debt is reckoned in pounds sterling; and, thirdly, all the salaries and estimates of income are based upon that unit, which has one advantage, it expresses a great sum in few figures.

What would you recommend as regards the silver coinage?—First, I would recommend that an abundance of 10-mil or cent pieces and florin pieces should be circulated, and that all half-crowns and crowns should be withdrawn as speedily as possible, and that no more threepenny and fourpenny pieces should be issued, nor indeed sixpences or shillings.

How would you deal with sixpences and shillings?—Sixpences and shillings I prefer to the crowns and half-crowns; they are of very little inconvenience, because they express fractional and even decimal parts of a pound, and therefore would easily harmonise with any system that might be introduced.

You do not see any objection merely because they are not divisible by 10?—Not at all; and instead of being called shillings and sixpences, I should hope they would be called half florins and quarter florins.

You suggest 1-mil pieces and 2-mil pieces only; would not that be attended with very considerable inconvenience in the payment of tolls and of penny stamps, inasmuch as you would have to carry about so many single mil-pieces?—The penny is an unfortunate coin; it is neither the one thing nor the other, because you cannot make it harmonise with any system that has convenience for its object, and is one of the chief difficulties in the change proposed. If the penny were only thought of as the 240th part of a pound, all difficulty would vanish. During the last three months I have paid considerable attention to this matter, and have taken pains to ascertain, from all classes of people, what their opinions are with regard to a copper coinage, and I am satisfied that in 99 cases out of 100 two halfpence would be preferred to a penny piece. People prefer a single coin when it saves weight or trouble; but if neither object is attained, they prefer the smaller coin, because a halfpenny will often serve the purpose of a penny.

How would you like a 5-mil piece?—I think 5-mil pieces would be very objectionable, as they would be very clumsy; and as they would be the same weight as two 2-mil pieces and one 1-mil piece, there is therefore no advantage gained.

When you speak of economising labour in the small coins, do you mean in the counting of them?—I do; thus, to the merchant, and all others engaged in trade and commerce where book-keeping is necessary, a decimal system is of high utility, for a simple process of multiplication and addition produces the result desired, while fewer figures are used.

Have you any calculations to show to the committee explanatory of your views?—I have taken two or three easy calculations; for instance, if I wish to enter and carry out 799 yards, at one farthing or one mil per yard, the figures 799 embrace the fact decimally without calculation; but if I have to reduce it into pence and shillings, I have first to divide by four, and then by twelve, making fifteen figures and five lines to produce the result, 16*s.* 7¾*d.* If I am quick in mental arithmetic, and do not require to put my pen to paper, I have still the same mental working, which is so much time wasted. I may also refer to another fact, that if I wish to express 19*s.* 11¾*d.*, or to enter it in columns of my book, I use six figures and three lines, where three figures, 999, are enough; and instead of three columns in our ledgers and day books, we need only two,—a simple line to divide the pound sterling from its decimal parts; or we may have three columns, as now, one for pounds, one for florins, and one for mils, which would have this important advantage, all our present account-books would be ruled correctly.

In either paying or receiving accounts, do you consider the decimal system the most convenient?—Decidedly, and for this reason: if I have to pay 999 mils, I might pay it in one half sovereign, one quarter sovereign, two florin pieces, one quarter florin piece, two cent pieces, and two 2-mil pieces, making nine coins in all. In our present coinage it would require, to pay the same amount, one half-sovereign, one crown, one half-crown, one florin, one fourpenny piece, one penny, one halfpenny, and one farthing, also making nine coins; but that arises from the fact of our having in circulation a florin. In an ordinary case, instead of paying the whole money, we should probably pay a sovereign and receive back one mil or a farthing in exchange.

Have you considered any plan by which the objection to the small silver and gold coins might be overcome?—I have; one by having a perforated coin like the Chinese, where they can be strung like beads and suspended round the body. There is, indeed, some reason for believing that among the earliest coins of the world the perforated system prevailed; pockets not being used, the money or property so carried gave distinction to the owner, and this was doubtless the origin of bracelets and neck ornaments of precious stones, and also of chains of gold.

As a means of carrying money?—As a means of carrying money. As a sort of support of the theory I have just mentioned, I may state that there is abundance of inferential proof of the probability that such was the case; and the fact will be found very interesting. It is recorded that one of our Ambassadors or Ministers of State, on visiting Antwerp, wrote that he had purchased a painting by Rubens, with so many links of his gold chain, from which we may reasonably conclude that the links were of a certain weight and fineness, and perhaps stamped by the goldsmiths, who at any time might be called to lend their notes on the deposit of the chain; and the stamp would save the trouble of re-assaying, self-protection being the cause of the introduction of the hall-mark of the goldsmiths.

Have you any objection to the perforated coin?—I have, especially of the more valuable metals; it would give a tempting facility to the dishonest to scrape metal from the inner edge, and thus the coin might get rapidly reduced in weight, and of course decreased in value.

How would you overcome the objection?—I should prefer a solid coin, and when I know that the dollar gold coin is becoming popular in America, where the people are quite as alive to a true system as we are, and when I remember that a coin of similar character was common in England 600 years ago, when hands were as hard and horny as they are now-a-days, the advantages weighed against the disadvantages are vastly superior. The small silver coin might have more alloy than the other coins, as in the case of the 3-cent piece in the United States, where the alloy is, I believe, seven per cent. more than in the other silver coins.

What are the advantages and disadvantages of the large and small coins? —The advantages of the large coins, or coins of considerable amount, are, that a large sum is more easily counted; the disadvantage is to the poorer classes, who frequently have some difficulty to get them changed. The advantage of the small coin is to all who have to pay wages, the result of piece-work, where fractional payments are to be made, and to all the poor, who have to buy their articles in small quantities.

Can you show what are the evils resulting from an abundance of large coins, whilst there is a scarcity of coins of smaller value?—Every manufacturer in the kingdom is cognisant of the mischief, inconvenience, and even vice, resulting from the difficulty of obtaining an abundance of small coins.

How is that?—I have known, when silver was scarce, several workpeople collect together in the pay-office of a manufactory, each person received a slip of paper, with the amount due, and one of them (nominated by themselves) received a round sum in gold, and as little silver as possible, and were then dismissed to divide it among them. They might not all deal with the same grocer, or baker, or butcher, but there was one with whom they all dealt—I mean the publican,—where change could be obtained; and

I need hardly add, that frequently the division of their wages by this method led to the diminution of their wages and the debasement of their minds.

