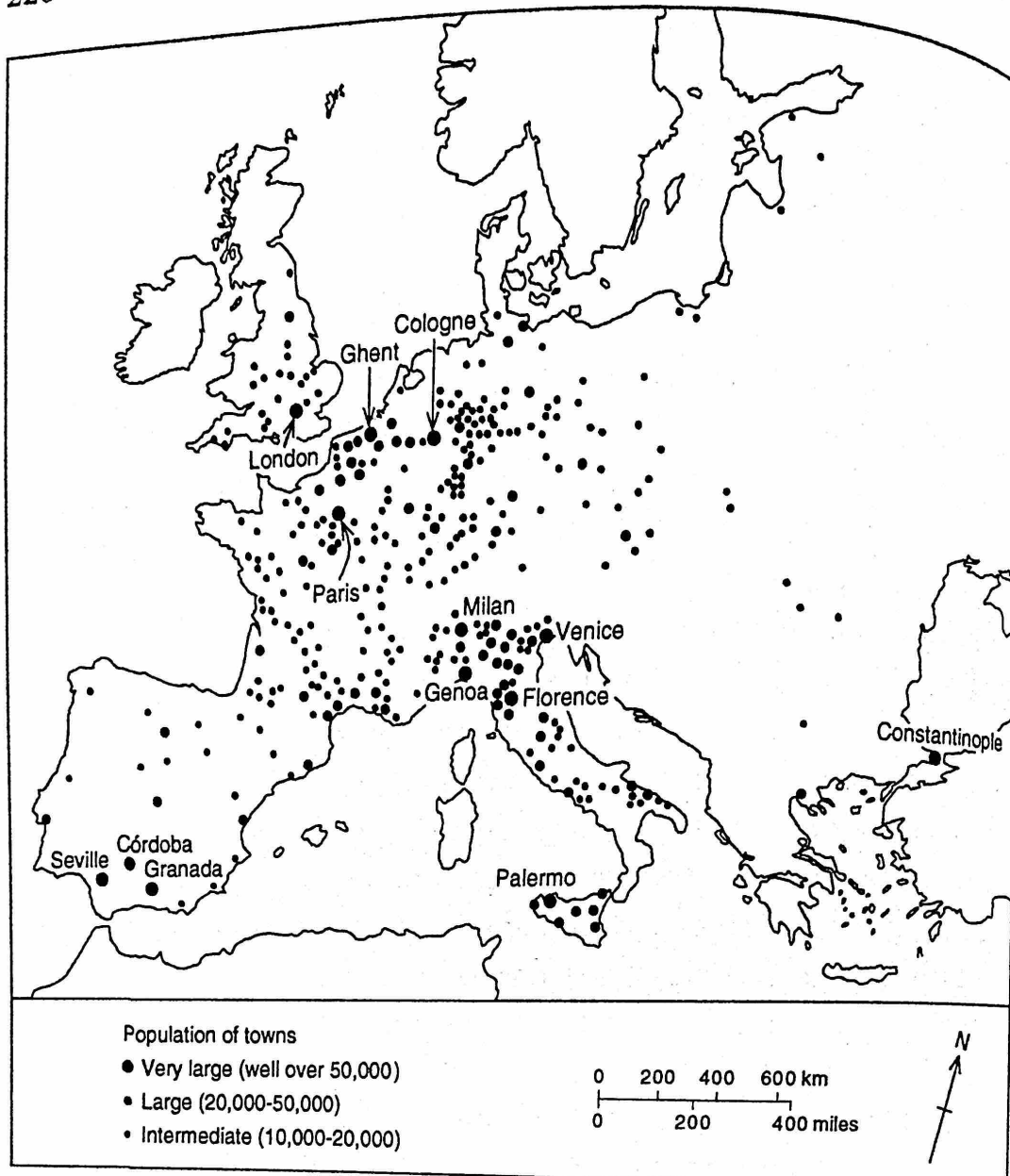


Also localized but widespread and ever more central to the expanding socio-cultural system of medieval European Christendom were cities and an increasingly integrated urban network. Urban ecologies formed special relationships between the cultural and natural spheres of medieval Europe.

