

Department of Trade and Industry
Consumer and Competition Policy Directorate
www.dti.gov.uk/ccp/

**REPORT (1862) FROM THE SELECT COMMITTEE ON
WEIGHTS AND MEASURES**

THE SELECT COMMITTEE appointed to consider the practicability of adopting a Simple and Uniform System of WEIGHTS and MEASURES, with a view not only to the Benefit of our Internal Trade, but to facilitate our Trade and Intercourse with Foreign Countries:- HAVE considered the Matters to them referred, and have agreed to the following REPORT:-

On a subject of such general importance to nations as well as individuals, your Committee have taken advantage of the opportunity afforded by the International Exhibition, to obtain the opinions, and profit by the experience of enlightened foreigners, who have studied the question of Weights and Measures, and assisted in reforming them in their several countries. The Committees feel indebted to these eminent persons - at the head of whom may be placed M. Michel Chevalier - for their valuable testimony, which was not more willingly accepted than spontaneously and liberally given.

Your Committee have also examined men of science, merchants, manufacturers and working men belonging to our own country. They have sought for advocates of the existing system, but they have found it difficult to discover them.

The great diversity of Weights and Measures which has existed in all countries has principally arisen from the lesser communities of which they were originally composed having each adopted its own system. In process of time these lesser communities were amalgamated into separate nations, with whose increase of population and trade the inconvenience of a variety of Weights and Measures soon made itself apparent, and the desire of establishing uniformity arose. France was the first country to relieve itself from its barbarous multiplicity of weights and measures, by adopting a uniform system. Louis the XVI, at the recommendation of the Constituent Assembly, invited, by a decree, all the nations of Europe, and particularly the King of Great Britain, to confer respecting the adoption of an international system of Weights and Measures. No response being given to this invitation, France committed the consideration of the subject to some of the most learned men of the age, who devised what is called the Metric system; the most simple, convenient, and scientific system of weights and measures in existence.

In this country a standard of uniformity existed before the conquest. It was enacted in the time of Richard I, and declared by Magna Carta, that there should be one weight and one measure throughout the realm. In more recent times, committees and commissions have been appointed to inquire into the practicability of introducing a more simple and uniform system of weights and measures, as well as a system of decimal coinage. Several Acts have been passed for the purpose of enforcing or promoting uniformity, the last among the leading statutes being the 5 & 6 Will. 4, c. 63.

The silent influence of usage has baffled the decrees of legislation; and we are still far distant from the uniformity at which we have so often, yet so vainly, aimed. Omitting many specific anomalies, we have no less than ten different systems of Weights and Measures, most of them established by law. Our

neighbours, the French, and many other nations, have only one, founded on the *mètre*, which is a near approximation to the English yard. We find in our country the following different systems:

1. Grains, computed decimally, used for scientific purposes.
2. Troy weight, under 5 Geo. 4, c. 74 and 18 & 19 Vict. c. 72.
3. Troy ounce, with decimal multiples and divisions, called bullion weights, under 16 & 17 Vict. c. 29.
4. Bankers' weights, to weigh 10, 20, 30, 50, 100 and 200 sovereigns.
5. Apothecaries weight.
6. Diamond weights and pearl weights, including carats.
7. Avoirdupois weight; under 5 Geo. 4, c. 74, and 18 & 19 Vict. c. 72.
8. Weights for hay and straw.
9. Wool weight, using as factors, 2, 3, 7, 13, and their multiples.
10. Coal weights, decimal, under 1 & 2 Will. 4, c. 76, and 8 & 9 Vict. c. 101; Nos. 1, ·5, ·2, ·1, ·5, ·025.