Have any other inconveniences resulted from it?—Where goods are manufactured at the homes of the workpeople, the manufacturer finds it easier to treat with one person than with a number of persons, and this has led to the introduction of a class called undertakers or middlemen, who come between the master and the workpeople; they undertake all the responsibility, and receive and pay all the money.

Might not the well-being and convenience of the working-classes be promoted by the middlemen?—Undoubtedly; one man could perform the details for 20, so that 20 might be kept at work while one was doing a duty which otherwise each must do for himself; nevertheless, I consider our clumsy coinage to have been the primary cause of the system.

Do you apprehend any difficulties in carrying out a system of decimal coinage?—Of course there are great difficulties, and doubtless there will be objections innumerable, but a little firmness will overcome all obstacles. A little enlightened despotism, or the mild exercise of arbitrary power, would, in such cases, be a national good. We are so much the slaves of custom, that we cling with tenacity to acknowledged evil, because we are either too timid or too idle to adopt a wiser course.

Who, in your judgment, would be the chief objectors; merchants and traders, or the general public?—I cannot conceive it possible for any one pretending to the character of a banker or a merchant objecting to a system which would save him 20 per cent in clerks, whose aim is to do the largest possible amount of business with the least possible amount of labour. I should naturally expect that great prejudice would exist among the ignorant, and all that extensive class who still sell butter at seventeen and a half ounces instead of sixteen ounces to the pound, corn by the old instead of by the imperial bushel, and reckon by bolls instead of quarters. Government, however, is to blame here for levying the duty on the cwt. of 112 lbs. instead of by the pound; sometimes by shillings and pence, instead of on some principle which should be a certain part of a pound sterling. From this defect nearly £5,000 per annum is lost by the Income Tax, being the difference 3 per cent. and 7d. in the pound. In the silk trade, a contract for so many cwt. means so many 100 lbs. net.

Would not the quantity sold very much adjust itself to the amount received, after a little experience?—No doubt it would.

Do you think a half farthing would be of any use?—I think they would be of no use whatever. I think it would be given in, the same way as people now give the farthings. There is one point I should like to name to the committee in regard to the name of our new coins. I have said I consider there need be only four; the pound, the florin, the cent, and the mil as coins of account. I think it is very important also that we should establish the principle of heading our ledger columns with the initial letters of our simple

English terms, and it is very important that, whatever names you adopt, they should be as far as possible removed from those we now have in use, in order to prevent confusion; more especially where a new value might be given to a coin with an old and familiar name.

As you have dealings in French goods, you may probably be able to inform us whether it would be any convenience if we were to accept a decimal system of weights and measures, as well as a decimal system of coinage?—There can be no doubt whatever that it would greatly facilitate commercial transactions.

Do you think it would be attended with more public difficulty than the adoption of a decimal system of coinage?—I think it would, because the chances are you would have a greater variety of articles to measure than merely in money.

If both systems were adopted, do you think it should be done at the same time?—I think it would be well if we could manage it, but it is not essential; our present weights and measures could be calculated in decimal money very easily; but I think it would be very convenient that they should bear a relationship to the money calculations, and be regulated by the same principle, and the sooner the better. Every year increases the evil, and makes the change more difficult.

(III.)

TABLE FOR CONVERTING THE VARIOUS EXISTING SUBDIVISIONS OF THE POUND STERLING INTO DECIMAL COINS, SUPPOSING THE PLAN OF THE COMMITTEE IS ADOPTED.

s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.
			0	10	·041	1	8	·083	2	6	·125
0	0¼	·001	0	10¼	·042	1	8¼	·084	2	6¼	·126
0	0½	·002	0	10½	·043	1	8½	·085	2	6½	·127
0	0¾	·003	0	10¾	·044	1	8¾	·086	2	6¾	·128
0	1	·004	0	11	·045	1	9	·087	2	7	·129
0	1¼	·005	0	11¼	·046	1	9¼	·088	2	7¼	·130
0	1½	·006	0	11½	·047	1	9½	·089	2	7½	·131
0	1¾	·007	0	11¾	·048	1	9¾	·090	2	7¾	·132
0	2	·008	1	0	·050	1	10	·091	2	8	·133
0	2¼	·009	1	0¼	·051	1	10¼	·092	2	8¼	·134
0	2½	·010	1	0½	·052	1	10½	·093	2	8½	·135
0	2¾	·011	1	0¾	·053	1	10¾	·094	2	8¾	·136
0	3	·012	1	1	·054	1	11	·095	2	9	·137
0	3¼	·013	1	1¼	·055	1	11¼	·096	2	9¼	·138
0	3½	·014	1	1½	·056	1	11½	·097	2	9½	·139
0	3¾	·015	1	1¾	·057	1	11¾	·098	2	9¾	·140
0	4	·016	1	2	·058	2	0	·100	2	10	·141
0	4¼	·017	1	2¼	·059	2	0¼	·101	2	10¼	·142
0	4½	·018	1	2½	·060	2	0½	·102	2	10½	·143
0	4¾	·019	1	2¾	·061	2	0¾	·103	2	10¾	·144
0	5	·020	1	3	·062	2	1	·104	2	11	·145
0	5¼	·021	1	3¼	·063	2	1¼	·105	2	11¼	·146
0	5½	·022	1	3½	·064	2	1½	·106	2	11½	·147
0	5¾	·023	1	3¾	·065	2	1¾	·107	2	11¾	·148
0	6	·025	1	4	·066	2	2	·108	3	0	·150
0	6¼	·026	1	4¼	·067	2	2¼	·109	3	0¼	·151
0	6½	·027	1	4½	·068	2	2½	·110	3	0½	·152
0	6¾	·028	1	4¾	·069	2	2¾	·111	3	0¾	·153
0	7	·029	1	5	·070	2	3	·112	3	1	·154
0	7¼	·030	1	5¼	·071	2	3¼	·113	3	1¼	·155
0	7½	·031	1	5½	·072	2	3½	·114	3	1½	·156
0	7¾	·032	1	5¾	·073	2	3¾	·115	3	1¾	·157
0	8	·033	1	6	·075	2	4	·116	3	2	·158
0	8¼	·034	1	6¼	·076	2	4¼	·117	3	2¼	·159
0	8½	·035	1	6½	·077	2	4½	·118	3	2½	·160
0	8¾	·036	1	6¾	·078	2	4¾	·119	3	2¾	·161
0	9	·037	1	7	·079	2	5	·120	3	3	·162
0	9¼	·038	1	7¼	·080	2	5¼	·121	3	3¼	·163
0	9½	·039	1	7½	·081	2	5½	·122	3	3½	·164
0	9¾	·040	1	7¾	·082	2	5¾	·123	3	3¾	·165

