THE PREHISTORIC ORIGINS OF EUROPEAN ECONOMIC INTEGRATION

By George Grantham*

Abstract: *It appears likely that at its peak the classical economy was almost as large as that of Western Europe during the Industrial Revolution. The following review of the archeological and document evidence indicates that three events occurring in the first half of the first millennium BC trigger the emergence of a specialized and integrated classical economy after 500 BC: (i) growth in demand for silver as a medium of exchange in economies in the Near East; (ii) technical breakthroughs in hull construction and sailing rig in merchant shipping of the late Bronze Age; (iii) perfection of ferrous metallurgy into the European hinterland. This last event raised agricultural productivity to a level capable of supporting the occupational specialization needed to sustain a vigorous trading economy. To these initial causes may be added the diffusion of alphabetic writing. While it did not create opportunities for long-distance trade, the diffusion of writing supplied the means of responding on a scale large enough economically to matter.*

KEY WORDS: trade, economic integration, Usher, markets, Bronze Age, Iron Age, history of Europe, ferrous metallurgy, agriculture, alphabetic writing, literacy

I. Introduction

In recent decades, the conventional dating of the origins of Western Europe's economic ascendancy to the tenth and eleventh centuries AD has been called in question by archaeological findings and reinterpretations of the early medieval texts that indicate significantly higher levels of material prosperity in Antiquity than conventional accounts consider plausible. On the basis of that evidence, it appears likely that at its peak the classical economy was almost as large as that of Western Europe on the eve of the Industrial Revolution.[1] Population estimates have also been revised upward. Lo Caschio has shown that the conventional estimates of the Italian population that Beloch extracted from late Republican and Augustan censuses to form the foundation of his much-cited conjectural estimate of the population of the Roman Empire significantly underreport the true

*Department of Economics, McGill University, George.grantham@mcgill.ca. Competing Interests: The author declares none.

[1] For a review of the evidence and its significance for modeling the pre-industrial economy, see George Grantham, "Contra Ricardo: On the Macroeconomics of Europe's Agrarian Age," *European Review of Economic History* 3 (1999): 199–232.

doi:10.1017/S0265052522000140

population.[2] That critique is supported by recent archaeological findings indicating that in the more fertile districts of southern Britain and northern Gaul, rural population density in the late Iron Age and the Roman period was as high as in the late seventeenth century.[3] As skeletal evidence shows no significant difference in body size between the two epochs, one may presume that despite a putatively inferior agriculture, the high ratio of people to cultivated land did not depress agricultural productivity in antiquity below levels obtaining in the early modern era.[4] These findings have obvious implications for the history of European agriculture.

The achievement of a high level of factor productivity is further suggested by ongoing discoveries of small towns that flourished in the Roman period, and subsequently vanished.[5] While the inventory of such sites is far from complete, it is clear that their primary role was to serve as nodes in a network of exchange that reached from the Baltic to the Sahara, and from the Hebrides to Mesopotamia. Archaeological finds in Denmark and north Germany prove that this network extended well beyond the Roman *limes*.[6] The volume of and extent of classical trade at its peak in the first centuries AD is visible in a well-preserved ceramic record of mass-produced tableware and oil lamps, and in the dumps containing tens of thousands of amphorae that were discarded when their contents were decanted into other vessels for transshipment into the interior.[7] The archaeological record, then, indicates a robust and specialized economy.

[2] Elio Lo Caschio, "The Size of the Roman Population: Beloch and the Meaning of the Augustan Census Figures," *Journal of Roman Studies* 84 (1994): 23–40.

[3] The data indicate average farmstead separation of 300 to 500 meters, which for an average household size of five implies an areal density of 31 to 86 persons per square kilometer, and for eight-person households, densities of 50 to 137. These are well within the recorded range of population densities in Europe on the eve of the Industrial Revolution. The estimates are based on calculations from a hexagonal lattice settlement pattern. For the basic data see Christopher Taylor, *Village and Farmstead: A History of Rural Settlement in England* (London: George Philip, 1983); Robin Holgate, *Neolithic Settlement of the Thames Basin* (Oxford: British Archaeological Reports. British Series 194, 1988); David Miles, ed., *The Romano-British Countryside: Studies in Rural Settlement and Economy* (Oxford: British Archaeological Reports British Series 13, 1982); Alain Ferdière, *Les Campagnes en Gaule Romaine, Tome 1. Les Hommes et l'Environnement en Gaule Rurale (52 av. J.-C. - 486 ap. J.-C.)* (Paris: Errance, 1988); Jean-Luc Fiches, "L'Espace Rurale Antique dans le Sud-Est de la France: Ambitions et Réalités Archéologiques," *Annales E.S.C.* 42 (1987): 219–38; Edith Peytremann, "Les Structures Antiquités de la Seine-Maritime," 1–28.

[4] Nicola Koepke and Joerg Baten, "The Biological Standard of Living in Europe during the Last Two Millennia," *European Review of Economic History* 9 (2005): 61–98.

[5] Barry C. Burnham and John Wacher, *The Small Towns of Roman Britain* (Berkeley and Los Angeles: University of California Press, 1990); David J. Mattingly and R. Bruce Hitchner, "Roman Africa: An Archaeological Review," *Journal of Roman Studies* 85 (1995): 165–213; Dominique Garcia and Florence Verdin, eds., *Territoire Celtiques: Espaces Ethniques et Territoires des Agglomérations Protohistoriques d'Europe Occidentale* (Paris: Errance, 2002); Herbert Schutz, *The Prehistory of Germanic Europe* (New Haven, CT: Yale University Press, 1982).

[6] Lars Jørgensen, Birger Storgaard, and Lone Gebauer Thomsen, ed. *The Spoils of Victory: The North in the Shadow of the Roman Empire* (Copenhagen: National Museum, 2003).

[7] D. J. Mattingly, "Oil for Export? A Comparison of Lydian, Spanish, and Tunisian Olive Oil Production in the Roman Empire," *Journal of Roman Archaeology* 1 (1988): 33–56; André Tchernia, *Le Vin de l'Italie Romaine: Essai d'Histoire Économique d'après les Amphores* (Rome: Ecole

The reinterpretations of early medieval texts bear less directly on the state of economic activity than the physical record. However, deconstruction of late Roman and early medieval writings on the fall of the Roman Empire, and renewed analysis of the corpus of Merovingian and Carolingian documents that bear on the status of persons and property in Merovingian and Carolingian Gaul, yield a far less catastrophic narrative of the early medieval transition than the one that scholars have constructed from late-Roman and early-medieval Christian polemics.[8] In particular, the revisions indicate significant political, administrative, and economic continuity from the fourth century through the ninth century, sustained by a surprisingly literate political and administrative elite.[9] The finding of widespread lay literacy is significant because the supposed illiteracy beyond the confines of ecclesiastical establishments was long taken to be a structural determinant of early-medieval autarky. Intensive culling of that corpus further reveals persisting commercial connections between north and south Europe and between Europe and the Near East.[10] While the volume of trade contracted dramatically after 450 AD, the links were never severed. The conventional pessimistic assessment of Carolingian agricultural productivity is also now seen as a misinterpretation of the early texts.[11]

If these findings are correct, the beginnings of European economic integration must be dated to before the Fall of Rome. But how far before? Economic historians have begun to view ancient economy much as Rostovtzeff saw it, as a market economy with property rights secure enough to

Française de Rome, 1988); Patrick Galliou, "Days of Wine and Roses? Early Armorica and the Atlantic Wine Trade," in Sarah Macready and F. H. Thompson, eds. *Cross-Channel Trade between Gaul and Britain in the Pre-Roman Iron Age* (London: The Society of Antiquaries of London, 1984), 24–36; D. P. S. Peacock, *Pottery in the Roman World: An Ethnoarchaeological Approach* (London and New York: Longman, 1982); W. V. Harris, "Roman Terra Cotta Lamps: The Organization of an Industry," *Journal of Roman Studies* 70 (1980) 126–45; D. Bailey, "The Lamps of Sidk Khrebish, Benghazi (Berence): Imported and Local Products," in Graeme Barker, John Lloyd, and Joyce Reynolds, eds., *Cyrenaica in Antiquity.* Society for Lybian Studies Occasional Papers I (Oxford: Oxford University Press, 1985), 195–204.

[8] See Philip Wynn, "Wars and Warriors in Gregory of Tours Histoire I-IV," *Francia* 28, no. 1 (2000): 1–35; Michael E. Jones, *The End of Roman Britain* (Ithaca, NY: Cornell University Press, 1996), and more broadly, Walter Goffart, *The Narrators of Barbarian History (AD 550–800): Jordanes, Gregory of Tours, and Paul the Deacon* (Princeton, NJ: Princeton University Press, 1988).

[9] Rosamund McKitterick, ed., *The Uses of Writing in Early Medieval Europe* (Cambridge: Cambridge University Press, 1990); McKitterick, *The Carolingians and the Written Word* (Cambridge: Cambridge University Press, 1989). On continuity, see the major synthesis of this new research by Karl-Ferdinand Werner, *Naissance de la Noblesse: L'Essor des Élites Politiques en Europe* (Paris: Fayard, 1990).

[10] Michael McCormick, *Origins of the European Economy: Communications and Commerce, A.D. 300–900* (Cambridge: Cambridge University Press, 2001).

[11] Raymond Delatouche, "Regards sur l'Agriculture aux Temps Carolingien," *Journal des Savants* (1977): 73–100. Georges Comet, "Technology and Agricultural Expansion in the Middle Ages : The Example of France North of the Loire," in Grenville Astil and John Langdon, ed., *Medieval Farming and Technology: The Impact of Agricultural Change in Northwest Europe* (Leiden, New York, Köln: Brill, 1997), 11–40.

induce familiar market responses to economic opportunity.[12] That consensus nevertheless leaves unanswered when and how that economy assumed its integrated state. For when the Romans occupied Spain, Gaul, North Africa, Germany, and Pannonia in the second and first centuries BC, they acquired territories that in varying degrees had been trading with each other and with the outside world for centuries. Political unification intensified that trade but did not create it. Our question, then, is how and when the links that emerged with such explosiveness in the late Hellenistic Age originated.

A. Columbian analogy

Probably the closest analogy to the events and processes giving rise to the late Hellenistic takeoff in the volume of interregional trade is the Columbian moment. It is widely conceded that the accelerated growth in factor productivity in the early modern period reflected the opportunity for local and long-distance trade triggered by the establishment of a seaborne connection between Europe and Asia, and between the Old World and the New. Although volumes were small in relation to total product, the transcontinental displacement of goods altered the geography of early-modern urbanization and increased per capita labor supply in peasant households exposed to them.[13] The commodities in question included silver, addictive substances like tobacco, tea, coffee, chocolate, and sugar, and luxury textiles and ceramics imported from points of advanced technology in South and East Asia. Since none of these products had good European substitutes, and since they had a high demand price relative to the cost of production at their points of origin, the high cost of shipping them around the world did not impede their movement. At a time when the cost of intercontinental shipping barely fell, European imports of exotic goods rose three times faster than the population.[14] It was well into the nineteenth century before the objects of intercontinental trade moved beyond that limited list.[15] Yet, in price levels and the longer

[12] Peter Temin, "A Market Economy in the Early Roman Empire," *Journal of Roman Studies* 91 (2001): 169–81; Jairus Banaji, *Agrarian Change in Late Antiquity: Gold, Labour and Aristocratic Dominance* (Oxford: Oxford University Press, 2002); Evan Halley, Baetica Felix: *People and Prosperity in Southern Spain from Caesar to Septimius Severus* (Austin: University of Texas Press, 2003).

[13] Jan de Vries, "The Industrial Revolution and the Industrious Revolution," *Journal of Economic History* 54 (1994): 249–70; Jan de Vries, *European Urbanization, 1500–1800* (Cambridge, MA: Harvard University Press, 1984).

[14] Kevin H. O'Rourke and Jeffrey G. Williamson, "After Columbus: Explaining Europe's Overseas Trade Boom, 1500–1800," *Journal of Economic History* 62 (2002): 420.

[15] Kevin H. O'Rourke and Jeffrey G. Williamson, "The Heckscher-Ohlin Model between 1400 and 2000: When It Explained Factor Price Convergence, When It Did Not, and Why," in Ronald Findlay, Lars Jonung, and Mats Lundahl, eds., *Bertil Ohlin: A Centennial Celebration (1899–1999)* (Cambridge, MA and London: MIT Press, 2002), 431–62.

swing of macroeconomic fluctuations, the economies of Asia, Europe, and America were clearly connected.[16]

The pre-Hellenistic connecting of Europe's economic space shares several features with that moment. The objects of trade include specie, ceramics, textiles, and wine—at that time, as now, physiologically and socially addictive.[17] And just as in the early modern period, a steep regional gradient in textile and ceramic technology stimulated the flow of manufactured goods from advanced civilizations to the periphery. We are less well informed about the goods and services that purchased these imports to western and northern Europe, but Hellenistic and Roman sources speak of fish sauce (*garum*) from Iberia and adjacent districts in Africa, fine hams from the Celtic interior, furs, slaves, and mercenaries. In none of these did transport cost loom large. Indeed, after late Bronze Age advances in ship design to be discussed below, and the advent of iron-fitted carts in the late Iron Age, the technology of land and water transport experienced little improvement in the period of greatest expansion. In the Hellenistic and Roman ages, gains in productivity were mainly due to investment in roads, port facilities, and other infrastructure, and to scale economies in manufacturing and distribution that resulted from concentration of production and wholesale operations at a limited number of sites.[18] As in the early modern period, gains in productivity in an economy characterized by handicraft methods of manufacture resulted mainly from greater division of labor supported by the extension of markets.[19]

While no historical analogy is perfect, the parallel between the early modern expansion and economic integration in Antiquity points to the importance of long-distance trading connections as an early stimulus to specialization. The following review of the archaeological and documentary evidence indicates that three events occurring in the first half of the first millennium BC triggered the emergence of a specialized and integrated classical economy after 500 BC: (1) growth in demand for silver as a medium of exchange in economies of the Near East; (2) technical breakthroughs in hull construction and sailing rig in merchant shipping in the late Bronze Age; and (3) perfection and diffusion of ferrous metallurgy into the European hinterland. This last event raised agricultural productivity to a level capable of supporting the occupational specialization needed to sustain a vigorous trading economy. To these initial causes may be added the

[16] Dennis O. Flynn, Arturo Giráldez, and Richard von Glahn, eds., *Global Connections and Monetary History, 1470–1800* (Burlington, VT: Ashgate, 2003).

[17] Andrew Sherratt, "Cups that Cheered: The Introduction of Alcohol to Prehistoric Europe," in Andrew Sherratt, *Economy and Society in Prehistoric Europe* (Princeton, NJ: Princeton University Press, 1997), 376–402.

[18] The distinction between technological advance and scale economies is fine and perhaps contestable. I choose to think of the technological changes in the sphere of transportation as originating in the demands created by the growth of trade rather than the other way round. This approach emphasizes the continuity of technological traditions.

[19] Grantham, "Contra Ricardo."

diffusion of alphabetic writing. While it did not create opportunities for long-distance trade, the diffusion of writing supplied the means of responding to them on a scale large enough economically to matter.

The essay is organized as follows. Section II reviews the early movement of objects across Europe prior to the first millennium to date the *terminus a quo* for a permanent North-South trading connection. Section III reviews the respective roles of silver, iron, wine, and maritime technology in creating conditions for potential economic integration in the first millennium, but not earlier. Section III examines the development and significance of writing to the achievement of an integrated economy. In Section IV, I conclude. Analysis of these historically distinct strands of technological and economic change supports Usher's hypothesis that major historical discontinuity have usually been precipitated by a fortuitous synthesis of different lines of technological developments than by institutional changes affecting the structure of private incentives.

II. The Pre-History of European Trade

A. Long-distance trade and the faculty of speech

"Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signify to another, this is mine, that is yours; I am willing to give this for that."[20] Adam Smith was the first, and for a long time the only, economist to observe that the ability to communicate is a precondition for voluntary exchange. That capacity is tightly linked to the faculty of speech. For although conceptual information is mostly stored in nonlinguistic neural networks, contingent agreements involving temporally and spatially separated actions are all but impossible to achieve in the absence of linguistic referents to immediately unobservable events.[21]

From that perspective, Europe has in a loose way of speaking been minimally connected by long-distance exchange since the arrival of modern man about 50,000 years ago. We know this from the geographical movement of objects unambiguously worked by hominid hands. In the archaic epoch of human occupation of Europe (750,000 to 200,000 BC), the distribution of such objects falls within fifteen kilometers of the known point of origin, suggesting that they were picked up, slightly chipped, used once, and discarded. In the age of Neanderthal man (200,000 to 50,000 BC), that radius grows to one hundred and fifty kilometers. Continent-wide movement of Baltic amber and the shells of Mediterranean mollusks coincides with the arrival of modern man about 45,000 years

[20] Adam Smith, *The Wealth of Nations* (New York: Modern Library, 1937), 13.

