Department of Economics
and
Institute for Policy Analysis
University of Toronto
150 St. George Street
Toronto, Ontario M5S 1A1
Canada

June 18, 1998

WORKING PAPER
NUMBER UT-ECIPA-MUNRO5-98-01

The Maze of Medieval Mint Metrology in Flanders, France and England: Determining the Weight of the *Marc de Troyes* and the Tower Pound from the Economics of Counterfeiting, 1388 -1469

by

John H. Munro

Author's e-mail: munro5@chass.utoronto.ca
On-line version: http://www.chass.utoronto.ca/ecipa/wpa.html

The Maze of Medieval Mint Metrology in Flanders, France and England: Determining the Weight of the *Marc de Troyes* and the Tower Pound from the Economics of Counterfeiting, 1388 - 1469

Professor John Munro
Department of Economics, University of Toronto

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ABSTRACT:

In 1795, the French Revolutionary government, in establishing our modern metric system, also established, directly or indirectly, the metric values for the historic European mint weights of the *ancien régime* era. If those mint-weights are undoubtedly valid for the 18th century, can we be certain that all they had all remained unchanged over the centuries; and in particular that these metric values, and thus the mathematical relationships between the various mint weights, are valid for the later Middle Ages? The answer is vitally important if we are to measure with reasonable confidence the coinage outputs and relative coin values of various medieval European principalities and nations, and thus their relative price movements, etc. Furthermore, as a particularly vexing problem, can we be certain that the so-called *marc de Troyes* used throughout the mints of the later medieval Low Countries was precisely the same *marc de Troyes* used in Paris and throughout France (supposedly 244.753 g)? This latter question is still hotly contended in the numismatic literature in particular because there are no surviving mint weights or coin dies for the medieval Low Countries, and none in France that can be dated before 1483; and surviving coins do not provide unbiased random samples (because of culling and clipping). In this paper, I seek to vindicate the modern metric equivalents by resorting to the mint accounts of 14th- and 15th- century Flanders and England, and in particular the Flemish data on minting gold *nobles* that were coined (from 1388) as counterfeits of the widely circulating English gold *nobles*; I have also used various ordinances that describe the weights of the nobles in terms of both the English Tower Pound and the Flemish *marc de Troyes*. With mathematical examples, I demonstrate that only if the modern metric equivalents of these mint weights were precisely valid for this period (1388-1469) would the Flemish mints have been successful, i.e. in gaining the substantial seignorage profits so recorded: and successful in minting a noble close enough in weight and fineness to the English to "pass" undetected, except by experts using well calibrated scales, yet inferior enough in gold content to allow merchants selling their gold bullion for these counterfeit coins to gain a profit (and compensate for their higher risks and transaction costs). Such evidence also proves that the Flemish and French *marcs de Troyes* had to be identical in this era. Indirectly, this paper also challenges some recent publications about the nature of medieval moneys and of Gresham's Law in this era.

JEL Classifications:

N1, N2, N4, E4, E5

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The Debate about Mint Weights in Medieval Flanders and England

Throughout the later-medieval and early-modern eras, the standard mint-weight used in both France and most of the adjacent Low Countries was the *marc de Troyes*, whose metric equivalent, according to modern metrologists, is 244.7529 grams.[1] In later-medieval England, the corresponding mint-weight was the Tower Pound, used exclusively until 1526, when Parliament displaced it with the now much better known Troy Pound, weighing 373.242 grams. At the time of that formal conversion, one Tower Pound, with 12 'Tower' ounces, was reckoned to contain 11.25 Troy ounces. If so, that would give the Tower Pound the modern metric equivalent of 349.9144 grams, and thus a weight (i.e. mass) 1.43 times greater than that of the *marc de Troyes*.[2] Can we be certain, however, that this ratio was precisely the same for the later Middle Ages, and

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[1] Most authorities seem agreed that the origin of the mark was Scandinavian; and in England, from the influence of the Danish invasions, the mark was a money-of-account (rather than a mint weight) equal to two-thirds of a pound sterling, i.e. 13s 4d (160/240d). For the history of the *marc de Troyes*, and more specifically for northern France and Flanders, see Alphonse Dieudonné, *Les monnaies capétiennes our royales françaises de Louis IX à Louis XII* (Paris, 1932); Armand Machaby, *La métrologie dans les musées de province et sa contribution à l'histoire des poids et mesures en France depuis le treizième siècle* (Paris, 1962); Carlos Wyffels, 'Note sur les marcs monétaires utilisés en Flandre et en Artois avant 1300,' *Handelingen van het Genootschap 'Société d'Emulation' te Brugge*, 104 (1967); Joseph Ghyssens, 'Quelques mesures du poid du moyen âge pour l'or et l'argent', *Revue belge de numismatique et de sigillographie*, 123 (1986), pp. 55-82; Harald Witthöft, 'Von der mittelalterlichen Handhabung des Gewichts in Nordeuropa: Brügge in Flandern', in K. Friedland, ed., *Brügge-Kolloquium*, Quellen und Darstellungen zur hansischen Geschichte NF 36 (Cologne-Vienna, 1990), pp. 51-5; Harald Witthöft, 'Die Markgewicht von Köln und von Troyes im Spiegel der Regional- und Reichsgeschichte vom 11. bis ins 19. Jahrhundert', *Historisches Zeitschrift*, 253:1 (1991), pp. 52-70; Harald Witthöft, 'Le marc de Troyes: un marc régional?', *Cahiers de métrologie*, 14-15 (1996-97), pp. 227-40; Pamela Nightingale, 'The Evolution of Weight Standards and the Creation of New Monetary and Commercial Links in Northern Europe from the Tenth Century to the Twelfth Century', *Economic History Review*, 2nd ser., 38:2 (May 1985), pp. 192-209.

[2] The Troy pound first appears in the statutes in 1414: *Statutes of the Realm*, Vol. II, p. 188: statute 2 Henrici V stat. 2 c. 4 (concerning goldsmiths). In use from at least 1267 (under Henry II), the Tower Pound supposedly weighed 1.5 Cologne marcs, which would have meant a metric weight of 1.5 x 233.856 g. =

valid for all those mint-weights called *marcs de Troyes*? The two major metrological questions to be raised, therefore, are: (1) did all the *marcs* used in the French, Flemish, and other mints of the Low Countries have precisely the same mass or weight during the fourteenth and fifteenth centuries; and (2) did they all maintain the same weight until the metric conversion of 1795, i.e. 244.7529 g.?[3]

Although these questions may seem unduly arcane, the answer is nevertheless absolutely crucial in making any comparisons of coin issues and mint outputs in the various countries and regions of later medieval and early modern Europe; and thus it is equally important for understanding the nature of their price movements. Furthermore, the resolution to this problem better illustrates the economics of medieval coinage and in particular of that all too common fiscal practise that today would be considered counterfeiting, then a private vice but often a national virtue.

From the very commencement of my doctoral dissertation in the early 1960s to the present day, my own research has involved such monetary comparisons between and amongst England, the Low Countries, and

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350.783 g. It was also said to weigh 4/5 of the 15-ounce pound of 435.20 grams, which would have meant a metric weight of 348.16. According to Henry VIII's mint officials in 1526, however, the Tower Pound then contained 11.25 Troy ounces, for a metric weight of 349.914 g. See Rogers Ruding, *Annals of the Coinage of Great Britain and Its Dependencies*, Vol. I (London, 1840), pp. 7-10; Friedrich Schrötter, *Wörterbuch der Münzekunde* (Berlin, 1930), p. 508; J. A. Decourdemanche, *Traité pratique des poids du moyen âge* (Paris, 1915), pp. 37-39; and A. Engels and R. Serrure, *Traité de numismatique du moyen âge*, Vol. I (Paris, 1891), p. xxxvii. For further discussions of English mint metrology, see: Pamela Nightingale, 'Weight Standards', pp. 192-209; D.F. Allen, 'A Fourteenth-Century Coin Weight', *British Numismatic Journal* (1934-37), pp. 189-90; R.D. Connor, *The Weights and Measures of England* (London: Science Museum, 1987); Norman Biggs, 'Coin Weights in England - Up to 1588', *British Numismatic Journal*, 3rd ser. 60 (1991), pp. 65-179; plates 14-15; Richard E. Zupko, *A Dictionary of English Weights and Measures: From Anglo-Saxon Times to the Nineteenth Century* (Madison/Milwaukee/London, 1968), pp. 133-5. For the Cologne mark, see sources in no. 1 and above and also: H. Ziegler, 'Die Kölner Mark in neuem Licht: mit besonderer Berücksichtigung des Normannorum pondus', *Hansische Geschichtsblätter*, 98 (1980), pp. 39-60; Harald Witthöft, 'Das Fundament des Gewichts in Köln nach schriftlichen Überlieferungen des 14.- 19. Jahrhunderts', *Jahrbuch des Kölnischen Geschichtsvereins*, 61 (1990) ; and see also n. 15 below.