s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.
3	4	·166	4	4	·216	5	4	·266	6	4	·316
3	4¼	·167	4	4¼	·217	5	4¼	·267	6	4¼	·317
3	4½	·168	4	4½	·218	5	4½	·268	6	4½	·318
3	4¾	·169	4	4¾	·219	5	4¾	·269	6	4¾	·319
3	5	·170	4	5	·220	5	5	·270	6	5	·320
3	5¼	·171	4	5¼	·221	5	5¼	·271	6	5¼	·321
3	5½	·172	4	5½	·222	5	5½	·272	6	5½	·322
3	5¾	·173	4	5¾	·223	5	5¾	·273	6	5¾	·323
3	6	·175	4	6	·225	5	6	·275	6	6	·325
3	6¼	·176	4	6¼	·226	5	6¼	·276	6	6¼	·326
3	6½	·177	4	6½	·227	5	6½	·277	6	6½	·327
3	6¾	·178	4	6¾	·228	5	6¾	·278	6	6¾	·328
3	7	·179	4	7	·229	5	7	·279	6	7	·329
3	7¼	·180	4	7¼	·230	5	7¼	·280	6	7¼	·330
3	7½	·181	4	7½	·231	5	7½	·281	6	7½	·331
3	7¾	·182	4	7¾	·232	5	7¾	·282	6	7¾	·332
3	8	·183	4	8	·233	5	8	·283	6	8	·333
3	8¼	·184	4	8¼	·234	5	8¼	·284	6	8¼	·334
3	8½	·185	4	8½	·235	5	8½	·285	6	8½	·335
3	8¾	·186	4	8¾	·236	5	8¾	·286	6	8¾	·336
3	9	·187	4	9	·237	5	9	·287	6	9	·337
3	9¼	·188	4	9¼	·238	5	9¼	·288	6	9¼	·338
3	9½	·189	4	9½	·239	5	9½	·289	6	9½	·339
3	9¾	·190	4	9¾	·240	5	9¾	·290	6	9¾	·340
3	10	·191	4	10	·241	5	10	·291	6	10	·341
3	10¼	·192	4	10¼	·242	5	10¼	·292	6	10¼	·342
3	10½	·193	4	10½	·243	5	10½	·293	6	10½	·343
3	10¾	·194	4	10¾	·244	5	10¾	·294	6	10¾	·344
3	11	·195	4	11	·245	5	11	·295	6	11	·345
3	11¼	·196	4	11¼	·246	5	11¼	·296	6	11¼	·346
3	11½	·197	4	11½	·247	5	11½	·297	6	11½	·347
3	11¾	·198	4	11¾	·248	5	11¾	·298	6	11¾	·348
4	0	·200	5	0	·250	6	0	·300	7	0	·350
4	0¼	·201	5	0¼	·251	6	0¼	·301	7	0¼	·351
4	0½	·202	5	0½	·252	6	0½	·302	7	0½	·352
4	0¾	·203	5	0¾	·253	6	0¾	·303	7	0¾	·353
4	1	·204	5	1	·254	6	1	·304	7	1	·354
4	1¼	·205	5	1¼	·255	6	1¼	·305	7	1¼	·355
4	1½	·206	5	1½	·256	6	1½	·306	7	1½	·356
4	1¾	·207	5	1¾	·257	6	1¾	·307	7	1¾	·357
4	2	·208	5	2	·258	6	2	·308	7	2	·358
4	2¼	·209	5	2¼	·259	6	2¼	·309	7	2¼	·359
4	2½	·210	5	2½	·260	6	2½	·310	7	2½	·360
4	2¾	·211	5	2¾	·261	6	2¾	·311	7	2¾	·361
4	3	·212	5	3	·262	6	3	·312	7	3	·362
4	3¼	·213	5	3¼	·263	6	3¼	·313	7	3¼	·363
4	3½	·214	5	3½	·264	6	3½	·314	7	3½	·364
4	3¾	·215	5	3¾	·265	6	3¾	·315	7	3¾	·365

s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.
7	4	·366	8	4	·416	9	4	·466	10	4	·516
7	4¼	·367	8	4¼	·417	9	4¼	·467	10	4¼	·517
7	4½	·368	8	4½	·418	9	4½	·468	10	4½	·518
7	4¾	·369	8	4¾	·419	9	4¾	·469	10	4¾	·519
7	5	·370	8	5	·420	9	5	·470	10	5	·520
7	5¼	·371	8	5¼	·421	9	5¼	·471	10	5¼	·521
7	5½	·372	8	5½	·422	9	5½	·472	10	5½	·522
7	5¾	·373	8	5¾	·423	9	5¾	·473	10	5¾	·523
7	6	·375	8	6	·425	9	6	·475	10	6	·525
7	6¼	·376	8	6¼	·426	9	6¼	·476	10	6¼	·526
7	6½	·377	8	6½	·427	9	6½	·477	10	6½	·527
7	6¾	·378	8	6¾	·428	9	6¾	·478	10	6¾	·528
7	7	·379	8	7	·429	9	7	·479	10	7	·529
7	7¼	·380	8	7¼	·430	9	7¼	·480	10	7¼	·530
7	7½	·381	8	7½	·431	9	7½	·481	10	7½	·531
7	7¾	·382	8	7¾	·432	9	7¾	·482	10	7¾	·532
7	8	·383	8	8	·433	9	8	·483	10	8	·533
7	8¼	·384	8	8¼	·434	9	8¼	·484	10	8¼	·534
7	8½	·385	8	8½	·435	9	8½	·485	10	8½	·535
7	8¾	·386	8	8¾	·436	9	8¾	·486	10	8¾	·536
7	9	·387	8	9	·437	9	9	·487	10	9	·537
7	9¼	·388	8	9¼	·438	9	9¼	·488	10	9¼	‘538
7	9½	·389	8	9½	·439	9	9½	·489	10	9½	·539
7	9¾	·390	8	9¾	·440	9	9¾	·490	10	9¾	·540
7	10	·391	8	10	·441	9	10	·491	10	10	·541
7	10¼	·392	8	10¼	·442	9	10¼	·492	10	10¼	·542
7	10½	·393	8	10½	·443	9	10½	·493	10	10½	·543
7	10¾	·394	8	10¾	·444	9	10¾	·494	10	10¾	·544
7	11	·395	8	11	·445	9	11	·495	10	11	·545
7	11¼	·396	8	11¼	·446	9	11¼	·496	10	11¼	.546
7	11½	·397	8	11½	·447	9	11½	·497	10	11½	·547
7	11¾	·398	8	11¾	·448	9	11¾	·498	10	11¾	·548
8	0	·400	9	0	·450	10	0	·500	11	0	·550
8	0¼	·401	9	0¼	·451	10	0¼	·501	11	0¼	·551
8	0½	·402	9	0½	·452	10	0½	·502	11	0½	·552
8	0¾	·403	9	0¾	·453	10	0¾	·503	11	0¾	·553
8	1	·404	9	1	·454	10	1	·504	11	1	·554
8	1¼	·405	9	1¼	·455	10	1¼	·505	11	1¼	·555
8	1½	·406	9	1½	·456	10	1½	·506	11	1½	·556
8	1¾	·407	9	1¾	·457	10	1¾	·507	11	1¾	·557
8	2	·408	9	2	·458	10	2	·508	11	2	·558
8	2¼	·409	9	2¼	·459	10	2¼	·509	11	2¼	·559
8	2½	·410	9	2½	·460	10	2½	·510	11	2½	·560
8	2¾	·411	9	2¾	·461	10	2¾	·511	11	2¾	·561
8	3	·412	9	3	·462	10	3	·512	11	3	·562
8	3¼	·413	9	3¼	·463	10	3¼	·513	11	3¼	·563
8	3½	·414	9	3½	·464	10	3½	·514	11	3½	·564
8	3¾	·415	9	3¾	·465	10	3¾	·515	11	3¾	·565

