Exploratory Workshop:  
Maths Meets Myths

Participants (26 participants including the ESF representative)

1. Silvio Dahmen, Duisberg-Essen & Rio Grande do Sul
2. Robin Dunbar, Oxford
3. Jóhanna Katrín Friðriksdóttir, Reykjavik & Harvard
4. Robert Gramsch, Jena
5. Mats Gyllenberg, Helsinki & ESF
6. Yurij Holovatch, Lviv
7. Julien d'Huy, Sorbonne, Paris
8. Elva Johnston, Dublin
9. Ralph Kenna, Coventry
10. Emily Lyle, Edinburgh
11. Máirín Mac Carron, Galway
12. Pádraig Mac Carron, Oxford
13. Sean Martin, Edinburgh
14. Daniel Mc Carthy, Dublin
15. Louise Milne, Edinburgh
16. Olesya Mryglod, Lviv
17. Emer Purcell, Cork
18. Katja Ritari, Helsinki
19. Owen Roberson, Leicester
20. Jo Story, Leicester
21. Maria Magdolna Tatár, Oslo
22. Sarolta Tatár, Oslo
23. Jamshid Tehrani, Durham
24. Stefan Thurner, Vienna
25. David Weiss, Tübingen
26. Joseph Yose, Coventry

**Titles of Presentations** (19 presentations)

1. Silvio Dahmen -- 'Little Red Riding Hood 2.0: When Humanities Go Mathematical'
2. Robin Dunbar -- 'The Story-Teller's Art'
3. Jóhanna Katrín Friðriksdóttir -- 'Women’s Access to Power in the Íslendingasögur: Motivations and Strategies'
4. Robert Gramsch -- 'Political networks in medieval historiographical texts – modeling, analysis and interpretation'
5. Julien d'Huy -- 'Phylogenetic reconstruction of the Paleolithic myth of Polyphem'
6. Elva Johnston -- 'Mapping Networks of Learning and Literacy in Early Medieval Ireland'
7. Emily Lyle -- 'The Indo-European Gods and their Stories on our Ten Fingers'
8. Máirín Mac Carron -- 'History, hagiography and network theory'
9. Pádraig Mac Carron -- 'Mythological networks'
10. Daniel Mc Carthy - 'Analyzing and restoring the chronological structure of Irish annals'
11. Louise Milne -- 'Some possible applications of mathematical analysis in visual comparative mythology'
12. Olesya Mryglod -- 'Can analysis of a virtual world help to understand the mythological one?'
13. Katja Ritari -- 'Mapping saints and their networks'
14. Owen Roberson -- 'Modelling Preferences in Medieval Manuscripts'
15. Jo Story -- 'Intellectual Networks in Early Medieval Europe: Insular Manuscripts'
16. Maria Magdolna Tatár -- 'Reality and/or myths in the epic songs from the Sayan mountains: The heroine sister'
17. Jamshid Tehrani -- 'Folktale Phylogenetics'
18. Stefan Thurner -- 'Quanitification of human collective behaviour - experiments in virtual game space'
Abstracts

1. Silvio Dahmen

*Universität Duisburg-Essen, Germany*
*Universidade Federal do Rio Grande do Sul, Brazil*

**Little Red Riding Hood 2.0: When Humanities Go Mathematical**

The idea of my talk is to discuss some ideas about ways of using mathematics and physics in the humanities. The use of statistical tools in physics was responsible for some of the greatest revolutions in physics we have witnessed in the past century. Powerful as they are, we can only use them if we know what questions are relevant and worth knowing. I will briefly describe some problems I have been working on with colleagues from Coventry, Lviv and Wuerzburg and some yet unexplored questions which, in my view, could be explored.