[3] See the collected studies, and those for France especially, in: Jean-Claude Hocquet, *Anciens systèmes de poids et mesures en Occident*, Variorum Collected Series CS388 (London, 1992).

northern France from the thirteenth to sixteenth centuries.[4] Initially, though only briefly, I had assumed that, since medieval Flanders was a feudal fief of the crown of France, it had used the same mint weight as the one dictated by the French royal mints, i.e. the *marc de Troyes*. I soon found, however, that in the thirteenth century the Flemish mints had also used a weight based upon the mark of Cologne -- whose purported weight of 233.856 g. was almost precisely two-thirds that of the Tower Pound and thus of a Tower 'mark' -- and then had switched exclusively to the *marc de Troyes* only during the early fourteenth century.[5] Nevertheless, from all of the relevant documents and archival sources that I examined, I had also assumed that the *marc de Troyes* used with that name in the mints of the Low Countries (Flanders, Mechelen, Brabant, Namur, Hainaut, and Holland), during the fourteenth and fifteenth centuries, was the same *marc* in each of these principalities; and that all were identical in mass to the French *marc*, each with 8 *onces de Paris*. My greater and indeed prime concern had been to compare that *marc de Troyes* with the medieval Tower Pound, in order to compare and analyse the mint outputs of later-medieval north-west Europe.

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[4] See John H. Munro, *Wool, Cloth, and Gold: the Struggle for Bullion in Anglo-Burgundian Trade, 1340-1478* (Brussels and Toronto, 1973); and collected essays in J.H. Munro, *Bullion Flows and Monetary Policies in England and the Low Countries, 1350-1500* (Aldershot: Variorum, 1992). Subsequently also: J.H. Munro, 'The Central European Mining Boom, Mint Outputs, and Prices in the Low Countries and England, 1450 - 1550', in Eddy H.G. Van Cauwenberghe, ed., *Money, Coins, and Commerce: Essays in the Monetary History of Asia and Europe, From Antiquity to Modern Times* (Leuven, 1991), pp. 119 - 83; J.H. Munro, 'Patterns of Trade, Money, and Credit', and 'The Coinages of Renaissance Europe, in 1500', in James Tracy, Thomas Brady Jr., and Heiko Oberman, eds., *Handbook of European History in the Later Middle Ages, Renaissance and Reformation, 1400 - 1600*, Vol. I: *Structures and Assertions* (Leiden: E.J. Brill, 1994), pp. 147-95, 671-8.

[5] For its use in late thirteenth-century Flanders, see Victor Gaillard, ed., *Recherches sur les monnaies des comtes de Flandre*, Vol. II: *Sous les règnes de Louis de Crécy et de Louis de Male* (Ghent: H. Hoste, 1856), doc. no. XIV, pp. 27-28: a monetary accord between Robert, son of Count Guy de Dampierre of Flanders, and Duke Jan II of Brabant, which may have required the Cologne mark as a common unit. Brabantine mints, however, subsequently also switched to a *marc de Troyes*. Note that in England the mark as a monetary unit was two thirds of a pound: and thus 349.9144 * 0.6667 = 233.277g., very close to 233.856 g, for the Cologne mark, thus further suggesting that the modern metric equivalent for the Tower Pound was valid for the later Middle Ages. For the Cologne mark and its use in Brabant in this era, see Ghyssens, 'Quelques mesures de poids', pp. 69- 71; and see also a discussion of the Cologne mark in the sources cited above in n. 1 and below n. 10.

The Miskimin Dispute

In commencing my archival research on the mint accounts in the Brussels Algemeen Rijksarchief, I did not, however, initially use that ratio of 1.43 *marcs* per Tower Pound, derived from the modern metric equivalents, but rather a ratio of 1.1719 *marcs* per Tower Pound, which Prof. Harry Miskimin, the co-supervisor of my dissertation, had used as the basis for his analyses of mint outputs and monetary fluctuations in fourteenth-century France and England, in a recent article and in his just published monograph. He had computed it as the ratio of the number of grains in the two mint weights: i.e. as the quotient of 5400 Troy grains in the Tower Pound divided by the 4608 *grains de Troyes* in the *marc de Troyes.*[6] But in using this ratio to compute Flemish and English outputs in the later fourteenth century (temporally overlapping his comparisons of English and French mint outputs), I became increasingly disturbed by mathematical results that did not seem to correspond with my other empirical data on Anglo-Flemish monetary relations. To resolve my doubts, I then consulted about twenty published sources on metrology and numismatics, in various languages, to find that they all unanimously agreed upon the modern metric equivalents for these mint weights; they thus also necessarily established, explicitly or implicitly, that the proper ratio between the weights of the Tower

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[6] Harry Miskimin, 'Price Movements and Specie Debasement in France, 1295 - 1395', *Yale Economic Essays*, 1 (1961), pp. 233-73, republished in Harry A. Miskimin, *Cash, Credit and Crisis in Europe, 1300 - 1600*, Variorum Reprints CS289 (London, 1989), no. 1; and Harry Miskimin, *Money, Prices, and Foreign Exchange in Fourteenth-Century France* (New Haven and London: Yale University Press, 1963), pp. 88-9. Prof. Miskimin's monograph was based upon a dissertation, accepted by Yale University in 1962, and supervised by Prof. Robert Lopez, who also became my chief supervisor. In presenting my own dissertation (accepted by Yale in 1965), I decided that discretion was the better part of valour and made no mention of this rather painful dispute with both Robert Lopez and Harry Miskimin, though citing both modern metrological studies and archival documents to justify my choice of mint weights. Not wishing to endanger my friendship with either of them, nor to endanger the Miskimin's then untenured post at Yale (whose world-renowned Hospital was treating his children for cystic fibrosis), I also refrained from any explicit discussion of this dispute in subsequently converting my thesis into the monograph *Wool, Cloth, and Gold: The Struggle for Bullion in Anglo-Burgundian Trade, 1340-1478* (Brussels and Toronto, 1973). Prof. Miskimin's subsequent admission of this dispute (see n. 10 below) certainly permits me to discuss it more fully now, though it will be noted that I have delayed publication of these matters until after the recent deaths of both Robert Lopez and Harry Miskimin, both victims of cancer.

Pound and the *marc de Troyes* was indeed 1.43:1.[7] If all these authorities were wrong about these medieval weights, then the ratio appearing in Miskimin's article and book meant either that: (1) the medieval *marc de Troyes* had weighed 298.587 grams and thus 22% *more* than its modern metric equivalent; or conversely, (2) that the Tower Pound had actually weighed only 286.826 grams, and thus 22% *less* than its modern metric equivalent.

The other possibility, though not one lightly to be entertained by a 22-year old graduate student, was that my own professor had made a major error. Because such a difference was far too large to be ignored in my dissertation on Anglo-Burgundian monetary relations, especially with a 20-year overlap in our analyses of English mint outputs, I had no choice but to communicate with him about this observed discrepancy; and I suggested that possibly its source was the inequality of the grains in the two mint weights[8]. That inequality can readily be deduced from the internal subdivisions of the *marc de Troyes*, the *Tower Pound*, and the *Troy Pound*, as delineated in the accompanying Table 1. Obviously the crucial difference lies in the number of pennyweights or *deniers* to the ounce: 20 *dwt.* in the English system, and 24 *d.* in the French. The Flemish *marc* is, in a sense, a hybrid. Though in fact based upon and weighing the same, or virtually the same, as the *marc de Troyes*, the Flemish *marc* contained two internal subdivisions with a distinct English influence: the *esterlin* or *ingelschen* -- i.e. the English *dwt*; and the *grains* (Flemish *as*). For, as the accompanying table shows, both the Tower Pound and Flemish *marc* contain 20 *dwt* or *esterlins* to the ounce, and 32 grains or *as* to the *dwt* or *esterlin* (and thus 640 grains to the ounce). Obviously the variations in these subdivisions meant that the English, Flemish, and French grains all had different weights. Their modern metric equivalents in Table 1 are: 0.0531 g. for the *grain de Troyes*, and 0.0648 g. for the Troy grain, or 22% more, and thus the

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[7] See n. 4 above.

[8] See n. 6 above.

very difference between the two ratios.[9]

In his letter of reply, Prof. Miskimin insisted that he had been quite correct in maintaining that the Troy grain and the *grain de Troyes* were, as the etymology of their names indeed suggest, the very same thing, despite evident differences in internal divisions. Indeed for this reason, many historians have speculated about the possibly common origins of the *marc de Troyes*, Cologne mark, Tower and Troy Pounds;[10] and indeed, Joseph Ghyssens has recently noted that the ounce in the curious six-ounce 'little silver marc' of thirteenth-century Flanders had a weight almost precisely identical to that of the Troy ounce.[11] Amongst his two options, Miskimin chose the higher metric equivalent for the *marc de Troyes*, i.e. 298.587 grams, rather than a lower theoretical weight for the Tower Pound (286.826 grams). He also observed that 'all of your figures date back to the [metric] conversion made in 1799 [sic] and hence are open to some doubt when extended backwards in

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[9] Conversely, by the mathematical reciprocal, the *grain de Troyes* weighed 18.06% less than the Troy grain (i.e. 0.0531 - 0.0648).

