

## Where does science end? Statement of the Institutes of Archaeology of the Czech Academy of Sciences on the so-called approximation of the face of Jan Žižka of Trocnov

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- To mark the 600th anniversary of the death of Jan Žižka of Trocnov, an attempt by an international team of researchers to digitally reconstruct his face has been published. In reality, however, it is an image of an average Central European man with general metric features based on a severely deformed skull fragment of uncertain origin.
- The reconstruction is derived from the so-called Calva from Čáslav, i.e. the skull remains attributed to Jan Žižka. However, there is no clear evidence for this attribution and the state of preservation of the find is very fragmentary, as almost the entire facial part of the skull is missing, based on which scientific modelling could only be carried out.
- Although the model of Žižka's head is widely published as a scientific result, the published reconstruction is not based on scientific evidence. It is lacking, among other things, because the authors of the reconstruction do not present in any form the data they worked with, nor the verifiable results of the processing steps.
- The method used is scientifically inadequate for reconstructing the whole face from small fragments. This does not preclude its use in other disciplines or for testing hypotheses for better defined purposes in archaeology.
- We consider it unacceptable to continue to uncritically accept and disseminate the reconstruction presented, which leads to the mystification of the public. In this sense, we appeal to the media to exercise caution. A distinction must be made between the publication of scientific results and the pursuit of sensationalism.
- We strongly object to personal attacks by the author team on individual members of the professional community who choose to publicly criticise the current or past work of C. Moraes and his colleagues.

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Reconstructions of the faces and figures of representatives of the past populations (Ötzi, Cheddar Man, Neanderthals, the Bronze Age woman from Mikulovice, etc.), sometimes even of historical persons (Nefertiti, Tutankhamun, etc.), are among the most attractive ways of popularising scientific historical work. They arouse interest even among people who last devoted time to history in their school classes. However, when the authors of reconstruction models are scientists, one of the main aims of these undoubtedly media-savvy outputs should always be to raise a fundamental question: how did the scientists develop the result and what exactly did they base it on?

On the occasion of the 600th anniversary of the death of Jan Žižka of Trocnov, a team led by the Brazilian researcher Cicero Moraes and the Czech geodetic surveyor Jiří Šindelář, in cooperation with other researchers and institutions (in particular the South-Bohemian Museum in České Budějovice and the Hussite Museum in Tábor), published a [press release](#) on the "*scientific approximation of the face of a historical figure dead for six centuries*". They published their work in more detail on the private publishing platform [OrtogOnLineMag](#), managed by C. Moraes. Later, a translation of this text into Czech was added to the [ResearchGate](#) portal by the authors. We use the Czech version of the text as the main reference for our opinion below.

The work on Jan Žižka attracted a great deal of media interest, which is understandable in view of its importance for Czech cultural identity, but also in view of the choice of a publication date close to a significant anniversary, when there is heightened public interest in the subject. In this respect, the

authors cannot be blamed a priori for trying to meet the demand, but one cannot help feeling that in this case the quest for sensationalism outweighed scientific rigour. Source criticism should be strict for such exposed topics, as well as for the methods used to process them, because the possible social consequences of published errors are not insignificant. If the authors' interest were primarily scientific, at least the choice of material for reconstruction should not be driven by social demand, but by the intersection of its availability and quality (i.e. the choice of remains that safely allow the application of the method) and the presentation of hypotheses to be tested by the procedure. In our view, the method chosen is extremely problematic, particularly in its attempt to blur the distinction between a scientifically based reconstruction of a specific historical figure vs. an artistic rendering of the appearance of an unknown individual based on general anatomical models of the human skull. The reasons for doubt are based on several factors - the origin of the find, its state of preservation, the method of reconstruction chosen and the method of presentation.