We have also, in occasional scientific use, the weights of the Metric system. For measures of length, we have the ordinary inch, foot and yard. We have in cloth measure, yards, nails and ells. There are four different sorts of ells. For nautical purposes, we have fathoms, knots, leagues and geographical miles differing from the common mile. The fathom of man-of-war is 6 feet; of a merchant vessel, 5 1/2 feet; of a fishing-smack, 5 feet. We have also the Scotch and Irish mile, and the Scotch and Irish acre. There are several sorts of acres in the United Kingdom, and there are a great variety of roods. We have, in almost every trade, measures of length especially used in those trades: for the measurement of horses, we have the hand; shoemakers use sizes; and we are compelled to adopt gauges where the French use the *millimetre*. These gauges are entirely arbitrary. The custom of the trade is the only thing which would decide the question, in case of dispute. For measures of capacity, we have 20 different bushels: we can scarcely tell what the hogshead means. For ale it is 54 gallons, for wine 63. Pipes of wine vary in many ways; each sort of wine seems to claim the privilege of a different sort of pipe. For measures of weight, we have about 10 different stones; a stone of wool at Darlington is 18 lbs.; a stone of flax at Downpatrick is 24 lbs.; a stone of flax at Belfast is only 16 3/4 lbs.; but it is also at Belfast 24 1/2 lbs., having in one place two values. The hundredweight may mean 100 lbs., 112 lbs., or 120 lbs. If you buy an ounce or pound of anything, you must inquire if it belongs to Dutch, troy, or avoirdupois weight. But it is needless to lead the reader through all these mazes of numerical confusion. Fuller particulars will be found in the evidence of Professor Levi, Mr. Fellows, and other witnesses.

Our system of Weights and Measures, being in this state of disorder and of darkness, a sudden light was thrown upon it, and the advantage of a common international system fully brought into view, by the Great Exhibition of 1851. The

jurors of that Exhibition experienced the greatest embarrassment from the various, Weights and Measures used by the exhibitors of different countries. They could with difficulty arrive at any common standard. This induced the Society of Arts to petition the Treasury in favour of a uniform system. The same object was promoted by the Statistical Congress held at Brussels in 1853. When the Great Paris Exhibition of 1855 took place, the jurors found themselves obstructed by similar impediments. The members of the international jury, on that occasion, issued an important declaration, recommending the adoption of a universal system of Weights and Measures. At the London meeting of the International Statistical Congress held in 1860, His Royal Highness, the ever-lamented and ever-memorable Prince Consort, in his opening address, used these words: "The different weights, measures, and currencies in which different statistics are expressed, cause further difficulties and impediments: suggestions with regard to the removal of these have been made at former meetings, and will, no doubt, be renewed." All these occurrences led to repeated discussions at the Society of Arts and other Institutions, respecting the best system of Weights and Measures. At these meetings the preponderance of opinion was strongly in favour of the Metric system, now becoming common to so many other nations. The Associated Chambers of Commerce of the United Kingdom; at their annual meeting in 1861; speaking as delegates on behalf of their various districts, and representing some of the most important towns in the country as well as various branches of industry, unanimously passed the following resolution: "It is highly desirable to adopt the Metric system which has been introduced into many European countries with great advantage to the saving of time in trading and other accounts."

There appear to be three modes of proceedings before us: to retain the present system: to create a separate decimal system of our own, distinct from that of other nations; or simply to adopt, in common with other countries, the Metric decimal system. Scarcely any witness examined by your Committee has defended the present system. Even apart from the anomaly of using so many weights and measures, that system has been condemned as cumbrous and inconvenient. The units are founded on no natural basis. They are not decimally related to each other. Their multiples and divisors follow no given ratio: and the best proof of their insufficiency for all the practical purposes of life is found in the adoption of so many systems better suited to their wants, by different classes of the people. The superiority of a decimal system has long been acknowledged. Our engineers have, for a considerable time, made use of one. The decimal measuring-chain and decimal levelling staff are instruments familiar to them. Insurance companies have long employed decimals. The Equitable Insurance Company have kept their ledger on the *pound* and *mil* system for a hundred years. But it would involve almost as much difficulty to create a special decimal system of our own as simply to adopt the Metric decimal system, in common with other nations; and if we did so create a special national system, we should, in all likelihood, have to change it again in a few years, as the commerce and intercourse between, nations increased, into an international one.

These and other considerations invite our attention to the Metric system. That system is ready-made to our hands. It is complete and homogeneous in all its parts, and perfectly decimal in its multiples and divisors; it is becoming more and more an international system, at once benefiting and uniting the countries which have adopted it; by whose experience we can be guided if we choose to follow in their path.