[21] Adam Kendon, "Some Considerations for a Theory of Language Origins," *Man* 26 (1991): 199–221; Clive Gamble, "Palaeolithic Society and the Release from Proximity: A Network Approach to Intimate Connections," *World Archaeology* 29 (1998): 246–49.

ago.[22] The most likely cause of that quantum jump in distance was modern man's capacity for articulate speech.[23]

What most distinguished *Homo sapiens sapiens* from *Homo neanderthalensis* was not their respective cranial volumes, which overlap, but modern man's capacity to articulate consonants and vowels required to sound an extensive vocabulary of distinct words.[24] As Adam Smith observes, and anthropologists have more recently argued, the possession of language is the *sine qua non* of voluntary exchange and the social division of labor. Even today the spoken word remains the preferred medium of complex negotiation because the variations in pace and the distribution of stress and intonation in auditory speech generate a vocabulary exceeded only by body language.[25] Although, as we shall see below, patterns of regional specialization based on high levels of interregional economic integration are inconceivable in the absence of writing, the spoken word was sufficient to support the minimal long-distance connections needed to signal opportunities for exchange.[26] Speech, then, was a physiological precondition for trade across space.

Good post-Paleolithic evidence for long-distance exchange prior to 1000 BC exists for two categories of goods. The first comprised small objects serving to mark elevated social status in early farming communities.[27] Small, light, and no doubt highly prized for their scarcity, the demand price of rare shells, amber, and faience beads easily covered the cost of transport from one end of the continent to the other. Since the earliest central European Neolithic sites contain necklaces made from shells of a Mediterranean gastropod, long-distance movement of small ornamental objects

[22] Clive Gamble, "The Peopling of Europe, 700,000–40,000 Years Before the Present," in Barry Cunliffe, ed., *The Oxford Illustrated Prehistory of Europe* (Oxford: Oxford University Press, 1994), 5–41; Herbert Schutz, *The Prehistory of Germanic Europe* (New Haven, CT: Yale University Press, 1983), 31; Paul Mellars, "Stage 3 Climate and the Upper Palaeolithic in Europe: Evolutionary Perspectives," in John Cherry, Chris Scarre, and Stephen Shennan, eds., *Explaining Social Change: Studies in Honour of Colin Renfrew* (Cambridge: McDonhald Institute for Archaeological Research, 2004), 27–44.

[23] The earliest archaeological evidence for the use of symbols can be dated no earlier than 32,000 BC, or about the time that modern man displaced Neanderthal man. William Noble and Ian Davidson, "The Evolutionary Emergence of Modern Human Behaviour: Language and Its Archaeology," *Man* 26 (1991): 223–53.

[24] The larynx of Neanderthal man was situated immediately below the oral cavity, as is the case with chimps and newborn children. Such a position makes it impossible to form the vowels "a," "i," and "u," (Schutz, *Prehistory*, 16–17). Recent debate on this view is summarized by Constance Holden, "No Last Word on Language Origins," *Science* 282 (1998): 1455–58.

[25] Anthropologists have observed that the greater part of the corpus of manual skills is acquired by imitation—that is to say, through body language. Maurice Bloch, "Language, Anthropology, and Cognitive Science," *Man* 26 (1991): 186–87. On the comparative inferiority of written language, see Florian Coulmas, *Writing Systems: An Introduction to Their Linguistic Analysis* (Cambridge: Cambridge University Press, 2003), 27–32.

[26] Ulrich Blum and Leonard Dudley, "Standardized Latin and Medieval Economic Growth," *European Review of Economic History* 7 (2003): 212–38.

[27] Colin Renfrew, "*Peer Polity Interaction and Socio-Political Change*," in Renfrew and John F. Cherry, eds., *Peer Polity Interaction and Socio-Political Change* (New York: Cambridge University Press, 2009), 1–19.

must date almost to the beginning of permanent agricultural settlement.[28] The most spectacular examples of that displacement are the objects of lapis lazuli mined in Afghanistan found on the Levantine coast.[29] Although trade in such objects was necessarily limited in volume, it was occasionally big enough to induce specialized production. A recently excavated site in Northern Greece shows clear signs of division of labor in the manufacture of buttons and rings from *spondylus* shells.[30] More imposing are the extensive galleries at Can Tintore (Barcelona), where miners around the turn of the fifth millennium extracted a green gemstone that was locally worked into beads that were subsequently deposited in tombs along the full range of Atlantic Europe's megalithic rim.[31] At a more modest level is fine cardial ware produced in Languedoc in the early fifth-millennium trading a hundred kilometers from its site of fabrication.[32]

The other class of good that was widely traded in Neolithic and Chalcolithic time consists of semi-worked flint loaves and cores quarried from mines situated at sites possessing high quality stone. Unlike the ornamental objects discussed above, flint was an "industrial" raw material used in manufacturing hand axes, weapons, wood- and bone-working tools, sickle blades, and plow shares. With the spread of farming in the fifth millennium, demand for high quality flint increased, and because flint tools wear out, the trade was sustained by a strong replacement demand. Stone extracted from the best quarries in Poland, Picardy, and lower Loire traded up to six hundred kilometers from their point of origin.[33] As at Can Tintore, the flint mines show evidence of considerable fixed investment. Sites in the Holy Cross Mountains of southern Poland contain over a thousand shafts with underground galleries covering an area exceeding four hundred square kilometers.[34] The flint mines in Picardy and Belgium give evidence of

[28] Christian Jeunesse, "La Coquille et la Dent: Parure de Coquillage et Évolution des Systèmes Symboliques dans le Néolithique Danubienne (5600–4500)," in J. Guilaine, ed., *Matériaux, Productions, Circulations du Néolithique à l'Âge du Bronze* (Paris: Éditions Errance, 2002), 49–64.

[29] Michèle Casanova, " Le Lapis-Lazuli, Joyau de l'Orient Ancient," in Guilaine, ed., *Matériaux, Productions, Circulations*, 169–92.

[30] Paul Halstead, "Spondylus Shell Ornaments from Late Neolithic Dimini Greece: Specialized Manufacture or Unequal Accumulation?" *Antiquity* 67 (1993), 603–9.

[31] Maria Joefa Villalba, "Le Gîte de Variscite de Can Tintore: Production, Transformation, et Circulation du Minéral Vert," in Guilaine, *Materiaux, Productions, Circulations,* 115–29.

[32] William K. Barnett, "Small-Scale Transport of Early Neolithic Pottery in the West Mediterranean," *Antiquity* 64 (1990): 859–65.

[33] Pierre Pétrequin, Serge Cassen, Cristophe Croutsch, and Michel Errera, "La Valorisation Social des Longues Haches dans l'Europe Néolithique," in Guilaine, *Matériaux*, *Productions, Circulations*, 67–100; Andrew Sherratt, "The Transformation of Early Agrarian Europe: The Later Neolithic and Copper Ages," in Cunliffe, *Oxford Illustrated Prehistory*, 188; Magdelena Midgely, *TRB Culture: The First Farmers of the North European Plain* (Edinburgh: Edinburgh University Press, 1992).

[34] Marian Domanski and John M. Webb, "Flaking Properties and Use of Polish Flint," *Antiquity* 74 (2000): 822–32; R. Shepherd, *Prehistoric Mining and Allied Industries* (London and New York: Academic Press, 1980).

deliberate exploration to determine the location of the highest quality flint nodules that lay up to ninety meters below the surface.[35]

The preparation of the flint also shows considerable division of labor stimulated by widening markets. Workers commonly manufactured flint cores and loaves near the mines to reduce the cost of transporting raw material to local knappers striking the finished product. There is also evidence of product differentiation. At some sites in Provence, flint cores were heated, while other cores were prepared in a cold state. The heated cores were easier to knap and can be thought of as an input to "mass production." The cold-treated cores, on the other hand, yielded tools that were more robust and longer-lasting.[36] The pattern of chips at Neolithic sites in Denmark shows that specialization in stonework existed in the ultimate phases of fabrication.[37] Neolithic stone-working, then, shows all the features of later specialized handicraft economies.

The scale of trade in flint loaves and the specialization in the manufacture of flint cores is inconceivable in the absence of permanent or at least semi-permanent trading networks. Their construction could not have been a matter of chance, but probably reflects the growing population density that followed the diffusion of agriculture. In a setting as loosely settled as the Mesolithic, random crossings of individuals were unlikely to create stable networks supporting reciprocal specialization.[38] The geographical concentration of good knapping stone, on the other hand, meant that any growth in geographically diffuse agricultural demand would give rise to trade. In the Great Hungarian Plain, farmers obtained stone for tool by selling cattle to Carpathian flint miners.[39] Presumably, similar exchanges supported mining in other parts of Europe. Stone for tools, of course, was not the only quarried object traded extensively in the Neolithic. Coloring agents used to decorate ceramics were also shipped short to medium distances, and special clays used to glaze the higher qualities of pottery sometimes traded over long distances.[40]

[35] The miners sunk exploratory bores to locate the best flint. At Spiennes (Belgium) they cut through five seams of flint before working the sixth, and another shaft crossed twelve seams in order to work the thirteenth. Peacock, *Prehistoric Mining*, 70–71.

[36] Vanessa Lea, "Raw, Pre-Heated, or Ready to Use: Discovering Specialist Supply Systems for Flint Industries in Mid-Neolithic (Chassey Culture) Communities in Southern France," *Antiquity* 79 (2005), 51–65.

[37] John Michael Steinberg, *The Economic Prehistory of Thy, Denmark: A Study of the Changing Value of Flint Based on a Methodology of the Plowzone.* Ph. D. Dissertation. UCLA (1997). I am indebted to Dr. Steinberg for making this work available to me.

[38] Based on calculations making use of the principle of six or seven degrees of separation between random individuals in a network. See Gamble, "Palaeolithic Society and the Releases from Proximity."

[39] Andrew Sherratt, "Neolithic Exchange Systems in Central Europe," in Sherrat, *Economy and Society*, 320– 32.

[40] Françoise Andouze and Olivier Buchsenschutz, *Villes, Villages et Campagnes de l'Europe Celtique. Du Début du IIe Millénaire à la Fin du Ie Siècle Avant J.-C.* (Paris: Hachette, 1989), 14–16; 218–19.

B. Determining a terminus a quo for a pan-European economy

A minimal measure of the evolution of trade between northern and southern Europe can be constructed from the changing geographical distribution of Baltic amber.[41] The cost of transporting it was trivial, and the number of objects recovered from tombs is so small that the whole lot could have been transported across the continent by one or two men; but the temporal pattern is nevertheless suggestive of blockaded trade until around 1500 BC.[42] Down to 2600 BC the distribution is confined to the Baltic littoral and the Jutland peninsula. Over the next four centuries it spread southward and eastward along the manor fluvial axes into central and Eastern Europe, lapping against the foothills of the Alps and flowing down the Saône-Rhône corridor toward the Mediterranean. The expansion then stuttered for nearly a half millennium until the final flowering of Aegean Bronze-Age civilization drew Baltic amber into Greece and, at the other end of the Mediterranean, into Languedoc. The uneven diffusion of amber objects southward, in some measure doubtless reflects regional unevenness of archaeological excavation, but the intensity of work in the eastern Mediterranean surely establishes that a trading connection with Transalpine Europe did not emerge before the middle of the second millennium. Looking at the matter from the other direction, there is no direct evidence of Aegean jewelry and other Mediterranean artifacts in Britain as late as the Mycenaean age (1600–1200 BC).[43]

The achievement of a Baltic-Aegean connection is plausibly explained by the prosperity of the Minoan First Palace Period (1900–1700). The concentration of wealth on Crete was clearly great enough to support the cost of importing objects from northern Europe, just as it supported importing objects from Africa and Egypt.[44] The real breakthrough in North-South trade connections, however, occurred after 1400, when the eastern Mediterranean was at its Bronze Age peak. By that time the Greek and Levantine trading area was already reaching toward the central Mediterranean.[45] On this evidence, then, the establishment of permanent trading connections

[41] Colette du Gardin, "L'Ambre et sa Circulation dans l'Europe Protohistorique," in Guilaine, *Matériaux, Productions, Circulations*, 213–35.

[42] The majority of the amber articles weighed one to two grams. Colette du Gardin, "L'Ambre et sa Circulation dans l'Europe Protohistorique," 232–33.

[43] A. C. Harding, *European Societies in the Bronze Age* (Cambridge: Cambridge University Press, 2000), 190; L. H. Barfield, "Wessex with and without Mycenae: New Evidence from Switzerland," *Antiquity* 65 (1991): 102–107.

[44] Peter Warren, "Minoan Crete and Pharaonic Egypt," in W. Vivan Davies and Louis Schofield, ed., *Egypt, the Aegean and the Levant: Interconnections in the Second Millennium BC* (London: British Museum Press, 1995), 1–15.

[45] Lucia Vagnetti, "Variety and Function of the Aegean Derivative Pottery in the Central Mediterranean in the Late Bronze Age," in Seymour Gitin, Amahai Mazar, and Ephraim Stern, ed., *Mediterranean Peoples in Transition. Thirteenth to Early Tenth Centuries BCE* (Jerusalem: Israel Exploration Society, 1998), 66–77; Oliver Dickson, *The Aegean Bronze Age* (Cambridge: Cambridge University Press, 1994), 250–52. Linguistic evidence for early Phoenician contact is reviewed by Martin Bernal, *Cadmean Letters: The Transmission of the Alphabet to the Aegean and Further West before 1400 B.C.* (Winona Lake, IN: Eisenbrauns, 1990), 44–52.

between northern and southern Europe must be dated to late in the second half of the second millennium.

The amount of amber discovered in Bronze Age southern Europe is so small that only by a great stretching of the concept can one place its movements under the rubric of trade. The same was not true of tin, which was required in substantial amounts to make bronze, and, unlike copper, is extremely scarce.[46] The most accessible deposits of alluvial cassiterite, however, lay beyond the trading perimeter of the Near East, so that despite high demand for the metal there, tin was not an integrating commodity for Europe.[47] As for the geographically more accessible hard-rock deposits in Central Europe, the tools of Bronze Age prospectors and miners were incapable of extracting the veins of ore from their granite encasement.[48] There is no question that if European ores had been better-known or technologically accessible, Bronze Age civilizations in the eastern Mediterranean would have tapped them. Instead, they tapped sources of supply located to the east. The quantities that were shipped were evidently large, which suggests that transport costs were not a significant impediment to the trade. Nineteenth-century business correspondence generated by the activities of the Assyrian merchant community at Kultepe in eastern Anatolia documents shipments of up to eleven tons from Mesopotamia, and an eighteenth-century tablet from Ugarit on the Syrian coast records a one-ton shipment from Elam in southwestern Iran.[49] Nearer to home, Anatolia possessed a source of tin in the Taurus Mountains exploited in the early second millennium as a by-product of gold and silver mining; but the quantities involved, which may have met the needs of bronze founders at Troy, did not satisfy the voracious demand for bronze in the Aegean and the Near East.[50] The greater part of the tin used to make bronze in the Near East and Aegean thus had to be drawn from Iran or from deposits located further to the east, most likely in Afghanistan and possibly Burma and Malaysia.[51]

[46] The proportion of tin in early bronzes ranges between 7 and 10 percent, which implies a massive import into the bronze-founding districts of the Near East.

[47] J. D. Muhly, *Copper and Tin. The Distribution of Mineral Resources and the Nature of the Metals Trade in the Bronze Age* (Yale University, Ph.D., 1969). While there is evidence of local exploitation of alluvial tinstone in Cornwall after the turn of the third millennium, there is no evidence of its export to the great consuming centers of the eastern Mediterranean. Harding, *Bronze Age Societies*, 200–201.

[48] The deposits in the Erzegebirge of central Europe are hydrothermal veins encased in granite. Harding, *Bronze Age Societies*, 201.

[49] J. D. Muhly, "Sources of Tin and the Beginnings of Bronze Metallurgy," *American Journal of Archaeology* 89 (1985), 282; K. R. Veenhof, *Aspects of Old Assyrian Trade and its Terminology* (Leiden: E. J. Brill, 1972), 69–76. The Ugarit document lists 876 kilograms, but some lines are missing, indicating that the total was higher. Michael Helzer, "The Trade of Crete and Cyprus with the East," *Minos* 24 (1989): 13.