s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.	s.	d.	Decimals of £1 in Mils.
11	4	·566	12	4	·616	13	4	·666	14	4	·716
11	4¼	·567	12	4¼	·617	13	4¼	·667	14	4¼	·717
11	4½	·568	12	4½	·618	13	4½	·668	14	4½	·718
11	4¾	·569	12	4¾	·619	13	4¾	·669	14	4¾	·719
11	5	·570	12	5	·620	13	5	·670	14	5	·720
11	5¼	·571	12	5¼	·621	13	5¼	·671	14	5¼	·721
11	5½	·572	12	5½	·622	13	5½	·672	14	5½	·722
11	5¾	·573	12	5¾	·623	13	5¾	·673	14	5¾	·723
11	6	·575	12	6	·625	13	6	·675	14	6	·725
11	6¼	·576	12	6¼	·626	13	6¼	·676	14	6¼	·726
11	6½	·577	12	6½	·627	13	6½	·677	14	6½	·727
11	6¾	·578	12	6¾	·628	13	6¾	·678	14	6¾	·728
11	7	·579	12	7	·629	13	7	·679	14	7	·729
11	7¼	·580	12	7¼	·630	13	7¼	·680	14	7¼	·730
11	7½	·581	12	7½	·631	13	7½	·681	14	7½	·731
11	7¾	·582	12	7¾	·632	13	7¾	·682	14	7¾	·732
11	8	·583	12	8	·633	13	8	·683	14	8	·733
11	8¼	·584	12	8¼	·634	13	8¼	·684	14	8¼	·734
11	8½	·585	12	8½	·635	13	8½	·685	14	8½	·735
11	8¾	·586	12	8¾	·636	13	8¾	·686	14	8¾	·736
11	9	·587	12	9	·637	13	9	·687	14	9	·737
11	9¼	·588	12	9¼	·638	13	9¼	·688	14	9¼	·738
11	9½	·589	12	9½	·639	13	9½	·689	14	9½	·739
11	9¾	·590	12	9¾	·640	13	9¾	·690	14	9¾	·740
11	10	·591	12	10	·641	13	10	·691	14	10	·741
11	10¼	·592	12	10¼	·642	13	10¼	·692	14	10¼	·742
11	10½	·593	12	10½	·643	13	10½	·693	14	10½	·743
11	10¾	·594	12	10¾	·644	13	10¾	·694	14	10¾	·744
11	11	·595	12	11	·645	13	11	·695	14	11	·745
11	11¼	·596	12	11¼	·646	13	11¼	·696	14	11¼	·746
11	11½	·597	12	11½	·647	13	11½	·697	14	11½	·747
11	11¾	·598	12	11¾	·648	13	11¾	·698	14	11¾	·748
12	0	·600	13	0	·650	14	0	·700	15	0	·750
12	0¼	·601	13	0¼	·651	14	0¼	·701	15	0¼	·751
12	0½	·602	13	0½	·652	14	0½	·702	15	0½	·752
12	0¾	·603	13	0¾	·653	14	0¾	·703	15	0¾	·753
12	1	·604	13	1	·654	14	1	·704	15	1	·754
12	1¼	·605	13	1¼	·655	14	1¼	·705	15	1¼	·755
12	1½	·606	13	1½	·656	14	1½	·706	15	1½	·756
12	1¾	·607	13	1¾	·657	14	1¾	·707	15	1¾	·757
12	2	·608	13	2	·658	14	2	·708	15	2	·758
12	2¼	·609	13	2¼	·659	14	2¼	·709	15	2¼	·759
12	2½	·610	13	2½	·660	14	2½	·710	15	2½	·760
12	2¾	·611	13	2¾	·661	14	2¾	·711	15	2¾	·761
12	3	·612	13	3	·662	14	3	·712	15	3	·762
12	3¼	·613	13	3¼	·663	14	3¼	·713	15	3¼	·763
12	3½	·614	13	3½	·664	14	3½	·714	15	3½	·764
12	3¾	·615	13	3¾	·665	14	3¾	·715	15	3¾	·765