An earlier chapter briefly mentioned the effects of classical urbanism. Now the remainder of this chapter takes an environmental view of medieval urbanization, which established features of a urban sector that continued through the early modern period. After the late antique depopulation and disappearance of many urban sites, city living in the west reached a nadir during the seventh and eight centuries, when a realistic viewer has difficulty finding genuine urban communities outside Rome, a few other relicts, and, of course, al-Andalus. In Carolingian times the only large cities on European soil were Byzantine Constantinople (population 500,000–800,000) and Muslim Córdoba (roughly 500,000 in the tenth century), Seville, and Valencia. A western revival began in creeping form in ninth-century Italy and was strong there by the end of the tenth century. By the years around 1000 and thereafter, urbanization had again become a culture-wide socio-economic phenomenon, however small its prevalent scale. These little towns, both resuscitated and new, tended to acquire internal self-government after their original economic evolution during the course of the eleventh to the thirteenth century, while Europeans everywhere undertook from the twelfth century into the early fourteenth a wave of new urban foundations. The result was that by around 1300 an urban network had become well established. Its basic shape would endure thereafter even into the industrial age and still underlies much of Europe's core urban network today. The medieval pattern featured intensive urbanization in northern Italy and a secondary dense zone in the Low Countries, with outliers extending to places like London, Paris, and Cologne, and elsewhere a sparser but widespread reticulation. In Spain the thirteenth-century Christian conquest shrank the big Andalusí centres as new inhabitants found places in a different European web.



Map 6.2 Europe's larger medieval cities, c. 1300

Map 6.2 indicates the distribution of the larger towns of Europe around 1300. Urban historians now believe that certain places then much surpassed what was formerly thought a high range of 35,000–50,000 inhabitants. Paris is now agreed to have had a population of 200,000; Florence, Milan, Venice, and London all approached the 100,000 mark, and another dozen or so cities pushed 50,000. The pattern of urban life then extended out and down a gradient to literally the hundreds of little towns with 2,000–5,000 people, spaced out all over the relatively developed parts of western Christendom.

Urbanization both created in medieval Europe a new kind of landscape with problems and possibilities for local environmental management and established metabolic patterns that affected environmental relations across much wider areas.

Medieval cities provided a new human environment (see frontispiece). Juridical boundaries and physical walls cut the city off from its immediate surroundings. Within was very largely a built environment full of people. Cities crowded humans and commensal organisms – those creatures that have successfully adapted to living close to human beings rather than trying to get away from them – densely together. This they did in physical surroundings that had been purposely modified for human social needs – late twelfth-century Braunschweig was erected on some two million tonnes of earthen fill put into low ground beside the river Oker – and at what was, in the perspective of Europe as a whole, an unprecedented scale. In the mid-thirteenth century, a recent estimate suggests, every human resident of Florence had some forty eight square metres as his or her share. Indeed so large a number is reached only by including the surface area of the Arno and its meadows, all the streets and piazzas, and everything else within the town walls. Florence at that time probably held about 80,000 inhabitants who were rapidly multiplying. Paris by 1300 housed more than twice as many in an area somewhat smaller than that of Florence, compressing the urban space of each to only sixteen square metres (a 4×4 metre unit). Seen another way, the population density of Florence was about 2,100 per square kilometre and of Paris about 6,200; the latter number is higher than present-day London, at 5,100 /per square kilometre the densest in western Europe. That few dwellings rose more than three storeys from the ground further constricted medieval urban living space.

Building practices and living habits replicated their vernacular rural origins. Wood, wattle-and-daub, and thatch construction, unpaved passageways, stored foods and raw materials of organic origin provided ample habitat for rats and mice, pigeons and sparrows, cockroaches, and certain exo- and endoparasites (liver fluke, tapeworms, lice, fleas), as well as the dogs, cats, chickens, pigs, and horses townsfolk intentionally kept nearby. The close proximity of people, households, and animals meant easy transfer of parasites between different households and hosts. The one mitigating factor was frequently recurring fire, which cleared things out for a time.