[50] K. AslihanYener and Hazi Özbal, "Tin in the Taurus Mountains: The Bolkardag Mining District," *Antiquity* 61 (1987): 220–26.

[51] Muhly, "Sources of Tin," 282–83. The coincidence of tin with *lapis lazuli* from Afghanistan at Mari suggests an Afghanistan origin.

As we shall see below, the difficulty of maintaining these trade links after 1200 probably stimulated the development of ferrous metallurgy.

It is plausible, then, that lack of knowledge of the tin deposits in northwest Europe and not high transport costs impeded a potentially large trading connection. The same cannot be said of trade in foodstuffs. Here, transport costs clearly dominated its geographical scope. With notable exceptions, trade in comestibles has until recently always been local, and long-distance trade in such commodities was long restricted to "luxury" foods that were almost always transported by water. Nevertheless, where a seaborne trade in wine, olive oil, and cereals developed, it had the capacity to transform naval architecture in ways that ultimately made long-distance maritime connections possible. In this respect the late prehistoric innovations in shipbuilding also prefigure the late medieval innovations that preceded the Columbian moment.

By the second half of the second millennium, a bulk trade in cereals, wine, and olive oil existed in the eastern Mediterranean, alongside a large trade in timber between Lebanon and Egypt.[52] The size of the larger individual shipments can be inferred from a Ugaritic text dated to around 1200 BC that mentions two thousand measures of barley to be sent in "one big ship." Assuming the measure in question is the Ugaritic *kor*, that ship would have displaced upwards of four hundred tons.[53] Other contemporary cuneiform tablets record large exports of Syrian olive oil.[54] Olive oil exports are also mentioned in the Linear B (and it is suspected also Linear A) tablets from Crete.[55] What appears to be a warehouse near Knossos contains an assemblage of large ceramic jars (*pithoi*) that could have stored as much as ten thousand liters of oil.[56] A seal dated to the eighteenth century BC from a site in the Nile delta and thought to be of Syrian origin depicts amphorae of wine and oil, and cattle being unloaded from a round-hulled ship in exchange for loadings of processed food, textiles, and sandals.[57] The documentary evidence of a bulk trade in foodstuffs is supported by the contents of fourteenth- and thirteenth-century wrecks off the Turkish and Peloponnese coast. In addition to the standard Mediterranean triplex of grain, wine,

[52] Bernard A. Knapp, "Thassolocracies in Bronze Age Eastern Mediterranean Trade: Making and Breaking a Myth," *World Archaeology* 24 (1993): 332–47.

[53] Shelley Wachsmann, *Seagoing Ships and Seamanship in the Bronze Age Levant* (College Station: Texas A&M University Press, 2001), 41. (translation of the original text, 341.)

[54] Ibid., 338. The texts read "680 [jars of oil] for Alashian [the Cypriot]; 130 jars for Abiramu the Egyptian." The jars in question would be the twenty-two-liter Canaanite amphora. Michael Heltzer, "Olive Oil and Wine Production in Phoenicia and in the Mediterranean Trade," in Marie-Claire Amouretti and J.-F. Brun, *La Production du Vin et de l'Huile en Méditerranée* (Athens: Ecole Français Athènes, 1993), 49–54.

[55] Harriet Blitzer, "Òlive Cultivation and Oil Production in Minoan Crete," in Amouretti and Brun, *Production du Vin et de l'Huile*, 163–75.

[56] A. Bernard Knapp, "Spice, Drugs, Grain and Grog: Organic Foods in Bronze Age East Mediterranean Trade," in Gale, *Bronze Age Trade*, 29.

[57] Seán McGrail, *Boats of the World. From the Stone Age to Medieval Times* (Oxford: Oxford University Press, 2001), 130.

and oil, the wreck at Ulu Burun held a cargo of fruits, nuts, spices, sainfoin, safflower, and the rare and costly pomegranate.[58] In brief, by 1200, agricultural produce was being shipped in slow-moving ships specifically constructed to carry bulky goods.[59] By 1200, such ships were capable of making the journey to the Atlantic, though there is no reliable evidence that eastern seafarers in the Bronze Age got beyond Corsica and Sardinia.

To sum up, shells and amber passed between the Mediterranean and the North Sea as early as the late Paleolithic, and regional trading systems were emerging by the Neolithic. But as late as the middle Bronze Age, the climatically distinct Mediterranean and the Atlantic and North Sea regions were not economically connected in any meaningful sense. Through the thirteenth century BC, contacts between the civilizations of west Asia and eastern Mediterranean and western and northern Europe remained sporadic, and their economies continued to develop independently of each other. That lack of contact poses unresolved problems for the prehistory of the European economy. The (admittedly controversial) linguistic evidence of a "pigeon Aryan" extending from Anatolia to the British Isles suggests an early second-millennium connection that pre-historians are unable to explain by migration or conquest.[60] Trade is an obvious possibility.

The cost of land transport did not impede interregional commerce, since most goods, then and later, moved by pack animal. By the early second millennium, the Mediterranean commodities that formed the backbone of North–South trade in antiquity—ceramics, wine, olive oil, and luxury textiles—were already the object of specialized production in the eastern Mediterranean, and thus available to be exported north and west if the opportunity had presented itself. We must suppose, therefore, that a threshold level of contact had to be achieved before trade could begin to grow. There had to be a tipping point opening the Old World to the New and the New to the Old, to reveal what they had to offer each other.

[58] Cheryl Haldane, "Direct Evidence for Organic Cargoes in the Late Bronze Age," *World Archaeology* 29 (1993): 348–60; Cheryl Ward, "Pomegranates in Eastern Mediterranean Contexts during the Late Bronze Age," *World Archaeology* 34 (2003): 519–41.

[59] The Greeks called the Phoenicians' ships "tubs" [*galloi*]. Lionel Casson, *Ships and Seamanship in the Ancient World* (Princeton, NJ: Princeton University Press, 1971), 66. On the timing and intensity of contact, see W. Vivian Davies and Louise Schofield, *Egypt, the Aegean and the Levant: Interconnections in the Second Millennium BC* (London: British Museum Press, 1995).

[60] Christopher Ehret, "Language Change and the Material Correlates of Language and Ethnic Shift," *Antiquity* 62 (1988): 564–74; John Robb, "A Social Prehistory of European Languages," *Antiquity* 67 (1993): 747–60; Robert Drews, *The Coming of the Greeks: Indo-European Conquests in the Aegean and the Near East* (Princeton, NJ: Princeton University Press, 1988) suggests a language spoken by professional warriors who seem, on his account, to bear a faint resemblance to eleventh-century Norman mercenaries. In criticism of Drew's hypothesis, see James Hooker, "The Coming of the Greeks–III," *Minos* 24 (1989): 55–68. The traditional account is summarized in J. P. Mallory, *In Search of the Indo-Europeans: Languages, Archaeology, and Myth* (London: Thames and Hudson, 1989).

III. The Dawn of Europe's Economic Integration

A. The first Dark Age

The European archaeological record is punctuated by large-scale breaks in the series of artifacts and mortuary customs that recall episodes of mass extinction that mark the fossil record. The period between 1200 and 800 BC is one such episode. Like the better-known economic contraction of the fifth through eighth centuries AD, the first European Dark Age was succeeded by a long period of relatively uninterrupted economic expansion that marks the true birth of the European economy.

The profound cultural and economic collapse that began in the eastern Mediterranean sometime after 1250 and reached catastrophic proportions in the first two decades of the twelfth century has been variously attributed to climatic shocks, foreign conquest, changing military tactics, and geological catastrophes.[61] Like the later medieval "Dark Age," the Aegean regression was characterized by the virtual disappearance of writing, destruction of urban life, and a noticeable decline in the level of material welfare that is clearly evident in the ceramic and architectural record.[62] The disappearance of pre-alphabetic writing systems is particularly striking. Cretan Linear B script passed out of use along with the cuneiform writing systems employed by the Hittites in Asia Minor and the peoples of western Syria. The vigorous late Bronze Age commerce between the urbanized islands of the Aegean and urbanized districts of the Levantine coast and Egypt all but disappeared, as did the connection between the Aegean and the Italian Peninsula, Sicily, and Sardinia, which, though never large, had been sufficient to transmit certain elements of eastern technology and cultural artifacts to the "barbarian" west.[63] The period between 1200 and 950 to 900, then, was one of economic and political disintegration from the Aegean to the eastern edges of the Neo-Assyrian Empire.[64]

[61] Seymour Gitin, Amihai Mazr, and Ephraim Stern, eds., *Mediterranean Peoples in Transition: Thirteenth to Early Tenth Centuries BCE* (Jerusalem: Israel Exploration Society, 1998); Mervyn Popham, "The Collapse of Aegean Civilization and the End of the Late Bronze Age," in Cunliffe, *Oxford Illustrated Prehistory*, 277–303; Amélie Kuhrt, *The Ancient Near East, c. 3000–330 BC.*, Vol. II (London: Routledge, 1995), 385–400. Evidence for the onset of a severe dry spell around 1200 is reviewed by Neil Roberts, Tony Stevenson, Basil Davis, Rachid Cheddadi, Simon Brewster, Arlene Rosen, "Holocene Climate, Environment and Cultural Change," in Richard W. Battarbee, Françoise Gassse, and Catherine E. Buckley, eds., *Past Climate Variability through Europe and Africa* (Dordrecht: Springer, 2004), 343–62. The case for a change in military tactics is set out by Robert Drews, *The End of the Bronze Age: Changes in Warfare and the Catastrophe ca.1200 B.C.* (Princeton, NJ: Princeton University Press, 1993).

[62] Sigrid Deger-Jakotsky, "The Last Mycenaeans and Their Successors Updated," in Gitin et al., *Mediterranean Peoples in Transition*, 114–28.

[63] Thyrza R. Smith, *Mycenaean Trade and Interaction in the West Central Mediterranean, 1600 to 1000 BC* (Oxford: British Archaeological Reports International Series 371, 1989); Vagnetti, "Variety and Function of the Aegean Derivative Pottery," in Gitin et al., *Mediterranean Peoples in Transition.*

[64] Kuhrt, *Ancient Near East*, Vol. II.

Roughly contemporaneous breaks in the archaeological record characterize western and central Europe. In Iberia an indigenous Bronze Age culture on the southeastern Spanish coast decayed while less advanced settlements sprouted on the hitherto underpopulated *mesetas.*[65] In England, farmers and stock raisers abandoned cleared moorlands that would not be resettled until the high Middle Ages, and in some instances not until the Napoleonic Wars.[66] Throughout Europe the ancient practice of inhuming elites in barrow graves was replaced by cremation and burial in urns set in communal cemeteries ("urnfields").[67] The connection, if any, between these changes and the eastern Mediterranean collapse is as yet undetermined. There were no mass invasions from the East, and climatic change was probably too modest to have had much effect on the primitive forms of agriculture then practiced.[68] As to a broken trading connection, the degree of economic integration between the eastern Mediterranean and the rest of Europe was too modest for events in the Near East to have affected the economies so far away. There remains the intriguing possibility of epidemiological catastrophe originating in the tropical regions of south Asia or Africa and diffused through the networks of trade and communication that had begun to form in the later Bronze Age. Whatever the cause, the European economy in the twelfth and eleventh centuries BC receded like the backwash of a comber on the ocean shore, rolling back to form a powerful following wave that would sweep away all before it.

The Eastern collapse remains a lively object of debate among Orientalists and classical historians but has received only slight attention by economic historians. There is a consensus that the decline was precipitated by raiders from the sea whose surprise tactics resemble those employed by the Vikings two thousand years later.[69] The inability of the politically sophisticated societies of the Aegean and the Levant to withstand the attacks (Egypt successfully repelled the raiders by making a surprise attack on their ships in the Nile Delta) raises problems similar to those posed by the failure of the Carolingians to repel the Normans in the ninth and tenth centuries AD. The visitations began sometime after 1300 and

[65] Richard J. Harrison, *Spain at the Dawn of History* (London: Thames and Hudson, 1988); Robert Chapman, *Emerging Complexity: The Later Prehistory of Southeast Spain, Iberia and the West Mediterranean* (Cambridge: Cambridge University Press, 1990).

[66] Colin Burgess, "Population, Climate and Upland Settlement," in Don Sprett and Colin Burgess, eds., *Upland Settlement in Britain: The Second Millennium and After*, British Series 143 (Oxford: British Archaeological Reports, 1985), 195–229.

[67] Harry Fokkens, "The Genesis of Urnfields: Economic Crisis or Ideological Change?" *Antiquity* 71 (1997), 360–73; Harding, *European Societies in the Bronze Age*, 77–122.

[68] As against this conjecture, see Klaus-Dieter Jäger and Vojen Ložek, "Environmental Conditions and Land Cultivation during the Urnfield Bronze Age in Central Europe," in Anthony Harding, ed., *Climatic Change in Later Pre-History* (Edinburgh: Edinburgh University Press, 1982), 162–78.

[69] Shelley Wachsmann, "Were the Sea Peoples Mycenaean? The Evidence of Ship Iconography," in S. Swiny, R. Hohfelder, and H. W. Swiny, *Res Maritimae: Cyprus and the Eastern Mediterranean from Prehistory to Antiquity* (Atlanta: American School of Archaeological Research, 1997), 339–56; Drews, *End of the Bronze Age.*

intensified over the next century and a half, culminating in the destruction of Ugarit in 1200 and the abandonment of the Mycenaean cities and palaces on Crete, on the mainland, and, slightly later, on Cyprus. The invaders are known to have settled the southern coast of Palestine, where they achieved immortality in the biblical texts as the Philistines before assimilating to the local population.[70] The circumstances of this urban destruction are mixed. Ugarit and Knossos seem to have been taken completely by surprise, as clay tablets utilized for recording commercial ephemera were baked in the fires that destroyed them. On the other hand, the Mycenaeans of Pylos on the southwest point of the Peloponnese abandoned their city in advance of an expected invasion, as evidenced by the complete absence of valuables, some of which would surely have escaped rummaging by the invaders.[71] What is not at issue is that the Aegean urban economy was destroyed and that the specialized objects of fine craftsmanship it supported vanished.[72]

Like the economic contraction of the early Middle Ages, the Aegean Dark Age possesses a strong claim to be the starting point for the long-term economic expansion of Europe. While it is tempting to ascribe the turning point to new mentalities and openings for exchange created by the shake-up of older ossified economic formations, the actual causes appear to be rooted in more pedestrian factors shifting supply and demand in ways that encouraged more intensive connections between northwest Europe and the eastern Mediterranean.

Technological change dominates the supply shifts. Between 1300 and 900 BC, three innovations turned out to be crucial for the eventual integration of Europe's economic space. The earliest was the improvement in ship construction and sailing technique. As will be discussed in more detail below, the decisive changes in rigging and hull construction that permitted larger and more robust ships were achieved before the Aegean collapse in response to the growing bulk trade in timber and agricultural produce. The perfection of ferrous metallurgy by Cypriot and Aegean smiths was the second decisive innovation. Unlike the changes in naval architecture, the metallurgical innovations of the Aegean Dark Age were an unexpected by-product of economic collapse. The third major development affecting the later expansion of trading networks was the transformation of Proto-Canaanite syllabaries into a true alphabet consisting of approximately two dozen phonetic signs. The triumph of the alphabet was also a consequence of the Aegean collapse, which destroyed the earlier and slightly more cumbersome cuneiform script employed to document administrative and commercial transactions outside Egypt.

[70] Seymour Gitin, "Philistia in Transition: The Tenth Century BCE and Beyond," in Gitin, Mazar, and Stern, *Mediterranean Peoples in Transition*, 162–83.
[71] Wachsmann, *Seagoing Ships*, 159–60.
[72] Deger-Jakotsky, "The Last Mycenaeans," 122–23.

Each of these innovations can be linked to later development of more extensive and permanent commercial links between the eastern Mediterranean and the rest of Europe. Improved ship design supplied the material basis for the marine breakout to the European Far West; The perfection and diffusion of ferrous metallurgy into the European interior raised agricultural productivity enough to generate a surplus of tradable goods capable of sustaining permanent and increasingly dense commercial relations with other parts of the continent. The spread of alphabetic writing, slower and less universal than the spread of iron, but more rapid and complete than the scripts it succeeded, made it possible to organize administration and commercial contacts on a scale impossible to maintain by word of mouth. Taken alone or in combination, however, none of these innovations were sufficient to provoke that contact. For trade to emerge and grow to the proportions it reached in late Hellenistic and Roman times, there had to be a reciprocal demand for commodities whose demand price covered the still considerable cost of long-distance transport. The critical commodities were Iberian silver and Mediterranean wine. The former sustained the opportunity for trade created by the ninth-century maritime breakout to the Atlantic; the latter created in the following century a trading connection between the Etruscans in North Italy and the Celtic peoples living beyond the Alps.[73] Each of these was crucial to the first European economic integration, and each recalls the great intercontinental connecting of the early modern age.

