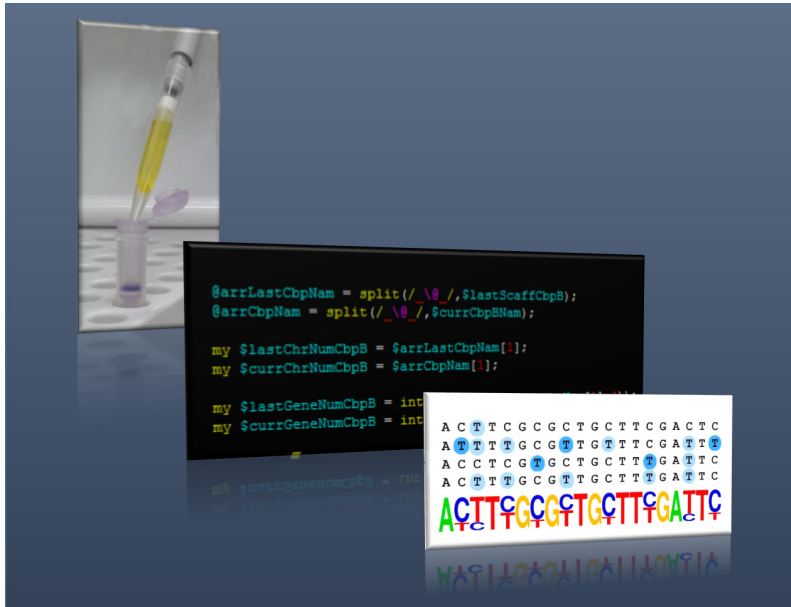


# IEMNews



The main steps of an ancient DNA study: Extraction (left), next generation sequencing (middle), and bioinformatics analyses (right).

Spotlight on the ongoing IEM research (by Dr. Irina Morozova, Ancient Biomolecular Group, IEM):

## Evolution & civilization: How our genome have been shaped since the Bronze Age

The history of all of the great pandemics show that the resources of the human organism are underestimated and need to be studied more thoroughly. For this, it is necessary to better understand the mechanisms of the connections between the human organism and the environment, on the one hand, and between different systems (immune, endocrine, metabolic etc.) within the human body, on the other. We need to know how quickly our body learns to respond to new environmental factors, how deeply our genomes are affected and how our responses are modified by modern lifestyle (diet, urbanization, modern medicine etc.). Here, the evolutionary approach is essential.

In order to understand how, in creating civilization, we affected our evolution, and how evolution, in turn, has shaped our bodies, we study genetic features of human populations from different epochs, including such important civilization milestones as the introduction of farming, the start of urbanization, the

industrial revolution, and the era of modern medicine.

We started with the comparison of two very important epochs, namely the Bronze Age and the modern era. Direct comparison between ancient and modern whole genome data is now possible thanks to a combination of ancient DNA analysis, next-generation sequencing, and novel bioinformatic methods. We used an approach allowing us to study human evolution at the functional level: we detected mutations in molecular pathways representing molecular interactions and reaction networks for the main organismal systems. Thereby, we investigated which particular processes in the human body were most affected during the last 5000-6000 years.