It is generally known that the French Metric system has the *mètre* (the unit of length) for its basis. The *litre* (the unit of capacity) is derived from the tenth part of the *mètre* (the *decimètre*) by cubing it. The *gramme* (the unit of weight) is

derived from a hundredth part of the *mètre* (the *centimètre*) by cubing it also, and filling it with water of a given temperature. The multiples of the several units are expressed by Greek numerals, the divisors by Latin numerals. The French coinage is based on the unit of weight, the *gramme*; the *franc* being equal to five *gramme*: thus the whole system, not only of Weights and Measures, but of coins also, is connected, and rests upon the *mètre*; which is now a practically established standard, originally based on the ten-millionth part of the distance from the Equator to the Pole.

The countries in which the Metric system has been, or is being, introduced are:-

France, Holland, Belgium, Sardinia and Tuscany, (beyond which countries it is now extending to the whole Kingdom of Italy), Spain, Portugal, Switzerland, Greece, Several countries of South America.

The German Zollverein is accepting the *mètre* instead of the foot, as its basis of length, and the half kilogramme as the basis of weight. The Hanse Towns have also adopted the half kilogramme. Russia has intimated its readiness to follow in the same direction. It appears also that the Metric system is gradually advancing in England.

It is remarkable that the foreign witnesses concur in stating, that no nation which has adopted the Metric system has failed to derive the greatest benefit from such adoption, or, after adoption has shown any desire to abandon it.

The wisdom, justice, and peaceful consequences of extending international commerce are conspicuous reasons in favour of the general acceptance of the Metric system. In a less comprehensive point of view, it is for our own interest to adopt it. Our commerce with the continent of Europe is probably only in its infancy; and with those countries which have admitted the Metric system it appears to be peculiarly, largely, and steadily increasing. They who consult the pages of this Evidence and the Appendix* will find that the total exports of our home-products have, since 1853, increased about 26 per cent., whilst to those countries which have adopted or are adopting the Metric system, they have increased above 70 per cent. Our total exports of home-products in 1853 amounted to nearly 99,000,000 *l.* in value; in 1861 to 125,000,000 *l.* Of these, our exports to countries using the Metric system were in 1853 about 32,000,000 *l.*, in 1861 above 55,000,000 *l.* In 1859, 60 per cent. of our outward and 60 per cent. of our inward bound vessels, and 40 per cent. of the tonnage of each, are stated to be from countries which use the kilogramme.

* Not re-produced on the DTI Website

The certainty and precision which commerce, (though more especially international commerce) would derive from uniformity are another obvious advantage of the Metric system. Mr. Dickson, a Scotch gentleman, a large manufacturer, resident during 30 years at Dunkirk, ascribes his early success in France to his use of the *mètre* as a uniform measure, having a clear and definite meaning. While others were using the ill-defined measures of the older system, he thus gave to his transactions that certainty which simplifies and accelerates commercial dealings. Mr. Henley, M.P. justly observes, that the continuous extension of internal communication by means of railways increases the necessity for uniform terms in trade; since, as intercourse expands, it becomes more and more necessary that traders from distant parts should clearly and readily understand terms which are employed.

In machine-making the adoption of a decimal, but especially of the Metric, system, is stated to be of great importance. The superiority of British machinery (says Mr. Fairbairn) is established by the results of the International Exhibition. As its construction becomes finer, accuracy in small measures becomes more and more necessary. "The demand for our manufacture of machinery," (says Mr. Crosley, a civil engineer), "would extend much more if an international system were adopted." Some of our machine-makers have adopted the Metric system. Mr. Fairbairn states, that "it works very well". He adds, that "when the decimal system has once been used in a machine-making establishment, he never knew an instance of its being given up. It will ultimately be introduced into all mechanical operations. The Metric system is, of all he knows, the best." The necessity for the application of decimals to minute admeasurement is shown by Mr. Anderson in his account of the formation of Armstrong guns. "The *millimètre*", says Mr. Siemens, "is used extensively in France, and is an exceedingly convenient measure as a unit in mechanical construction. It induces greater precision in measurement." Mr. Crosley applies the same observation to the construction of locomotive engines and to the railway gauge.