B. Maritime innovation

Late Bronze Age innovations in ship design were a response to growing opportunities for bulk trade by sea following the emergence of a vigorous commercial network linking the civilizations of Egypt, Anatolia, Mesopotamia in the Levant, and Crete, Cyprus, and Mycenaea after 1650 BC. In the present state of historical research, much influenced by the nineteenth- and early twentieth-century obsession with the forms of economic organization rather than its effects, it is impossible to quantify that growth. It is likely that the emergence of a centralized Hittite state in Anatolia, the emergence of the New Empire in Egypt, and the evident prosperity of northern Syria and the Greek islands and mainland, provided the material basis for a substantial increase in goods carried by sea, as textual and archaeological evidence reveals.

The critical innovation was the use of locked mortise and tenon joints to assemble the planks making up the shell of large ships. Although mortise and tenon joinery was employed on some Egyptian ships in the early second millennium (in most the planks were sewn together), the use of wooden pins to secure the tenons is a Levantine innovation dating to the fifteenth

[73] The ancient literary tradition dating the foundation of a Phoenician colony at Cades (Cadiz) to the beginning of the twelfth century has not been archaeologically substantiated. Serge Lancel, *Carthage: A History* (Oxford: Wiley-Blackwell, 1995), 1–11.

century.[74] Although costly to build, shell-built ships were exceptionally sturdy and remained the standard in Mediterranean waters until the decline in craftsmanship and probably higher capital costs in late antiquity led shipbuilders to adopt the cheaper (and less durable) method of nailing strakes onto pre-built frames.[75] The new method of construction supported a quantum jump in the realizable size of cargo ships. The weight of stone anchors dated to fifteenth and fourteenth century is consistent with displacements on the order of 200 to 225 tons, and as noted above, a fifteenth-century Syrian text seems to imply a vessel displacing 400 tons.[76] These were large ships by medieval standards. Historians long considered that ships this size were not built before the third century BC, but the discovery in 1991 of a fifth-century Greek wreck displacing 120 tons has altered that assessment.[77] Bronze and Iron Age shipbuilders thus could construct ships as great as any that sailed before the late seventeenth century.[78] It is likely, however, that, as in later periods, most cargo ships were relatively small. The fourteenth-century wreck off Ulu Burun displaced 15 or 16 tons, and few known Bronze Age harbors are large enough to have accepted ships exceeding 100 tons.

The second critical maritime innovation was in the rigging. The mainsail on middle Bronze Age ships was attached at the bottom to a heavy beam that the crew raised and lowered to reduce or increase sail. As the size ships increased, so did the amount of sail needed to drive them, necessarily increasing the length and the weight of the beam and making it more difficult to trim the sail in response to changing wind conditions. During the fourteenth and thirteenth centuries, the heavy beam was discarded, and the lines (brails) were used to trim the suspended sail like a Venetian blind. Less cumbersome than the boom-footed sail and easier to set on tacks, the suspended sail made sailing safer in open water.[79] The new rigging seems to have brought Mediterranean sailing to a level comparable with medieval

[74] The earliest dated evidence of mortise-and-tenon planking comes from a fragment of an Egyptian Red Sea ship dated c. 1975 BC It has no locking pins, however. Wachsmann, *Seagoing Ships*, 215–16. The joinery for the hulls of the wrecks at Uru Burun and Cape Gelidonya (c. 1300 and 1200 BC) consisted in deep mortises and tenants secured by pins. The mortises were cut to within a half an inch of the opposite edge of the plank, creating an exceptionally strong structure. McGrail, *Boats of the World*, 122–23.

[75] Richard W. Unger, *The Ship in the Medieval Economy 600–1600* (London: Croome Helme, and Montreal: McGill-Queen's Press, 1980).

[76] Wachsmann, *Seagoing Ships*, 159–60; and Andrew Sherratt and Susan Sherratt, "From Luxuries to Commodities: The Nature of Mediterranean Bronze Age Trading Systems," in N. H. Gale, ed., *Bronze Age Trade in the Mediterranean: Studies in Mediterranean Archaeology* Vol. XC (Jonsered: Paul Åströms Förlag, 1991), 364.

[77] Elpida Hadjidaka, "The Classical Shipwreck at Alonessos," in Swiny et al., *Res Maritimae*, 125–34.

[78] Lionel Casson, *Ships and Seafaring in Ancient Times* (Austin: University of Texas Press, 1996).

[79] Casson, *Ships and Seafaring*, 38–39; Wachsmann, *Seagoing Ships*, 248–51.

https://doi.org/10.1017/S0265052522000140 Published online by Cambridge University Press

performance.[80] From the standpoint of long-distance sailing, the two late Bronze Age innovations cleared the way for large-scale commerce between distant shores. By 1200 BC at the latest, no technical obstacles beyond the adequacy of harbor facilities impeded long-distance commerce from one end of the Mediterranean to the other.

C. The search for silver

Exploiting the capacity for long-distance commerce required finding objects to trade. Given the universal self-sufficiency in necessaries, objects of long-distance trade typically had to be exotic luxuries that could stand the cost of long-distance transport, or inputs like tin whose small share in the total cost of bronze made its demand price inelastic. Highly decorated pottery, textiles, and metalwork manufactured by the peoples of the eastern Mediterranean doubtless supplied articles for export to backward regions of western and northern Europe, but what did the peoples of those remote districts have to offer in return?

By the end of the thirteenth century the Aegean trading network had begun to include southern Italy, Sicily, and Sardinia.[81] Pottery recalling Mycenaean techniques of painted decoration and high-temperature firing, glass works, and the lost-wax bronzes show the connection with the East. By 1300 the large storage jars known as *pithoi* were being used on the toe of Italy, signifying not only an increase in agricultural productivity, but also trade with Crete and Cyprus where some of the jars had been procured.[82] The Central Mediterranean seems to have marked the limit of Mycenaean trade, however. The discovery of Mycenaean shards near Cordoba suggests at most an ephemeral contact.[83] It is likely that some easterners knew of Iberia but had no commercial incentive to trade there. The true connecting of the Levant with the central and western Mediterranean occurred after 1000 BC.

The decisive factor in the breakthrough to the European Far West was the exceptionally rich silver lode extending from southwest Spain into

[80] Sailing a replica of a fourth-century wreck from Cyprus to Greece, experimenters consistently reached the speed of five knots per hour with a top speed of twelve knots, although the steering oars tended to break at speeds over five knots. Tacking was difficult but possible in winds up to four on the Beaufort scale (eleven to fifteen knots). Glafkos A. Cariolu, "Kyrenia II: The Return from Cyprus to Greece of the Replica of a Hellenic Merchant Ship," in Swiny et al., *Res Maritimae*, 83–97. Apart from the limits on tacking, the performance is comparable with that of later periods, when the standard velocity of ocean-going vessels with a good wind was three to four knots. John H. Parry, *The Age of Reconnaissance; Discovery, Exploration and Settlement, 1450 to 1650* (New York: Praeger, 1969), 104.

[81] Smith, *Mycenaean Trade.*

[82] Vagnetti, "Variety and Function of the Aegean Derivative Pottery," 66, 71–73.

[83] José Clemente Martín de la Cruz, "Die Erste Mykenische Keramik von der Iberischen Halbinsel," *Praehistorische Zeitschrift* 65 (1990): 49–52; Christian Podzuweit, "Bemerkungen zur Mykenischen Keramik von Llanete de los Moros," *Praehistorische Zeitschrift*, 53–59. The stratigraphy of the original find is sufficiently disturbed to make the date of deposition uncertain.

Portugal.[84] The El Dorado of antiquity, the ores of the Rio Tinto equal the size and richness of the deposits later discovered in the New World.[85] Obtained from the early Copper Age as a by-product of copper mining, by the time the Phoenicians arrived in the early eighth century, their existence and their whereabouts would not have been a secret to anyone. It is possible that rumors of the great lode induced the Phoenicians to penetrate the Straits of Gibraltar. It is hard to imagine what other inducement might have pulled them so far from home.

Unlike tin, silver had no important industrial use apart from the confection of jewelry; its value in exchange instead reflected its function as a medium of exchange in the Near East. We are poorly informed about the factors that determined the demand for money in that part of the world because Oriental scholarship has focused primarily on questions bearing on forms of economic organization rather than on the macroeconomic factors determining the price level and trend in real output.[86] As a result, the monetary history of the Near East in the second and first millennia must be extrapolated from political narratives supporting archaeological evidence on the rise and fall of centralized states, on the supposition that periods of state expansion were generally associated with internal peace and prosperity. On that conjecture, the consolidation of the Neo-Assyrian Empire in Mesopotamia and Syria after 1000 BC, and the subsequent Neo-Babylonian and Achaemenid consolidation of an economic space that at one time stretched from India to Egypt, provided the basis for major increases in the demand for money.[87]

The use of silver as a means of payment is recorded in early second millennium tablets from Kultepe, where Assyrian merchants who bought silver for tin at the rate of 15:1 and used the silver to buy tin in Elam at 7:1.[88] Silver money is attested in Babylonia from the thirteenth century.[89] Through much of the second and early first millennia, silver was one of several means of payment. In Babylonia, tin at times performed that function. The Hittite Empire used mainly copper, as did Egypt. Nevertheless, by the late Bronze Age silver seems to have been the main medium of international payment.

[84] In addition to silver, the region contained large deposits of copper and tin, which were not exploited until Roman times. Muhly, *Copper and Tin.*

[85] The exceptionally thick veins of silver are supergene enrichments lying about thirty meters below the surface. Analysis of slag from Phoenician workings shows silver content as high as 10 kg per ton. Today, 0.6 kg concentrations are considered exceptionally rich. Harrison, *Spain at the Dawn of History,* 149–50. The highest concentrations at Laurion are the same order of magnitude, though the average was apparently 2.5 kg. C. K. J. Cunningham, "The Silver of Laurion," *Greece and Rome* 14 (1967): 146.

[86] Peter Vargyas, *A History of Babylonian Prices in the First Millennium BC.* Studien Zum Alten Orient Bd 10 (Heidelberg: Heidelberger Orientverlag, 2001) is an exception, but the author makes no attempt to work the material into an economically rigorous framework of aggregate supply and demand.

[87] For a review of the political history, see Kuhrt, *Ancient Near East*, Vol. 2.

[88] Veenhof, *Aspects of Old Assyrian Trade*, 349–51; 360–61.

[89] Muhly, "The Bronze Age Setting," in Theodore Wertime and James Muhley, eds., *The Coming of the Age of Iron* (New Haven, CT and London: Yale University Press, 1980), 207, 235.

At Ugarit, which served as the main Bronze Age entrepôt for trade between Mesopotamia, Egypt, Anatolia, and the Aegean, prices are most often quoted in silver. In Egypt, silver became more important after 1200.[90] The increasing use of silver as a means of payment probably reflects the growing importance of interregional trade and the corresponding need for a common medium of large-scale payment. By 1200, silver dominated the other monetary metals, and it retained that place through the succeeding economic collapse. When the Near Eastern economies began to recover after 900 BC, their money was silver.

Shortly after the Phoenicians reached Spain, demand for money in the east received a fillip from the invention of coinage. The earliest confirmed reference to payment by tale rather than by weight dates to the first decade of the seventh century.[91] For most commercial purposes, however, coins were unnecessary. The silver circulated in pre-weighed bags bearing seals certifying their content, like the sealed bags of full-weight coins used in medieval banking. To make small change, the bags simply had to be opened and the requisite amount of silver weighed out.[92] While adoption of coinage should have raised the value of silver, the admittedly scanty records on Babylonian prices indicate that the value of money down to about 400 BC was remarkably stable, implying that as the eastern economy recovered and expanded, it was able to attract silver at roughly constant cost.[93] The subsequent decline in the value of money no doubt reflects the huge increase in output from Iberia and the newly discovered Greek mines at Laurion.

A stable value of silver in the Near East is of course compatible with a large differential in its value as between Iberia and the Orient. Iberian archaeological evidence indicates a sharp increase in the rate of silver production between 750 and 550.[94] As it is unlikely that indigenous demand for money was growing fast enough to support that increase, the obvious alternative is demand for money in the Near East transmitted by newly established Phoenician trading posts in the West. Diodorus Siculus has left a description supporting this conjecture.

> Now the natives were ignorant of the use of silver, and the Phoenicians, as they pursued their commercial enterprises and learned of what had taken place, purchased the silver in exchange for other wares of little if

[90] Daniel Snell, "Methods of Exchange and Coinage in Ancient Western Asia," in Jack Sasson, ed., *Civilizations of the Ancient Near East*, Vol. III (New York: Scribner; London: Simon and Shuster and Prestice-Hall International, 1995), 1493.

[91] Peter Vyargas, "Sennacharib's Alleged Half-Shekel Coins," *Journal of Near Eastern Studies* 61 (2002): 111–16.

[92] "Snell, "Methods of Exchange and Coinage in Ancient Western Asia," 1494.

[93] Between the seventh and fifth centuries, the value of silver in terms of commodities rose 4 to 12 percent Vyargas, *Babylonian Prices*, 49. Prices subsequently rose after Alexander's conquest of the area.

[94] Harrison, *Spain*, 42–43. Citing Susan Frankenstein, "The Phoenicians in the Far West: A Function of Neo-Assyrian Imperialism," in M. T. Larsen, ed., *Power and Propaganda: A Symposium on Ancient Empires* (Copenhagen: Academisk Forlag, 1979).

> any worth. And this was the reason why the Phoenicians, as they transported this silver to Greece and Asia and to all other peoples, acquired great wealth.[95]

Muhly disputes this passage on the grounds that the Near East could obtain silver from Greece, the Taurus mountains of southern Turkey and the Pontic.[96] The mines at Laurion, however, date to the fifth century, and as noted above, it is hard to conceive what other Iberian exports could have induced both Phoenicians and Greeks to establish emporia on the Iberian coast in the seventh century. The wine, oil, perfumes, ivories and other products of the advanced cultures of the East was bought with silver from Tartessos.

The Iberians' undervaluation of their silver was of short duration. While Phoenicians set up new smelting operations to process the ore, the natives retained control of the mines.[97] The resulting prosperity created the basis for an urban revolution on the upper Guadalquivir characterized by occupational specialization, the development of organized states, and alphabetic writing.[98] The growth in wealth between 750 and 500 BC is also reflected in the consumption of olive oil and wine imported from abroad by sea in Phoenician amphorae. Perhaps most telling are the jeweled rings, gold *appliqué* objects entombed with their owners along with a bronze sphinx and a green bottle inscribed in Egyptian hieroglyphs.[99] The Iberian moment set off an arc of economic growth that peaked in the Augustan Age, by which time southwest Spain was the richest district in Western Europe.[100]

Having reached the Atlantic, the Phoenicians touched another trading network, which is attested by the presence in Brittany of "carp's tongue" swords manufactured by Iberian blacksmiths.[101] The routes were exploited by the Phoenicians sailing south along the African coast to Cape Mogador and possibly Sierra Leone, north to the British Isles.[102] The Phoenician voyages into the Atlantic are the outstanding achievement of late Bronze Age maritime technology. In the fourth century, a Greek sailing out of Marseilles voyaged around the northern tip of Great Britain into the North Sea and the Baltic, eventually reaching the present site of Kaliningrad (Königsberg).[103] The primary goal of the maritime trade to the north was

[95] María Cruz Fernández-Castro, *Iberia in Prehistory* (Oxford and Cambridge, MA: Blackwell, 1995).

[96] At present the analytical evidence provides no support for Greek literary traditions regarding the export of Spanish silver in Archaic and classical times.

[97] Eighth-century Phoenician smelting operations are signaled in R. F. Tylcote, "Furnaces, Crucibles and Slags," in Wertime and Muhley, *The Coming of the Age of Iron*, 207.

[98] Fernandez-Castro, *Iberia in Prehistory.*

[99] Harrison, *Spain*, 61–64.

[100] Evan W. Haley, *Baetica Felix: People and Prosperity in Southern Spain from Caesar to Septimius Severus* (Austin: University of Texas Press, 2003).

[101] Fernández-Castro, *Iberia in Prehistory*, 145.

[102] E. G. R. Taylor, *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis and Carter, 1956), 46.