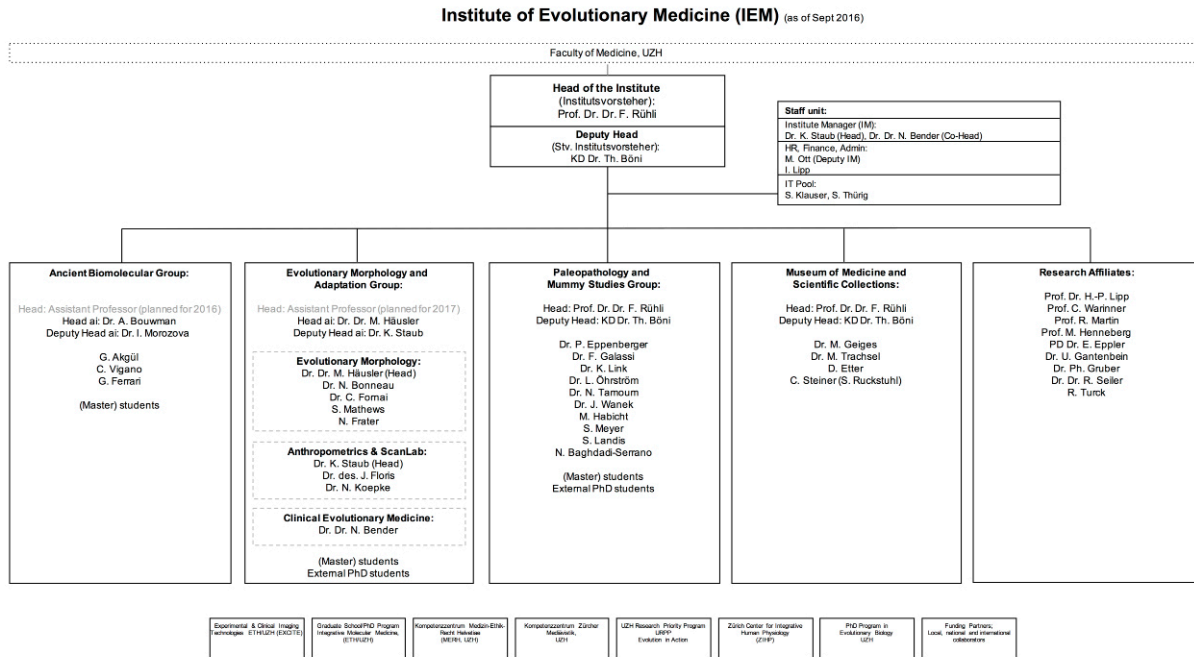
We revealed significant changes in processes connected with the metabolism of carbohydrates, amino acids, lipids, vitamins, and xenobiotics, as well as with immune response

and autoimmune diseases. We presume that these changes were caused by cultural practices which were introduced during the last 6000 years, i.e. the new diet resulting from farming, and, later, industrial processing of food, new environmental factors, such as unknown pathogens, heavy metals, sanitation, and modern medicine, as well as the increase in human population density.

In short, we detected evolution in action and directly observed how man-induced factors affected the genetic status of the human organism. Our next step is to understand when, during the last millennia, these changes began and how their further evolution proceeded. I believe that this knowledge will help us not only to reveal the present dynamics of the human organism, but also to predict prospective changes.

**Dr. Irina Morozova,**  
Ancient Biomolecular Group, IEM

# IEM Organigram



## Vision and Mission Statement

We are a leading international and globally connected research, teaching and service institute which is part of the medical faculty at the University of Zurich. We analyse ancient biological material and associated data to better understand modern human health issues and diseases. Due to specialist scientific expertise, excellent infrastructure and state-of-the-art methodologies, we are able to work on various interdisciplinary research questions in the context of the field of Evolutionary Medicine. Our core competencies include:

- In the area of morphology: Clinical Anatomy; Variability and adaptation of body morphology as a function of sex, robustness, time (Microevolution), socio-economic factors (etc.); Macroevolution of joint pathologies.

- In the area of imaging: application of modern imaging techniques (MRI, terahertz) on historical tissues; Radiological diagnosis of pathologies.

- In the area of ancient DNA: Co-evolution of diseases and the human genome (evolution of human pathogens, microbiome analyses etc.); Service for Archaeology/Historical Anthropology (paternity testing, sex determination).

- Maintaining a novel medical museum for the public and a medical history object collection for the scientific community.

- Ethical considerations for research on historical human tissues.

We will increase the recognition of the research field of Evolutionary Medicine and expand academic teaching of the subject within and outside the Faculty of Medicine. This will be of a sustainable value for our stakeholders at the University of Zurich, in the research community of evolutionary medicine and adjacent areas, to the economy and ultimately for society in general.

## Words from a UZH collaborator



Prof. Dr. Max Gassmann  
Institute of Veterinary Physiology, Vetsuisse Faculty  
Zurich Center for Integrative Human Physiology  
University of Zurich

Living at high altitude requires adaptation to a reduced oxygen supply. The most common adaptive mechanism in men is the increase of hemoglobin (Hb) levels that in turn elevate blood oxygen supply. So far, it was thought that life in low altitudes (<1000 m above sea level) has no impact on the Hb level. But is it true? Most attempts to compare Hb values obtained from low and high altitude dwellers are hampered by the heterogeneity of the tested population especially due to variations in ethnicity and socio-economical aspects.