[10] Correspondence from H.A. Miskimin to J.H. Munro, dated 12 September 1963, and the draft of a never published article entitled 'A Statistical Crime of the Ancien Regime?' For the etymology, he cited the *Oxford English Dictionary*, entry on *Troy*. This dispute proved to be a partial foundation for the subsequent article: Harry Miskimin, 'Two Reforms of Charlemagne? Weights and Measures in the Middle Ages', *Economic History Review*, 2nd ser., 20:1 (1967), pp. 35 -52, which implicitly accepted the modern metric equivalent of the *marc de Troyes* as valid for the later Middle Ages, though without noting the metrological implications of the ratio established in his two earlier publications (n. 5 above); on p. 35 he stated that '...we will postulate that the weight of the grain, the smallest subdivision of the pound, was once the same in France, Flanders, and England, but was subsequently altered'. Subsequently this article was republished in Harry Miskimin, *Cash, Credit and Crisis in Europe, 1300 - 1600* (London, 1989); and in his introduction (p. xi) he very generously commented that 'several critics, the first of them Professor John Munro of Toronto in private correspondence, have called my attention to the fact that I assumed equivalence between English and French grain weights and this was not true by the end of the middle ages.' His views about the origins of European metrological systems were the subject of a debate published as: D.M. Metcalf and H.A. Miskimin, 'The Carolingian Pound: A Discussion', *Numismatic Circular*, 76 (1968), pp. 296-8, 334; and they were further challenged, though not in relation to this current debate, by Witthöft and Nightingale, as cited in n. 1 above. More generally for this debate about the weight relationships see sources cited in nn. 1 and 2 above, 15 below.

[11] Ghyssens, 'Quelques mesures de poids', p. 67. He also noted that 14 of these ounces made up the Flemish mercantile pound of this era; and noted the similarity of this division with the 14-pound (*avoirdupois*) English stone weight.

time for 600 years'.[12] To justify his argument that the medieval weight of the Troy grain and *grain de Troyes* were identical, he presented a statistical analysis of late-medieval French coin weights, drawn from a sample of coin weights published by the French numismatist Jean Lafaurie.[13] Even with a standard deviation of 5%, more generous than the tolerance (*remède*) permitted in French mints, his statistical analysis indicated a metric weight for the *marc de Troyes* far above -- conveniently 20% above -- that stated by modern metrologists. Furthermore, from his observation of the coin photographs, he contended that the surviving coins had evidently suffered wear and tear in circulation and thus evidently some loss of their original weights. That argument was designed to counter the obvious objection, one raised by Lafaurie himself, that such coins, chiefly based on hoards, were an unrepresentative sample that owed their survival to a tendency of both hoarders and collectors to cull the heavier coins from circulation, because their intrinsic worth was higher than their nominal exchange value. Such plausible arguments nevertheless cannot provide a firm foundation for converting these coin-weight data into a truly unbiased random statistical sample.

Other Views on the Weight of the Flemish *Marc*

Nevertheless, Prof. Miskimin had every right to object that no one had yet verified the true metric weight of the *marc de Troyes* (or of the *Tower Pound*, for that matter) during the fourteenth and fifteenth centuries, not to his satisfaction, at least. Nor did my evidence so far adduced prove that the *marc* used in Flemish, Brabantine, and Dutch mints was in fact the same *marc de Troyes* then used in French mints, despite the common terminology. Furthermore, the eminent French metrologist J. A. Decourdemanche had long ago raised doubts about such an identity, also contending that the Flemish *marc* was in fact derived from the English Troy pound.[14] Decourdemanche noted in particular that, in 1529, the Habsburg mint officials of

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[12] See previous note.

[13] Jean Lafaurie, *Les monnaies des rois de France* (Paris, 1951); Harry Miskimin, unpublished manuscript 'A Statistical Crime of the Ancien Regime?' (September 1963).

[14] Jean Decourdemanche, *Traité pratique des poids du moyen âge* (Paris, 1915).

Charles V had sent two *marcs* from the Brussels mint to Paris for examination, only to learn, from the French mint officers, that each then weighed 24 *grains de Troyes* more than the *marc de Troyes* in Paris. The metric equivalent for such a Flemish *marc* with an extra 24 grains would have been 246.028 g., a weight for the Flemish *marc* that the equally eminent French numismatists, A. Engels and R. Serrure, and many subsequent scholars have also reported for the Low Countries' mint weight.[15] Some verification for that estimate can be supplied by the contemporary measurement of a set of four mint *marcs* that the Brussels mint had employed from 1755: they weigh 984.387 g, with a mean of 246.09675g.[16] Nevertheless, the now undeniable fact that the first extant Brussels' mint weights, those for 1529, were not precisely identical in weight to France's official *marc de Troyes* does not necessarily mean that the Flemish mint *marcs* (at Ghent and Bruges) or even earlier Brabantine mint *marcs* (Brussels, Leuven, Antwerp, Mechelen -- technically a Flemish seigneurie) had that same weight. They might have been identical to the current *marc de Troyes* in Paris, or they might have diverged, by slightly varying amounts. One may, of course, cite the well known observation of that seemingly omniscient Italian merchant Francesco Pegolotti, from his *Pratica della mercatura* of c.1340, on the supposed

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[15] See A. Engels and R. Serrure, *Traité de numismatique du moyen âge*, I (Paris, 1891); Alphonse Dieudonné, *Manuel des poids monétaires* (Paris, 1925); Friedrich Schrötter, *Wörterbuch der Münzekunde* (Berlin, 1930); Georges Bigwood, *Le régime juridique et économique du commerce de l'argent dans la Belgique du moyen âge* (Brussels, 1921); Louis Deschamps de Pas, *Essai sur l'histoire monétaire des comtes de Flandre de la maison de Bourgogne* (Paris, 1863); Adolphe Landry, *Essai économique sur les mutations des monnaies dans l'ancienne France de Philippe le Bel à Charles VII* (Paris, 1910); Jean Lafaurie, *Les monnaies des rois de France: Hughes Capet à Louis XII* (Paris, 1951); E. Fournial, *Histoire monétaire de l'occident médiéval* (Paris, 1970); Frank C. Spooner, *The International Economy and Monetary Movements in France, 1493-1725* (Cambridge, Mass. 1973); Hans Van Werveke, *De muntslag in Vlaanderen onder Lodewijk van Male* (Brussels, 1949); H. Enno Van Gelder and Marcel Hoc, *Les monnaies des Pays Bas bourguignonnes et espagnols, 1434 - 1713: répertoire général* (Amsterdam, 1960); Peter Spufford, *Monetary Problems and Policies in the Burgundian Netherlands, 1433-1496* (Leiden, 1970). For the most recent discussion of this problem, see: Harald Witthöft, 'Le marc de Troyes', 228-9, and n. 12 , who also believes that the *marc* used throughout the later medieval Low Countries had this same weight, though citing a figure of 246.08386 g. [Note: 244.7529/4608 = 0.053114778 g. per *grain de Troyes*; and extra 24 grains = 1.27475 g., for a total of 246.02765 g.]; see also Witthöft, 'Köln und Troyes', p. 87. See also n. 17.

[16] Ghyssens, 'Quelque mesures de poids', p. 57, based upon A. Coekelberghs, 'Le marc de Troyes dans les Pays-Bas autrichiens', *Bulletin du cercle d'études numismatiques*, 9 (1972), pp. 13-19. This set of 4 mint weights is currently conserved in the Musée de la Maison du Roi, in Brussels.

identity of the Bruges and Paris *marcs* (for gold): 'lo marco dell'oro di Bruggia e di tutta Fiandra si è once 8 a peso d'oro, ed è tutt'uno peso col marco di Parigi'.[17] But in this statement, Pegolotti in fact tells us nothing more than can be found in hundreds of late-medieval Flemish mint documents; and together they do not necessarily prove that the two marcs had exactly or even approximately the same weight; furthermore, in another and probably separately constructed list of monetary values, Pegolotti notes a slight difference in the weights of the Bruges and Paris marcs, though also noting an identity between the Bruges gold marc and the marc of the Champagne Fairs (i.e. of Troyes).[18]

As for France and its *marc de Troyes*, the eminent French metrologist Armand Machabey, in a monumental study published in 1962, contended that the *marc* from the Champagne Fair town of Troyes and the *marc* used in the royal mint at Paris were identical as a 'national' *marc*; and furthermore that all his evidence, drawn from over 50 museums and thousands of documents, had 'justifié la stabilité du marc de

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[17] Francesco Balducci Pegolotti, *La pratica della mercatura*, ed. Allan Evans, Medieval Academy of America Publication no. 24 (Cambridge, Mass., 1936), p. 237. On this see also Carlos Wyffels, 'Note sur les marcs monétaires', pp. 1-2; and note 1 above. Since Pegolotti also said that the 21 silver marcs (with 6 onces each) were equivalent to 16 gold marcs, Wyffels calculated the weight of the Bruges silver marc or 'petit marc', as: 244.729(16/21) = 186.4784 g. Miskimin, in 'Two Reforms of Charlemagne', speculates, on the basis of this same 21:16 ratio cited by Pegolotti, rather than a ratio of 20:15, which would be suggested by their nominal 8 *once* and 6 *once* weights, that the Flemish silver *marc* then weighed 248.491 grams [i.e. as 16/21 * 326.144g: on the assumption that the Flemish gold *marc*, with 5,120 grains, had a grain weight identical to the English Troy grain, of 0.0637 grams, so that 5120 * 0.0637 = 326.144 g.]. See the following note.