[103] Muhly, *Copper and Tin*, 475.

Cornish tin. With the development of a land route across Gaul in the second century, however, the Atlantic route lost its importance, Cornish tin being more cheaply shipped to Brittany and transported on pack animals to Mediterranean ports at the mouth of the Rhone.[104] We now turn to the establishment of that land link.

D. Breakthrough across the Alps

While the Phoenicians were tapping the silver of Tartessos, Etruscans and Greeks were opening a trading connection with the Celtic peoples living beyond the Alps. Mediterranean trade with transalpine peoples was a natural outgrowth of exposure of Italian peoples to oriental luxuries. By the early eighth century, Etruscan civilization had become sufficiently stratified and wealthy to support regular imports of wine and pottery from Greece.[105] The intensification of that trade is evident in the ceramic sequence. In the eighth and seventh centuries, it contains fine Greek wares produced for Greeks; by the sixth century, the imported wares had assumed Etruscan shapes to serve a well-defined market.[106] What the Etruscans sent back in return is unknown, though iron wares and perhaps objects from the north are obvious candidates. By the seventh century, the Etruscans had mastered the techniques of winemaking and olive cultivation. In the course of that century, Etruscan wine (possibly wine from the Greek colonies in south Italy) was being carried by Etruscan merchants to peoples inhabiting the Ligurian coast, and across the Alps to the centers of Hallstatt civilization on the upper Rhine and Rhone.[107] At the end of the seventh century, Greeks from the Anatolian coastal city of Phocaea established a colony at Marseilles with the aim of pursuing the same commerce.[108] The Greeks aggressively explored this new region, importing their writing and techniques of fortification. By the early sixth century they knew enough about the upper Rhone and Rhine to locate the *Keltoi* on the first map of the known world.[109]

Like specie, addictive substances have played a central role in integrating the world economy. Alcohol consumption in the European interior goes back to the third millennium and was evidently a central element in early ritual.[110] Until northern Europeans learned how to malt grain to brewing

[104] Muhly, *Copper and Tin*, 475–76, quoting the Greek historian Diodorus Siculus.

[105] Graeme Barker, "Archaeology and the Etruscan Countryside," *Antiquity* 62 (1988): 772–85.

[106] Jocelyn Small, "Scholars, Etruscans and Attick Painted Vessels," *Journal of Roman Archaeology* 7 (1994): 34–58. Thomas J. Figueira, *Aegina*: *Society and Politics* (Salem, NH: Ayer, 1986), 239–40.

[107] Fanette Laubenheimer, *Le Temps des Amphores en Gaule* (Paris: Errance, 1991), 14–21.

[108] Fanette Laubenheimer, "Le Vin Gaulois," *Revue des Études Anciennes* 91 (1989): 5–22; André Tchernia, *Le Vin d'Italie Romaine: Essai d'Histoire Économique d'après les Amphores* (Rome : École Français de Rome, 1986), 56–57; 90–91.

[109] Schutz, *Prehistory of Germanic Europe*, 202–203.

[110] Andrew Sherratt, "Cups That Cheered: The Introduction of Alcohol to Prehistoric Europe," in Andrew Sherratt, *Economy and Society in Prehistoric Europe* (Princeton, NJ: Princeton University Press, 1997), 376–402.

beer, however, alcohol could only be obtained by fermenting fruit and honey, which made it costly and rare. The arrival of a beverage having an alcoholic content upwards of ten percent worked a revolution in trans-Alpine Europe. Writing when the trade was in full swing immediately after the Roman conquest, Diodorus observed that

> The Gauls are exceedingly addicted to the use of wine and fill themselves with the wine brought into their country by merchants, drinking it unmixed; and since they partake of this drink without moderation by reason of their craving for it, when they are drunken they fall into a stupor or state of madness. Consequently, many of the Italian traders, induced by the love of money that characterizes them, believe that the love of wine of these Gauls is their own Godsend.[111]

Caesar reports that the Nerviens and the Suevians refused entry to wine traders for fear the drink would weaken their warriors.[112]

Although initial contact by the Etruscans dates to the end of the ninth century, the great expansion of wine exports to the Celts in Gaul begins with the founding of Marseilles at the end of the seventh century. That Gallic wine market stimulated specialized winemaking in the eastern Mediterranean, then in the Latium and Etruria, and by the beginning of the fifth century in the hinterland of Marseilles.[113] Archaeological findings on the coastal plain of lower Languedoc provide some guidance with respect to the timing of the establishment of trading connections in southern Gaul.[114] Between 620 and 630 the region began to import wine and fine pottery from the Etruscans, who restricted their dealings to coastal districts.[115] A few years later the region was visited by Phoenicians, also bearing wine, and then by Greeks installed at their Catalonian factory at Amphorias. In the sixth century, Iberians entered the region to broker the trade between the Greeks at Marseilles and the Celtic peoples of southwest Gaul.[116] The establishment of Greek comptoirs on the Languedoc coast toward the turn of the sixth century marks the decisive break in the ceramic series. Copies of Greek vases manufactured in Marseilles become common, silos and *dolia* for storing grain and wine proliferate, and the construction of fortifications, large stone buildings, and signs of increasing division of labor point to incipient urbanization.[117] The imports may have been purchased by farm

[111] Cited in Peter Garnsey and Richard Saller, *The Roman Empire: Economy, Society and Culture* (Berkeley and Los Angeles: University of California Press, 1987), 13.

[112] Tchernia, *Vin d'Italie*, 90. Other tribes were more accommodating.

[113] Laubenheimer, *Temps des Amphores*, 23.

[114] Michel Py, *Les Gaulois du Midi: De la Fin de l'Âge de Bronze à la Conquête Romaine* (Paris: Hachette, 1993).

[115] Py, *Gaulois du Midi*, 84–86.

[116] Ibid., 92–98. In the second century BC, Iberian was still the spoken language in the Languedoc interior. Laubenheimer, *Temps des Amphores*, 37.

[117] Ibid., 110–13.

produce and iron, of which the region was a significant producer in later classical antiquity. A similar development can be observed nearby in north-east Spain.[118]

The quantity of wine exported into Celtic Europe can be appreciated by the size of the amphora dumps at the major points of transshipment from the Mediterranean, like Toulouse (for the Atlantic coastal trade to Brittany and the British Isles), Châlons-sur-Saône (for trade into the Paris basin), and Aquila (for the trade over the Alps to the Celts on the Danube).[119] In Eastern Europe, amphorae deposited at major crossroads and river junctions testify to a similar trade up the Danube from Greek stations on the Black Sea.[120] The wine trade involved many nationalities and flowed in many directions, linking specific vineyards with specific markets. The pattern suggests commercially important distinctions in type and quality that are well documented in later Roman literature.[121] Punic ships carried Greek wines to North Africa, Spain, and Gaul; Greek ships imported vintages from the Levant. Etruscan wine was known in Greece in the time of Alexander and was being exported up the Danube to the Celts of Pannonia.[122] The trade was not restricted to the finished product. In the fourth century BC, a Punic ship that foundered off El Hoz in in the Balearics was carrying vine stocks rooted in earth for transplanting.[123] By the first century BC, vineyards had colonized the areas subject to Mediterranean climate, and vines were being acclimatized to resist colder conditions further north. Together with olive oil, then used mainly as lighting fuel, wine was the primary agricultural commodity traded in bulk throughout the non-urbanized European world. What that world sent back in exchange, we do not know, though it is likely to have been a combination of tin, silver, slaves, and agricultural produce. Our ignorance in this regard is not unlike what we would know about how Native Americans acquired European goods in the seventeenth and eighteenth century if the fur trade were undocumented. What is clear from the shards is that the "barbarian world" was able to produce exports in exchange for Mediterranean produce.

[118] Rosa Plana Mallart and Akurora Martin Ortega, "Le Territoire Ibérique: Structure du Peuplement et Organisation Territoriale, Quelques Exemples," in Dominique Garcia and Florence Verdin, eds., *Territoires Celtiques: Espaces Ethniques et Territoires des Agglomérations Protohistoriques d'Europe Occidentale* (Paris: Errance, 2002), 18–19.

[119] Patrick Gallou, "Days of Wine and Roses? Early Armorica and the Atlantic Wine Trade," in Sarah Macready and F. H. Thompson, eds., *Cross-Channel Trade between Gaul and Britain in the Pre-Roman Iron Age* (London: The Society of Antiquaries, 1984), 24–36. Tchernia, *Vin d'Italie*; Fanette Laubenheimer, *Les Amphores en Gaule: Production et Distribution* (Besançon: Annales Littéraires de l'Université de Besançon, 1990).

[120] Ivan Glodariu, *Dacian Trade with the Hellenistic and Roman World* (Oxford: British Archaeological Reports, 1976).

[121] Tchernia, V*in de l'Italie Romaine*, 30–31.

[122] Ibid., 56.

[123] A. J. Parker, "Classical Antiquity: The Maritime Dimension," *Antiquity* 64 (1990): 337.

E. The Classical agricultural revolution and the advent of iron

The capacity of non-urbanized Europeans to produce such exports is most likely due to the diffusion of ferrous metallurgy into the European hinterland after 800 BC.[124] The economic significance of that metallurgical revolution has been overlooked by historians mainly concerned with its military consequences, but the growth of specialized production and trade in an overwhelmingly rural economy could not have occurred in its absence. The key to that upswing was the rise in agricultural productivity that resulted from the introduction of iron implements to work the soil and harvest crops. The advent of iron was a necessary condition for the growth of interregional trade. To understand why, we need briefly to review how shortage of metal implements affected prehistoric agricultural productivity.

Not that metal was unheard of in the countryside. Bronze sickles, hoe blades, and doubtfully identified plowshares have been recovered from founders' hoards. But the metal was clearly too expensive for general farming use, and as early as the eighth century BC, and in some caches for several centuries more, the working pieces of farm implements still consisted mainly of bone, flint, and fire-hardened wood.[125] The poverty of metal implements affected two main spheres of general farming. The first was soil preparation, where the high rate of wear of flint and wooden shares condemned cultivators to superficial stirrings that left the seed bed poorly aerated, poorly drained, and weed-infested.[126] These defects in tillage were accentuated by the tendency of unreinforced joints to break under the stress and strain of deep plowing.[127] On garden plots that comprised the overwhelming majority of prehistoric farms, these deficiencies in tillage could be

[124] On the dating of the diffusion, see Anthony M. Snodgrass, "Iron and Early Metallurgy in the Mediterranean," Wertime and Muhley, C*oming of the Age of Iron*, 325–74; Radomir Pleiner, "Early Iron Metallurgy in Europe," in Wertime and Muhley, *Coming of the Age of Iron*, 375–415.

[125] The pieces identified as plowshares resemble hoes. Catling notes that "any or all of them mounted on a knee-joint haft could have been used manually as mattocks." H. W. Catling, *Cypriot Bronzework in the Mycenaean World* (Oxford: Clarendon Press, 1964), 79–80; The original identification of these implements as plowshares was by Jean Deshayes, *Les Outils de Bronze: De l'Indus au Danube, IV^e au II^e Millénaire* (Paris: Geuthner, 1960), 133ff. On hoards, see Richard Bradley, "Hoarding, Recycling, and the Consumption of Prehistoric Metalwork: Technological Change in Western Europe," *World Archaeology* 20 (1989): 249–60; A. F. Harding, *European Societies in the Bronze Age* (Cambridge: Cambridge University Press, 2000), 125– 27, 203. On the persistence of stone tools, see Py, *Gauls du Midi*, 60; Harrison, *Spain at the Dawn of History*, 29, 152–53. Pleiner dates the advent of iron in northwest Europe to ca. 500 B.C. Radomir Pleiner, "Early Iron Metallurgy in Europe," in Wertime and Muhly, *Coming of the Age of Iron*, 384.

[126] In Danish experiments wooden shares had to be replaced after plowing 1.5 to 1.75 hectares. Grith Lerch, "Ridged Fields and Profiles of Plough Furrows: Ploughing Practices in Medieval and Post-Medieval Times: A Study in Experimental Archaeology," *Tools and Tillage* 5 (1986): 131–56. Analysis of the wear and fracturing of flint shares indicates that they were too fragile to be employed for deep tillage. Jean Guilaine, *Pour une Archéologie Agraire* (Paris: A. Colin, 1991), 60–61; Niall K. Bredy, "Early Ard Pieces in Finnish Museums," *Tools and Tillage* 6 (1989): 158–59.

[127] Boris Shranko, "Tilling Implements of Southeastern Europe in the Bronze Age and Early Iron Age," *Tools and Tillage* 7 (1992): 48–64; Bredy, "Early Ard Pieces," 159; Lerch, "Ridged Fields."

https://doi.org/10.1017/S0265052522000140 Published online by Cambridge University Press

offset by intensive manual cultivation, but the weakness of the plows seriously obstructed the emergence of larger farms that were alone capable of releasing significant amounts of foodstuffs into trade by substituting animals for men in the preparation of the seed bed.[128] The second sphere was the harvest of meadow grasses, where the inability of farmers armed with flint sickles to cut enough forage to support a stock of animals capable of sustaining soil fertility under intensive cultivation set a limit to the productivity of the land. Iron relieved both constraints, though in different ways.

From an agronomical perspective, iron implements gave farmers a means of imposing greater control over the weeds that constituted the primary cause of depressed yields.[129] With iron-tipped spades and heavy sod forks farmers could work land to depths of a foot and more.[130] This was mainly a matter of eradicating deep-rooted perennials like quackgrass and corn thistles and burying shallow-rooted weeds like corn cockle to suppress germination. Deep spading, however, was costly and was usually carried out more as an investment in long-term fertility than as routine maintenance.[131] Thus, while technically less effective, the labor-savings of plowing made it economically more efficient. Bronze Age plows, however, could not easily turn the soil, but merely stirred it.[132] In this respect the most important benefit from iron shares was to facilitate asymmetric plowing that turned the soil to one side, making it possible to work the arable into ridges and furrows to facilitate drainage and provide a seedbed with some natural insurance against the vagaries of climate. This was particularly important in cultivating soils where a high clay fraction and wet soils frustrated deep plowing. Such soils characterized much of northern Europe's agricultural land.

[128] On the productivity of primitive hand tillage, see P. J. Reynolds, "A Study of the Crop Yield Potential of the Prehistoric Cereals Emmer and Spelt Wheats," in Jean-Pierre Devroey and Jean Jacques van Mol, *L'Épeautre (*Triticum Spelta*): Histoire et Ethnologie* (Brussels: Centre d'Histoire et de Technologie Rurals, 1989), 12, and more broadly P. J. Reynolds, *Iron-Age Farm: The Butser Experiment* (London: British Museum, 1978).

[129] W. Harwood Long, "The Low Yields of Corn in Medieval England," *Economic History Review* 32 (1979): 459–79. Excavations of Bronze Age sites in Germany and Poland dating to the late second millennium revealed huge concentrations of weed seeds associated with the introduction of plowing. Graeme Barker, *Prehistoric Farming in Europe* (Cambridge: Cambridge University Press, 1985), 152.

[130] Both implements were late Iron Age products, the earliest Mediterranean examples dating only from Roman times. The reason would appear to be the difficulty of forging an implement in which the full load generated in lifting the soil is concentrated on a hollow socket. On the dating, see Signe Isager and Jans Erik Skydsgaard, *Ancient Greek Agriculture* (London: Routledge, 1992), 49.

[131] In the early nineteenth century, farmers in the south of France periodically spaded their fields as an investment in fertility. Rising labor costs after 1840 caused the practice to be discontinued. Charles Parain, "L'Évolution de l'Ancien Outillage dans l'Aude et les Départements Voisins au Cours du XIX^e Siècle (Culture des Céréales)," *Folklore* (1940): 48–61. See also Pierre Coutin, "L'Évolution de la Technique des Labours dans le Nord de la Limagne Depuis le Début du XIX^e Siècle Jusqu'en 1938," *Folklore Paysan* 2 (1939): 30–43.

[132] Bronze Age archaeology exhibits no sign of sod-busting ards. Harding, *European Societies*, 128.