Further, the urban landscape was increasingly and then purposely impervious. Despite the sometimes significant intramural burial grounds, gardens, and even vineyards or meadows, towns were a terrain of beaten earth, of buildings, of increasingly paved squares, streets, and courtyards. Tenth-century Ulm was but a mercantile settlement beside a royal residence, but its two principal streets already

boasted a hard surface. A chronicler reports that Philip II of France (1180–1223) ordered streets in Paris to be paved to make them easier to clean and to reduce the stench of accumulated waste, but this affected only a handful of principal routes. While residents were supposed to pave and maintain the street before their doors, as late as the 1390s royal officials were trying to enforce this obligation on major lay and religious lords. Florence instituted a paving programme for major streets in 1237. In so far as such policies succeeded, rain or melt water, as well as any spilt liquids, either ran rapidly off or pooled on the surface, flooded, and so offered more habitat for additional kinds of creatures willing to live beside humans. The city was environmentally very different from a rural village.

Urban authorities, be they officers of a traditional lord or officials of self-governing communes, were well aware of the hazards of medieval urban life. They promoted planning, sanitation measures, and the exile of offensive or dangerous trades to downstream or extramural locations. So, for example, the thirteenth-century statutes of Ferrara banned preparation of flax or hemp, cleaning of fish, and dumping of tannery waste in the river Po. At Bologna communal legislation forbade urinating in public and required butchers to take their waste to designated dump sites outside town. Municipal authorities in Coventry obliged each householder to clean the street in front of his or her place each Saturday under pain of a fine and, as in York and Norwich, provided city-run weekly rubbish removal services. Right-bank Paris, where the greater portion of the population lived, was ringed by a circumferential sewer canal that came off the Seine above town, went around the city, and returned below to the river with its load. This existed by some time in the 1200s, was covered over from the 1370s, and maintained by civic officials. Financial records of sewer maintenance operations remain in the Paris municipal archives starting from about the 1420s. On the left bank the little river Bièvre, named for long-extirpated beavers, was canalized in the thirteenth century and became an open sewer. Municipal funds designated to clean and restore it were diverted in 1390 to repair bridges and royal officials instructed to prosecute riparian residents for damage or neglect. But by the end of the Middle Ages its course was clogged with mills, tanneries, and dye-works. Buried not long thereafter, the Bièvre has lately become the object of campaigns to restore urban streams to the light of day, so undoing on modern cultural grounds medieval efforts to reduce risk.

The aim of this urban environmental management, as it would now be labelled, was improving the quality of life for citizens, not environmental protection. City governments were among the first in Europe to take on these problems. But still, the paved streets and the fire-resistant stone, brick, and tile construction came first to the prestigious commercial, administrative, and residential quarters in the city centre. The best part of town, as the centre was in all pre-industrial cities, remained remorselessly more salubrious than were labourers' dwellings crammed beneath the walls or clustered around the city gates.

Nevertheless, and not just from general cultural ignorance about how some diseases spread, medieval cities always suffered distinctly higher death rates than did the countryside. Infant and child mortality was always high in these societies, but in cities the rate was twice that of the countryside. Cities were death traps for little people. While established mercantile and craft families could last through generations, a very large floating population of impoverished newcomers – rural-urban migration is typical of pre-modern urbanism – turned over rapidly. Cities soaked up rural reproductive surplus because of their high mortality rates. This, too, was part of the environmental reality of medieval urban life.

Cities are unusual ecosystems because, unlike most others, urban ecosystems cannot maintain or replace themselves. City ecosystems are formed and maintained by cultural inputs, really in one sense by inputs of information. Much as rural decisions made woodlands into fields, urban cultural ferment generated programmes, which generated work, in this case the construction and maintenance of the city itself. Cities are not colonized ecosystems, either, but rather wholly artificial ones. Urbanization was not a transformation of nature, but creation of an entire second nature. Natural processes certainly go on in every city, but many of those processes were not in that place, did not exist, until the city was created.

Most city people were engaged in non-agricultural activities. Hence in metabolic terms they were not 'producers' and had continually to exchange materials and energy with a differentiated hinterland outside the city's boundaries (physical or conceptual). In 1287 Austrian monk Engelbert of Admont precociously estimated that four agricultural producers were needed to support one non-productive individual. Every city exists by exchange with what is outside the city. Cities cannot be without a more extensive ecological footprint because cities do not themselves produce what is required to maintain

the life of the organisms within them. In consequence urban centres call for analysis in metabolic terms, examining the flows of energy and materials into a pre-industrial city, staying behind in the city as a sink, and flowing out of such a city, here, concretely, the cities of medieval Europe. From a spatial perspective this approach resembles the urban market supply regions famously conceived as concentric rings by nineteenth-century economist Johan Heinrich von Thünen (1783–1850), but augments that theory to recognize the non-contiguous quality of some inflows, the importance of urban effluents, and the environmental impact of all these movements.