[18] In Pegolotti's *Pratica*, pp. 114, 237, the ounce in the gold marc of Bruges [*in Bruggia a peso d'oro*] was said to contain 34 Sicilian/Neapolitan tari and 10 grains, with 20 grains per tari, for a total of 690 Neapolitan grains: i.e. (34*20) + 10 = 690 grains per ounce; and thus for the 8-ounce Bruges mark, a total of 5520 Neapolitan grains (8 * 690). That is precisely the same weight that Pegolotti assigns to the marc used at the Champagne Fairs (p. 114: *once 1 in fiera*, i.e. at Troyes), while stating that the ounce in the Paris marc [also of 8 onces] contained 34 tari and 13 grains, for a total of 5544 Neapolitan grains in the Paris marc. But, for all we know, this difference may have just been a clerical error in the original manuscript or subsequent copies. With commendable ingenuity, however, Joseph Ghyssens, in 'Quelques mesures de poids', pp. 58-62, Tables 1 and 2, has constructed a cross-tabulation table, based upon all the metrological data to be found in Pegolotti's *Pratica*: in particular, for Bruges, a comparison of the 5520 Naples grains in the gold marc with the known equivalent of Naples grains in various other medieval weights (see the previous note). On the basis of the known metric equivalents for various other medieval weights, Pegolotti's gold marc of Bruges ranged from 243.693 g. to 248.76 g.

France, du 13e au 19e siècle'.[19] Recently, however, Harald Witthöft has subjected that thesis to severe criticism, contending that the *marcs* of Troyes and Paris were probably different from each other and also from the *marc* used in Bruges; and, thus 'nous constatons qu'on ne peut maintenir ce qui a été avancé jusqu'à présent sur le marc de Troyes en tant que marc de Paris et de Bruges'.[20] For all of France, the only surviving late-medieval material evidence, probably dating from the reign of Louis XI (1461-83) or his successor Charles VIII (1483-98), is the famed and misnamed *Pile de Charlemagne*, presently conserved in the Conservatoire des Arts et Métiers in Paris, consisting of 13 pieces, in *gros*, *onces*, and *marcs*, which add up to 50 *marcs*. Its exact weight was determined to be 12,237.6429 g., with an arithmetic mean for the *marc* 244.7529 g. One of the 13 pieces, however, was a *boîtier* (box) of 20 marcs weighing 4,895.1068 g, which thus has a slightly lower mean weight of 244.706 g.; and an even lower *marc* weight was produced by adding together seven other pieces (in gros and *onces*) to make up one marc of 8 *onces*: 244.661 g.[21]

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[19] Machabey, *Métrologie dans les musées*, pp. 9-13, 357-9.

[20] Witthöft, 'Marc de Troyes', pp. 234-35, 240 (quotation). On the basis of a late thirteenth-century French document from the Chambre de Comptes [presented in Machabey p. 375], which notes that the *marc de Troyes* contains 14s. 2d. or 170 *penny sterlings*, evidently English dwt, that the *marc* in Paris was divided into 160 *esterlins* [sterlings] or 192 *deniers*, that the English *marc de la Rochelle*, according to the same document contained 13s 4d or also 160d.; that it weighed 233.280 g., he made the following computation: 233.820/160 = 1.458 g.; and 160 * 1.458g. = 247.860 g. for the Paris marc. He also notes (n. 47, p. 234) that 'avec cette source, mon ancien calcul et l'hypothèse concernant le marc de Troyes de Paris sont obsolètes (cf. WITTHÖFT, "Köln und Troyes" 77)'. He further contends (p. 237) that 'l'assertion de Machabey, que le marc de Paris "était identique au marc célèbre en usage aux foires de Champagne, dit 'marc de Troyes'," est désormais insoutenable'.

[21] It consisted of four gros weights (1 + 1 + 2 + 4), adding up to one *once*; 3 *once* weights adding up to 7 *onces*, which, with the *gros* weights, makes up one *marc*; five *marc* weights, of 1, 2, 4, 8, and 14 *marcs*; and one *boîtier* of 20 *marcs*. First described in Louis Blancard, 'La pile de Charlemagne: éetude sur l'origine et les poids des deniers neufs et de la livre de Charlemagne', *Annuaire de la société française de numismatique* (1887), pp. 595-38. The evidence above is taken from Ghyssens, 'Quelque mesures de poids', p. 56. Ghyssens believes (pp. 72-73) that the Paris *marc* in Pegolotti's day (1338-43) may have been slightly heavier; and on the basis of comparisons with mint-weights for Florence, Venice, and London found in Pegolotti, he estimates that the French marc may have then weighed between 245.057 g. and 245.583 g, while the marc of the Champagne Fairs may have weighed slightly less, around 243.6 g. For evidence that some of Pegolotti's material was derived from various sources dating from the late thirteenth century, see John Munro, 'Wool Price Schedules and the Qualities of English Wools in the Later Middle Ages c. 1270-1499', *Textile History*, 9

Without any extant examples of Flemish mint *marcs* for the fourteenth and fifteenth centuries, or for that matter, any earlier French *marcs*, can their true metric weights for this late-medieval era be verified in some other manner; and furthermore, can we verify their relationship with the Tower Pound, i.e. the purported ratio of 1.43 *marcs* per Tower Pound? As already suggested, attempting to deduce the weight of the *marc* by examining surviving coins of this era is an enterprise fraught with very grave statistical hazards. Fortunately, however, the archives, in the form of a multitude of mint indentures and mint accounts, do provide a considerable amount of documentary evidence on contemporary English and Flemish (and also French) coin weights, expressed in Flemish metrology, which may satisfactorily resolve this problem.[22]

Metrology and the Economics of Counterfeiting: the 'War of the Gold Nobles', 1388-1402

The most compelling evidence comes from the mint accounts and monetary ordinances on the coinage of Flemish gold nobles, which the Flemish count, Duke Philip the Bold of Burgundy, began striking on 1 October 1388, as counterfeit imitations of the English gold nobles, currently being struck in London's Tower Mint and the Calais Staple mint. Calais was the recently conquered enclave on the French coast through which all merchants in the crown-chartered Staple cartel were required to sell English wools, so vital for the luxury cloth production of the Flemish and other Low Countries' draperies.[23] According to the mint indenture, Philip

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(1978), pp. 129-35; but these arguments apply only to the wool-prices in the *Pratica*.

[22] My chief sources have been listed in Appendix I of my *Wool, Cloth, and Gold* (1973), pp. 193-211; and in the Bibliography, manuscript sources, pp. 216-18; and printed documentary sources, pp. 219-22. For other and subsequent research see the publications cited in n. 4 above and nn. 23-4 below.