In asymmetric plowing, the wear on the share is concentrated on one edge. Steeled shares were more resistant than shares of hardened wood or flint, which wore too quickly to maintain an edge. Abrasion patterns on early iron shares show that from an early date farmers took advantage of the more resistant material by tipping the plow to one side to effect an asymmetric tillage. This was the first in a sequence of innovations leading up to the moldboard plow in the third- or second century BC.[133] The moldboard plow was a cumbersome implement armed with an iron coulter fixed in the beam and an asymmetric share on the foot that released a ribbon of earth to slide up against the moldboard to be overturned as the plow advanced across the field. To stabilize the draft in the face of the tremendous lateral force exerted by the weight of the earth against the moldboard, the beam was frequently attached to a wheeled platform. The amount of iron going into these implements was considerable. Evidence from medieval documents and ancient metal shares and coulters suggests that the iron in ordinary ards and plows ranged between two and twelve kilograms, though a large implement strengthened with bolts and chains might contain as much as fifty.[134] Spades and the heavy hoes (*rastrum*) used by the Romans for trenching and breaking clods weighed upwards of ten kilograms.[135] Moreover, even though they were more resistant than wood or stone, iron shares wore out and had to be replaced or reforged on a regular basis. The diffusion of iron plowshares thus implies a huge increase in the availability of iron.

Although animal-powered tillage never matched the quality of manual cultivation, it raised labor productivity enough to permit specialized production of cereals on a scale large enough to release significant grain surpluses into trade. For while yields per hectare were lower with the plow, the smaller amount of grain needed to feed the labor force producing it more than offset the decline. The labor savings were achieved on farms large enough to support a team of animals, and they increased with farm size, providing an endogenous means of raising labor productivity through

[133] The evolution is worked out in chapter 3 of my book in progress on the history of European agricultural productivity.

[134] Speaking of the primitive swing plow utilized in the province of Berri at the turn of the eighteenth century, the Prefect of Indre observed that "Il entre dans chaque charrue environ 50 kilogrammes de fer" ("*Each plow holds about fifty kilograms of iron*"). F. J.-B. Alphonse, *Mémoire Statistique du Département de l'Indre* (Paris: An XII, 1804), 54. In the fourteenth century, swing plows on Norfolk estates embodied about 12 kilograms of iron and steel Miller and Thirsk, *Agrarian History of England and Wales,* Vol. 3, 305–306. Pieces assembled by a nineteenth-century collector in Kazan weigh one to five kilograms. R. E. F. Smith, "Some Tillage Implements in the Zausilof Collection in the National Museum of Finland," *Tools and Tillage* 4 (1983): 205–15.

[135] Sod forks utilized by Limousin peasants around 1800 weighed four to six kilograms. M.-L. Texier-Olivier, *Statistique Générale de la France … Département de la Haute-Vienne* (Paris, 1808), 336. The upper pound seems to be represented by the Irish *loy*, said to weigh 12 kilograms. Jean-René Trochet, "Les Plantes Américaines et l'Europe. L'Innovation dans l'Outillage et les Techniques Agricoles à l'Époque Moderne," *Histoire et Sociétés Rurales* 1 (1994): 99–117.

increasing farm size.[136] The response can be seen in the spread of *latifundia* in Italy, and the consolidation of farmland into large farms in northern Gaul. The advantage conferred by the heavy plow was an advantage that came with growing farm size.

The responsiveness of agricultural supply to improved terms of trade also depended on finding a more efficient means of harvesting forage plants. As noted above, the supply of winter fodder was constrained by the low productivity of flint and bronze sickles. The solution to this problem was the iron-bladed scythe. Early sickles were essentially straight blades five or six inches long. Blades that short could not cut enough hay in the brief period when meadow grasses were at their nutritional peak to feed more than a handful of animals through winter.[137] The sweep of the great scythe raised the rate of cutting by a factor of five to ten, transforming a binding labor constraint on livestock holdings into an elastic land constraint. Moreover, unlike bronze, an iron blade could be sharpened and hammered back into shape in the field, a necessary evil when cutting grass low on stony, root-infested ground.[138]

That displacement in the constraint on livestock holdings from labor to land affected the subsequent evolution of European mixed husbandry in important ways. In raising the shadow price of land, it created incentives for land-saving innovation, of which the most important involved sowing fodder crops on fields otherwise dedicated to a fallow course and rotating cultivated land through long alternating sequences of arable and grassland. The additional livestock supported by these substitutions increased the supply of manure to sustain the fertility of soils subjected to more-intensive cultivation. This evolutionary path received a powerful fillip at the turn of the sixth century BC with the introduction of forage legumes by the Persians in the course of their aborted conquest of the Greek mainland.[139]

The scythe and the moldboard plow completed the classical synthesis of crops, animals, and cultivation practices that created a species of mixed husbandry that would carry European agriculture through the first century of industrialization.[140] The combination of variable farm size and variable

[136] The early modern evidence on this point is conclusive. See Jean-Marc Moriceau and Gilles Postel-Vinay, *Ferme, Entreprise, Famille: Grande Exploitation et Changements Agricoles, xvii^e–xix^e Siècles* (Paris: Editions EHE S, 1992), and Robert C. Allen, *Enclosure and the Yeoman* (Oxford: Clarendon Press; New York: Oxford University Press, 1992).

[137] The Danish archaeologist Gundmund Hatt remarked that cutting hay with a flint or bronze sickle was like harvesting it with a penknife. Cited by Lotte Hedeager, *Iron-Age Societies. From Tribe to State in Northern Europe, 500 BC to AD 700* (Oxford: Blackwell, 1992), 207.

[138] Harding reports that some sickles found in Slovenian Bronze Age hoards have a low tin content, which might reflect an attempt by bronze smiths to make the blades more malleable for frequent sharpening. Harding, *European Societies*, 203.

[139] Mauro Ambrosoli, *The Wild and the Sown: Botany and Agriculture in Western Europe, 1350–1850* (Cambridge: Cambridge University Press, 1997), 3. The story of the Persian introduction is related by Pliny.

[140] George Grantham, "La Faucille et la Faux: Un Exemple de Dépendence Temporelle?" *Etudes Rurales* (1999): 103–31.

intensity of crop rotation made possible by the advent of the heavy plow, and the scythe provided the foundation for an elastic supply response to shifts in effective market demand for farm produce.[141] The initial effects of the scythe can be seen in growing size of late Iron Age buildings constructed to hold animals in northern Europe.[142] The larger effects of the Iron Age agricultural revolution are reflected in the economic prosperity of the high Roman age. The advent of iron made specialized farming in landlocked districts economically feasible.

F. The metallurgical revolution

The agricultural revolution and its impacts would have been impossible in the absence of large supplies of iron. Prehistoric iron working experienced two phases of intense development that by the second century AD brought the art of bloomery smelting to a technical level not to be surpassed until the introduction of the blast furnace in the fourteenth century AD. The first occurred between 1200 BC and 900 BC, when smiths on Cyprus and at other sites in the eastern Mediterranean achieved sufficient control over reduction, carburization, and tempering to make iron a practical alternative to bronze in weapons and tools. The second worked itself out between 400 BC and 100 AD as a result of increasing division of labor in the preparation and handling of ore, fuel, and fluxes at major smelting sites. The critical development in this phase was the slag-tapping shaft furnace, which increased the yield of a typical smelt by tenfold and lowered the cost of iron to the point where it became a quotidian element of rural economic life,[143] This phase represents the response to a growing demand for iron in the countryside, the primary market support for large-scale production.[144]

What explains the first phase, without which the second phase that was the basis for the Iron Age agricultural revolution could not have occurred? The question is provoked by the fact that iron had been known and unintentionally smelted for millennia, and in contrast to the second phase the initial breakthrough in ferrous metallurgy occurred in a context of contracting demand for metal. What makes that breakthrough even more puzzling

[141] The evidence from the early modern period is ventilated in George Grantham, "Agricultural Supply in the Industrial Revolution: French Evidence and European Implications," *Journal of Economic History* 49 (1989): 1–30, and George Grantham, "Espaces Privilégiés: Productivité Agricole et Zones d'Approvisionnement Urbains dans l'Europe Pré–Industrielle," *Annales. Histoire, Sciences Sociales* 3 (1997): 697–725.

[142] Hedeager, *Iron-Age Society*, 206–209.

[143] Gerard Sperl, ed., *The First Iron in the World. Proceedings of the Populonia/Pombino 1983 Symposium* (Straabourg: Council of Europe, 1983). Primitive bowl furnaces yielded three kilograms of sponge per smelt. The shaft furnaces used in the late Iron Age yielded up to thirty kilograms. Pleiner, "Early Iron Metallurgy," 408.

[144] The level of production at major sites can be inferred from ancient slag heaps. The major Etruscan works at Populonia, imply production of more than two million tons of iron during their four to five hundred years of operation. Pleiner, "Early Iron Metallurgy," 384–85. Unfortunately, most of the large slag heaps from antiquity have been destroyed by subsequent resmelting for their iron.

https://doi.org/10.1017/S0265052522000140 Published online by Cambridge University Press

is that the hardness of bronze equals the hardness of low-carbon steel, and in the Bronze Age, bronze was much cheaper than iron.[145] The advent of iron, then, cannot be explained by slowly accumulating know-how acquired in non- ferrous smelting; nor can it be attributed to rising demand for a bronze substitute generated by a growing economy.

In native and meteoritic forms, iron has been known and worked since the Paleolithic.[146] There are attested modern instances of people extracting iron from fallen extraterrestrial objects, but until men learned to remove the oxygen from terrestrial ores by heating them in the presence of carbon, the vast reserve of the metal locked up in its oxides and sulfides was inaccessible.[147] The reduction of iron ores occurred originally as a by-product of copper smelting. In the reducing atmosphere of a primitive bowl hearth, some small portion of the iron ore commonly found in conjunction with ores of copper would have been reduced to spongy bits of pure iron in the slag.[148] The earliest example comes from a Mesopotamian tool dated to the end of the sixth millennium.[149] As the practice of using iron ore to flux copper slag became more prevalent, iron would appear more frequently in the resulting slag.[150] The amount of iron recovered was small, however, and the metal remained rare and costly.[151] As late as 1200 BC, it was exclusively dedicated to ceremonial objects and jewelry.[152] Nevertheless, the process of reducing ferrous ores to metallic iron within the temperature range attained in primitive bowl hearths to smelt copper was well understood by the early second millennium. Through the late Bronze Age, however, iron remained

[145] James A. Charles, "The Coming of Copper and Copper Base Alloys of Iron: A Metallurgical Sequence," in Wertime and Muhly, C*oming of the Age of Iron,* 151–81; Tylecote, *History of Metallurgy*, 10.

[146] Native iron is nearly pure, and is found mainly in Greenland, where it was fashioned into knives by the Eskimos. Theodore Wertime, "The Pyrotechnologic Background," in Wertime and Muhly, *Coming of the Age of Iron*, 11.

[147] In 1621, Punjabi natives forged several knives and swords from a fallen meteorite weighing two kilograms. In 1859, inhabitants of the Wadi Bani Kahled in Saudi Arabia watched a 59.4 kilogram meteorite fall to earth and subsequently extracted its iron. Buchwald, *Handbook of Iron Meteorites: Their History, Distribution, Composition and Structure* (Berkeley: University of California Press, 1975), 1273, 1275.

[148] Attaining sufficiently high temperatures was crucial, as high temperatures release the extra carbon monoxide needed to liberate oxygen from its metallic compounds. At temperatures lower than 700° C, the combustion cycle for charcoal is C---CO---CO_2; above that temperature the cycle extends to $C0_2$ + C---2CO. Since copper reduces more readily than iron ores, most of the CO would have combined with copper ores. James A. Charles, "The Coming of Copper and Copper-Base Alloys and Iron: A Metallurgical Sequence," in Wertime and Muhly, *Coming of the Age of Iron*, 151–81.

[149] Jane C. Waldbaum, "The First Archaeological Appearance of Iron and the Transition to the Iron Age," in Wertime and Muhly, *Coming of the Age of Iron*, 69–70.

[150] Copper becomes molten at 1100° C, while silicate slag fluxed with iron ores fuse between 1150° and 1250°. By maintaining the higher temperatures long enough for the copper and slag to separate out and be drawn off to distinct basins, smiths significantly increased the output of the smelt. Ronald Tylecote, "Furnaces, Crucibles and Slags," in Wertime and Muhly, *Coming of the Age of Iron*, 183–89.

[151] The extant examples are ceremonial objects deposited in graves, hoards and temples. Waldbaum, "First Archaeological Appearance," 69–98.

[152] Ibid., 78–79.

an expensive metallurgical curiosum. Prices from thirteenth-century Ugarit tablets indicate that it was sixty times dearer than copper and two to four times more expensive than silver.[153] It was also exceptionally pure, and therefore too soft for use in weapons and tools.

The physical properties of toughness and hardness that make iron alloys useful in structures and cutting tools are a function of its carbon content and crystalline structure. The former depends on how long the metal reduced from ore remained in contact with carbon in the furnace. As carburization did not impart hardness to copper, early smiths had no reason to prolong a smelt in order to carburize non-essential iron inclusions in the slag; and given the narrow range of carbon/iron ratios that determine iron's steeliness, variations in the reduction and carburization at different points in the furnace would have made it virtually impossible even for experienced smiths to predict the outcome of varying the length of the smelt. This remained true long after the adoption of iron as Europe's primary metal and after smiths had learned to steel wrought iron by heating it in the presence of charcoal. Well into the Middle Ages ironmasters still could not reliably control the carburization of smelted iron.[154]

Carburization was only the first step in producing an iron alloy competitive with bronze, of which the most important were heat treatments provoking solid-state reactions in the crystalline structure to alter its hardness and plasticity. The effects of quenching and tempering, however, are highly sensitive to temperature and temperature dynamics, and thus difficult experimentally to determine. In this respect, the early history of ferrous metallurgy has much in common with the early history of agricultural innovation. In both, the underlying ecological and physical processes were affected by too many unobserved variables for specific interventions to give predictable results. Moreover, because carburization and heat treatment have no place in bronze and copper metallurgy, they were not part of the bronze smith's tool kit. The Iron Age thus represents a true break in metallurgical tradition. If quenching and tempering had been easier to master, the huge discrepancy between the supply of iron and copper ore probably would have made iron the dominant metal by the early second millennium. But ferrous metallurgy was an extremely difficult and obscure art, and in the absence of any reason to improve it, it was a neglected one. Despite the presence of wrought iron in copper slag, then, the advent of iron was not a linear evolutionary extension of Bronze Age metallurgy.

[153] Jane C. Waldbaum, *From Bronze to Iron* (Göteborg, Paul Åström, 1978), 17; Muhly, "Bronze Age Setting," in Wertime and Muhly, *Coming of the Age of Iron*, 35.

[154] Robert M. Ehrenreich, *Trade, Technology and the Ironworking Community in the Iron Age of Southern Britain* (Oxford: British Archaeological Reports, 1985); R. Pleiner, "Investigation into the Quality of the Earliest Iron in Europe," in Gerard Sperl, ed., *The First Iron in the Mediterranean. Proceedings of the Populonia/Piombino 1983 Symposium* (Strasbourg: Council of Europe, 1988), 33–36.

For iron to become a feasible substitute for bronze in tools and weapons, smiths had to accumulate observations bearing on the effects of carburization and heat treatment; until 1200 BC, they had no reason to do so, as bronze was not only cheaper than iron, but it was also tougher and harder. To judge from the quantity of bronze circulating in the late Bronze Age, the metal was abundant.[155] The reason seems to be a dramatic decline in the price of tin, which was the binding constraint on the production of bronze in the Near East and Aegean. A comparison of prices drawn from Middle Assyrian tablets from the nineteenth and fourteenth centuries suggests a twelve- to sixteen-fold decline in the price of tin.[156] We do not know the demand elasticity of bronze, but by 1500 its price had fallen enough for it to be employed in hoes and sickles.[157] The amount locked up in such everyday objects must greatly have exceeded what was embodied in weapons and armor, which probably explains the emergence of a wholesale trade in scrap metal reflected in the contemporary founders' hoards.[158] The source of the decline in the price of tin must lay in the increasing efficiency of the trading network that connected mining districts in Afghanistan (and more doubtfully, Cornwall) to the Near East, since the cost of transport would have constituted the major part of the final price.

That state of abundance ended shortly after 1200 BC. The probable cause is the collapse of the trading network connecting the Near East to sources of tin in the wake of the destruction visited upon Near Eastern cities. According to Muhly, Eastern tin made its way to the West across northern Iran to Assyria and through the Arabian Sea up the Persian Gulf to the Euphrates.[159] Although the state of documentation after 1200 makes it impossible to track the price of tin in the crucial centuries of the ferrous revolution, the breakdown of centralized authority in Assyria and Persia would have raised the cost of long-distance transport from the main point of supply.[160] Moreover, falling demand for metal in the West after the catastrophes of 1200–1270, would have made it impossible to sustain the fixed costs of maintaining an efficient network of trade and transport extending across more than two thousand miles of desert and mountains.