The reconstruction of the appearance was based on a part of a skull discovered in Čáslav (hence referred to as the Calva from Čáslav), which is being attributed to Jan Žižka of Trocnov. Given the circumstances surrounding the find in the early 20<sup>th</sup> century, verifying the hypothesis that the skull belongs to Jan Žižka is inherently challenging. Recent research by the Nuclear Physics Institute of the CAS (NPI) shows that the dating of the finds associated with the skull ranges from the early mediaeval to modern times, reflecting the problematic formation of the entire assemblage, while the skull itself has been definitively dated to the Late Middle Ages. According to the NPI, the dating results cannot confirm a death in 1424, but only allow for the possibility. The results were presented in a vague manner in a short text within the [popularisation section](#) of the NPI's website. Even a basic critical evaluation of the information and knowledge of the [possibilities of radiocarbon dating](#) should not have allowed the authors to publish a statement that "*radiocarbon dating carried out in 2024 confirms the year of death 1424*", let alone argue from it, especially when the detailed results of the dating are not published in the scientific media, thus the results were clearly not available to the team. They admit the interpretive uncertainty in principle in their text, but this fact did not prevent them from widely publicising their model as a reconstruction of Jan Žižka's appearance. Nor did they attempt in any way to correct the media's interpretation of their published report.

Even if we fully accept the archaeologically unproven hypothesis that the Calva from Čáslav is a genuine relic of Jan Žižka, other, much more problematic methodical steps have been taken by C. Moraes' team. In the first step, the fragmentary skull – which almost completely lacks the facial part (see [photo of the find](#)) and has been subject to a number of deformations due to its multiple deposition, recovery and conservation – was digitised using photogrammetry. It should be noted that the data obtained have not been published with the published texts (or anywhere else), nor have any other data or statistical results related to the various stages of processing the find. It is therefore only possible to work with a brief description of the procedure, accompanying illustrations and references to the methods used or the [software](#) developed by the authors. The actual description of the method is limited to a few paragraphs of text which, among other things, lacks any specification of how to deal with post-depositional deformations of the find. Thus, it is not at all clear how and with what precision the authors managed to digitally 'correct' the preserved skull fragment to the shape and size it could have had at the time of the death of the examined individual, regardless of the missing parts. This would be one way of ending this text and declaring the whole work scientifically unverifiable. Nevertheless, we will try to evaluate the next steps and generally treat the claimed deviations as a possible bias (#1).

The next processing step was the lateral axial projection of the existing skull parts to obtain the first metric attributes partly from the original fragment and partly from the projection, based on previously processed skeletons of complete individuals (sample size, composition and method of assembly were

not described; bias #3), and then the addition of the point-anchored dimensions based on the skull of a virtual donor (bias #4).

At this point it should be noted what the authors have obtained in the given situation - it is an image of a skull whose parameters may (!) correspond in general size characteristics to the skull from which the preserved fragment comes. However, they do not present any verifiable evidence as to how reliable this model really is. If it were to be presented, it would be in the form of standard deviations based on variational models of possible solutions based on a sample of the real population, in the best-case contemporary with the find. It can be argued with a high degree of probability that in the case of such a fragmentarily preserved find, the number of variant solutions would be so large that the standard deviation of the values would be at least on the order of higher units of millimetre, and perhaps even higher. However, in modern European populations, the standard deviation of the error of the estimate of the dimensions of the lower face from the dimensions of the upper face is about 3 mm - so the estimated dimension may be more than 6 mm larger or smaller than its point estimate. Put simply, most individuals in the population fall within this range (we are grateful to M. Jurda of the Faculty of Science at Masaryk University for this information). And we are only talking about the estimation of the shape and size of the bone base. In this case, the C. Moraes method would have to produce deviations that are orders of magnitude smaller in order to be able to define Jan Žižka's individual characteristics, which is extremely unlikely. Moreover, the authors themselves do not give us any indication of how to assess these deviations, since the data are not available. In addition, the whole method is based on the assumption of complete symmetry of all parts of the reconstructed face, which in itself contradicts the anatomical development of the human being, which is influenced, for example, by the manner of growth and the particular state of the teeth, which is again missing (bias #5). In addition, Jan Žižka suffered a serious accident in his youth and lost an eye, which undoubtedly influenced the development of his face in a completely unknown but not insignificant way (bias #6). Later depictions suggest that it may have been the left eye, but even this is not certain. The sources contradict each other to varying degrees, and contemporary sources do not give us any precise information about Žižka in this respect. Among other things, the Calva from Čáslav itself is used as evidence, but its attribution to Žižka is problematic in itself, and thus forming a typical circular argument (bias #7).

