DIGITAL CLASSICS ONLINE

Commentary

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Abstract: In conclusion to the thematic issue of the Digital Classics Online – "Simulation of Trade and Traffic in Antiquity", this paper gives a comment in English, which summarizes the main statements of the contributions and embeds them in a wider context.

In context of the corona crisis, we are currently experiencing, that the simulation of outbreak scenarios of the disease immediately entered the public consciousness and accompanies us daily in the news, as well as in virologist podcasts and similar formats. With model calculations, as recently done by the Max Planck Institute for Dynamics and Self-Organisation in Göttingen, different strategies for overcoming the epidemic can be outlined.[1] Such scientific simulations based on experimental or empirically collected data are the basis for political decisions and assessments with a direct impact on all our lives. There is no doubt that simulations and resulting models are scientific applications to simulate nature if they are based on transparent and carefully collected empirical, experimental, calculated values. In short, it is, as Leif Scheuermann points out above, a scientific method that is used to analyse current phenomena or to produce forecasts. Using digital technologies, this method has become increasingly accurate, and, above all, easier to apply.

If, however, complex historical contexts, such as entangled history, are to be adequately analysed with digital instruments, this can only be achieved by mobilising digital techniques of data analysis and presentation already in research process, which themselves require "entanglement". In the future, this will be possible through completely new ways of working, combining a wide variety of applications, including those from the natural sciences, which in turn requires precise documentation. This will primarily involve new ways of hypotheses development, shifting perspectives through the genesis of explorative spaces, visualization of complex temporal and geographical spaces through simulations that cannot be implemented to the same extent purely textually, syntactic manipulation as a possibility for model formation, the manipulability of visualizations, the combination of different tools, and the handling of heterogeneous fuzzy, non-standardized data.

The question, which Scheuermann also poses in his introductory contribution, is whether and how a scientific model can be applied to the hermeneutically working humanities, which are focused on reading, understanding and interpreting texts, and even more in relation to the historical sciences, which are concerned with the analysis of past events. Here, one quickly thinks of reconstructions and the 3D models that are becoming more and more common in architectural history and archaeology, which attempt to virtually complete and develop buildings and even entire townscapes on the basis of existing material remains and documentation of all kinds, using the method of simulation. However, it has to be critically noted that these reconstructions often have a suggestive character and often do not correspond

1 https://www.ds.mpg.de/3572228/news_publication_14773011_transferred?c=148849 (last access 23-05-2020).

to scientific standards.[2] Such reconstructions carry the danger of a relapse into pre-scientific or early scientific times, in which one pretends to represent "history as it was", hyper-realistic models develop a normative statement and a monopolisation of knowledge dissemination through media design. The most prominent example is the 'Time Machine'-consortium.[3] Time Machine promises to build a large-scale simulator mapping 2000 years of European History, transforming kilometres of archives and large collections from museums into a digital information system. This volume clearly shows that there is reason to be wary whether such an ambitious enterprise in top-down mode will ever be able to provide reliable data in a reasonable time frame in order to develop scientifically substantiated simulations. Before success the gods have set the sweat. This is all the more true if, as discussed in this volume, models are to be created to simulate trade and transport in the Roman Empire. After all, there are numerous variables here, and the information that can be found in the ancient sources are incomplete and often problematic. We are talking here about a period of at least 300 years of the history of the Roman Empire with numerous geographical, climatic, ethnographic, and political changes. Nevertheless, a simulation of traffic routes and travel times would be of great benefit to research by its own, as it would provide great insights, especially into military and civil logistics and the economy of the Roman Empire.

Unfortunately, "ORBIS: The Stanford Geospatial Network Model of the Roman World" appears also a top-down model with an ambitious goal: "Roman communication costs in terms of both time and expense. By simulating movement along the principal routes of the Roman road network, the main navigable rivers, and hundreds of sea routes in the Mediterranean, Black Sea and coastal Atlantic, this interactive model reconstructs the duration and financial cost of travel in antiquity". Leif Scheuermann uses the results of Pascal Warnking's dissertation as an example to show that the small number of measuring points of wind and flow conditions in the ORBIS-system does not allow a simulation of long-distance travel times,[4] and Ulrich Fellmeth clarifies in his contribution that a static assumption of Diocletian's maximum price edict from the year 302 AD is not only insufficient for the calculation of the profitability of trading transactions, it is even misleading while an ORBIS simulation of long-distance trading transactions results in a large minus for the merchant. This clearly shows that a great deal of additional data is required to develop more reliable simulations and that, as the present contributions clearly show, these can only be obtained bottom up to a large extent by experimental methods.

The fact that coastlines could already change in Roman times and that this must be taken into account in simulations is clearly shown by the contribution of Toon Bongers "Connectivity in the Scheldt Basin: The role of the river Scheldt in the Roman-era transport network". He can show a transport network around river Scheldt as a transport corridor and its change by including numerous archaeological, epigraphic, and geographic sources and evaluating them in a Spatial-Network-Analysis. An important result is certainly the role of Ganuenta as an important long-distance trade centre as a maritime harbour for the Atlantic sea routes to the Baetica (oil trade)[5] and the North Sea trade with Britain, as among other sources testified by the votive monuments to the goddess Nehalennia. At the same time, Ganuenta was a transhipment port for Germania and Gaul via the river connections Rhine and Scheldt, especially for the military supply. It has to be considered that this was influenced by temporal changes, for example, due to the transformation of the coastal landscape, as well as political influences, for example, due to Chaucish piracy from the middle of the 2nd century AD on.[6]

2 Exceptions are the scientifically proven reconstructions of Prof. Dominik Lengyel, Cottbus (https://www.b-tu.de/fg-architektur-und-visualisierung/, [last access 23-05-2020]).