In the short run, diminished demand for bronze objects was probably satisfied by melting down stocks of existing metal. This practice probably

[155] The wreck off Capet Gelidonya contained eight tons of copper ingots. Tylecote, *History of Metallurgy*, 37.

[156] The Assyrian correspondence of the early second millennium puts the tin price of silver at 15:1 in eastern Anatolia and 7:1 in Elam. Assyrian texts from between 1300 and 1500 put the price at between 180:1 and 240:1. The late price is from Muhly, "Bronze Age Setting," 48.

[157] J. Christophe and J. Deshayes, *Index de l'Outillage. Outils en Métal de l'Age du Bronze des Balkans à l'Indus* (Paris: Frence National Centre for Scientific Research, 1964); H. W. Catling, *Cypriot Bronzework in the Mycenaean World* (Oxford: Clarendon Press, 1964).

[158] Some hoards contain upwards of a ton of metal. Harding, *European Societies*, chap. 10. See also Richard Bradley, "Hoarding, Recycling and the Consumption of Prehistoric Metalwork."

[159] Muhly, *Copper and Tin*, 586–87, 593.

[160] The same phenomenon can be seen in the disruption of the medieval trade route to China following the fourteenth-century breakup of the Mongol Empire.

accounts for a dramatic increase in the size of hoards in Central Europe and Britain.[161] Yet, even in the context of overall contracting demand, shortages seemed to have appeared in certain districts. In the absence of information bearing on population movements, any judgment on the relative shift in supply and demand for bronze after 1200 is necessarily speculative, but it is conceivable that the catastrophic attacks that destroyed late Bronze Age urban culture left the rural population relatively untouched. If so, the demand for bronze may have been maintained at levels high enough to stress local supply. Alternatively, the shortage of tin in copper smelting districts may have encouraged smiths to experiment with iron. Cyprus appears to be one such place. Historians believe that the economic contraction occurred later there than in Greece, Anatolia, and other parts of the Levant.[162] If so, the maintenance of high levels of economic activity on Cyprus would have put pressure on the diminishing supply of bronze resulting from the shortage of tin. In any event, the strongest evidence for the initial appearance of iron as a working metal—that is to say, smelted iron deliberately carburized and heat treated to achieve the steeliness required for its use in weapons and tools—comes from Cyprus, closely followed by eastern Greece and coastal Anatolia.[163]

The key to the adoption of iron for everyday objects lay in mastering the art of carburization, quenching, and tempering. The evidence indicates that it took about 150 years for Cypriot smiths to achieve that mastery.[164] The experiments with iron would have been motivated by the rising price of bronze. Initially, the use of iron would have been restricted to ornaments, where its inferiority to bronze did not matter. Over time, experimentation and serendipitous discovery would have raised its substitutability to the point where it could be used in other applications. Because rising production would set into motion a positive feedback loop by increasing the rate of learning by doing, the quality and reliability of iron alloys rose enough to make them superior to bronze in most utilitarian applications. Eventually, the cost advantage conferred by the vastness of iron ore reserves would reverse the original relation between the two metals, bronze now being reserved for ornaments and objects of display. By that time iron was being used in agricultural implements.

Waldman has compiled an inventory of iron objects from the eastern Mediterranean that are datable to the period of transition from bronze to

[161] Harding, *European Society*, 356–57. A hoard in Cambridgeshire dating to around 1100 BC contained over 6,000 pieces; six hoards in Transylvania had 10,000 pieces totaling more than five tons. As suggested above, accumulations of this size must surely represent wholesale accumulation for later distribution through a trading network.

[162] Gerald Cadogan, "The Thirteenth-Century Changes in Cyprus in the East Mediterranean Context," in Gitin et al., *Mediterranean Peoples in Transition*, 6–16; Vagnetti, "Aegean Derivative Pottery," 73.

[163] Snodgrass, "Iron and Early Metallurgy," 340–45.

[164] Metallographic analysis dates the critical period as 1200 to 1050 BC. Snodgrass, "Iron and Early Metallurgy," 345.

https://doi.org/10.1017/S0265052522000140 Published online by Cambridge University Press

Table 1. Ratio of iron to bronze objects, c. 1200–c. 900 BC (sample size)

Date	Jewelry	Weapons & Armor	Tools
1200-1100	.12 (403)	.03 (331)	.13 (238)
1100-1000	.14 (713)	.19 (334)	.27 (254)
1000-900	.31 (817)	.54 (289)	.69 (192)

iron. I summarize her findings in Table 1,[165] which shows how the relative proportion of bronze and iron shifted across the three main categories of metallic objects. In the beginning, iron was restricted to jewelry and small tools; in the eleventh century the proportion increased in all categories; by the tenth century, iron was the preferred material for tools.

From the perspective of European economic integration, the diffusion of ironmaking throughout rural Europe between 900 and 600 BC created the conditions permitting an elastic agricultural supply response to trading opportunity. The establishment of trading links between the East and the West and the south and the north between the eighth and sixth centuries was critical in extending the east Mediterranean trading network into the western Mediterranean and transalpine Europe. That extension implied a complementary rise in agricultural productivity. The main effects of the revolution occurred after 500 BC, which on a number of measures seems to date the true upswing in the classical economy.[166] The growth of Iberian mining is inconceivable without a parallel growth in local farm output. The same is true of the growth in wine consumption north of the Alps, and of wine production south of it. We may not know exactly what was exchanged for the few visible products that have left a record in the documentation and archaeological debris, but logic requires us to suppose that they could not have found their way into exchange networks in the absence of a rise in agricultural productivity.

IV. The Alphabetic Revolution

It is possible to maintain long-distance economic connections without the help of written documents, but it would have been virtually impossible for significant interregional specialization to emerge in the absence of some way to keep track of transactions that (owing to the time it took to move goods over long distance) inevitably involved credit. The value of writing in the conduct of interregional trade was such that within five hundred years

[165] Waldbaum, *From Bronze to Iron*, 56.

[166] Between 600 and 450 BC the median house size in the Aegean roughly doubled. Between 450 and 350 BC it nearly tripled. Over the same period, the number of houses with second floors probably doubled. Ian Morris, "Archaeology, Standards of Living, and Greek Economic History," in J. G. Manning and Ian Morris, eds., *The Ancient Economy: Evidence and Models* (Stanford: Stanford University Press, 2005), 108.

of the transformation of the signs employed by the Sumerians into a linguistically adequate writing system, merchants from Assyria were using it to conduct a trade that stretched from Anatolia to the Persian Gulf.[167] The knitting of stable economic connections between northern and southern Europe and between the eastern and western Mediterranean was contemporaneous with the diffusion of the art of writing based on the Phoenician alphabet. A notable feature of that diffusion was the proliferation of scripts adapting Phoenician letters to the phonetic peculiarities of the non-Semitic of Europe and North Africa. That extension reflects the new value of writing created by the growth of trade. Earlier writing systems in the Near East were geographically restricted to originating cultures and their immediate neighbors and roughly map the space of intense economic interaction. Until the second third of the first millennium, that space did not include Western Europe.[168]

To assess the contribution of alphabetic writing to European economic integration in the first millennium BC, we need to answer several questions that are difficult, and perhaps impossible, to answer. The first is why people found it necessary to go beyond the simple systems of recording quantities of goods that appear everywhere to be the source of writing systems. The second is why writing spread from the original fiscal administrators and merchants, for whom it was initially most useful, to broader communities. Much of the prehistoric linguistic heritage consists of monumental inscriptions. To whom were they addressed? This raises the third question of who read, and how they learned. A final set of questions concerns the evolution of written communication from semasiographic systems, in which the signs denote thought without the intervening medium of words (as in highway signs and the symbols and syntax of mathematical proofs), and logographic systems, in which the signs stand for words (as in Chinese and Egyptian hieroglyphs), toward systems in which signs denote the sound values of speech.[169] This last class has two subdivisions: syllabic scripts or syllabaries, where signs represent the sound value of the combination of consonants and vowels comprising a syllable (for example, Δ to represent the sound of the syllable <tok> and □ to represent <tak>) and alphabetic scripts, where the signs represent component consonantal and vowel sounds. For more than two thousand years, the writing systems of the Near East managed with scripts that in varying proportions combined logographic and syllabic signs. Alphabetic scripts originated sometime after 1700 BC, and eventually

[167] Veenhof, *Aspects of Old Assyrian Trade.*

[168] Tablets and pottery shards incised in figures that faintly recall early Sumerian pictographs have been found at a Neolithic site in Transylvania dated to the early third millennium. Their purpose is unknown, though bookkeeping would be the most likely function of the tablets. There is no other evidence of writing prior to the introduction of Phoenician characters. M. S. F. Hood, "The Tartaria Tablets," *Antiquity* 41 (1967): 97–113.

[169] This discussion and much that follows is drawn from the arguments advanced by Geoffrey Sampson, *Writing Systems: A Linguistic Introduction* (Stanford, CA: Stanford University Press, 1985).

displaced cuneiform and hieroglyphics in the Near East to become the writing system for the whole world outside the ideographic space of East Asia. Is there an economic logic to this development, or is it simply a spurious correlation associated with path dependence? In short, did the alphabet make a difference, and if so, how?

On the face of things, phonological writing makes literacy accessible to more people by lowering the cost of learning to read. Plato considered that a young person could learn to read in three years, and it is thought that a high proportion of the free citizens of Athens and other Greek cities could read. Whereas readers have to memorize the "picture" of a meaning or a word representing a meaning to understand semasiographic and logographic writing, they have only to memorize the signs standing for sound values in phonological scripts, greatly reducing the amount of memorization required to read.[170] By making reading a natural extension of listening to speech, phonemic scripts also encourage literacy at an early age when the opportunity cost of study is least, since by the time children's eyes are sufficiently developed to distinguish letters, they have already mastered speech, and can sound out words they already know. The value-added of specifically alphabetic writing relative to the syllabic writing systems it supplanted may nevertheless be doubted. Research on how fast Japanese, Chinese, and Western children learn to read shows no essential differences as between ideographic and phonetic scripts; further, within the class of phonetic scripts, syllabaries are actually easier to master than alphabets as means of phonetic reading.[171] One should not jump to the conclusion that because alphabetic scripts have fewer characters than syllabic and logographic scripts, they have a selective advantage over them. The successful resistance of Chinese writing to alphabetization proves the point. Indeed, once the initial investment in memorizing a large set of Chinese characters has been incurred, reading may even be faster, and research indicates that syllabic script generates less dyslexia than alphabetic script.[172] Perhaps the most that can be said for the alphabet is that it makes a little learning go a long way by making it possible for fledgling readers to sound out words. Yet, the cognitive cost of learning a 75-character

[170] Semasiographic signs send ideas directly without the need for an intervening word that triggers their meaning. Mathematical and musical notation are semasiographic, as are some traffic signs. Logographic signs indicate meanings that have sounds, but do not derive from the original sound. Symbols like $, &, @ and % are logographic. Phonographic scripts represent sounds and combinations of sounds. The two main families of phonographic scripts are syllabaries, which sign for complete syllables, and alphabets, which sign for each sound going into a syllable. Sampson, *Writing Systems*, 33–34.

[171] Daisy L. Hung, Ovid J. L. Tzeng, W. L. Lee, and J. M. Chung, "Orthography, Reading Disability and Cerebral Organization," in Watts, *Writing Systems and Cognition*, 11–35. My own experience in learning to read and speak Chinese is that it takes about two years to master the basic ideographic vocabulary of two thousand words needed to read a modern Chinese newspaper without losing an excessive amount of time consulting the dictionary.

[172] Although they require more visual memory, words written in morphographic (pictorial) symbols are comprehended more rapidly than words written in phonographic symbols. Hung, et al., "Orthography, Reading Disability and Cerebral Organization."

syllabary as compared to a 26-character alphabet is trivial compared to the difference between either of these phonological scripts and the two to three thousand characters needed to read Chinese or Japanese.

With respect to the costs of learning to write, the value-added of alphabetic script is even more problematic. Dictation experiments using cognitively impaired subjects indicate that the ability to use an alphabetic code (that is, to read) by sounding words out is not the same as the ability to write words. Subjects wrote down familiar words, but not unfamiliar ones they had difficulty "hearing."[173] More importantly, writing demands a high degree of neuromuscular coordination, as anyone attempting to write with his weak hand immediately discovers. It is generally conceded by specialists that mastering the art of writing by hand takes about ten years, and as with reading the time taken is independent of the language and writing system used.[174] Moreover, in writing for private use (taking and making notes, for example) people ease the physical stress of writing by developing idiosyncratic cursive scripts useful to themselves but often unintelligible to others.[175] Writing partakes of manual craft. It was probably for that reason that extended writing was generally relegated to slaves and persons of low social status taking dictation from the author. In Attic pottery, most of the persons who are depicted writing are women and children.[176]

Overall, the advent of alphabetic writing does not seem to have conferred a decisive advantage over the syllabic scripts current in the second millennium. Literacy rates in the urban districts of Mesopotamia where the syllabic script hung on through the first millennium were high. According to Wilcke, between one-sixth and one-third of the private houses in Babylonia in the eighth and seventh centuries BC possessed private libraries, and excavations indicate that more than half of the buildings there contained inscribed tablets.[177] It seems quite plausible that the incidence of reading was equally high in the other advanced Bronze Age societies that utilized syllabic scripts.

The question remains why the explosive diffusion of writing in the early Iron Age was carried by the alphabet rather than the syllabic writing systems of the late Bronze Age. As we shall see, the decisive change was not the appearance of the alphabet *per se*, but the spread of writing carried by Phoenicians, and later Greeks and Etruscans, to the New World of western and northern Europe. Like the history of ferrous metallurgy, the history of

[173] A patient writing to dictation correctly wrote 568 out of 622 words, but only 9 out of 50 non-words. This result has been confirmed by subsequent research. Sirat, "Handwriting and the Writing Hand," in W. C. Watts, ed., *Writing Systems and Cognition: Perspectives from Psychology, Physiology, Linguistics and Semiotics* (Dordrecht and Boston: Springer, 1994), 445–46.

[174] Sirat, "Handwriting and the Writing Hand," 430–32.

[175] Ibid., 411–12.

[176] Ibid., 401.

[177] Claus Wilcke, *Wer las und Schrieb in Babylonien und Assyrien* (München: Verlag der Bayerischen Akademie der Wissenschaften, 2000), 9; and Olof Pedersén, *Archives and Libraries in the Ancient Near East, 1500 – 300 B.C.* (Bethesda MD, CDL Press, 1998).

writing displays path dependence. Alphabetic and syllabic scripts were good substitutes, and the success of one of them partakes more of chance than of rational selection. More important than the alphabet itself were economic processes that encouraged the development and diffusion of any kind writing at a time when among the trading peoples of the eastern Mediterranean, the alphabet was the last script standing after the catastrophe of the twelfth century.

There is nevertheless an evolutionary path that by the middle of the second millennium carried Near Eastern writing to the brink of an alphabetic system. As is well known, writing originated in primitive counting systems used to record the number of homogeneous objects subject to a transaction, such as the number of measures of grain allocated to a particular use or person. In most cases the signs consisted in pictographs representing the thing, but not the sound that identified the word for it. Such systems required little more than markers identifying the object, the parties to the transaction, and the number of units involved.[178] Because they possess neither syntax nor a grammar, linguists classify them as "incomplete."[179] Writing systems of this type barely rise above the simplicity of a tally stick, and seem to have been fairly widespread, even among pre-agricultural peoples.[180] The development of complete writing systems from these primitive devices was rare, and specialists have identified no more than a dozen independent inventions of complete writing systems, mostly in or around the ancient Near East.[181] When it happened, however, the achievement was swift. At Sumer, and later in Egypt, the transformation from accounting to writing took no more than a century and a half.[182] The critical element was the introduction of signs representing abstract concepts that possessed no self-evident pictorial representation, like the verb "to be." Once that crucial step had been taken, the elaboration of a system that tracked the linguistic structures of the spoken language seems to have been easy.

Subsequent evolution toward phonographic representation was driven by the need to represent foreign names and other words identifiable to users of the originating script only by sound. As in the parlor game "charades," in

[178] The original Sumerian system originated in the practice of encasing the number of stones or tokens corresponding to the number of units accounted for in a clay container (*bullae*) the exterior of which was marked with the seals or "names" of the parties to the transaction, and an indication of the nature and number of objects pertaining to it. Presumably the baked encasement would be broken only in the event of a dispute over the terms of the agreement. In time the inscriptions became sufficient proof, and the *bullae* replaced by baked inscribed tablets. Sabah Abboud Jasmin and Joan Oates, "Early Tokens and Tablets in Mesopotamia: New Information from Tell Abeda and Tell Brek," *World Archaeology* 17 (1986): 348– 61.