2. Robin Dunbar

*University of Oxford, England*

**The Story-Teller's Art**

Stories (aka myths) are a central part of human culture and form an important basis for creating a sense of community. However, the human mind has a number of important constraints in what it can handle, and a good storyteller has to take these into consideration or s/he will leave the audience stranded. Some of these are cognitive (such as limits on the audience's mentalising skills) and some of them are structural (such as emergent properties in networks). I will illustrate this with examples from Shakespeare and contemporary film genre.

3. Jóhanna Katrín Friðriksdóttir

*Árni Magnússon Institute for Icelandic Studies, Reykjavík, Iceland*
*Harvard University, USA*

**Women's Access to Power in the Íslendingasögur: Motivations and Strategies**

In medieval Icelandic sagas, men and women have discrete gender roles, and women's role is often limited to traditionally female tasks such as child-rearing and running the household. Women were allowed to inherit and own property, but the chief ways in which to negotiate and resolve conflict both in saga and historical reality – formal legal structures and blood feud – were not open to them. Despite these constraints, female characters in the sagas are nevertheless able to gain agency and affect events and people, with or without social sanction.
Women have several tools at their disposal with which to gain power. Chief among these are words, witchcraft, and money, and they are often shown as using these in different ways or contexts than men. The most common of these strategies is the employment of speech intended to influence the (male) recipient’s actions and decisions. The most famous image of this type is the female inciter, who spurs her male kin to take revenge for real or perceived crimes against her family, but there are also many women who urge peaceful courses of action. A number of factors that further affect women’s access to power are social status, access to economic resources and marital status.

In my talk, I will outline the main motivations for women’s actions, the strategies that they use, and how successful they are in achieving their ends. My goal is to show how a gender perspective can complicate and nuance our understanding of social relations in the society depicted in the sagas.

4. Robert Gramsch

Historisches Institut, University of Jena, Germany

Political networks in medieval historiographical texts – modeling, analysis and interpretation

The social network analysis (SNA) is a promising instrument in medievistic research. In a weakly institutionalised face-to-face society concrete social relations and interactions were obviously very important. A systematic reconstruction and analysis of these networks permit a deeper understanding of various social and political phenomena. Admittedly, the lack of sources sets certain restrictions to the application of SNA in medievistic research. In regard to the great diversity of basic approaches and methods of the SNA it is also crucial to find adequate ways to study different historical network scenarios. Particularly interesting for historians is the problem of network dynamics because historical processes can be understood as the development of networks in time. One of the most important factors influencing a network are conflicts. We can model mathematically their emergent effects using Fritz Heider’s concept of the so-called structural balance. Examples from medieval literature and historiography show that this analytic approach suits the medieval social and political behaviour very well. Finally, the presentation briefly introduces my study “The Empire as a network of princes”, in which SNA techniques as well as the structural balance theory are used for modelling and explaining a large 13th-century political network.

7. Julien d'Huy

Paris I Sorbonne / IMAf, UMR 8171 (CNRS/IRD/EHESS/Univ.Paris1/EPHE/Aix-Marseille Univ-AMU)

Phylogenetic reconstruction of the Paleolithic myth of Polyphem

Mythology and folklore, like genetics and language, provides essential elements in the understanding of human history; phylogenetic trees based on mythological versions can allow to reconstruct the history and prehistory of human cultures right back the Palaeolithic period. Phylogenetics trees of the Polyphemus family have been built. The results clearly support low horizontal transmissions(borrowings), Palaeolithic diffusions and punctuated evolution. Additionally, a probable Palaeolithic version of the story has been reconstructed.
8. Elva Johnston

*University College Dublin, Ireland*

**Mapping Networks of Learning and Literacy in Early Medieval Ireland**

Early medieval Ireland had a well-connected literate class, of multiple origins, which is responsible for a great deal of our knowledge about that era. In my own research, I mapped the literate networks by using the data provided by the annals. This was largely made up of death notices and placenames. However, these literate individuals were connected to a much wider community and to each other. Would network theory allow scholars to connect these individuals creatively by using non-traditional sources such as Saints Lives and Sagas?

