ON A UNIFORM SYSTEM OF WEIGHTS, MEASURES, AND COINS FOR ALL NATIONS

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FOR

ALL NATIONS.

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ON A UNIFORM SYSTEM,

ETC., ETC.,

Simplicity important in business calculations.

CALCULATIONS connected with money, weights, and measures make up a great part of the active business of life; and by far the most extensive application of the science of numbers is that made in our daily transactions of buying and selling. Few who are engaged in such calculations will be prepared to state that, considered as arithmetical exercises, they are accompanied with any peculiar intellectual pleasure. The astronomer, who labours over an apparently inextricable mass of numbers, usually feels some interest in a task which even in its progress unfolds relations of symmetry in the arrangements of the material universe; yet he would gladly welcome new processes of computation, which, without impairing the accuracy of his results, would diminish the labour necessary for their evolution. It is, therefore, extremely natural that persons engaged in the ordinary calculations of every-day business should, in like manner, be willing to adopt methods for lessening the time and labour devoted to their computations. In order to arrive at sound conclusions on this question, it is first indispensable to consider the means employed in all kinds of calculations.

Mode of counting universally adopted by mankind

Mankind have been so long and so universally accustomed to count by tens, that the decimal system of numeration has become associated in our minds with the groundwork of all numerical computations. But this might have been otherwise, and if man had been created with four or six fingers on each hand, instead of five, we should most probably now employ either eight or twelve as the *modulus* of our numerical system. Much might be said as to the advantages attending the employment of either of these numbers as a numerical modulus, but such remarks would be wholly speculative at the present day, and would probably never possess the slightest practical utility.

should be employed with reference

The calculations of trade have reference either to objects capable of being directly and separately counted, such as pieces of money, or of being counted by comparison with other objects, such as most of the solids and all the liquids

to all countable things.

that are commercial commodities. Such substances must generally be weighed or measured before they can become subjects for computation. In order to effect these processes in such a way as to attach definite notions to our results, we refer all weights and measures to certain fixed standards. Had we only one coin, one weight, and one measure, as we have only one UNIT in arithmetic, much practical inconvenience would result; and accordingly civilized nations have been long accustomed to employ a great variety of coins, weights, and measures. Every single member of each of these classes has usually some fixed numerical relation with the other individuals of its class; but, as the fundamental standards employed by different nations have been generally different, so have been the relations among their groups of coins, weights, and measures. Yet as these relations necessarily form what constitutes the subject matter of ordinary computations, it follows that they should harmonize as closely as possible with the numerical system employed in such computations. If, therefore, we count numbers, considered as abstract representations of countable things, by tens, we should also count the real things themselves in the same way, whether they happen to be coins, weights, or measures. In other words, having adopted a decimal system of arithmetic as a pure science, a decimal system of counting objects to which it is applied will be the easiest and most natural. Had we a duodecimal or any other system of arithmetic, a corresponding system of counting coins, weights, and measures would be the simplest; but with our actual system of computation, calculations referring to objects whose relations are discordant with that system, must be attended with increased trouble and complication. These general arguments are true not merely to-day, but were equally true thousands of years ago, when man first commenced numbering; they are true not merely for us, but for every nation on the surface of the Earth. The rigorous truth of these conclusions has, moreover, been verified thousands of times in practice, and is now apparently universally admitted; yet different nations have for centuries employed systems of coins, weights, and measures, not only unconnected one with the other, but framed without any immediate reference to the system of numbering which has been almost instinctively adopted by every family of the human race.

Although an important advance has been made in

recent times towards the establishment of an improved system, the great nation which has had the honour of taking the first step in this rational course, has as yet been followed by but few others,[1] and by none belonging to the limited number which can bear comparison with her, in population, territorial extent, and material resources. Improvements which require the most simple change in a man's mental habits, even when these improvements spare trouble to the lazy mind itself, are often slowly received by an individual: such improvements are surrounded with difficulties incomparably more serious when a great number of minds must agree before they can be adopted. Our simple and elegant arithmetical notation, usually called the Arabic system of numerals, made very gradual progress into Europe, through Arabia, from India, where it was originally invented. Its advantages over the Greek and Roman systems of notation are so immense, that its absence was undoubtedly the principal cause of the remarkably imperfect condition of the calculating portions of astronomy and mathematics among the ancients, compared to pure geometry and its applications. To the influence of Pope Sylvester the Second is mainly due the adoption of the Arabic numerals during the middle ages in the South of Europe. But centuries elapsed before they entirely displaced the complex and cumbrous Roman numerical symbols among the northern nations. The Arabic numerals were unknown in Russia until the time of Peter the Great; they were employed in England about two centuries before, but there, the barbarous Roman system still lingered among the accounts of the exchequer down to a very recent time. And this improvement was even for a while successfully resisted by one of those statesmen[2] whose rank is usually supposed to supply all the qualities required for managing public affairs. The progress of the higher departments of the exact sciences was greatly retarded in England during the last century by the adherence of mathematicians to a system of notation much inferior to that employed on the continent. This