s.	*d.*	Decimals of £1 in Mils.	*s.*	*d.*	Decimals of £1 in Mils.	*s.*	*d.*	Decimals of £1 in Mils.	*s.*	*d.*	Decimals of £1 in Mils.
15	4	·766	16	4	·816	17	4	·866	18	4	·916
15	4¼	·767	16	4¼	·817	17	4¼	·867	18	4¼	·917
15	4½	·768	16	4½	·818	17	4½	·868	18	4½	·918
15	4¾	·769	16	4¾	·819	17	4¾	·869	18	4¾	·919
15	5	·770	16	5	·820	17	5	·870	18	5	·920
15	5¼	·771	16	5¼	·821	17	5¼	·871	18	5¼	·921
15	5½	·772	16	5½	·822	17	5½	·872	18	5½	·922
15	5¾	·773	16	5¾	·823	17	5¾	·873	18	5¾	·923
15	6	·775	16	6	·825	17	6	·875	18	6	·925
15	6¼	·776	16	6¼	·826	17	6¼	·876	18	6¼	·926
15	6½	·777	16	6½	·827	17	6½	·877	18	6½	·927
15	6¾	·778	16	6¾	·828	17	6¾	·878	18	6¾	·928
15	7	·779	16	7	·829	17	7	·879	18	7	·929
15	7¼	·780	16	7¼	·830	17	7¼	·880	18	7¼	·930
15	7½	·781	16	7½	·831	17	7½	·881	18	7½	·931
15	7¾	·782	16	7¾	·832	17	7¾	·882	18	7¾	·932
15	8	·783	16	8	·833	17	8	·883	18	8	·933
15	8¼	·784	16	8¼	·834	17	8¼	·884	18	8¼	·934
15	8½	·785	16	8½	·835	17	8½	·885	18	8½	·935
15	8¾	·786	16	8¾	·836	17	8¾	·886	18	8¾	·936
15	9	·787	16	9	·837	17	9	·887	18	9	·937
15	9¼	·788	16	9¼	·838	17	9¼	·888	18	9¼	·938
15	9½	·789	16	9½	·839	17	9½	·889	18	9½	·939
15	9¾	·790	16	9¾	·840	17	9¾	·890	18	9¾	·940
15	10	·791	16	10	·841	17	10	·891	18	10	·941
15	10¼	·792	16	10¼	·842	17	10¼	·892	18	10¼	·942
15	10½	·793	16	10½	·843	17	10½	·893	18	10½	·943
15	10¾	·794	16	10¾	·844	17	10¾	·894	18	10¾	·944
15	11	·795	16	11	·845	17	11	·895	18	11	·945
15	11¼	·796	16	11¼	·846	17	11¼	·896	18	11¼	·946
15	11½	·797	16	11½	·847	17	11½	·897	18	11½	·947
15	11¾	·798	16	11¾	·848	17	11¾	·898	18	11¾	·948
16	0	·800	17	0	·850	18	0	·900	19	0	·950
16	0¼	·801	17	0¼	·851	18	0¼	·901	19	0¼	·951
16	0½	·802	17	0½	·852	18	0½	·902	19	0½	·952
16	0¾	·803	17	0¾	·853	18	0¾	·903	19	0¾	·953
16	1	·804	17	1	·854	18	1	·904	19	1	·954
16	1¼	·805	17	1¼	·855	18	1¼	·905	19	1¼	·955
16	1½	·806	17	1½	·856	18	1½	·906	19	1½	·956
16	1¾	·807	17	1¾	·857	18	1¾	·907	19	1¾	·957
16	2	·808	17	2	·858	18	2	·908	19	2	·958
16	2¼	·809	17	2¼	·859	18	2¼	·909	19	2¼	·959
16	2½	·810	17	2½	·860	18	2½	·910	19	2½	·960
16	2¾	·811	17	2¾	·861	18	2¾	·911	19	2¾	·961
16	3	·812	17	3	·862	18	3	·912	19	3	·962
16	3¼	·813	17	3¼	·863	18	3¼	·913	19	3¼	·963
16	3½	·814	17	3½	·864	18	3½	·914	19	3½	·964
16	3¾	·815	17	3¾	·865	18		·915	19	3¾	·965

s. d.	Decimals of £1 in Mils.	s. d.	Decimals of £1 in Mils.	s. d.	Decimals of £1 in Mils.	s. d.	Decimals of £1 in Mils.
19 4	·966	19 6	·975	19 8	·983	19 10	·991
19 4¼	·967	19 6¼	·976	19 8¼	·984	19 10¼	·992
19 4½	·968	19 6½	·977	19 8½	·985	19 10½	·993
19 4¾	·969	19 6¾	·978	19 8¾	·986	19 10¾	·994
19 5	·970	19 7	·979	19 9	·987	19 11	·995
19 5¼	·971	19 7¼	·980	19 9¼	·988	19 11¼	·996
19 5½	·972	19 7½	·981	19 9½	·989	19 11½	·997
19 5¾	·973	19 7¾	·982	19 9¾	·990	19 11¾	·998

20 shillings equal to 1·000 mils.

(IV.)

TABLE No. 2.—*Showing Value of Decimal Coinage in Present Coinage, with Fractional parts.*

FROM 1 MIL TO 176 MILS.

Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.
.001	0	0 6/25	.045	0	10 4/5	.089	1	9 9/25	.133	2	7 23/25
.002	0	0 12/25	.046	0	11 1/25	.090	1	9 3/5	.134	2	8 4/25
.003	0	0 18/25	.047	0	11 7/25	.091	1	9 21/25	.135	2	8 2/5
.004	0	0 24/25	.048	0	11 13/25	.092	1	10 2/25	.136	2	8 16/25
.005	0	1 1/5	.049	0	11 19/25	.093	1	10 8/25	.137	2	8 22/25
.006	0	1 11/25	.050	1	0	.094	1	10 14/25	.138	2	9 3/25
.007	0	1 17/25	.051	1	0 6/25	.095	1	10 4/5	.139	2	9 9/25
.008	0	1 23/25	.052	1	0 12/25	.096	1	11 1/25	.140	2	9 3/5
.009	0	2 4/25	.053	1	0 18/25	.097	1	11 7/25	.141	2	9 21/25
.010	0	2 2/5	.054	1	0 24/25	.098	1	11 13/25	.142	2	10 2/25
.011	0	2 16/25	.055	1	1 1/5	.099	1	11 19/25	.143	2	10 8/25
.012	0	2 22/25	.056	1	1 11/25	.100	2	0	.144	2	10 14/25
.013	0	3 3/25	.057	1	1 17/25	.101	2	0 6/25	.145	2	10 4/5
.014	0	3 9/25	.058	1	1 23/25	.102	2	0 12/25	.146	2	11 1/25
.015	0	3 3/5	.059	1	2 4/25	.103	2	0 18/25	.147	2	11 7/25
.016	0	3 21/25	.060	1	2 2/5	.104	2	0 24/25	.148	2	11 13/25
.017	0	4 2/25	.061	1	2 16/25	.105	2	1 1/5	.149	2	11 19/25
.018	0	4 8/25	.062	1	2 22/25	.106	2	1 11/25	.150	3	0
.019	0	4 14/25	.063	1	3 3/25	.107	2	1 17/25	.151	3	0 6/25
.020	0	4 4/5	.064	1	3 9/25	.108	2	1 23/25	.152	3	0 12/25
.021	0	5 1/25	.065	1	3 3/5	.109	2	2 4/25	.153	3	0 18/25
.022	0	5 7/25	.066	1	3 21/25	.110	2	2 2/5	.154	3	0 24/25
.023	0	5 13/25	.067	1	4 2/25	.111	2	2 16/25	.155	3	1 1/5
.024	0	5 19/25	.068	1	4 8/25	.112	2	2 22/25	.156	3	1 11/25
.025	0	6	.069	1	4 14/25	.113	2	3 3/25	.157	3	1 17/25
.026	0	6 6/25	.070	1	4 4/5	.114	2	3 9/25	.158	3	1 23/25
.027	0	6 12/25	.071	1	5 1/25	.115	2	3 3/5	.159	3	2 4/25
.028	0	6 18/25	.072	1	5 7/25	.116	2	3 21/25	.160	3	2 2/5
.029	0	6 24/25	.073	1	5 13/25	.117	2	4 2/25	.161	3	2 16/25
.030	0	7 1/5	.074	1	5 19/25	.118	2	4 8/25	.162	3	2 22/25
.031	0	7 11/25	.075	1	6	.119	2	4 14/25	.163	3	3 3/25
.032	0	7 17/25	.076	1	6 6/25	.120	2	4 4/5	.164	3	3 9/25
.033	0	7 23/25	.077	1	6 12/25	.121	2	5 1/25	.165	3	3 3/5
.034	0	8 4/25	.078	1	6 18/25	.122	2	5 7/25	.166	3	3 21/25
.035	0	8 2/5	.079	1	6 24/25	.123	2	5 13/25	.167	3	4 2/25
.036	0	8 16/25	.080	1	7 1/5	.124	2	5 19/25	.168	3	4 8/25
.037	0	8 22/25	.081	1	7 11/25	.125	2	6	.169	3	4 14/25
.038	0	9 3/25	.082	1	7 17/25	.126	2	6 6/25	.170	3	4 4/5
.039	0	9 9/25	.083	1	7 23/25	.127	2	6 12/25	.171	3	5 1/25
.040	0	9 3/5	.084	1	8 4/25	.128	2	6 18/25	.172	3	5 7/25
.041	0	9 21/25	.085	1	8 2/5	.129	2	6 24/25	.173	3	5 13/25
.042	0	10 2/25	.086	1	8 16/25	.130	2	7 1/5	.174	3	5 19/25
.043	0	10 8/25	.087	1	8 22/25	.131	2	7 11/25	.175	3	6
.044	0	10 14/25	.088	1	9 3/25	.132	2	7 17/25	.176	3	6 6/25

No. 2 TABLE—*Continued.*

FROM 177 MILS TO 250 MILS.

Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.	Florins. Cents. Mils.	s.	d.
.177	3	6$\frac{12}{25}$	.196	3	11$\frac{1}{25}$	.215	4	3$\frac{3}{5}$	.234	4	8$\frac{4}{25}$
.178	3	6$\frac{18}{25}$	.197	3	11$\frac{7}{25}$	.216	4	3$\frac{21}{25}$	.235	4	8$\frac{2}{5}$
.179	3	6$\frac{24}{25}$	.198	3	11$\frac{13}{25}$	.217	4	4$\frac{2}{25}$	.236	4	8$\frac{16}{25}$
.180	3	7$\frac{1}{5}$	.199	3	11$\frac{19}{25}$	.218	4	4$\frac{8}{25}$	.237	4	8$\frac{22}{25}$
.181	3	7$\frac{11}{25}$	.200	4	0	.219	4	4$\frac{14}{25}$	.238	4	9$\frac{3}{25}$
.182	3	7$\frac{17}{25}$	.201	4	0$\frac{6}{25}$	.220	4	4$\frac{4}{5}$	.239	4	9$\frac{9}{25}$
.183	3	7$\frac{23}{25}$	.202	4	0$\frac{12}{25}$	.221	4	5$\frac{1}{25}$	.240	4	9$\frac{3}{5}$
.184	3	8$\frac{4}{25}$	.203	4	0$\frac{18}{25}$	.222	4	5$\frac{7}{25}$	.241	4	9$\frac{21}{25}$
.185	3	8$\frac{2}{5}$	.204	4	0$\frac{24}{25}$	.223	4	5$\frac{13}{25}$	.242	4	10$\frac{2}{25}$
.186	3	8$\frac{16}{25}$	.205	4	1$\frac{1}{5}$	.224	4	5$\frac{19}{25}$	.243	4	10$\frac{8}{25}$
.187	3	8$\frac{22}{25}$	.206	4	1$\frac{11}{25}$	.225	4	6	.244	4	10$\frac{14}{25}$
.188	3	9$\frac{3}{25}$	.207	4	1$\frac{17}{25}$	.226	4	6$\frac{6}{25}$	.245	4	10$\frac{4}{5}$
.189	3	9$\frac{9}{25}$	.208	4	1$\frac{23}{25}$	.227	4	6$\frac{12}{25}$	.246	4	11$\frac{1}{25}$
.190	3	9$\frac{3}{5}$	.209	4	2$\frac{4}{25}$	.228	4	6$\frac{18}{25}$	.247	4	11$\frac{7}{25}$
.191	3	9$\frac{21}{25}$	.210	4	2$\frac{2}{5}$	.229	4	6$\frac{24}{25}$	.248	4	11$\frac{13}{25}$
.192	3	10$\frac{2}{25}$	.211	4	2$\frac{16}{25}$	.230	4	7$\frac{1}{5}$	.249	4	11$\frac{19}{25}$
.193	3	10$\frac{8}{25}$	.212	4	2$\frac{22}{25}$	.231	4	7$\frac{11}{25}$	.250	5	0
.194	3	10$\frac{14}{25}$	.213	4	3$\frac{3}{25}$	.232	4	7$\frac{17}{25}$			
.195	3	10$\frac{4}{5}$	.214	4	3$\frac{9}{25}$	.233	4	7$\frac{23}{25}$			

(V.)