[23] The English had seized Calais from the French, after the Battle of Crécy, in 1346-47; in March 1363, the crown, ostensibly with the support of Parliament, made Calais the official Staple port for the wool-export trade to northern Europe. For the following, see John Munro, 'Mint Policies, Ratios, and Outputs in the Low Countries and England, 1335 - 1420: Some Reflections on New Data', *Numismatic Chronicle*, 141 (1981), pp. 71-116 (correcting and elaborating on chapter 2, pp. 43-63, in Munro, *Wool, Cloth, and Gold*); and also the studies in John Munro, *Textiles, Towns, and Trade: Essays in the Economic History of Late-Medieval England and the Low Countries*, Variorum Collected Studies series CS 442 (London/Aldershot, 1994); Terence Lloyd, *The English Wool Trade in the Middle Ages* (Cambridge, 1977), pp. 193-256. Certain poor-quality English wools, and wools destined for Mediterranean ports, and shipped directly by the 'Straits of Marrock' were exempted from the mandatory Staple requirements.

the Bold struck these new nobles in response to a petition from the Ghent *schepenen* or civic magistrates, dated 8 March 1388, after the governors of the Calais Staple had informed the Flemish drapery towns that henceforth the only acceptable form of payment for these wools would be in gold nobles.[24] That pejorative term *counterfeiting* will not be found, of course, anywhere in these monetary ordinances, which simply stipulate that the issue of new Flemish nobles 'be similar to the English noble, with the same weight and alloy, as good as or better than the aforesaid noble, and to circulate at the same rate as the English noble'.[25] The English gold noble, worth 6s 8d sterling, was accorded a value of 8s 6d *groot* Flemish, as was the counterfeit Flemish noble, until December 1389, when the Flemish monetary reform, strongly 'favouring' silver, thereby reduced the value of both nobles to 6s 0d *groot* Flemish.[26]

The chief physical objectives of coin counterfeiting were clearly two-fold: (1) that the fraudulent coins not be so deficient in weight and/or fineness that they thereby invited inspection, detection, and confiscation; in other words, that the counterfeit coins be so convincing in appearance that they would readily 'pass' for the same value as the imitated coin, without arousing suspicions; and, furthermore, (2) that, beyond this necessary

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[24] The English wool staple, which had been at Middelburg since 1383, was restored to Calais in 1388. See Munro, *Wool, Cloth, and Gold*, pp. 22-48; Terence Lloyd, *English Wool Trade*, pp. 230-32. For the Ghent petition, dated 3 March 1388, see Archives départementales du Nord, Série B. 632/14.534, with a précis published in Deschamps de Pas, *Histoire monétaire des comtes de Flandre* (Paris, 1863), doc. no. 7, p. cxi. See also the report of Duke Philip the Bold's monetary officials (receiver general, maître général de la monnaie, garde de la monnaie, and maître de la Chambre de Comptes) of 8 March 1388 (also in ADN, B.632/1454), published in Pierre Cockshaw, 'A propos de la circulation monétaire entre la Flandre et le Brabant de 1384 à 1390', *Contributions à l'histoire économique et sociale*, 6 (1970-71), doc. no. iv, pp. 138-41.

[25] See the monetary report of 8 March 1388 (ADN B.632/14.534, cited in n. 7): 'Et est son intencion de eulz faire un denier dor semblable au noble d'Angleterre de tel pois et aloy et aussi bon ou milleur que les dis nobles sont, et que il ait course pour atretel pris justement comme le dit noble d'Angleterre, laquelle chose il ne porroit refuser'. For the subsequent monetary ordinance of 1 October 1388, see John Bartier and Andrée Van Nieuwenhuysen, eds., *Les ordonnances de Philippe le Hardi, de Marguerite de Mäle, et de Jean Sans Peur, 1381-1419*, Vol. I: *du 16 octobre 1381 au 31 décembre 1393*, Recueil des ordonnances des Pays Bas (Brussels, 1965), doc. no. 193, pp. 292-94, prescribing nobles of 23.75 carats fine gold with a *taille au marc de Troyes* of 31 2/3. For their issues, from October 1388 to June 1402, see nn. 22-3 below.

[26] See Munro, *Wool, Cloth, and Gold*, pp. 43-64, Table J, p. 209; and Munro, 'Mint Policies', pp. 83-86.

margin of safety, the quantity of the precious metal in each counterfeit coin be sufficiently less than that in the 'true' or imitated coin, to permit both the merchants supplying the mints with bullion and the prince owning those mints to gain substantial profits. In this particular case, the Flemish mints had to offer merchants a greater number of Flemish gold nobles per *marc* of fine gold than they could obtain in true English gold nobles, for that same *marc*, from the London or Calais mints; and obviously therefore the Flemish mint masters did not and could not follow the injunction to produce nobles that were 'as good as or better than the aforesaid [English] noble'. The prince's profit lay in attracting much more gold bullion to his mints than he would have done by pursuing more honest monetary policies -- especially when the mint ratio came to favour silver -- and thus by reaping larger seigniorage revenues, as a fixed percentage of the coinage output, per *marc* so coined. The mintmaster, whose good will, skills, and full co-operation were obviously mandatory in carrying out this dubious enterprise, would also have gained from the increase in the brassage revenues, similarly exacted as a fixed fee on each fine *marc* so coined.

We must therefore also assume, by the very nature of this act of counterfeiting, by its subsequent evident success, and by the documentary evidence for this era, that even gold coins then passed by tale, i.e. according to the prescribed 'face value', without being subjected to testing, with weighing scales and touchstones, unless, of course, suspicions were unduly aroused. Such coin testing greatly increased the transaction costs of commerce and was fraught with uncertainty, especially given the nature of medieval minting. Medieval coins were cut with shears or circular stamps as round blanks from thin sheets of pressed, alloyed metal, without any milling; and were placed between two hammered dies, each with engraved designs that were imprinted on the blank when the upper 'reverse' die received the hammer blow, often distorting the edges. Under such conditions, even the most skilled craftsmen could not ensure that each and every coin had the exact weight stipulated in the mint indentures. Indeed such indentures normally required only that a specific number of alloyed coins be cut from the *marc* or Tower Pound -- what is known as the *taille* -- with some leeway, tolerance, or *remède* permitted for each *marc* of fine metal so struck into coins. Thus the only effective

method of detecting a deliberately fraudulent weight was to place at one time a large number of those coins on accurate, finely balanced scales, which most merchants did not possess. Thus, while any individual honest coin, randomly selected, might well have been under- or overweight, 50 or 100 such coins should not collectively have been underweight. Testing the fineness by the touchstone was even more problematic; and, according to Philip Grierson, Britain's most eminent numismatic historian, it was accurate only to half a carat. The only sure test normally required melting, thus destroying the coin itself.[27]

The surviving mint indentures and accounts for the London, Calais, Ghent, and Bruges mints permit us to ascertain how much these coins were supposed to weigh and how much gold they were intended to contain.[28] The English gold noble that was struck from July 1351 to October 1411 consistently had, according to both sets of documents, a fineness of 23.875 carats and a weight reckoned as a *taille* of 45 to the Tower Pound, worth in total £15 0s 0d sterling per Pound, at 6s 8d sterling per noble.[29] If the Tower Pound did indeed weigh 349.914 grams, that would indicate a prescribed weight of 7.776 grams (i.e. 349.9144/45), with a pure gold content of 7.735 grams. The Flemish mint accounts, from the opening of the Ghent mint on 1 October 1388 until the closure of the Bruges mint on 16 June 1402, indisputably show that the Flemish nobles were consistently struck with a fineness of 23.75 carats and a weight or *taille* of 31.667 [31 2/3] nobles cut from the alloyed *marc de Troyes*.[30] If, however, Prof. Miskimin's supposed weight for the Flemish *marc de*

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[27] See Philip Grierson, *Numismatics* (Oxford, 1975), pp. 100-11, 150-5; Philip Grierson, *Les monnaies de moyen âge* (Paris, 1976); Philip Grierson, *Later Medieval Numismatics (11th - 16th Centuries): Selected Studies* (London: Variorium Reprints, 1979).

[28] See nn. 4,5 and 19 above.

[29] See G.C. Brooke and E. Stokes, 'Tables of Bullion Coined from 1337 to 1550', *The Numismatic Chronicle*, 5th ser. 9 (1929), pp. 27-69; *Calendar of Close Rolls, 1360-1364*, pp. 293-95 (2 Dec. 1361); *Calendar of Close Rolls, 1399-1402*, pp. 579-80 (18 July 1402). See data in n. 23 below.

[30] Archives Générales du Royaume (Algemeen Rijksarchief), Comptes en Rouleaux, nos. 824-26 (Ghent, 1388-90) and 776-87 (Bruges, 1392-1402); 2142-46 (Mechelen, 1390-92); and 2586-87 (Fauquemont, 1396-99).

Troyes had been true, i.e., 298.587 grams, then this counterfeit Flemish noble would have weighed 9.429 grams, or 21.9% more than the English noble (with 9.331 grams fine gold, i.e. 20.63% more than in the English noble). Any mint-master who used a *marc* of that weight to coin nobles according to the forgoing stipulations would have been an exceptionally stupid counterfeiter, i.e. in producing an imitative gold noble that weighed so much more than the English noble. He would have consequently received no gold to mint and would have become very quickly bankrupt, because any rational merchant would have taken all his gold to the London or Calais mints, to obtain more true nobles per *marc* of fine gold: i.e. 37.957 English nobles for 298.587 grams of pure gold (the Miskimin *marc*), instead of the 31.163 nobles per *marc* of pure gold (31 per *marc* of 23.75 carats) offered by the Bruges mint.[31] Clearly this did not and could not happen: for the mint accounts show a drop in the gold mint outputs at London and Calais, with a proportional rise in the Flemish mint outputs of gold nobles.[32]

If, however, the Flemish *marc de Troyes* had indeed weighed 244.753 grams, the same weight that modern metrologists give to the French *marc*, then perfectly cut Flemish nobles would have weighed just 7.729 grams -- or 99.4% as much as the currently (and perfectly) struck English noble, and with only 98.9% as much gold (i.e. 23.75 vs. 23.875 carats). If such numismatists as Decourdemanche, Engels & Serrure, Fournial, and several others are correct in contending that the Flemish *marc* then weighed 246.027 grams,[33] i.e. slightly more than the true French *marc de Troyes*, then a perfectly cut Flemish noble would have weighed 7.769 grams,

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[31] The London and Calais mints were then purchasing a Tower Pound of gold, 23.875 carats fine, for £14 15s 0d: i.e. the *traite* or tale value of £15 [45 nobles x 6s 8d], less 5s 0d in total mintage fees (1s 6d in brassage and 3s 6d in seignorage): or 44.25 nobles per Tower Pound fine gold. The Miskimin *marc* of 298.587 represents 0.85331441 Tower Pound; and at this ratio, a merchant would have received 37.7592 nobles; or, for a theoretical *marc* of 24 carats, 37.957 nobles. See sources in n. 21 above.