A saving of labour is effected by the use of the Metric system in mercantile establishments. Mr. Dickson, a witness already cited, says, that "under the Metric system" (which he considers "one of the greatest blessings ever conferred on France") he can carry on his trade with fewer clerks than he could under the English system. M. Lorsont, a merchant and manufacturer in Belgium, France, and England, says, that if the Metric system existed in England, he could conduct his business with a considerably diminished number of clerks, "and prevent a great deal of error. An English office is made up of ready reckoners and *vade-mecums*, things utterly unknown abroad." "Under the Metric system," he adds, "it is much easier and shorter to make the calculations yourself". The evidence of Mr. Bass M.P., tends to the same result.

Sir Rowland Hill states that in exchanging letters with our Colonies or with the United States of America, where the system of weights is similar to our own, no difficulties arise; but as respects most foreign countries, we are obliged to alter our scale of weights. As, however, there is no exact correspondence between our weights and those of other countries, the loss to our Post-Office of the postage with France amounts to 6 per cent., and with Germany to 17 per cent. An international system of weights would obviate this loss, and greatly facilitate our postal arrangements with foreign countries.

Economy of time in education is one of the beneficial results of the Metric system. While the study of English weights and measures is laborious and repulsive to both teacher and pupil, any one can easily master the Metric system. "Comparing the English system of calculation with the decimal" says M. Lorsont, "I think the difficulty of the English system is as great as it would be to make a calculation in the old Roman figures." The Metric system is soon learnt; "any person" says Mr. Fellows, "in a quarter or in half an hour would be able to master the whole Metric system." The time which the use of a decimal system would save in education has been generally stated (on the authority of schoolmasters) to be at least a year. Mr. Mumford, later certificated Master of the British School at Highgate, describes the readiness and interest with which children have acquired it. Dr. Ihne, of the University of Bonn, conductor of a large school at Liverpool, finds his pupils, especially foreign boys, "repelled and annoyed" by the English system of weights and measures, and his teachers also; he states that it requires considerably more time to learn; so that a boy is prevented from ever attaining the higher position of knowledge, which he might otherwise reach, by this preliminary barrier of arithmetic. "The waste of time", says the Rev. Alfred Barrett

(a clergyman extensively engaged in education) "to junior pupils in learning the tables of weights and measures is immense." He describes the work of education in the French military academies as "much higher, and more forward than ours," and traces the cause to the time of juvenile pupils being lost in their wanderings through the mazes of our arithmetical system. That eminent mathematician, Professor DeMorgan, thinks that "the whole time devoted to arithmetical education, might, by adopting the decimal system, be reduced by one half, or probably more." "Its adoption", says Dr. Farr (Superintendent of the Statistical Department in the General Register Office), "would get rid of all compound rules of arithmetic; it would make calculations simple and mechanical. Decimal logarithms are calculated and printed by machinery; with the vulgar fractions of our common arithmetic, this could not be done." Your Committee examined, on this part of the subject, more than one working man. There is abundant testimony to the ease with which working men acquire the Metric system. Mr. Dickson, already referred to, says: "In the works I carry on" (at Dunkirk) "I employ about 1,000 persons. I have had frequently a great many overseers from Scotland; they come not knowing the French language, far less the weights and measures, or the money, but they very soon get acquainted with the Metric system." Mr. Richard Wyse has been in the employment of Mr. Brassey, as a mechanic, 25 years; he has been engaged on railways in France, Belgium, and Savoy. He states, that he very soon understood the Metric scale, and found it much easier to comprehend than the English scale of yards, feet, and inches. "The English workman," he says, "get the weights very quickly." He is asked, "How long do you think it would take them " His answer is, "A fortnight, or a month at farthest. All the workmen I ever had anything to do with prefer the French method to the English."

But, as has been before observed, the Metric, as well as other decimal methods, have been already partly adopted in England. The Registrar General makes use of decimals, and they are about to be introduced into the Statistical Department of the Board of Trade. The pupils of the London University make their calculations by the *gramme*. Professor Miller, of Cambridge, is asked, "How long has the Metric system been introduced in scientific operations " He answers, "As long as I can remember. I should think that, since the year 1836, no chemist ever made use of weights which were not decimally divided." Mr. Graham, Master of the Mint, states that "the divisions of the Metric system form a sort of common language for scientific men, and that where it is not used in English scientific papers," those papers remain unnoticed in France. He adds, that it is also beginning to find a place in elementary scientific works in England.