3 https://www.timemachine.eu/ (last access 23-05-2020).

4 Warnking (2015).

5 Cf. Schäfer (2016).

6 Cf. Haywood (1999).

How laborious it is to reconstruct an ancient river landscape with reliable results is shown very impressively in the contribution by Uwe Arauner „Donauschifffahrt im Ingolstädter Becken in römischer Zeit – von der Rekonstruktion bis zur Reisezeit“. This is about a 67 km long section of the Danube river in the Ingolstadt basin, which has changed fundamentally several times over the centuries. Arauner succeeds in reconstructing the course of the river from antiquity to the present times based on numerous very different values and information from historical maps, the localisation of the groundwater and flood areas, difference models and terrain models, flood simulations, gradient and river velocities. By additionally collected reliable measurement data (wind, sailing characteristics, rowing speeds) of reconstructed Roman river ships, realistic travel times can be calculated for these sections, which can form the basis for further simulations.

Patrick Reinhard comes in his contribution „„… treidelten wir das Schiff mit viel Mühe in den Hafen des Arsinoites‘ – Überlegungen zu den Akteuren in der Binnenschifffahrt und zu Quantifizierungsmöglichkeiten“ about the analysis of the papyrus P.Enteux. 27 on the question of the efficiency of locomotion by inland waterways. Here, too, in addition to the ancient reports experimentally collected data play a decisive role in order to develop reliable simulations. Specifically, these are experiments carried out on the Moselle with a 1:2 scale replica of a Roman barge (Prahm), the typical cargo vessel on rivers. The good sailing characteristics and above all the easy handling during towing, where one person as the owing drive is usually sufficient to reach the equivalent of 3.24 km/h in the long run with a load of approx. 1.5 tons, suggest affordable transport costs and a large interweaving of trade networks including the construction of towing paths. The connections of the farms to the surrounding markets via larger and smaller river connections make market visits possible with optimal transport utilisation and a few overnight stays as possible. If it is also considered that empty runs are avoided as far as possible, such river connections appear to be very profitable despite sometimes adverse circumstances (as described in the papyrus analysed at the beginning). It would also be worthwhile to obtain information about professionalization of the boat operation by forwarding agencies that always travel the same routes with mixed goods from different producers, similar to those of today’s commercial river shipping. Possibly, modern traditions like the transport of coal on the river Ruhr with “Ruhraaken”, which were very similar to the Roman pontoons and were also towed, could provide further evidence.[7]

The question of the use of rural roads is taken up by Klaus Tausend in his contribution „Zur Rekonstruktion antiker Verkehrswege“. In order to be able to analyse the benefit of land-based transportations, the exact course must first be reconstructed. Tausend shows this using the example of Attica, where land routes were often used as an alternative to the endangered sea routes for trade connections. For their reconstruction, besides mostly very inaccurate ancient written sources, historical maps and travel reports of the 18th and 19th centuries, satellite images, lidar scans, remains of buildings and other archaeological relics, terraces, bridges, and wagon tracks can be used. Basically, however, an autopsy is necessary, the most laborious procedure to obtain reliable data.

Finally, Ulrich Fellmeth sheds light on the economic aspect of a cost-benefit analysis of trade connections, mathematically formulated in proportion to the value of the goods. In addition to his fundamental criticism of the ORBIS project at the University of Stanford, he is interested in showing as many facets and variables of a calculation of transport costs as possible. In addition to means of transport, the time factor, goods and their mix, trade networks, external factors (weather, catastrophes, wars), the formation of trade networks and organizational structures (freight forwarders, intermediary trade), about which we know little, are also important. Producers often marketed their goods within a radius of 15–20 km on local markets, which in turn have intersections with regional trade, whose radius over land can be 400–500 km, by river navigation up to 1000 km. Long-distance trade has the most question marks, with

7 Cf. Schmidt-Rutsch (2005).

the luxury goods trade having certainly brought the greatest profit, but there are still too many variables in calculating profitability.

The aim of the present volume is to illustrate the basic fields for simulation of traffic routes and transport connections in antiquity (simulation as a method, geography, landscape reconstruction, river and sea navigation, land routes, and transport costs) in all their complexity. For long-distance trade by sea, the expected results are to be expected during the test runs of a replica of a merchant ship of the type Lauron 2 named "Bissula" completed in Trier. The upcoming measurements and data collection with the sea-going "Bissula" should provide reliable conclusions about the potential and intensity of Roman merchant shipping and maritime trade.[8]

It could be clarified that a reliable simulation of ancient traffic routes requires a wide range of different data, some of which have to be obtained laboriously through individual measurements and experiments. Large "top-down projects" cannot provide the necessary granularity and are therefore of little use to scientific research. Consequently, a simulation of traffic routes must refer to geographically/politically clearly defined parts of the Roman Empire, where data collection is possible within a reasonable time frame. This can only be done in an interdisciplinary network of several scientists from the ancient sciences, computer science, and the natural sciences. Then it will also be possible to produce reliable results on trade and transport conditions and to generate sustainable models from simulations. There is great potential for projects involving several generations of researchers, whose results will be interesting to see, especially since they are always suitable for questioning modern conditions.

8 https://www.hochschule-trier.de/forschung/forschungsprofil/aktuelles/detail/bissula-erklaert-die-antike-wirtschaftsgeschichte (last access 23-05-2020).

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