Mr. Robert Mears has rendered good public service by his little pamphlet called "Decimal Coinage Tables." The decimal calculation shows the facility with which one system of weights and measures may be decimally reformed. In order to exhibit the saving of figures which decimals would accomplish in calculations of interest, I have here given extracts from Mr. Mears' calculations:—

DECIMALS OF A YEAR.

1 DAY TO 182½ DAYS (OR HALF-YEAR).

Days	Decimal of a Year	Days.	Decimal of a Year.	Days.	Decimal of a Year.	Days.	Decimal of a Year.
1	.0027	47	.1287	92	.252	138	.378
2	.0054	48	.1315	93	.2547	139	.3808
3	.0082	49	.1342	94	.2575	140	.3835
4	.0109	50	.1369	95	.2602	141	.3863
5	.0136	51	.1397	96	.263	142	.389
6	.0164	52	.1424	97	.2657	143	.3917
7	.0191	53	.1452	98	.2684	144	.3945
8	.0219	54	.1479	99	.2712	145	.3972
9	.0246	55	.1506	100	.2739	146	.4
10	.0273	56	.1534	101	.2767	147	.4027
11	.0301	57	.1561	102	.2794	148	.4054
12	.0328	58	.1589	103	.2821	149	.4082
13	.0356	59	.1616	104	.2849	150	.4109
14	.0383	60	.1643	105	.2876	151	.4136
15	.041	61	.1671	106	.2904	152	.4164
16	.0438	62	.1698	107	.2931	153	.4191
17	.0465	63	.1726	108	.2958	154	.4219
18	.0493	64	.1753	109	.2986	155	.4246
19	.052	65	.178	110	.3013	156	.4273
20	.0547	66	.1808	111	.3041	157	.4301
21	.0575	67	.1835	112	.3068	158	.4328
22	.0602	68	.1863	113	.3095	159	.4356
23	.063	69	.189	114	.3123	160	.4383
24	.0657	70	.1917	115	.315	161	.441
25	.0684	71	.1945	116	.3178	162	.4438
26	.0712	72	.1972	117	.3205	163	.4465
27	.0739	73	.2	118	.3232	164	.4493
28	.0767	74	.2027	119	.326	165	.452
29	.0794	75	.2054	120	.3287	166	.4547
30	.0821	76	.2082	121	.3315	167	.4575
31	.0849	77	.2109	122	.3342	168	.4602
32	.0876	78	.2136	123	.3369	169	.463
33	.0904	79	.2164	124	.3397	170	.4657
34	.0931	80	.2191	125	.3424	171	.4684
35	.0958	81	.2219	126	.3452	172	.4712
36	.0986	82	.2246	127	.3479	173	.4739
37	.1013	83	.2273	128	.3506	174	.4767
38	.1041	84	.2301	129	.3534	175	.4794
39	.1068	85	.2328	130	.3561	176	.4821
40	.1095	86	.2356	131	.3589	177	.4849
41	.1123	87	.2383	132	.3616	178	.4876
42	.115	88	.241	133	.3643	179	.4904
43	.1178	89	.2438	134	.3671	180	.4931
44	.1205	90	.2465	135	.3698	181	.4958
45	.1232	91	.2493	136	.3726	182	.4986
46	.126	91¼	.25	137	.3753	182½	.5

DECIMALS OF A YEAR.—(*Continued*).

183 DAYS TO 1 YEAR.

Days.	Decimal of a Year.	Days.	Decimal of a Year.	Days.	Decimal of a Year.	Days.	Decimal of a Year.
183	.5013	229	.6273	274	.7506	320	.8767
184	.5041	230	.6301	275	.7534	321	.8794
185	.5068	231	.6328	276	.7561	322	.8821
186	.5095	232	.6356	277	.7589	323	.8849
187	.5123	233	.6383	278	.7616	324	.8876
188	.515	234	.641	279	.7643	325	.8904
189	.5178	235	.6438	280	.7671	326	.8931
190	.5205	236	.6465	281	.7698	327	.8958
191	.5232	237	.6493	282	.7726	328	.8986
192	.526	238	.652	283	.7753	329	.9013
193	.5287	239	.6547	284	.778	330	.9041
194	.5315	240	.6575	285	.7808	331	.9068
195	.5342	241	.6602	286	.7835	332	.9095
196	.5369	242	.663	287	.7863	333	.9123
197	.5397	243	.6657	288	.789	334	.915
198	.5424	244	.6684	289	.7917	335	.9178
199	.5442	245	.6712	290	.7945	336	.9205
200	.5479	246	.6739	291	.7972	337	.9232
201	.5506	247	.6767	292	.8	338	.926
202	.5534	248	.6794	293	.8027	339	.9287
203	.5561	249	.6821	294	.8054	340	.9315
204	.5589	250	.6849	295	.8082	341	.9342
205	.5616	251	.6876	296	.8109	342	.9369
206	.5643	252	.6904	297	.8136	343	.9397
207	.5671	253	.6931	298	.8164	344	.9424
208	.5698	254	.6958	299	.8191	345	.9452
209	.5726	255	.6986	300	.8219	346	.9479
210	.5753	256	.7013	301	.8246	347	.9506
211	.578	257	.7041	302	.8273	348	.9534
212	.5808	258	.7068	303	.8301	349	.9561
213	.5835	259	.7095	304	.8328	350	.9589
214	.5863	260	.7123	305	.8356	351	.9616
215	.589	261	.715	306	.8383	352	.9643
216	.5917	262	.7178	307	.841	353	.9671
217	.5945	263	.7205	308	.8438	354	.9698
218	.5972	264	.7232	309	.8465	355	.9726
219	.6	265	.726	310	.8493	356	.9753
220	.6027	266	.7287	311	.852	357	.978
221	.6054	267	.7315	312	.8547	358	.9808
222	.6082	268	.7342	313	.8575	359	.9835
223	.6109	269	.7369	314	.8602	360	.9863
224	.6136	270	.7397	315	.863	361	.989
225	.6164	271	.7424	316	.8657	362	.9917
226	.6191	272	.7452	317	.8684	363	.9945
227	.6219	273	.7479	318	.8712	364	.9972
228	.6246	273¾	.75	319	.8739	365	1.0

Example—£240 for 120 days at 4 per cent.

Decimal Method.—34 Figures.