[32] See the evidence given below, and nn. 22-23.

[33] See note 15 above.

virtually the same as the English, with 99.4% as much gold.[34] Such an infinitesimally small difference between the English and Flemish nobles would never have attracted much bullion to the Flemish mints, not when their seigniorage and brassage charges were then considerably higher than the English: 2.105% (the minimum, as established in June 1393) vs. England's 1.667%. Thus counterfeiting would hardly have been profitable for merchants supplying bullion, especially when their extra transaction costs, including the costs of risking detection and confiscation, are added to these higher mint charges.[35]

In fact, not until that date of June 1393, after a considerable and exasperating series of ' trial and error' adjustments and a consequent reduction in mint charges, did Duke Philip establish the optimum mint price for purchasing gold bullion: at the rate of 31 gold nobles per alloyed *marc* of 23.75 carats, after also having been assured that the Calais mint price was then no more than the equivalent of 31 English nobles per fine gold *marc* (of 23.875 carats).[36] If these metric equivalents for the two mint weights are in fact correct, then merchants would have profited considerably more by selling their fine gold to the Flemish mints than to the English mints. Thus, for each *marc* of fine gold, at 23.875 carats, a merchant would have received 30.951 good English nobles

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[34] See nn. 22, 29-30 above; the following note; and Table 3.

[35] See Table 3. The total English mint charges (June 1361 to Nov. 1411) were: 1s 6d in brassage and 3s 6d in seignorage for a total 5s 0d per Tower Pound of gold of 23.875 carats coined into nobles, with a total value of £15 0s 0d sterling; and the mint thus purchased such bullion at the rate of £14 15s 0d per Tower Pound; and the total mintage fees thus amounted to 1.667% of the traite or tale value of the Tower Pound stuck into nobles. In the Flemish mints the combined brassage and seigniorage ranged from 6.84% of the *traite value* (18s 5d on a total *traite* value of £13 9s 2d groot, as the total value of the gold *marc* struck in nobles) in October 1388 to a low of 2.105% (4s 0d, or two-thirds of a Flemish noble) established in January 1393. *Calendar of Close Rolls, 1360-1364*, pp. 293-95; *Calendar of Close Rolls, 1399-1402*, pp. 579-80; Munro, *Wool, Cloth, and Gold*, Tables D, F, pp. 200, 202; Munro, 'Mint Policies', Table 10, p. 114. If the Flemish marc had actually weighed 246.027 grams, then the Calais mint would have purchased such a marc weight of bullion of 23.875 carats fineness for 31.11245, while the corresponding Bruges price for a marc of the same fineness would have been 31.16316 nobles, a very minimal difference.

[36] In November 1393 Duke Philip had demanded proof from his monetary officials that 'les gens du roy d'Angleterre de ses monnoies à Calais donnent xxxi nobles d'Angleterre pour marc d'or ainsi qu'il nous a esté affermé'. In Bartier-Van Nieuwenhuysen, *Ordonnances*, vol. I, no. 333, pp. 536-67. For other instructions to his mint officials, see *Ibid*, doc nos. 203-5, 223, 266, 332-5, on pp. 309-12, 335-6, 403-4, 535-41.

-- i.e. virtually the amount stated in the Flemish monetary report -- from the Calais or London mints;[37] but, as just noted, from the newly opened Bruges mint he would have obtained, for a gold *marc* of the same fineness, 31.163 Flemish nobles, for a gain or profit of 0.212 Flemish noble per *marc*.[38] That amount was then worth 1s 3d *groot* Flemish or 1s 5d sterling in silver coin, more than double the average daily wage of master masons in England and in most of the Low Countries (slightly less than double the daily wage of a master Bruges mason).[39]

Certainly the coinage of Flemish nobles was also profitable for Duke Philip. Despite a bimetallic ratio that now strongly favoured silver and thus consequently should have discouraged gold minting, the Flemish mints managed to produce quite large outputs of gold nobles. From October 1388 to June 1402, they struck 5,727.2 kg of fine gold, which compares very favourably to the aggregate total of 6,916.8 kg of fine gold struck in the 'pro-gold' English mints during that same period; at the same time, the Flemish struck vastly more silver, 22.6 times as much as London and Calais.[40] Furthermore, once Duke Philip had set the optimum mint

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[37] The English mint price for gold bullion 23.875 carats fine was then £14 15s 0d sterling or 44.25 nobles (at 6s 8d per noble) per Tower Pound fine gold. If the ratio of the two metric mint weights was indeed 349.914/244.753g = 1.4297, that would have meant a mint price of 30.951 nobles per *marc de Troyes* of the same fineness (44.25/1.4297) -- close enough to mint price described in the document cited in n. 17 above (31 nobles).

[38] The current Flemish mint price of 31 nobles per gold *marc* of 23 3/4 carats fineness = 31.163 nobles for a *marc* of 23 7/8 carats fine [i.e. 31(23.875/23.750)]. See n. 35 above; Munro, *Wool, Cloth, and Gold*, Table 5, pp. 202-03.

[39] The English and Flemish gold nobles were worth 6s 8d sterling (80d) and 6s 0d groot Flemish (72), respectively; and thus 0.212 noble was worth 1s 5d sterling (17d) and 1s 3¼d groot Flemish (15.25d), respectively. In the early 1390s the daily (summer) wage for a London master mason was 7½d; for an Oxford mason, 6d sterling; for a Bruges mason, 9d; for an Ypres mason, 7d; and for master masons in Leuven, Mechelen, and Brussels, 6d groot Flemish. See John Munro, 'Urban Wage Structures in Late-Medieval and the Low Countries: Work-Time and Seasonal Wages', in Ian Blanchard, ed., *Labour and Leisure in Historical Perspective, Thirteenth to Twentieth Centuries*, Vierteljahrschrift für Sozial-und Wirtschaftsgeschichte, Beheifte series no. 116 (Stuttgart, 1994), pp. 65-78, esp. Table 4-1, p. 67.

[40] See Table 2; and John Munro, 'Mint Policies', Tables 1-2, pp. 102-04: 59,423.59 kg of pure silver vs. 2,630.69 kg in the English mints.

price for gold in June 1393, the Flemish outputs of gold coinage rose, while the English fell (Table 2), until finally, in 1397, just when Flemish gold mint outputs had peaked, the English crown declared all Flemish nobles forfeit to royal mints as bullion (*billon*). At the same time (1397), Parliament enacted the *Ordenance de la Bullion*, which required all wool merchants to supply the Tower Mint with one ounce in bullion for each sack sold. Duke Philip retaliated in turn by declaring all English nobles similarly forfeit as bullion (*billon*) to his mints, so long as the English ordinances remained in force.[41] Thereafter, and perhaps because of this conflict and mutual bullionist bans, the gold outputs in both the English and Flemish mints fell; and Duke Philip the Bold was finally forced to close his Flemish mints in June 1402.

Despite all these hostile measures and the fall in mint outputs, Flemish nobles still continued to circulate in England. According to a Commons petition that produced a renewed parliamentary ban in 1401, these counterfeit nobles, inferior in value to the English by '2d sterling per noble', accounted for one quarter of the total circulation.[42] Only when Henry IV undertook a full recoinage, in 1411-12, which reduced the weight of the English noble from 45 to 50 per Tower Pound (i.e. from 7.776 grams to 6.998 grams), did the crown finally resolve the quarter-century problem of these counterfeit Flemish nobles.[43] As a preliminary

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[41] Munro, *Wool, Cloth, and Gold*, pp. 49-63; Munro, 'Mint Policies', pp. 84-93. The earliest ban on Flemish nobles as 'counterfeit coin' had been issued by Richard II on 2 February 1389: *Calendar of Close Rolls 1385-89*, p. 647. For the *Ordenance de la Bullion* of 23 January 1397 (ns), see *Rotuli Parliamentorum ut et Petitiones et Placita in Parliamento*, 6 vols (London, 1767-77), Vol. III, p. 340: no. 19; and *Calendar of Close Rolls 1396-1399*, pp. 37-38 (20 February 1397). For the term *billon* as bullion, see John Munro, 'Billon - Billoen - Billio: From Bullion to Base Coinage', *Revue belge de philologie et d'histoire*, 52 (1974), pp. 293-305. [*Belgisch tijdschrift voor filologie en geschiedenis*]; reprinted in John Munro, *Bullion Flows and Monetary Policies in England and the Low Countries, 1350 - 1500* (London, 1992), no. iii.