10. Emily Lyle

*University of Edinburgh, Scotland*

**Indo-European Gods and their Stories on our Ten Fingers**

Myth is the verbal side of the type of religion which is embedded in society and so relates to its social structure, notably kinship. The set of ten Indo-European gods can be related by correspondence to humans within a kinship structure centred on a king. Since a feature of mythological or cosmological thinking is homology, these ten gods can also be found expressed on the ten fingers and this register will be explored. Stories such as those of a fight with a dragon and the rescue of an abducted goddess relate to protagonists who can potentially be inscribed in the hands.

11. Máirín Mac Carron

*National University of Ireland, Galway, Ireland*

**History, hagiography and network theory**

This paper examines a sample of medieval historical and hagiographical texts using network theory. It will suggest that along with revealing the social structures of these texts, this methodology also has implications for understanding the role of the medieval author in his/her society and allows us to explore the inter-relationships of these texts.

12. Pádraig Mac Carron

*University of Oxford, England*
Mythological Networks

There are many approaches to the study of comparative mythology, most of which are entirely qualitative. In this paper, methods of network theory are applied to the myths and tales of different cultures in order to quantitatively compare them to one another. Social networks are constructed from characters' interactions within each narrative. The network properties allow us to make distinctions between the type of myth and, in some cases, to distinguish the myths of one culture from another.

Daniel McCarthy
Trinity College Dublin, Ireland

Analyzing and restoring the chronological structure of Irish annals

Annalistic chronicles of Irish affairs extending over the fifth to the eleventh centuries exist in eight medieval versions, but these exhibit considerable variation both in their sequence of events and the chronological apparatus used to link each year to the Julian calendar. Of these the Anno Domini dates of the Annals of Ulster has been the chronology principally relied upon by historians, even though these are demonstrably incorrect from the seventh century onwards. Moreover, its remaining chronological data of ferials and lunar epacts, that is, the day of the week and age of the moon on 1 January, are almost all interpolations by a later scribe.

On the other hand, the Annals of Tigernach have only kalends and ferials marking the commencement of each year up until the seventh century. Because these kalends and ferials are susceptible to scribal miscopying they were dismissed by historians and textual scholars as 'hopelessly confused'. However, analysis of the twenty-eight year cycle of the ferials reveals that they possess a powerful error-correction property, and exploitation of this property has enabled the restoration of all the missing kalends and erroneous ferials of the Annals of Tigernach, and likewise the kalends and ferials of the two closely related chronicles, the Chronicum Scotorum and Annals of Roscrea, known collectively as the Clonmacnoise group. Using computer table structures the kalends and ferials of these three have been synchronized with the Anno Domini years over the range AD 1–1178, and this tabulation, with cross-references to the other Irish medieval annals, has been made available online. This paper will illustrate the process of analysis, correction, and synchronization.

Louise Milne
Edinburgh College of Art, University of Edinburgh, and School of Arts & Creative Industries, Edinburgh Napier University, Scotland

Some possible applications of mathematical analysis in visual comparative mythology

Mythological ideas are carried and expressed as much in visual culture as in texts: arguably image-constellations are the primary building-blocks of myth, as they anchor ritual, oral tradition and formal literary narratives. This paper first presents examples of image-constellations, drawn from archaeological and historical sources, demonstrating how their composite structure explains both their stability and their capacity for
variation. Then I explain some of the challenges in interpreting this variability and suggest ways in which network analysis could be applied to address these issues.

16. Olesya Mryglod

Institute of Condensed Matter Physics, National Academy of Sciences of Ukraine

Can analysis of a virtual world help to understand the mythological one?

