How influential were technological innovations on the spatial layout of ancient Roman and medieval cities?

(All page references are from Chant & Goodman, 1999, unless otherwise stated)

This question is very wide reaching, referring to a historical span of one and half millennia and covering a huge geographical area. This essay will examine the issues in broad terms. After identifying some general features of Roman and medieval European and Arabic spatial layouts, it will consider the impact of technological innovation, in terms of general themes - military technology, building materials, transport, building techniques.

The stereotypical Roman city was spacious although enclosed by walls, with a partially planned layout reflecting a grid system. Main streets and roads were well paved and wide. The most distinctive features of the cities were monumental public areas or edifices (for water supply, entertainment, commerce, government.) The less wealthy lived in more chaotically laid out areas characterised by relatively high-rise apartment buildings (*insulae*).

In contrast, the medieval city was typically a “densely congested network of narrow winding streets, lined with high house fronts, a pattern relieved only occasionally by open squares and marketplaces.” (Friedrichs, in Chant, p147) It was enclosed by a heavily fortified wall, with guarded gates and defended towers. Dominant non-military public buildings were usually religious. The stereotypical Arabic medieval cities exhibited a distinctively labyrinthine layout.

Military technology was a dominant force in shaping cities in both Roman and medieval periods. A Roman military innovation was the organization of the army into an institution that served as a mobile building force. The army needed defensive fortification and a street pattern that would allowing swift troop movement but impede invaders. When soldiers settled in colonized territories they used their surveying and construction skills to build towns. For example, army surveyors laid out Tigris, North Africa, on military camp lines (p88).

Medieval cities were even more dominated by military needs. Castles, gates and fortified city walls are the notable secular medieval buildings. Fortifications altered to address innovations in tactics, weapons and siege techniques. The form of walls and castles was shaped directly by military technology. Stone city walls limited outward urban expansion, hence the tendency for buildings to be closely crowded together and to be built high.

The Roman invention of *pozzolana* concrete, in combination with brick and mortar, let the Romans build quickly in stages and create new forms. Concrete was combined with other materials to build the Aurelianic walls, in place of the weak tufa used in earlier fortifications. These walls were strong and thick enough to withstand current siege weapons and carry a long vaulted gallery. Strong walls protecting expanded urban territory could be constructed more easily than in stone, so Roman cities were not as spatially constrained as ancient Greek and medieval cities.

Concrete and brick were combined in the construction of *insulae,* which housed much of Rome’s population. Where land was in short supply, concrete’s properties allowed high (up to 5 storey) buildings to be built quickly

and economically, helping to sustain the Roman population expansion. It also allowed the building of monuments and structures, such as the Pantheon and the Flavian Amphitheatre, which shaped the visible landscape. *Pozzolana* concrete's ability to set under water, combined with the innovative Roman arch design, allowed the building of bridges, aqueducts and viaducts which allowed Roman cities to span water courses and enabled population growth by providing amenities.

European medieval building relied largely on natural materials – wood and stone, from their hinterlands.. In the Arabic world, brick construction was more common. Lime-mortar and wall reinforcement through the use of sandstone columns allowed Islamic cities to expand when mud-bricks did not allow buildings above a single storey (p137). These materials allowed the construction of complexes of up to six-storey buildings grouped round a courtyard, which shaped the structure of the seventh century Egyptian capital, Fustad.

In both Islamic and Christian medieval cities, large religious buildings became the main focus of public life. The manufacture and use of scientific instruments was crucial to the siting of mosques, allowing their orientation towards Mecca (p134). In medieval Europe, mathematical and engineering developments allowed the construction of Cathedrals on an unprecedented scale, involving forms based on the Roman Basilica but adapted to hold larger numbers. The European medieval Cathedral put new building design technologies to work. For example, the flying buttress allowed stresses to be transferred away from the walls of a building. Together with technologies such as the pointed arch, this allowed the construction of very tall cathedrals that dominated the visible space of medieval towns.

The Romans solved the problems of access to fresh water and sewage removal through a combination of pre-existing (largely Greek and Etruscan) technologies and their own techniques and materials and water distribution systems helped shape Rome. Although Roman systems fell into disuse in most of medieval Europe, water supply was crucial in the Arabic cities, most of which were situated in arid regions and depended on complex canal networks. Islamic engineers developed hydraulic technology (including water wheels, aqueducts and large dams) often relying on Roman techniques, customised to meet current needs. For example, huge water wheels irrigated crops in the urban hinterland, helping to sustain large urban populations; public baths were developed in ways that made best use of limited water. Where there were urban tenements, Arabic engineers developed a complex sanitation system involving flues on each floor that carried waste through underfloor channels to cess-pits (p137). Although inferior to Roman solutions, this system permitted a city form with high dwellings.

The use of animals for transport, agriculture and construction was a medieval innovation that took different forms in Europe and the Arabic world. Bulliet saw the “chaotic” layout of the Arabic medieval cities as resulting from the use of camels. Unlike wheeled vehicles, camel transport did not need wide streets. This allowed human, rather than transport, needs to determine city layouts. A camel’s carrying capacity also limited the use of stone and fostered brick-based architecture (Bulliet, discussed in p131-133). There are problems with this argument, including its technological determinism and the fact that it cannot explain the relatively chaotic growth of non-Islamic cities where wheeled transport was used. (In any case, the view of Arabic city

layouts as chaotic has been challenged by evidence of planned layouts in Iraq and the Lebanon (p132)).

In medieval Europe, the horse replaced the ox in transport and agriculture. The impact was less marked in shaping the city layout, although European cities needed some streets wide enough to accommodate wheeled vehicles. Horses contributed to a “revolution” in agriculture that provided a surplus allowing urban living (White, in Chant, pp99-103). Referring to a specific project in Renaissance Rome, Fontana saw the use of horses as the only innovation in building technology since ancient times (Fontana, in Chant, pp182-83).