Little opposition is to be expected to the introduction of the Metric system from wholesale dealers. It is probably from the retailers that the principal obstruction would arise. To them, indeed, a change would be a considerable trial; and it is principally for them that precautionary measures are requisite. But M. Visschers (*Conseiller des Mines* at Brussels), states that the tradespeople in Belgium have been much benefited by it. To the small retail traders of France the ease with which it is acquired and its extreme simplicity are a great advantage. "The *marchands*, or small traders," says Mr. Dickson, "can very often scarcely sign their names," yet, owing to its simplicity, "they get on remarkably well with the Metric system;" "there is nothing so difficult to a man of imperfect education as to take an invoice of 10 tons 3 qrs. or 7 cwts. and 18 lbs., at 25s. and 11d. the cwt.;" though he "can readily understand it when it is put into kilogrammes and francs." To the English workman, employed as he so frequently now is abroad, a knowledge of the Metric system is an obvious benefit.

Objections have been made to the decimal method on the ground that, for common purposes, binary subdivision is more convenient, and therefore more generally resorted to. But there is nothing to prevent the use of binary subdivision side by side with decimals; all the binary divisions, as one-half, one-fourth, one-eighth, one-sixteenth, admitting of precise decimal equivalents.

It has been much disputed whether, if the Metric system were adopted, it would be expedient to adopt also the French nomenclature, with its ascending scale based on Greek, and its descending scale based on Latin numbers. To educated persons, these terms are at one a name and a definition. But to the great mass of the people they can convey no meaning. It has been suggested that we might employ the existing terms, or other terms based on our own language. The Dutch applied their old names when they adopted the Metric system. But though to several persons this course has appeared a prudent compromise, the best authorities, the Dutch themselves who have tried it, and other witnesses, disapprove of it. "The retention of the old Dutch names," says Dr. Von Baumhauer, Professor of Chemistry at Amsterdam, "was a great error. It introduced much confusion. It would have been better to introduce the French system of nomenclature altogether." Dr. Van Eÿck also, Director of the Palace of Industry in Holland, and Commissioner at the International Exhibition, thinks it would have been better if the Dutch had adopted the French, nomenclature; and adds, "it was a very bad thing to retain the old names." With the adoption of the Metric system, therefore, it appears the sounder and simpler course to adopt its nomenclature also.

It is clear that no plan of reform can succeed unless it is accompanied by a comprehensive and exact system of Inspection. On this subject we appear to have been long and exceedingly remiss. Local inspectors are appointed by magistrates in counties and boroughs. But we require the establishment of an efficient central department to give force and unity to local action. In the year 1859 the Comptroller General of the Exchequer addressed a letter to the Secretary of State for the Home Department, enclosing a communication from the Astronomer Royal, Mr. Airy. In these documents both those public officers expose and condemn the irregularity and uncertainty of the present system. The Astronomer Royal considers that more than two-thirds of our provincial and local standards have been used more than twenty years without re-verification, and that no reliance can be placed on their general accuracy. It is not possible, he continues, that this omission can exist without serious errors in the local standards, especially those of weight. Local liberty appears to be the rule, Governmental interposition the exception. It seems to be necessary to call in the old standards for re-verification; otherwise, a discordance of weights and measure may arise in the different provinces, which it will be almost beyond the power of the Government to remove. "The Government now takes no part either in supplying the standards, or in compelling local bodies to supply themselves;" and our legislation, with respect to Weights and Measures, has left untouched the privileges of municipalities, guilds, universities, and even of court leets.

So abnormal a condition of our standards seems to require the creation of a Department, which, under Governmental responsibility and Parliamentary control, may impart life and circulation from the centre to the extremities of the system of Inspection. "In France," says M. Chevalier, "there is a department which superintends the proper observance of weights and measures; it is under the Minister of Commerce. The officers of this department are called *Vérificateurs*. The *Vérificateur* makes his visits annually." Similar departments exist in Belgium and other countries, which have adopted the Metric system. Our Government, says Mr. Airy, takes the most praiseworthy care to rectify our coin; but "a want of