240 Principal
4 Rate per Cent.
———
960
3287 Decimal for Time.
———
6720
7680
1920
2880
———
3155520—which, divided by 100, gives 3 Pounds, 1 Florin, 5 Cents, 5 Mils; or, reconverted, £3 3s. $1\frac{1}{4}$d.

Present Method.—80 Figures.

£240
120
———
4800
240
———
28800
4 Rate per Cent.
———
365)1152/00(£3 3s. $1\frac{1}{4}$d.
1095
———
57
20
———
365)1140(3
1095
———
45
12
———
365)540(1
365
———
175
4
———
365)700(1
365
———
335

Another Example—£118 12s. 6d. for 73 days at 4 per cent.

Decimal Method.—20 Figures.

118·625 Decimal for Money, from Coinage Tables.
4 Rate per Cent.
———
474·500
2 Decimal for Time.
———
949·000—which, divided by 100, gives 9 Florins, 4 Cents, 9 Mils; or, reconverted, 18s. $11\frac{3}{4}$d. as the Interest.

Present Method.—88 Figures.

£118 12 6 Principal.
20
———
2372
12
———
28470
4 Rate per Cent.
———
113880
73 Time.
———
341640
797160
———
365)83132/40(12)227$\frac{227}{365}$
730 ———
——— 18s. $11\frac{3}{4}$d.
1013
730
———
2832
2555
———
277

(VI.) SYNOPTICAL INFORMATION ON THE SUBJECT OF FRENCH COINS.

MINISTRY OF FINANCE. COMMISSION OF MONEYS AND MEDALS.

Price per Kilogramme of Fine and Standard Metal.				Nature and Value of the Pieces.			Diameter of the Pieces.	Number of Pieces per Kilogramme.	Weight per Piece.			Standard of Gold and Silver.
GOLD.		SILVER.										
@ $\frac{1000}{1000}$	@ $\frac{900}{1000}$	@ $\frac{1000}{1000}$	@ $\frac{900}{1000}$		Nominal Value.	Real Value.			Exact Weight.	Weight above.	Weight below.	
a	a	a	a			a	b	c	c	c	c	d
f. c.	f.	f. c.	f. c.		f. c.	f. c.	Millims.		g. m.	g. m.	g. m.	
				Gold	20 0	19 96	21	155	6 451·6	6 464·5	6 438·7	
				Gold	10 0	9 98	19	310	3 225·8	3 232·25	3 219·35	
				Silver	5 0	4 96·35	37	40	25	25 075	24 925	
3,437 77·77	3,094	220 36	198 50	Silver	2 0	1 98·50	27	100	10	10 050	9 950	900
				Silver	1 0	0 99·25	23	200	5	5 025	4 975	
				Silver	0 50	0 49·62	18	400	2 50	2 517·5	2 481·5	
				Silver	0 20	0 19·85	15	1000	1	1 010	9 990	
The material for brass or bronze* money is furnished by the State to the Directors.				Bronze	0 10		30	100	10	10 100	9 900	†
				Bronze	0 5		25	200	5	5 050	4 950	
				Bronze	0 2		20	500	2	2 030	1 970	
				Bronze	0 1		15	1000	1	1 015	0 985	

	Allowance.			Samples of each Parcel.				Retained on the Material for Expense of Coinage.	Expenses attached to the Coinage.			Proportion to be Coined of different Values.		Mints.	
		In Weight.			Weight.										
	In Purity.	Per Kilo. above and below.	Per Piece above and below.	Number of Pieces.	Exact.	Above.	Below.		Verification per 6,000 Pieces.	Price of dies per Kilo.	Price of broken Moulds per 200,000.	Proportion of Pieces in 40.	By 1,000 Coined.	Towns.	Letters.
	d	c	c	e	c	c	c	f	g	h	i	j	j	k	k
		g.	m.		g. m.	g. m.	g. m.	f. c.	f. c.	c.	f.	c.	f.		
Gold		2	12·50	6	38 71	38 79	38 63	6 0			40			Paris.	A.
Gold		2	6·25	6	19 354·8	19 393·5	19 316	6 0							
Silver	2 Mil.	3	75	8	200	200 60	199 40	1 50			40			Rouen.	B.
Silver	from	5	50	8	80	80 40	79 60	1 50	3 0	5		$\frac{8}{40}$	5,000	Lyons.	D.
Silver	898	5	25	8	40	40 20	39 80	1 50				$\frac{20}{40}$	12,500		
Silver	to	7	18	8	20	20 14	19 86	1 50				$\frac{10}{40}$	6,250	Bordeaux.	K.
Silver	902	10	10	16	16	16 16	15 84	1 50				$\frac{2}{40}$	1,250		
	The allowance of fineness above & below the standard is 1-100th for copper, and 1-50th for the other two metals.	The allowance of weight above and below the standard, is 1 per cent. for pieces of 5 and 10 cents., and 1½ per cent. for pieces of 1 and 2 cents.		10	100	101	99 0	0 92	1 50 per 10,000f	The dies are paid pr. pair 14, 18, and 22f.	The moulds may be made by the engraver general or by the director.			Strasburg.	BB.
					50	50 50	49 50	1 32						Marseilles.	MA.
					20	20 30	19 70	2 24							
					10	10 15	9 85	3 0						Lille.	W.

a. Tarifs annexed to the Loi of 17 Prairial, year XI., and the Decree of 15th September, 1849. *b.* Law of 7 Germinal, year XI. Decree of 3rd May, 1848. Addition to the programme of the competition of 18th April, 1848. *c.* Law of 7 Germinal, year XI. Decree of 3rd May, 1848. *d.* Law of 7 Germinal, year XI. Decree of 22nd May, 1849. *e.* Instruction of the Commission of 31st December, 1849. *f.* Law of 7 Germinal, year XI., and 15th September, 1849. *g.* Deliberation of the Commission of 13th April, 1848. *h.* Deliberation of the Commission of 10th March, 1832. *i.* Deliberation of 10th March, 1832. The price of the broken mould has been placed against the account of the Directors by Deliberation of 30th December, 1834. That of damaged moulds is regulated between the Directors and the Engraver-General. *j.* Deliberation of the Commission of 10th Jan., 1851. *k.* Ordonnance of Francis I. of 14th Jan., 1539.

* This fabrication has been directed by a law of 6th May, 1852.

† The composition of the alloy of bronze money is fixed at 95 parts of copper, 4 of tin, and 1 of zinc = 100.

PETTER AND GALPIN, PLAYHOUSE YARD, ADJOINING THE "TIMES" OFFICE.