Studying human behaviour in virtual environments provides extraordinary opportunities for a quantitative analysis of social phenomena with levels of accuracy that approach those of the natural sciences. In this paper we use records of player activities in the massive multiplayer online game Pardus over 1,238 consecutive days, and analyze dynamical features of sequences of actions of players. We build on previous work were temporal structures of human actions of the same type were quantified, and extend provide an empirical understanding of human actions of different types. This study of multi-level human activity can be seen as a dynamic counterpart of static multiplex network analysis. We show that the interevent time distributions of actions in the Pardus universe follow highly non-trivial distribution functions, from which we extract action-type specific characteristic "decay constants". We discuss characteristic features of interevent time distributions, including periodic patterns on different time scales, bursty dynamics, and various functional forms on different time scales. We comment on gender differences of players in emotional actions, and find that while male and female act similarly when performing some positive actions, females are slightly faster for negative actions. We also observe effects on the age of players: more experienced players are generally faster in making decisions about engaging and terminating in enmity and friendship, respectively.

Presenter: O. Mryglod
Co-authors: Stefan Thurner, Michael Szell, Yurij Holovatch, Benedikt Fuchs

References

18. Katja Ritari

University of Helsinki, Finland

Mapping saints and their networks

In this paper I intend to look into the possibilities of using quantitative methods in the study of medieval sainthood. First, it is possible to approach sainthood by asking who were the people considered as saints. By using a large body of data, analysing such things as variation in the types of saints between different centuries and regions becomes possible. On the other hand, the social networks of the saints as presented in the textual evidence available to us can be analysed in order to learn who did the saints interact with and on what occasions. We
can imagine saints as focal points in a web of Christians venerating them – there is no saint without a cult, a saint is always surrounded by people who consider him/her as a saint. Saints’ interaction with other people can vary from positive (healings, blessings etc.) to negative (cursing, punishments). In some cases the other people are there only to give witness and to tell others of the miraculous powers of the saint and the miraculous event happens between the saint and God or other supernatural powers like when someone witnesses the saint conversing with angels or surrounded by supernatural light. The aim of this paper is to give some examples of quantitative analysis of sainthood and to raise questions concerning the possibilities offered by and the limits of these methods.

19. Owen Roberson

University of Leicester, England

Modelling Preferences in Medieval Manuscripts

This paper explores the ways in which a combination of mathematical, economic, and humanities methods can be used to reconstruct decision processes from the results of those decisions as they survive. Manuscript compilations frequently show a desire for internal consistency, by including material that complements the texts that cohabit the manuscript witness, and by avoiding repetition of material that is already included in other parts of the work. Modelling each individual manuscript as an expression of a need for a unit that performs a function in a specific context, the investigation compares the decisions that comprise the creation of each work to each other. By taking blocks of texts that move together as a unit and considering the different texts, and types of texts, that are included in other manuscript copies, the paper seeks to identify trends in the preference for individual texts over time, how they can be considered complements to, and substitutes for, the other texts in the corpus. To some extent, this paper explores the possibilities for reconstructing what is lost, but with no way of verifying answers, that is not its principal aim. Rather, the study indicates the amount of potential work that could be done on a concentrated, small, data set, and discusses some of the issues of taking these new approaches to wider audiences in a manner that is rewarding to both the researcher and the subject.

20. Jo Story

University of Leicester, England

Intellectual Networks in Early Medieval Europe: Insular Manuscripts

Popular culture thinks of the centuries that followed the Roman Empire in Europe as a “Dark Age”. In fact, there is copious evidence for communication, exchange and intellectual vigour facilitated by many processes of human interaction (e.g.: migration; diaspora; warfare; diplomacy; trade; mission; pilgrimage; exploration) and which is visible through sources extant in many media and genres.

About 500 manuscript books survive from the period AD650–850 that were written by ‘Insular’ scribes – that is, by people who were trained in either Anglo-Saxon England or Ireland, or in monasteries on the Continent that had been founded by Irish or English missionaries, and which followed the book-making practices of their homelands. These books offer a statistically meaningful sample with to investigate methods of understanding the contemporary intellectual networks which connected people and places in Europe at this time,
and also the chronological palimpsest which linked them both to their own cultural heritage (the Classical, Germanic, and early Christian pasts) and forwards in time, to us today.