Into every medieval European city flowed foodstuffs (cereals, meats), water, fuel, building supplies (wood, stone), raw materials (fibres, skins), and human beings with their all too material bodies. Cities do not engage in primary production, so they must import energy. The very nature of the urban ecology means cities are dominated by consumer organisms and consumer activities.

Londoners around 1300 consumed between 34,000 and 35,000 tonnes of grain each year. They used it for food, for drink (ale), and for animal feed. Those quantities of cereal took the output of 10–15 per cent of the arable land in a zone that extended some 250 kilometres along the Thames and its estuary, reaching from just short of Oxford down to places fronting on the North Sea, all accessible by water transport. The grain literally floated into the city. The supply zone reached barely 30 kilometres away from navigable waters.

Concentrated medieval urban demand for heat energy organized and sustained intense coppice wood management on thousands of hectares close to London and close to Paris. Wood fuel was produced as near to the city as people could devise or cheap water transport provide. For Paris, woodlands as much as 100 kilometres up and down the Seine were needed to feed wood into the city. The Danube bore fuel wood and timber for fifteenth-century Vienna from as far upstream as the Isar in Bavaria. Urban demand for energy also drove the first commercial application of fossil fuel, the coal coming down from Newcastle. So, too, were generations of Flemish and Brabantine townsfolk the principal consumers of the dried peat being mined from deposits anywhere between 20 and 100 kilometres distant in north Flanders, north Brabant, and Holland.

Water delivered grain, fuel, and building materials to towns and was itself a critical metabolic input. Water supply for urban sites is a matter of quantity and quality. In a world without the germ theory,

culturally defined understandings of water quality had to do with smell, clarity, and the nature of the source. Most sites in the urban network of medieval Europe were located on rivers and streams, so townspeople began simply exploiting natural local supply, dipping surface water the same way as in a village. Urban growth outstripped or degraded natural local supplies. The response to that shortage depended on local conditions and the kinds of sources that could be acquired. Towns in some areas turned to a technology that had originated in monastic water systems, piping water in from springs or upstream diversions. Others used extensive rain-water cisterns, which had both monastic and castle forerunners. Medieval fortifications were sometimes built right on the water and others high up a waterless crag. Castle designers had to consider how deep a well could successfully be dug or else arrange runoff from every hard surface in the castle to flow into a storage tank.

Towns thus had models from which to adopt piping or cisterns. Paris brought its water down from the springs of Belleville, seven to eight kilometres northeast of the city, first through a stone conduit, then out through lead and ceramic pipes to domestic and institutional consumers. Italian towns repaired old aqueducts and built new ones. Spoleto was repairing its aqueduct in 1122; Salerno, Perugia, and Genoa all constructed new aqueducts from nearby mountains in the thirteenth century. The Sienese exploited the peculiar geology of their hill to excavate seepage tunnels beneath the city itself where the water gathered to flow to pools and fountains. More widely applicable was the innovative water-powered pumping system installed at Lübeck in the 1290s to bring water from the upper river Trave to the town's breweries. Such elaborate infrastructures were rare in England. It is next to impossible to find a serious urban water supply system there, even in London. Such systems were mainly private, which is to say they served the wealthy and powerful while most ordinary households obtained their water from wells tapping into ground water under the city or relied on water that professional water carriers brought in from the Seine, Thames, Rhine, Pegnitz, or a fair distance up the Tiber. (Even in classical times no one voluntarily swam in, much less drank from, the Tiber at Rome.) These arrangements for water supply help explain why medieval and early modern urban populations everywhere failed to reproduce themselves, so that rural-urban migration was a constant feature even though most newcomers soon died.