In conclusion, several factors, including technological innovation, influenced the spatial layouts of Roman and medieval cities. Each of these technological innovations must be considered in the social context in which they were created and to which they contributed. The very formal layout of Roman cities, for example, came about at a time of very strong central government and strong military dominance. The need to move troops, messengers and goods was important to the city designers and mechanisms existed by which the power structure could impose these needs on city layout. Roman culture imposed a degree of universality of philosophy, language, government forms and city design throughout the empire. Public space was valued and construction of public works (such as roads or aqueducts) and buildings for use or entertainment (such as the Flavian Amphitheatre) brought prestige to the ruler.

In contrast, medieval cities evolved at a time of constant social upheaval, with weak central states. The commanding secular structures were dominated by the needs of defence. Religious structures became the foci of social life and came to form dominating structures in the layout of cities, forming the focal points of urban centres, and visibly dominating the city layouts.

These structures expressed the values of feudal medieval cities and cannot be explained only in terms of the technologies that created them, although the social relations of medieval life shaped and were dynamically shaped by the available technologies.

City size was also controlled by this combination of influences although here technology seems largely determinant. The need for access to fresh water and sanitation limited the distance a city could expand away from a river. As better methods of moving clean water and sewage were developed, cities could increase in size – something the Romans truly mastered, through the innovative use of materials, engineering and construction skills and forms of labour organisation.

Among several valid non-technological explanations for the different layouts of classical and medieval cities (values, class relations, some writers have focussed on the weakness of state structures and increasing evaluation of the private sphere in medieval societies, expressed in Islamic legal codes (Kennedy, in Chant, p97) and in an increase in European property holders’ rights (Freidrichs, in Chant, p146). Where individual needs could override city plans chaotic use of space was more likely.

Bibliography

Alsford, Steven, "Florilegium Urbanum", http://www.trytel.com/~tristan/towns/florilegium/flor00.html [27 April 2003; consulted on 26 June 2004]

“Armenian Architechture - Virtual ANI", http://www.virtualani.freeserve.co.uk/ [consulted on 26 June 2004]

Atkins, Harry R., "The Medieval City of Gondar, Ethiopia", (Excerpted from "ETHIOPIA-LAND OF ENCHANTMENT") http://www.geocities.com/janicedennie/castle.html [consulted 26 Jun 2004]

“Battle of Adrianople (378)", http://en.wikipedia.org/wiki/Battle_of_Adrianople_%28378%29 [3 Jun 2004; consulted on 26 Jun 2004]

Chant, C (ed) (1999) *The Pre-industrial Cities and Technology Reader,* London, Routledge, in association with The Open University.

Chant, C. and Goodman, D. (eds) (1999) *Pre-industrial Cities and Technology,* London, Routledge, in association with The Open University.

Creighton, Oliver, "Castles, lordship and settlement in Norman England and Wales: O.H. Creighton examines the many and varied reasons behind the siting of Norman castles, and considers their decisive effect on the cultural landscape of Britain", http://articles.findarticles.com/p/articles/mi_m1373/is_4_53/ai_99746719 [April 2003; consulted on 26 June 2004]

Davis, Michael T., "Design of Medieval Churches", http://www.mtholyoke.edu/courses/rschwart/mac/churches/article/index.shtml [8 Aug 1999; consulted on 26 Jun 2004]

Dawson, David, "The English Medieval Castle", http://www.britannia.com/history/david1.html [1999; consulted on 27 June 2004].

Dowling, Mike, "The Electronic Passport to Roman Technology," http://www.mrdowling.com/702-technology.html [1 May 2002; consulted on 26 June 2004]

Dyer, Christopher, "How urban was medieval England", http://articles.findarticles.com/p/articles/mi_m1373/is_n1_v47/ai_19032747 [January 1997; consulted on June 2003]

Holmes, Richard, "Life In a Castle", http://www.pbs.org/wgbh/nova/lostempires/trebuchet/castle.html [November 2000; consulted on 26 Jun 2004]

“Medieval Transport", http://brickfields.org.uk/index.php/medieval/transport [consulted on 26 June 2004]

Miller, J., "Rome - Chronology", http://www.jmiller.demon.co.uk/chronology.htm [consulted on 26 June 2004].

Nelson, Lynn, H., "The Development of Towns", http://www.the-orb.net/textbooks/nelson/towns.html [1999; consulted on 26 June 2004]

Rinne, Katherine Wentworth (ed.) "Aquae Urbis Romae : the waters of rome", http://jefferson.village.virginia.edu/waters/ [10 January 2003; consulted on 26 June 2004].

Rymer, Eric (ed) "Roman Cities", http://www.historylink101.com/lessons/farm-city/roman-city.htm [2004; consulted on 27 June 2004]

Rymer, Eric, "Middle Ages by History Link 101", http://www.historylink101.com/midieval.htm [2004; consulted on 26 June 2004]

“Sieges", http://www.hyw.com/books/history/Sieges.htm [consulted on 26 June 2004]

Talarico, Kathryn, "The Medieval Technology Pages", http://scholar.chem.nyu.edu/tekpages/texts/eneas.html [8 Oct 2002; consulted on 26 Jun 2004]

“The Anglo-Saxon Chronicle", http://sunsite.berkeley.edu/OMACL/Anglo/ [9 November 1996; consulted on 26 June 2004].

“The Battle of Adrianople", http://www.roman-empire.net/army/adrianople.html [consulted 26 Jun 2004]

Young, Penny, "Deir Mar Musa - ancient monastery", http://articles.findarticles.com/p/articles/mi_m1373/is_7_51/ai_76402645 [July 2001; consulted on 27 June 2004]