21. Maria Magdolna Tatár
Oslo, Norway

**Reality and/or myths in the epic songs from the Sayan mountains: The heroine sister**

Archaeology confirmed the existence of ancient amasones on the Eurasian steppes. They occur in the epic songs of the Turkic peoples as well. However, it is not so easy to answer the question connected to their role in the stories. Narrowing down the types of the epics from fight because of romantic love (e.g. among Kazakhs) to fight against murderous enemies as real amasones (e.g. among the Kirghiz) it is possible to differentiate between subjects and regions. In most epics they are supporting women (mostly in Central Asia and among the Mongols). In some cases they are sisters, who are not real amasones but rather an embodiment of the murdered brother. They are not looking for personal happiness but secure the future of the kin (among the peoples in the Altai-Sayan mountains). They awake the brother, but with different methods. One of these methods is not folk medicine or folk religious ritual, but a kind of a sexual (but not incentuous!) act. Analysing the later fate of the sister it is obvious that the primary character was a divine woman and behind the quasi-historical epic song there was a myth, which originally belonged to the ancient population in the Sayan mountains. The subject spread from there and was changed from a myth to a heroic romance at the end.

There are many epic songs known in this large area and the materials are extremely rich. Maths are absolutely needed to systematize and visualize it!

23. Jamshid Tehrani

*University of Durham, England*

**Folktale Phylogenetics**

Folktales, like genes, mutate as they get transmitted from generation to generation. Elements of a story may be added, substituted or forgotten, generating new variants that catch on and flourish, or vanish into extinction. However, reconstructing these processes has been complicated by the fact that folktales are transmitted via mainly oral means, leaving scant literary evidence to trace their development and diffusion. In this paper I demonstrate how this problem can be addressed using phylogenetic methods developed by evolutionary biologists. I show how these methods can be used to identify cognate relationships among tales from different societies and eras, reconstruct their ancestral forms, and test hypotheses about how stories evolve – for example, which traits tend to be the most stable and which ones are more readily lost or substituted? Are there regular patterns and “mutational hotspots” in the transformation of stories? I will illustrate the approach through analyses of one of the most famous tales in the folklore record, the tale of Little Red Riding Hood.
24. Stefan Thurner

*Medical University of Vienna, Austria*

**Quantification of human collective behaviour - experiments in virtual game space**

Virtual worlds offer the first examples in human history where there is complete information about a an entire human society. It becomes possible for the first time to observe how a society as a multilevel multiplex structure that connects people (avatars) changes over time. A mathematical analysis of the multiplex structures allows to make quantitative, predictive and testable statements about social organisation, formation of social ties, gender differences of social life, reaction times of human interactions, the origin of good behaviour, and the wealth of virtual nations.

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25. David Weiss

*University of Tübingen, Germany*

**A comparative perspective on the struggle between Heavenly and Earthly Deities in Japanese Mythology**

In my talk, I will introduce the myth of the struggle between two groups of deities in Japanese mythology: the so-called Heavenly and Earthly Deities who compete for sovereignty over the earth. This struggle has often been interpreted as reflecting a historical struggle between two political and cultural centres. However, this hypothesis cannot explain the almost worldwide distribution of very similar myths. Greek and Scandinavian myths, which contain similar struggles between the Olympians and the Titans or between the gods and giants, respectively, will serve as an example of such parallel mythic structures. I will discuss two hypotheses which were proposed by comparative mythologists in order to explain these parallels: Georges Dumézil's trifunctional system and Michael Witzel's Laurasian theory. Finally, I will suggest how a network analysis of the myths in question might enable us to draw a more detailed and more convincing comparison between the different mythologies and support the comparative hypotheses (if the networks depicted in the various myths could be shown to be similar).