Some metabolic inflows came to rest in towns. Cities are a sink, a place where materials settle and energy is released into entropy. Medieval towns were sinks for wood and stone, as for cultural and biological wastes. Matter accumulates in cities. Medieval culture reused and recycled a wide variety of materials just as it did symbolic elements. Clothing was passed down from owner to owner until what once graced a prince had become mere rags wrapping a beggar. Bone was made into a wide variety of small utensils and tools, spoons, needles, and the like. Urine was recycled as a fixing agent for the dyeing of cloth: a bucket outside a dyer's shop invited passers-by to contribute. Built structures decayed, were refurbished, or pulled down and a new one erected on the rubble, often reusing the old materials. Bricks from a major Roman frontier post on the Danube, Ratispona, served to build elite family tower houses in twelfth-century Regensburg. Most undisturbed medieval urban sites have a richly organic black layer, as archaeologists call it, a gradually accumulated stratum of all the organic stuff and effluvia that blew, washed, or was kicked around the town until it settled between the stones or in a little-used corner. Carefully sieved, these now yield tiny but ecologically informative objects like seeds, small beads, beetles, or fragments of bird bones. As buildings were torn down, the ground surface rose. The place Vikings called *Yorvik* ended up to two to three metres below the surface of its successor, later medieval and modern-day York.

Medieval cities, unlike their Roman predecessors, were also sinks for human bodies. Romans had required that human corpses be removed from town. That is why all great early Christian sites lie outside the walls of classical Rome in places like the catacombs or St Peter's. Medieval cemeteries, however, were in town because early medieval Christians wanted to be buried as close as possible to the relics of saints, holy people whose remains were kept in or near an altar. As towns grew up around a cathedral church or another with many revered bodies, people tried to await eternity in that company. Space within the church was limited, so reserved for the most influential, but close beside the church up against the wall bodies were buried, reburied, and accumulated, and bones began to surface. To make room for newcomers, other skeletons were intentionally excavated, removed, and stored in charnel houses that lined the interior walls of the cemetery or the exterior walls of the church, or they were placed in a crypt below the building. This accumulation, too, raised the soil surface. The elevated level of old urban cemeteries is famous everywhere in Europe and in fact the rest

of the ground of the city rose as well. Almost any old city is several metres higher than it once was. Part of the contribution is the insoluble remains of the human bodies gathered there.

Further materials stayed in latrines, cesspits, and middens. The average adult human produces roughly 150 g of faecal matter and 1.5 litres of urine daily. For a small but significant medieval town of 5,000 inhabitants that was 250 tonnes of solids and 2,500 tonnes of liquids annually. Florence generated twenty times that, 5,000 tonnes of solid human waste (omitting that of animals as too difficult to estimate), and this piled up. It is not surprising that a stranded side-channel of the river Seine at Troyes, key mercantile centre in Champagne, blocked by construction at both ends but still full of liquid, was in a formal charter of 1208 called *merderon* ('shit hole'). Then there were complaints of pollution in the thirteenth century onwards, with Londoners grumbling about coal smoke and fourteenth-century Paris colleges moaning that the offal dumped by butchers on the Rue Sainte-Geneviève befouled the street and the air. So in many ways a medieval city was a metabolic sink.

Outflows from medieval cities included re-exports and value-added manufactured goods, probably more biomaterials (woollen cloth, leather, wood) than metals. Equally out of medieval cities, as out of modern ones, flowed large quantities of waste. Widespread practice intentionally directed effluents out of the city into the surroundings, especially down any available watercourse. In Rouen latrines were typically placed directly over streams that flowed out of town. In Cologne, the biggest city in medieval Germany, cesspits had to be emptied into the Rhine through the lower gate after dark. Landlocked pits in Nuremberg were periodically dug out by members of a special guild, called the Pappenheimer or Nachtmeister, and the contents carted by night to the river Pegnitz. In one well-documented case a cesspit that had not been cleared in seventeen years took three and a half nights' work and filled 108 cartloads that were dumped into the river. The Milanese had perhaps a better idea when they occasionally diverted two Po tributaries that ran through town out into the city streets themselves and simply flushed everything away. London barged its solid waste down to tidal reaches of the Thames and let the churning currents slosh it out into the North Sea. Market gardeners and vineyard operators in the vicinity of Ghent, Paris, Florence, and Wrocław eagerly bought urban 'night soil' for use as fertilizer to keep up intensive horticultural production.

Written texts describe the export of urban waste and some fortuitous archaeological evidence confirms the practice. Excavations along the shore of the Bodensee (Lake Constance) beside the town of Konstanz have shown a slow change from the 1200s onwards in the vegetation of the shallows. Clear water organisms gave way to those adapted to eutrophic conditions which had resulted from nutrient-rich pollution. Study of sediments of late medieval date from the Pegnitz below the then walls of Nuremberg reveals all sorts of household and craft waste.