precision in the measure of commodities is exactly equivalent to a want of precision in the measure of gold. Who would remit the power of coining to a court-leet " yet to a court-leet, we consign the standard of our weights and measures. "On such a subject, no uncertainty," says Lord Monteagle, "is excusable, or even endurable. In every nation, especially in the greatest commercial nation, the highest point of accuracy should be secured." Public standards should be exhibited (as barometers are at our ports and fishing-stations) in conspicuous places in our towns, and secured (as they are on the Continent) by insertion in the walls. "There is no such thing in Britain," says the Astronomer Royal, "as a public exhibition of a measure or a weight." The Government, instead of being passive, ought to be active on the question; and the readiest way to action is the appointment of an appropriate department, under a well selected chief. Mr. Airy has indicated the preliminary duties of such a department. Your Committee thinks, as they will hereafter show, that such a department may have a higher and more comprehensive destination.

But your Committee feel called upon to mention another defect in our present system; it is a defect in the law. It would appear that by a proviso added to clause 6, of the 5 & 6 Will. 4, c. 63, facilities to evade the statute are given, by allowing the use of "local and customary measures" in cases where the vessel employed "is not represented as containing any amount of Imperial measure, or of any fixed, local, or customary measure heretofore in use." They refer on this subject to the evidence of Mr. Bass and Mr. Hayman, who consider this a very great anomaly in the existing law.

After full and careful consideration of the evidence, your Committee have arrived at a unanimous conclusion, that the best course to adopt is, cautiously but steadily, to introduce the Metric system into this country.

They therefore recommend:-

1. That the use of the Metric system be rendered legal. No compulsory measures should be resorted to until they are sanctioned by the general conviction of the public:
2. That a Department of Weights and Measures be established in connection with the Board of Trade. It would thus become subordinate to the Government, and responsible to Parliament. To it should be intrusted the conservation and verification of the standards, the superintendence of Inspectors, and the general duties incident to such a department. It should also take such measures as may from time to time promote the use, and extend the knowledge of, the Metric system, in the departments of Government, and among the people:
3. The Government should sanction the use of the Metric system (together with our present one) in the levying of the Customs duties; thus familiarising it among our merchants and manufacturers, and giving facilities to foreign traders in their dealings with this country. Its use, combined with that of our own system, in Government-contracts, has also been suggested:
4. The Metric system should form one of the subjects of examination in the Competitive Examinations of the Civil Service:

5. The *gramme* should be used as a weight for foreign letters and books at the Post-office:
6. The Committee of Council on Education should require the Metric system to be taught, (as might easily be done by means of tables and diagrams), in all schools receiving grants of public money:
7. In the public Statistics of the country quantities should be expressed in terms of the Metric system in juxtaposition with those of our own; as suggested by the International Statistical Congress:
8. In Private Bills before Parliament, the use of the Metric system should be allowed.
9. The only weights and measures in use should be the Metric and Imperial, until the Metric has been generally adopted:
10. The proviso (already noticed) in the 5 & 6 Wm. 4, chapter 63, clause 6, should be repealed:
11. The Department which it is proposed to appoint should make an annual report to Parliament.

Your Committee feel it to be right to add that the evidence they have received tends to convince them that a decimal system of money should, as nearly as possible, accompany a decimal system of weights and measures. Both the foreign and English witnesses think the *maximum* of advantage cannot be attained without a combination of the two.

Such is an outline of the course recommended by your Committee for introducing into this country a system which may tend to enlarge our foreign trade - hitherto imperfectly developed, if not neglected - with countries yearly becoming more and more mutually connected and mutually dependent; most of them composing the great European family of nations, and many of them near our own shores. Your Committee think that no country, especially no commercial country, should fail to adopt a system which will save time and lessen labour; which will give to trade greater certainty in its operations, diminish the intermediate agency with which it is encumbered, render more exact machine-making, engineering and manufactures, and remove a number of arithmetical barriers which stand, like obstructive toll-bars, on the highway of education. It has been the destiny of this country to lead the way in introducing the great principles of commercial freedom. Let us not reject the use of those implements which may facilitate their application. Most of all, let us rejoice, if, by adopting a system freely and rapidly extending itself, and becoming more and more an international one, we may assist in promoting the peace, and enlarging the commerce, of the world.

15 July 1862

End