[42] *Rotuli Parliamentorum*, Vol. III, p. 470, no. 61; *Statutes of the Realm*, Vol. II, p. 122: stat. 2 Henrici IV c. 6. From various coin hoards, Peter Spufford has estimated that the Flemish nobles accounted for 10% to 20% of the total circulation. See Spufford, 'Continental Coins in Late Medieval England', *British Numismatic Journal*, 23 (1963), 130-31. See also J.D.A. Thompson, *Inventory of British Coin Hoards* (Oxford, 1956), pp. xlv, 146.

[43] *Calendar of Close Rolls 1413-19*, pp. 64-66; *Calendar of Close Rolls 1419-22*, pp. 204-05; 230-35; Munro, *Wool, Cloth, and Gold*, pp. 60-63; Munro, 'Mint Policies', pp. 92-95. The second and third dukes

conclusion, therefore, the history of this 'war of the gold nobles' and the success of Flemish counterfeiting over many years make sense only if the ratio between the two mint-weights was, or was very close to, the modern metric ratio of 1.43:1.

Metrological Comparisons of English and Flemish Nobles in Flemish Mint Ordinances

Virtually the same ratio between mint-weights can also be deduced from various Flemish and Brabantine monetary ordinances that describe the weights of the four late-medieval English nobles: those of 1351-1411, 1411-1464, and 1464-1526 (*ryals* and *angels*). First, the weight of both the pre-1411 English noble and the Flemish counterfeit of 1388-1402 are specified in terms of a *taille* ranging from 31.5 to 32.0 per *marc*; and a higher *taille* obviously indicates a somewhat lighter current noble that had suffered some wear and tear in circulation.[44] As just seen, the imitation Flemish noble (1388-1402) had a *taille* of 31.667 to the *marc de Troyes*, while the pre-1411 English noble had a *taille* of 45 to the Tower Pound. Therefore we can compute the relevant ratio as follows, with **X** as the Tower Pound and **Y** as the *marc de Troyes*:

Equation 1: The Pre-1411 English and Flemish nobles

$1/45\mathbf{X} = 1/31.5\mathbf{Y}$; and thus, since they must be equal,

$31.5/45\mathbf{X} = \mathbf{Y} = 1$

$31.5\mathbf{X} = 45$

$\mathbf{X} = 45/31.5 = 1.42857$,

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of Burgundy, John the Fearless and Philip the Good, also struck imitation nobles: in 1409, 1416, and 1425-29; but these were never as successful as those of Philip the Bold. See *Wool, Cloth, and Gold*, pp. 65-92; Table J, pp. 209-10.

[44] For examples, see Archives Générales du Royaume, Chambre de Comptes: (1) registre no. 580, fo. 40r: exchange rate ordinance issued by the Duke of Brabant in 1419, fixing a rate of 8s 8d groot Brabant for both the 'old' English and Flemish nobles with a *taille* of 32 'int marc troisch'; (2) *Ibid*, no. 580, fo. 44ro: Flemish monetary ordinance of Duke Philip the Good issued on 5 June 1418, fixing a rate of 7s 0d groot Flemish for both the old nobles of England and Flanders with a *taille* of 32 per *marc*; (3) Chambre de Comptes, registre no. 1158, fo. 11: Flemish monetary ordinance of Philip the Good, issued in March 1418, similarly fixing a rate of 7s 0d groot Flemish for 'Vlaemsche ende Inghelseche nobelen van xxxii in de troyscche marc, weghende ii ingelschen...'

which would indicate a theoretical *marc* weight of 244.940 g.: i.e. 349.9144/1.42857. With the slightly higher *taille* of 32 per *marc*, the relationship then becomes:

X = 45/32 = 1.40625,

which indicates a *marc* weight of 248.828 grams (349.9144/1.40625), or 101.66% of the *marc de Troyes's* presumed, theoretical weight.

In these and other Burgundian monetary ordinances, the next issue of English gold nobles, struck from 1411 and generally known as the *noble henricus*, is recorded with a *taille* of 35 to 36 per *marc*; and so is the next issue of Flemish nobles, struck from December 1416, again in imitation of the new English noble.[45] While the monetary ordinances of 1418-19 may have specified a *taille* of 36 per *marc* to account for weight losses in circulating English nobles, the more likely reason for that *taille* was to establish an exact identity with the new Flemish noble. Struck indeed with a *taille* of 36 to a *marc* of just 23.5 carats, these Flemish nobles were, however, much too inferior to pass at Calais or in England. More successful were subsequent Flemish nobles struck from September 1427, with a *taille* of 35.25 to a fine gold *marc* of 23.875 carats, and thus virtually identical to the current *Henricus* nobles.[46] Since London Tower mint accounts and coinage indentures state that 50 of these *Henricus* nobles were cut from a Tower Pound of fine gold (23.875 carats), we can employ the same equation, to produce similar results, as follows:[47]

Equation 2: English and Flemish nobles, 1412-1418

1/50**X** = 1/35**Y**

35/50**X** = **Y** = 1

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[45] Archives Générales du Royaume, Chambre de Comptes, registres no. 580, fo. 40r, 44r, 85r; reg. no. 1158, fo. 94v; reg. no. 18,069, fo. 3r.

[46] Munro, *Wool, Cloth, and Gold*, pp. 65-92; and Table J, pp. 209-10.

[47] Brooke and Stokes, 'Tables of Bullion Coined, 1337-1550', pp. 27-69; *Calendar of Close Rolls 1413-1419*, pp. 64-66 (14 April 1413); *Calendar of Close Rolls 1419-1422*, pp. 230-35 (13 February 1422).

35**X** = 50; and thus

X = 50/35 = 1.428571, producing a theoretical *marc* weight of 244.940 grams (349.9144/1.428571).

Again, if a *taille* of 35.25 per *marc* is employed, the result would be: **X** = 50/35.25 = 1.41844, for a theoretical *marc* weight of 246.6897 g, or 100.79% of the *marc*'s presumed theoretical weight.

And, with a *taille* of 36, the result would be:

X = 50/36 = 1.3889, for a theoretical *marc* weight of 251.934 g or 102.94% of the *marc*'s presumed weight.

Evidence from the Proposed Anglo-Burgundian Monetary Treaty of August 1469

Further evidence on these mint-weight relationships during the fifteenth century can be found in a proposed but ultimately abortive Anglo-Burgundian monetary treaty of August 1469, designed to permit their coins to circulate freely in each other's lands.[48] This document provides information on the weights of not just one but three different English nobles: the traditional *Henricus* noble (1411-64), and two new nobles that Edward IV had struck since March 1465. The *Henricus* noble (struck at 50 to the Tower Pound, 6.998 g), now worth 8s 8d sterling, was assigned a *taille* of 35.25 per *marc*, identical to that given in Equation 2. The heavier of the new nobles, known as the *ryal* or *royal*, worth 10s 0d sterling, was in fact physically a restoration of Edward III's noble (1351-1411), again struck at 45 to the Tower Pound (7.776 g); and its assigned treaty *taille* was again also 32, as indicated in Equation 1. The lighter of Edward IV's two new nobles, the *angel* or *angelot*, was struck at 67.5 to the Tower Pound (5.184 g); and its assigned treaty *taille* was 48 to the *marc*.[49] The same formula and methodology for comparing mint weights in Equation 3 produces the following ratio.

Equation 3: The English angel-noble of 1465

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[48] Archives Générales du Royaume, Chambre de Comptes, reg. no. 1158, fo. 94-113; Carton 65:bis 1. See Munro, *Wool, Cloth, and Gold*, pp. 173-76; Alphonse De Witte, *Histoire monétaire des comtes de Louvain, ducs de Brabant, et marquis du Saint-Empire Romain*, II (Antwerp, 1896), pp. 38-42.

[49] See *Calendar of Close Rolls 1476-1477*, pp. 138-39 (2 March 1469); Brooke and Stokes, 'Tables of Bullion Coined, 1337-1550', pp. 27-69.

X = 67.5/48 = 1.40625, which would indicate a theoretical *marc* weight of 248.828 g.

Finally, this 1469 monetary treaty also specified the weight of the *groat*, England's highest valued (4d sterling) and largest silver coin: with a *taille* of 80 to the *marc*. Since the English mint accounts state that 112.5 *groats* were struck to the Tower Pound, Equation 4, using the same methodology, produces the following ratio:

Equation 4*: *The English Silver Groat (4d) of 1464

X = 112.5/80 = 1.40625 (again indicating a theoretical *marc* weight of 248.828 g).