So at each medieval city, with particulars determined by local needs and opportunities, materials and energy flowed in, some stayed, and some flowed on out. Metabolic exchanges are visibly typical of medieval urban communities interacting with their natural surroundings.

As a result, each city's primarily market-oriented economy established its own extensive 'ecological footprint'. Some environmental effects of medieval urbanization recognizably anticipate those of present-day globalization, as well as echoing earlier Romanization. Medieval cities not only changed themselves, they imposed change on outside, sometimes even distant, natural and colonized ecosystems. Urban growth itself could provoke abandonment of nearby villas: forty-one of forty-two places immediately south of Paderborn were emptied in the fourteenth century and three of five beside Rottenburg am Neckar. The combination of transport costs and regionally different natural endowments meant that the material effects could occur in rings around the city or be discontinuous if the city drew from or sent its effluents to far-away places. Characteristically, bulk or perishable goods came from very close to the city as earlier remarked of the grain and wood consumed in London and Paris. Compared with London, the Flemish towns collectively consumed five times the amount of cereals, drawing most of this supply as surplus production from neighboring Artois, Picardy, and Hainault, where they competed with buyers for the Paris market. But with the 1200s they began also pulling grain by tens, then hundreds, of tonnes from the central Elbe. Land there had been cleared and ploughed up for arable in the course of the twelfth and early thirteenth century and its peasant tenants paid their rents in cereal grains. What the local lords thus accumulated was bought up by merchants, shipped down the Elbe to Hamburg, and then by sea to the Flemish consumers. When, however, Flemish urban populations fell after 1350, that trade ceased and much arable in western Brandenburg was simply abandoned. Loss of the distant

market allowed cereal production to collapse and secondary woodland to grow.

Florence drew 10,000 tonnes of grain annually from Sicily and Apulia. In the view of some modern scholars, this market demand from Florence and other large northern Italian cities was the principal force driving, in Sicily especially, creation of large landed estates which used higher labour inputs from small sharecropping farms to produce large quantities of marketable grain that was then shipped to consumers in Rome, Florence, and elsewhere. The demand for food by Dante and his fellows in an urban aesthetic and political elite thus changed the colonized ecosystems of southern Italian peasants.

Flemish urban demand for peat likewise destroyed agricultural use of marshes and boggy landscapes fifty to a hundred kilometres away, turning them into sandy heaths or open-water lakes. Anthropogenic small lakes remain still as distinctive landscape features and ecosystems in the peat lands of north Flanders, north Brabant, and south Holland, all formed by the mining of peat to fuel the stoves of Ghentish weavers or merchants in Bruges. Medieval urbanization created significant pressure on the ecosystem in a set of widening rings or sometimes discontinuous sites of disturbance shaped by particular local metabolic relationships.

ASSESSING HISTORIC SUSTAINABILITY

In retrospect, does the evident environmental impact of medieval urban living, the inorganic economy, and energy extraction, speak of medieval failure to maintain sustainability? Did medieval society push beyond ecological limits and bring about its own collapse in a 'dismal fourteenth century'? Remember first that throughout the Middle Ages the urban sector (people, landscapes, material and energy flow) remained a small fraction of the material life of a predominantly rural society. The interactions that medieval people had with their inorganic and non-living environment were but a fraction of those they had with their living or once-living surroundings. Hence any assessment of the overall relationship of medieval civilization with its natural world must always acknowledge this as a predominantly agrarian society which had colonized the biosphere to tap the solar energy flow. This is the only standpoint from which to consider sustainability against overexploitation and endogenous anthropogenic collapse.

That medieval Europeans *changed* their natural world, even permanently, has been amply shown. The question now is whether their

impacts brought about a breakdown of their own ecosystem. The difficulty is to assess or diagnose conditions, stresses, and trends in historical time where actual outcomes may remain ambiguous and caught up in other independent causal chains. Sustainability always applies within some bounding framework. The long-term continuity of a rate of coppice production becomes moot were a smelter's ore body flooded out or the wood itself cleared for arable. So, too, centuries-long maintenance of certain cereal yields to support a peasant household ceased to matter when the lord's or king's takings were abruptly increased. Some plausibly stable context is a likely precondition for helpful application of the sustainability concept.