[179] Hans J. Nissen, "The Archaic Texts from Uruk," *World Archaeology* 17 (1986) 317–34.

[180] The use of bone tallies goes back to the Paleolithic. They are thought to be lunar calendars. Denise Schmandt-Besserat, "Forerunners of Writing: The Social Implications," in Watt, *Writing Systems*, 303–10.

[181] Johanna Drucker, *The Alphabetic Labyrinth* (London: Thames and Hudson, 1995), 12.

[182] Nissen, "Archaic Texts," 326.

which the player touches her ear to signal "sounds like," foreign words and abstract terms would be indicated by a sign for a native word possessing a known sound and a mark to signal that the meaning of the character was restricted to its sound value. In this way a script originating in one language could be adapted to a new one, in which a significant proportion of the characters represented sounds. The best-known modern examples of this process are the hiragana and katakana scripts employed in Japanese to accommodate inflexions of Japanese, and words borrowed from foreign languages not included in the basic set of Chinese characters (kanji). The first known instance of this transfer of a script from an uninflected language to an inflected one was the Akkadian adaptation in the twenty-fourth century BC of Sumerian cuneiform to represent their Semitic speech.[183] A few centuries later, the Assyrians transformed it once again, by which time the script had become a viable medium of commercial correspondence, as evidenced by the huge archive of business letters deposited shortly after the turn of the third millennium by Assyrian merchants in the Anatolian city of Kultepe.[184]

Phoneticization of writing systems greatly reduces the number of signs needed to represent a language. Modern Chinese has close to 50,000 signs; the original Sumerian script includes more than 2500. By contrast Akkadian cuneiform got by with 1200 graphemes, and the Assyrian successor to it further reduced the effective number to between 150 and 200.[185] The trend in the phonological writing systems that developed in the third millennium, then, was toward an ever-smaller set of characters. As one might expect, simplification occurred most rapidly in the sphere of business correspondence, where erudition, tradition, and nuance would have been unimportant. The writing system utilized by merchants at Kultepe had approximately one hundred characters.[186] A similar reduction characterized Egyptian writing, which evolved (though the original glyphic writing was retained for ritual) into syllabic hieratic and demotic cursive scripts. Cretan glyphic script, Linear A, and Linear B appear to descend from the Egyptian example, with contributions from the scripts employed in the middle years of the second millennium by peoples inhabiting the coastal regions of southern and western Anatolia.[187] Around the middle of the

[183] Uninflected languages like Chinese are readily represented by signs representing complete words (logography), whereas inflected languages like Japanese require supplementary marks indicating the particular inflection. Akkadian was an inflected language, and as inflections were merely additional sounds, their adoption of the Sumerian writing inevitably pushed the script toward greater phoneticization. Geoffrey Sampson, *Writing Systems* (Sheffield: Equinox, 2015), 55–57.

[184] David Hawkins, "Writing in Anatolia: Imported and Indigenous Systems," *World Archaeology* 17 (1986): 363–75.

[185] M. T. Larsen, "What They Wrote in Clay," in Karen Schousbroe and Mogens Trolle Larsen, *Literacy and Society* (Copenhagen: Akademisk Forlag, 1989), 121–48.

[186] Ibid.

[187] Hawkins, "Writing in Anatolia."

second millennium, there thus existed a collection of distinct scripts derived from the two original Middle Eastern writing systems, of which, by virtue of its multiple transformations to accommodate new languages, cuneiform was the most extensively employed.[188] The amount of writing seems most readily explained by the presence of centralized states and the growth of trade between them.

In the context of the interaction of several syllabic scripts in the Near East, one must place the development of an alphabetic style of writing sometime around 1500 BC.[189] The peoples of Palestine lived at the crossroads of the two main writing systems, each of which employed different signs and different media, and both of which had by then evolved into semi-syllabic forms combining word signs and syllabic signs. Local scribes charged with drawing up commercial documents in the ports of trade that intermediated trade between the three main eastern civilizations had to read several syllabic languages, none of which was their mother tongue. Millard hypothesizes that these Canaanite and Syrian scribes borrowed signs from these scripts to express sounds in their own language, just as the Cuneiform signs had earlier been adapted to the linguistically distinct Akkadian, Assyrian, and Hittite languages. The stylized content of commercial documents composed in a tongue whose syllables were bounded by consonants and glottal stops permitted scribes to reduce the number of phonetic characters. Whereas the local syllabic scripts had fifty to a hundred characters, the alphabetic cuneiform tablets at Ugarit consisted of roughly thirty signs, as do the earliest examples of the Canaanite graffiti on fifteenth-century shards found in the western Sinai that are universally recognized as central to the modern alphabet. That proto-Canaanite alphabetic script was thus simply one of several coexisting alphabetic and syllabic writing systems in use around 1200. Given the reduction that had already occurred in the number of signs used to write in cuneiform and Egyptian hieratic, it could hardly have dominated the older texts used in the main eastern civilizations. The ultimate success of the alphabet raises the possibility of random selection and path-dependence in script selection.

A. The passage of alphabetic writing to the West

The paucity of alphabetic texts from before 1200 and, except for a handful of doubtfully dated inscriptions, the absence of any writing from much before 700, clouds passage of the alphabet into the West. There are few facts. Classicists prefer a late date that privileges the Greek's genial addition of characters to express vowel sounds. Orientalists prefer an earlier one on archaeological grounds. The debate turns on an alphabetic inscription engraved on a sarcophagus found in a shaft grave at Byblos that held shards

[188] Scarcity of papyrus outside Egypt may also have played a part.
[189] A. R. Millard, "The Infancy of the Alphabet," *World Archaeology* 17 (1986): 390–98.

datable to the late thirteenth century.[190] The letters of the inscription closely resemble a Phoenician script that includes characters not found in the earliest Greek alphabets. Assuming the Greeks would not have "wasted" letters acquired from the Phoenicians given that they needed some extra ones for vowels, they must have gotten their initial alphabetic set from a different proto-Canaanite source before the sarcophagus was engraved.[191] The dating of the inscription, however, is doubtful. The morphology of the letters supports any date between the thirteenth and tenth centuries, and the shards used to date the tomb could well have been deposited by grave robbers. More importantly, it is hard to conceive what use could have been made of alphabetic, or for that matter, any writing in the centuries following the collapse that destroyed the social basis for writing in Anatolia, Crete, and Ugarit. The Canaanite writing system survived, but if, as Bernal argues, a proto- Canaanite alphabet had passed to the West before 1200, the script would have been restricted to commercial correspondence between Levantine merchants trading into Greece and possibly the central Mediterranean. When that trade collapsed after 1200, the lines of alphabetic transmission were cut for two centuries, effectively eliminating the need for writing. The most recent study dates the passage to between the eleventh century and the mid-ninth century, which is contemporaneous with the revival of Phoenician trade to Cyprus and the Greek islands.[192]

The larger issue surrounding the adoption of the Phoenician letters in the Iron Age West concerns path-dependence in the selection of coding systems subject to extensive network externalities, the economics of which is well understood. In the late Bronze Age, the trading networks that demanded documentary support were restricted to the Middle East and the Aegean. It is conceivable that the alphabetic cuneiform scripts utilized in Anatolia and at Ugarit might have passed to the West if the economic and political catastrophe of the early twelfth century had not destroyed them.[193] As to Egyptian hieratic writing, the closed nature of an economy situated well-inland from the coast and perhaps more important, a local shortage of timber suitable for ocean-going ships, caused its domain to be limited to its land of origin. When trade between the Aegean islands and the Levant revived after 1000 Phoenician, intermediaries were using the local alphabetic script that probably survived because it continued to be useful in local trade. Like the contemporary advent of iron, the advent of the alphabet occurred not because of the *ex ante* superiority of a new technology, but by chance elimination of its next-best alternatives.

[190] The question is reviewed from an Orientalist perspective in Martin Bernal, *Cadmean Letters* (Winona Lake, IN: Eisenbrauns, 1990), 15–31.

[191] Bernal, *Cadmean Letters*, 35–52 and *passim.*

[192] Roger D. Woodard, *Greek Writing from Knossos to Homer* (New York and Oxford: Oxford University Press, 1997).

[193] The Tartaria tablets provide a faint suggestion of such a transfer. Cf. note 168 above.

Did the alphabet make a difference for classical economic growth? Writing surely did. Egyptian and Syrian *papyri* reveal a complex system of credit, banking, and notarized transactions that go well back to the Hellenistic period.[194] The fiscal system of the later Roman Empire rested on an enormous bed of documentation that required tax bills to be made out in triplicate so that records of payment could be kept by both provincial and central administrations.[195] By the second century BC, writing was common in the administration of large agricultural estates. Cato explicitly advises landlords to order stewards to keep accounts in writing, and to "leave the directions in writing," which means that not only landlords, but the lowlier stewards knew how to read and write.[196] The Roman tradition that property transfers and other contracts involving the status of persons be recorded on notarized documents is of course inconceivable in the absence of widespread literacy among the possessing classes.[197]

The speed with which the Etruscans, Greeks, Iberians, and Romans took up the alphabet suggests that in the presence of latent demand for written communication, contact with a writing system caused an immediate explosion of new writing. The latent demand came from the growth of trade. Perhaps the most curious case is the Celts, who like the Teutonic peoples to the East acquired runic letters from the Etruscans, but adopted Greek as their literary lingua franca, just as European scholars in the later Middle Ages and the Renaissance adopted Latin as theirs.[198] At the major Celtic *oppidum* of Alésia, not only imported pottery was marked with Greek graffiti, but also media of purely local provenance.[199] According to Strabo, the Greek city of Marseilles was a major educational center for aspiring Celts "fond enough of the Greeks to write even their contracts in Greek."[200] The acceptance of a foreign script with its language extended even to governmental documents, where one would expect the native language to be employed. Caesar reports that his soldiers found Greek documents in the camp of the defeated Helvetians containing "a register of the names of all the emigrants capable of bearing arms, and also, under separate heads, the

[194] R. Bogaert, "Recherches sur la Banque en Egypt Gréco-Romaine," in Tony Hackens and Patrick Marchetti, ed., *Histoire Économique de l'Antiquité: Bilans et Contributions* (Louvain-la-Neuve: Institut Supérieur d'Archéologie et d'Histoire d'Art, 1987), 49–77.

[195] Jean Durliat, *Les Finances Publiques de Dioclétien aux Carolingiens* (Sigmaringen: Jan Thorbeck, 1990).

[196] Cato, *De Agricultura*, trans. W. D. Hooper (Cambridge, MA: Harvard University Press, 1934), 9.

[197] Fustel de Coulanges, *L'Alleu et le Domaine Rural* (Paris: Hachette, 1889).

[198] When Samuel Johnson visited Paris in the 1770s, he was so unsure of his French that he conversed with his fellow intellectuals in Latin. James Boswell, *Life of Johnson* (Oxford: Oxford University Press, 1980), 659– 60.

[199] Michel Maugin, *Un Quartier de Commerçants et d'Artisans d'Alésia. Contribution à l'Histoire de l'Habitat en Gaule* (Paris: l'Université de Dijon, 1981), 336–37.

[200] Cited in Christian Goudineau, "Marseilles, Rome and Gaul from the Third to the First Century B.C." in Peter Garnsey, Keith Hopkins, and C. R. Whittaker, *Trade in the Ancient Economy* (Berkeley and Los Angeles: University of California Press, 1983), 83. Marseilles remained Greek-speaking into the Merovingian period.

numbers of old men, women and children. The grand total was 368,000."[201] Such a census, which was unlikely to have been the first, testifies to the degree of literacy among a people commonly considered culturally backward. By 58 BC the Celts had been exposed to the writing of the Greeks for more than five centuries.

The potential extent of literacy among the non-elite is, however, suggested by the following passages taken from letters written around 1800 BC, 125 AD and sometime around 1000 AD. The first three are clay tablets inscribed at Ugarit.[202] The second set were found on wooden slips recovered from a Roman latrine at the fort of Vindolanda on Hadrian's Wall.[203]The last are private letters written between the eleventh and fourteenth centuries at Novogorod.[204]

> I gave instruction to you to obtain for me two sacks by buying them at the 'Gate of the Merchandise'.
>
> I had silver sent to you. Buy me fish of good quality and have them sent to me so that I have something to eat.
>
> I shall give five sheep and take barley [for them] … give me a mature he-goat and buy oil for PN.

*

> Chrautius to Veldeius his brother and mess-mate, very many greetings. And I ask you, brother Veldius—I am surprised that you have written nothing back to me for such a long time—whether you have heard anything from our elders ….
>
> Octavius to his brother Candidus, Greetings. The hundred pounds of sinew from Marinus—I will settle up. From the time you wrote me about this matter, he has not even mentioned it to me. I have several times written to you that I have bought about five thousand modii of ears of grain, on account of which I need cash. Unless you send me some cash, at least five hundred denarii, the result will be that I shall lose what I have laid out as a deposit, about three hundred denarii, and I will be embarrassed…. The hides of which you speak are at Cataractonium—write that they be given to me and the waggon about which you write…. I would already have collected them except that I did not care to injure the animals

[201] Julius Caesar, *The Conquest of Gaul*, trans. S. A. Handford (Westminster: Penguin Books, 1951), 55.

[202] J. Renger, "Patterns of Non-Institutional Trade and Non-Commercial Exchange in Ancient Mesopotamia," in A. Archi, ed., *Circulation of Goods in Non-Palatial Context in the Ancient Near East* (Roma: Edizioni dell'Ateneo, 1984), 101.

[203] Alan K. Bowman and J. David Thomas, "Two Texts from Vindolanda," *Britannia* 21 (1990): 36–52.

[204] Evis Levine, "Novogorod Birchbark Documents: The Evidence for Literacy in Medieval Russia," in Charles Redman, ed., *Medieval Archaeology* (Binghamton, NY: State University of New York Press, 1989), 127–38.

> while the roads are bad. See with Tertius about the 8 ½ denarii which he received from Fatalis. He has not credited them to my account.... I have received letters from Gleuco. Farewell.
>
> *
>
> Greetings from Peter to Marija. I mowed the meadow, and the Ozerci took my hay. Write a copy from the purchase document and send it here. When the document explains I'll be understood.
>
> Greetings to Juij and to Miksim from all the peasants. What sort of person did you give us as a steward? He does not defend us, he sells us out, he robs us. We have suffered from him; if he doesn't leave we will perish from him. If he remains here, we will not be forced to stay here, too. Give us a peaceful man. And we petition you about this.
>
> From Mikita to Ulijanica. Marry me. I want you and you want me.

By the end of the Pre-Christian era, the diffusion of writing was sufficient to support sustained and intense commercial relations throughout Western Europe and between Europe, North Africa and the Near East. Literacy was clearly not a sufficient condition for the first phase of Europe's economic integration, but it was most certainly a necessary one, the fruits of which can be seen in the enormous, and still poorly understood economic expansion of the first and second centuries AD. The contours of that growth are slowly coming to be recognized by historians and archaeologists. Its roots, however, lie in events taking place nearly a thousand years before.

V. Conclusion

In some circles it has become fashionable to attribute the "rise of the West" to medieval institutional developments securing greater protection of private property and decentralized forms of government. This conventional vision of the "European miracle" draws its deepest roots in speculations and conjectures by David Hume and Adam Smith concerning the beneficial effect of trade on civilization, and of civilization on trade, and more recently, in a polemical literature stirred up by the Bolshevik experiment, in operating an economy without markets and private property in nonhuman capital. Its core rests on the proposition that the secret to economic prosperity is institutions that make the most of necessarily dispersed private knowledge of economic opportunity. In overemphasizing the role of private economic incentives, however, the literature spawned by the catastrophic events of the first half of the twentieth century has deformed our understanding of economic progress. The totalitarian revolutions that created the "command economies" of the last century were, one hopes, *sui generis.* The long-term record of European growth suggests that the constraints on the division of labor were not so much institutional limits on the freedom of economic action, but the more mundane factors of supply price, communication, and transportation that determined the scope of economic integration. In that regard, the events of the first millennium BC were crucial to the subsequent flowering of the European economy. By its end, the basic elements of mixed husbandry were in place to provide agricultural support for extended specialization and urbanization. The means of transportation and the trade routes were much the same as they would be two millennia later. Iron was available for multifarious uses. Nearly everywhere, there were people who could read and write, and thus communicate with other people over long distance. None of these developments seems traceable to identifiable institutional change. Rather, they reflect the response to a sequence of opportunities by people living in societies that had long known, but perhaps incompletely exploited, markets and private property.

Economics, McGill University, Canada