Resistance to analogous improvements illustrated, by the

Arabic numerals,

by modern mathematics,

[1] The system is now either in actual operation, or its introduction has been sanctioned by legislative enactments in the following states besides France, namely, Belgium, Greece, Spain, Sardinia, Holland, Lombardy, Switzerland, Modena, Mexico, Chili, Columbia, and Costa Rica. The well known union of the German States (Zollverein) for weights and measures has in part adopted the French metrical system.

[2] Lord Grenville.

arose in a great measure from natural though misdirected feelings of veneration for the memory of Newton; just as if the Genoese were to retain precisely the same methods in navigation and seamanship, as those which had been employed by Columbus. More than a century elapsed, before Newton's countrymen were able to understand that the splendid heritage which he had bestowed on mankind, was best cultivated by more manageable weapons than had been employed by the illustrious discoverer himself. In like manner, although incontestably better than that previously employed, our present mode of computing time, according to the Gregorian calendar, came very gradually into operation, except in Catholic countries, and at this day it is not yet universally adopted. In England, when the proposed reform of the calendar was first brought under the notice of the Duke of Newcastle by Lord Chesterfield, it appears that the minister was much alarmed at the project. He entreated the earl not to stir matters that had remained so long quiescent, and expressed his personal disinclination to *new-fangled things*.[3] With such powerful arguments in favour of retaining the old system, it seems wonderful that it has not held its ground up to the present day.

and by the Gregorian Calendar.

As a decimal system of coins, weights, and measures appears to have no peculiarity of a merely provincial or national character, which would adapt it solely for employment within the confines of any separate nation, it is reasonable to suppose that its general adoption by all nations would be universally attended with similarly beneficial results. Not only would the internal transactions of each country be simplified, but its external commercial intercourse would also be greatly facilitated by the similarity of its metrical and monetary arrangements with those of surrounding countries. This result would be yet more decisive were common standards adopted among the several countries. Here the peculiarities and habits of different races doubtlessly present some reasons for existing differences, and will probably interpose some obstacles to the final adoption of an universal system. Although the fundamental ideas of measure, weight, and value are now nearly alike among civilized nations, they are not so completely identical as the elementary notions of number. The primitive units of lineal measure appear generally to

Cosmopolitan nature of a decimal system of coins, weights, and measures.

[3] See Maty's Memoirs of Lord Chesterfield, section vi.

be derived from the dimensions of parts of the human body. Thus the foot has its equivalent designated by a corresponding word among all European languages, but its value is not the same in any two countries. Our first notions of weight are derived from the muscular effort required to sustain a mass of matter, and the commonest instrument for roughly estimating the relative weights of bodies is the hand. Arbitrary ideas of weight thus arise among men, according to their varieties of strength and physical constitution. The designations of certain units of weight also indicate their arbitrary character: thus the "stone" accounts by its very name for the actual varieties in the weight it represents. The fundamental notions of value among mankind, although still somewhat arbitrary, have been long approximating to a condition of uniformity, owing to the wide-spread circulation and universal adoption of the precious metals as representatives of wealth. A certain definite quantity of one of these metals, or of an alloy in fixed proportions, would thus assuredly be a sufficiently intelligible standard of value among all civilized nations.

Twofold operation for producing uniformity of weights and measures:

The formation of a uniform system of weights, measures, and coins for all mankind would thus require a twofold operation—the adoption of the same standards, and, in the subdivisions and multiples of these for smaller or greater values, the employment of that decimal system of numeration which in their arithmetical system mankind have *already* universally adopted. Nor is it solely to the metrical arrangements of separate and independent nations that this double operation would apply. In some countries we find a multitude of provincial weights and measures, as different from each other as those belonging to entirely different races. The weights and measures of Great Britain and Ireland are thus far from being uniform in any sense. They are not only arranged without reference to the decimal enumeration, but are variable in value and in name, in different counties and provinces. Selecting a few from numerous examples of metrical curiosities, it appears that while the length of a rood at Preston is from 16½ to 24 feet, in the Vale of Leven it is 36 yards or 108 feet. The Irish acre contains 7,840 square yards, the Scotch acre 6,084. In some parts of England an acre means 4,840 square yards, while in others it means 10,240. The square rood sometimes amounts to 1,210 square yards, and sometimes

necessity for its application in Great Britain and Ireland.