From the introduction to this 1469 treaty, however, we learn that this *marc* is the *Troy marc* of England, which was two-thirds of the Troy pound or 8 Troy ounces (373.242 g); and it thus presumably weighed 248.828 grams, precisely as specified in Equations 3 and 4. Furthermore, the treaty states this English Troy *marc* weighed 1.5 English *esterlins* or dwt -- i.e. 36 Troy grains -- more than the '*marc de Troyes* used in Flanders'. If so, that would indicate a weight of 246.495 grams for the Flemish *marc* (i.e.: 248.828g - 2.333g), which is indeed close to the Brussels' mint weight of 1529.

All of this evidence together points to one major conclusion: that the English, French, and Flemish mint weights enjoyed a relationship with each other that was virtually identical to those established by the metric conversions in the 1790s. Unless these mint weights came to vary by almost exactly the same degree between the fifteenth and eighteenth centuries, a proposition that defies the laws of historical probability, then we must assume that their late-medieval weights were identical or virtually identical to those specified by modern metrologists: i.e. 349.914 grams for the English Tower Pound and 244.753 grams for the *marc de Troyes*. The final evidence adduced in this study does not, however, rule out the possibility that the weight of the late-medieval Flemish *marc de Troyes* was slightly more, with 246.03 grams, and thus just 0.52% more, though the history of Flemish counterfeiting in the 1390s makes proper sense only with that lower bound, a weight of 244.753 grams. But such a difference is really much too small to be of any true significance in late-medieval monetary history. Clearly modern metrologists have been far close to the mark, and virtually on the mark, so

to speak, in relating these mint weights than was my graduate school professor.

Table 1. The Mint Weights of Late-Medieval England, Flanders, and France: Internal Divisions and Metric Weights

Internal Divisions	**Tower Pound of London**	**Tower Pound in Troy Units**	**Troy Pound of England**	***marc* de Troyes in Flanders**	***marc* de Troyes (France)**	**Livre de Troyes (France)**
Ounces in the pound/*marc*	12.000	11.250	12.000	8.000	8.000	12.000
Pennyweight (dwt), esterlins, or Deniers (d) to the Ounce	20.000	20.000	20.000	20.000	24.000	24.000
Grains* to the Dwt or Denier	32.000	24.000	24.000	32.000	24.000	24.000
Grains in the Ounce	640.000	480.000	480.000	640.000	576.000	576.000
Grains in the Pound or *marc*	7680	5400	5760	5120	4608	6912
Metric Weight of the Grain in grams	0.0456	0.0648	0.0648	0.0478	0.0531	0.0531
Metric Weight of the Ounce in grams	29.1595	31.1035	31.1035	30.5941	30.5941	30.5941
Metric Weight of the Pound or *marc* in grams	349.914	349.914	373.242	244.753 or 246.495	244.753	367.129

Sources: see sources given in nn. 1 and 2.

* In the Flemish metrological system, grains are indicated by the term *as*.

Table 2: ENGLAND AND FLANDERS: Gold and Silver Coinage Outputs in Kilograms of Pure Metal, 1380 - 1409

YEAR	GOLD kg	GOLD kg	GOLD kg	GOLD kg	SILVER kg	SILVER kg
29 Sept	London	Calais	ENGLAND	FLANDERS	ENGLAND	FLANDERS
1380	108.84	124.94	233.78	283.13	326.15	2,808.38
1381	108.84	78.38	187.22	477.38	326.15	3,072.39
1382	108.84	0.79	109.63	440.10	326.15	3,559.52
1383	108.84	0.79	109.63	439.82	326.15	3,881.20
1384	136.68	0.21	136.89	1,093.28	326.15	1,824.03
1385	265.82	0.00	265.82	198.47	282.45	1,747.28
1386	265.82	0.00	265.82	21.98	282.45	310.14
1387	265.82	177.23	443.05	0.00	282.45	0.00
1388	261.49	251.69	513.18	0.00	37.79	0.00
1389	373.56	251.69	625.25	1,130.57	53.98	2,064.71
1390	566.26	110.51	676.77	962.96	580.91	6,563.72
1391	534.44	51.19	585.63	276.33	708.35	3,319.57
1392	495.02	51.19	546.21	223.19	89.13	4,495.20
1393	397.41	377.65	775.06	386.91	74.65	2,371.60
1394	314.53	336.06	650.59	572.16	47.65	3,610.70
1395	314.53	260.97	575.50	348.48	47.65	4,583.25
1396	186.83	128.92	315.75	379.49	54.83	5,150.84

1397	398.58	122.58	521.16	517.81	190.15	7,324.48
1398	398.58	9.95	408.53	353.31	190.15	7,426.13
1399	370.61	18.06	388.67	209.12	355.95	5,202.12
1400	180.72	140.90	321.62	163.21	86.89	3,852.96
1401	172.46	140.90	313.36	92.16	75.20	2,021.42
1402	172.46	40.19	212.65	65.51	75.20	1,436.89
1403	103.96	23.59	127.55	0.00	41.80	0.00
1404	109.25	3.50	112.75	0.00	117.00	0.00
1405	77.06	0.00	77.06	0.00	22.52	0.00
1406	125.49	0.00	125.49	0.00	26.26	0.00
1407	69.18	0.00	69.18	0.00	20.63	0.00
1408	50.35	0.00	50.35	0.00	2.08	0.00
1409	50.00	0.00	50.00	0.00	2.00	0.00

Sources:

(a) England: Public Record Office, Lord Treasurer's Remembrancer Exchequer, E.364/22, 25, 28, 30, 36, 37; King's Remembrancer Exchequer, E. 101/184/10 (for Calais); C.G. Brooke and E. Stokes, 'Tables of Bullion Coined, 1337-1550', *Numismatic Chronicle*, 5th series, 9 (1929), 27-69; John Craig, *The Mint: a History of the London Mint from A.D. 287 to 1948* (Cambridge, 1953), pp. 408, 412; Christopher E. Challis, "Appendix 1. Mint Output, 1220-1985," in C. E. Challis, ed., *A New History of the Royal Mint* (Cambridge, 1992).
pp. 673-698;

(b) Flanders (Ghent, Bruges, Mechelen): Algemeen Rijksarchief, Rolrekeningen [Comptes en rouleaux] nos. 776-87 (Bruges), 824-31 (Ghent), 2142-43 (Mechelen), 2586-87 (Fauquemont); Rekenkamer (Chambre de Comptes), no. 48,976-97 (Mechelen); Acquits de Lille: Liasses de monnaies, nos. 931 (various), 936 (Ghent); Cartons nos. 65, 65:bis1, 65:bis2; J. Bartier and A. Van Nieuwenhuysen, eds., *Les ordonnanes de Philippe le Hardi, de Marguerite de Màle, et de Jean Sans Peur, 1381 - 1419*, Vol. 1: *du 16 octobre 1381 au 31 décembre 1393*, in *Recueil des ordonnances des Pays-Bas* (Brussels, 1965).

Table 3: The Minting of Gold Nobles in England and Flanders in 1393: A Comparison

Coinage Particulars	ENGLAND		FLANDERS		Flemish Noble as % of English Noble
Fineness in Carats	23.87500		23.75000		99.4764
Fineness out of 1.0000	0.99479		0.98958		99.4764
Taille to Tower Pound	45.00000		45.27269		100.6060
Taille to Marc de Troyes	31.47593		31.66667		100.6060
Weight in Grams	7.77588		7.72904		99.3977
Gold Content in Grams	7.73538		7.64853		98.8773
Tale/Traite Value per Pound in £ sterling	15.00000		15.09090		100.6060
Tale/Traite Value per Marc in £ groot Flemish*	9.44278		9.50000		100.6060
Brassage and Seigniorage in £ sterling	0.25000		0.22222		88.8889
Brassage and Seigniorage in £ groot	0.22500		0.20000		88.8889
Total Mint Fees as Percentage of Traite*	0.01667		0.02105		126.3158
Mint Price for Bullion per Pound in £ st.	14.75000		14.86868		100.8046
Mint Price for Bullion per Marc in £ groot	9.21778		9.30000		100.8920

Mint Price for Bullion in Nobles: per T. Pound	44.25000		44.53195		100.6372
Mint Price for Bullion in Nobles: per Marc of 23.75 carats	30.78929		31.00000		100.6844
Mint Price for Bullion in Nobles: per Marc of 23.875 carats	30.95133		31.16316		100.6844
Mint Price for Bullion in Nobles: per Marc of 23.876 carats and of 246.027 grams	31.11245		31.16316		

* mint weight of fine metal: coin rate x taille/fineness (23.875 carats reckoned as fine)

Sources: see table 2.