To circumvent the limitations caused by the population's heterogeneity, Frank Rühli and Kaspar Staub from the IEM joined forces with our institute to analyze a treasure trove of data: the Swiss Army provided different parameters obtained from over 70,000 young Swiss men that allowed us to compare Hb and ferritin levels, body-mass index (BMI) and C-reactive protein values to the altitude of residence of the conscripts. In a preliminary analysis we observed a significant increase of Hb values for every 300 meters of augmented altitude the young Swiss men live at, starting from the lowest Swiss city, Basel. We are convinced that these data are of utmost interest for research in various fields. But this is only the beginning of a very promising and fruitful collaboration with the IEM. We obtained much more data from the Army that will shortly be in the process of being analyzed.

Moreover, since 2015 Frank Rühli and I organize a lecture series called "Human Adaptation" for life science students every Fall semester. Humans have to adapt to various factors such as the environment, disease load or culture. Human body morphology and genetics thus undergo permanent evolution. The aim of this lecture series is to address the whole range of influencing factors and the subsequent adaptations in humans, with a particular focus on physiological and pathological processes.

**Prof. Dr. Max Gassmann**

## Words from a new member of the IEM



Dr. Nikola Koepke  
Evolutionary Morphology & Adaptation Group  
Institute of Evolutionary Medicine  
University of Zurich

It is approximately one year since I joined the IEM, in the Evolutionary Morphology and Adaptation Group. Looking back, my positive expectations of work here were fully confirmed.

Originally I was trained as a Magister in Archaeology of the Roman Provinces and Pre- & Early History at the Ludwig-Maximilians-University Munich, DE; back then my aspiration to enrich my research in a multidisciplinary way was formed. To that end, I added my doctorate in Anthropometrics at the Eberhard Karls University Tuebingen, DE. Subsequently, I took on appointments as Departmental Lecturer at the University of Oxford, UK and at the University of Barcelona, CAT. After being mainly involved in the Economic and Social History research environment during these previous years, I am now particularly happy that I have had the possibility to join the medical and health-oriented, and, moreover, highly interdisciplinary research institution of the IEM.

The interactive and prosperous working milieu within the IEM, with its variety of research groups and its international collaborations are very inspiring; as is the research support by investment in innovative equipment (e.g., lately, a cutting-edge photonic 3D-scanner). Correspondingly, I am currently working on a wide selection of different research topics, ranging from a solo study on gender differences in net nutritional status in a very long-run panel on pre-modern Europe, through research in mutual cooperative projects with my colleagues on recent historic Swiss living conditions, the transition to modern times, and work on today's health situation. At present, one particular objective of our Anthropometrics Team (as part of the Evolutionary Morphology and Adaptation Group) is establishing an improved monitoring method of obesity prevalence. Our emphases include a validation case study on 3D-body scanning to implement the 3D-scan technique (for a better standardised and faster measurement procedure) in epidemiological studies as well as the development of a standard protocol for waist and hip circumferences measurements to be applied in the conscription process.

**Dr. Nikola Koepke**

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## Upcoming Events

- 3rd International Society for Evolution, Medicine, and Public Health (ISEMPH) Meeting, Groningen, Netherlands, August 18-21, 2017
- 86th American Association of Physical Anthropologists (AAPA) Meeting, New Orleans, USA, April 19-22, 2017
- Paleopathology Association (PPA) North American Meeting, New Orleans, USA, April 17-19, 2017

## New IEM-Members

The IEM is happy to welcome the following members to the institute:

- Dr. Noémie Bonneau (Evolutionary Morphology and Adaptation Group)
- Dr. Martin Trachsel (Special Project Support)
- Anne Lehner (Master-Student MNF, Evolutionary Morphology and Adaptation Group)

## Selected Media Reports

- Forbes.com, 28 June 2016
- SWR TV, 20 July 2016
- Süddeutsche Zeitung, 29 July 2016
- Deutschlandradio, 1 August 2016
- CreaPharma, 2 August 2016
- Independent, 2 August 2016
- Welt am Sonntag, 7 August 2016
- Hochschulradio, 8 September 2016
- Int. Business Times, 20 September 2016
- Smithsonian Channel, 5 October 2016
- RSI Radio, 10 October 2016
- Forbes, 14 October 2016
- SRF Tagesschau, 19 October 2016
- Forbes, 19 October 2016
- SRF Einstein, 13 November 2016
- Ifscience.com, 1 December 2016
- Dailymail, 2 December 2016

Editorial:

Dr. Kaspar Staub  
Institute of Evolutionary Medicine,  
University of Zürich,  
Winterthurerstr. 190, 8057 Zürich, Switzerland

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