On the side of primary production (the organic economy), medieval uses of local ecosystems were fundamental to the survival of individuals, families, and whole societies. Their adaptative colonizations of the natural world kept them alive, functioning, and reproducing for many human lifetimes while imposing demonstrable impacts on their environments. In that sense the initiation of certain uses and impacts plainly did allow future generations to continue living from those same ecosystems. At the opposite extreme, practices which visibly diminished productive resources are also clear: imagine mining soil nutrients, losing soil to erosion, and depleting, even extirpating, certain wildlife species. Yet historic situations were rarely so simple. What of subsidizing a 'home' ecosystem by extracting from another, such as fertilizing arable land with leaf mould from woodland or turves from pasture? Certainly some well-known medieval practices were intended to limit or mitigate rates of exploitation and to restore productivity for continued use. Carefully managed rotational cycles in arable, in coppice, or even in fish ponds demonstrably continued for centuries so long as the producing and supervising human unit remained in place. Who can show an inevitable loss of social viability for a western Europe lacking pine marten or sturgeon? Change, even change to be mourned from a biodiversity or conviviality standpoint, is not ecosystem collapse. A damaged ecosystem is no longer pristine but may not have lost its resilience.

The energy sector importantly linked primary organic (solar-based) production to medieval use of non-living and anthropogenic resource systems. Emergent local shortages of wood fuel are indisputable and so, too, are subsequent rationing or limits on its use, but also intensified production methods (coppice), efforts to reduce transport costs to draw on hitherto untouched reserves, and strong regional turns to mineral

substitutes (peat, coal). But when human numbers and demand receded, medieval consumers largely abandoned the substitutes and wood fuel again sufficed. Increasing use of wind and water power drew on temporally limited but, as today recognized, fully renewable energy. Through and past the Middle Ages, future generations were again or still able to continue living from the same European ecosystem.

Inorganic materials had less quantitative significance for medieval society, although their use was always essential and gained importance owing to technological changes on both the production and demand sides. No use of stock resources such as minerals is ever infinitely sustainable; at issue is rather the depletion rate. Local exhaustion of stocks and wider environmental damage from destructive emissions have been shown for the Middle Ages. The formation, growth, and spread of the urban sector intensified many environmental pressures, but also efforts of urban authorities to manage these. Some of that management, however, simply transferred effluents to other, previously less stressed, ecosystems.

In sum, then, ought these relationships of medieval societies to their natural world be understood as unsustainable, as themselves leading to destructive overexploitation and collapse? Historians of a Malthusian bent have for some time argued for such an endogenous crisis of the European economy. As previously discussed, Michael Postan asserted that unsustainable rates of exploitation in the English agricultural sector brought declining yields by the late 1200s; Tom Williamson has labelled the Midlands system an 'environmental disaster' for being too rigid, too complex in its interlocking features, to adapt either to its own consequences or to broader social or natural changes. Donald Hughes has treated medieval Florence under the rubric of 'barriers to growth' and 'overshoot'. Sheep pastures for wool production and arable for cereals, both serving the urban economy, said he, reduced woodland to the point of general wood shortage and grassland to that of erosion. Long use of arable meant inevitable fertility decline. Commercial demand for silver outstripped medieval technical capacity to maintain output levels of mining. As overambitious princes defaulted on their debts to the city's bankers, a crash was inevitable. For those who see human material economies as embedded in larger ecosystems, it is an intellectually and ideologically inviting proposition that medieval Europeans pushed too far all of their relationships with the natural world, sent it over some kind of threshold, and left themselves suddenly vulnerable to ecosystem collapse.

As most historians know well and as will be rehearsed in detail below, the years around and following 1300 do offer clear signs of impoverishment, production failures, immiseration, and food and other resource shortages in many parts of Europe. At mid-century followed a great depopulation (from epidemic mortalities), abandonment of farmland, and regional episodes of soil erosion. Are these to be attributed to the failure of medieval European society to apply knowledge and develop appropriate technologies to sustain a stable relationship with the natural world? Did people make the wrong decisions? At the operational level, did they misunderstand their environment and their interaction with it?

There emerges a need to explore how medieval Europeans made decisions on their use of natural resources and responded to the effects of those uses. In terms of the heuristic interaction model, who and what established the programme, determined work, and eventually revised those efforts in view of new experiences? The next chapter sets out where medieval society vested the authority and power to make resource management decisions and the consequences of different actors doing so.