This was followed by soft tissue modelling based on a statistical model of adult European males aged 50-59 years (bias #8). Again, we pause to note that soft tissue modelling alone can give satisfactory results in producing an 'average' individual from a given age and population cohort. However, it in no way reflects the actual formation, thickness and other characteristics of the soft tissues of the alleged Jan Žižka as a person, since their specific reconstruction would theoretically be possible only by studying the traces and deformations that the soft tissues would have left on the actually preserved (i.e. non-existent) skeletal material. However, this did not prevent the authors' team from continuing their modelling, which they completed by approximating the effect of age on these modelled tissues (bias #9). The model was then virtually covered with skin; hair and beard were also arbitrarily added, and artefacts caused by shortcomings of the algorithm used had to be manually compensated (bias #10). Finally, the resulting [images of 'Jan Žižka'](#) were generated. The steps after the skin coating are considered by the originators themselves as a free design, and they consider their [skin-coated model](#) rendered in shades of grey to be scientifically based.

In the text above, one can count at least ten individual biases present in the procedure. Even though the authors provide literally no quantitative or qualitative data, they dare to present the result of their creative work as the true image of Jan Žižka of Trocnov. Even if we were to exclude those distortions that are in principle unavoidable even with well-preserved material (especially #9–10) and neglect the

archaeological source critique, there remain a large number that are in principle unavoidable. The process cannot therefore be described as scientific in any sense of the word. Although the authors of the work often publicly swear by their experience, professions and the use of the chosen method for completely different purposes (e.g. in medicine, where it can of course be used very well, but only for the intended purpose, i.e. as an aid in the reconstruction of missing parts of the faces of living persons), from the point of view of archaeological knowledge and with the use of such fragmentary input data, it is a worthless procedure that produces scientifically irrelevant results.

Surely it would be appropriate to ask what the authors are trying to achieve with their approach. If it is indeed an extension of human knowledge, as they actively claim, they are either unwittingly making a mistake or deliberately manipulating the public. Given that they repeatedly choose this course of action despite the opposition of the expert community (see the cases of the ['reconstruction' of the face of Saint Ludmilla](#) or the attempted [reconstruction of Amenhotep I](#), etc.), one might lean towards the second option. In our opinion, this is a long-standing and blatant violation of scientific and publishing ethics, which should be condemned unequivocally. The situation is not changed by the [study on St Ludmila](#) published in a peer-reviewed journal, which suffers from the same shortcomings as the current paper on Jan Žižka. The metric data contained in the paper are only compared with an idealistic statistical model, but are in no way related to the general variability of the sample used to generate them. Obviously, the research team has long operated on the premise that, if the reader so wishes, he or she can find data on the exact procedure in the numerous references and notes presented. When the scientific community claims that this is not the case, it is clear that there is a repeated misunderstanding of the principles of scientific communication. It is incumbent on authors to present evidence that is easily verifiable and irrefutable, or to make clear arguments as to why any bias is negligible. The challenge is to convince a critical mass of experts that the work is generally credible, with very specific data and descriptions of methods and calculations. If, instead of answering these doubts with data, the research team responds with attacks and attempts to denigrate their critics, they demonstrate an inability to understand and properly conduct scientific debate. Let us only mention the fact that the team of C. Moraes, especially through J. Šindelář, repeatedly makes disparaging remarks about certain members of the academic community, even when these persons cannot defend themselves and [are not directly affected by the discussion](#).

The authors [themselves state](#) that "*given that these are reconstructions intended for presentation in an ecclesiastical and museum context, there is not much pressure for structural accuracy in the case of both Saint Ludmila and Jan Žižka*". However, this does not prevent them from claiming in the conclusion that "*(...) it was possible to reconstruct the missing parts and subsequently to approximate the face of the supposed skull of Jan Žižka (...)*". For the above reasons, we consider this claim to be completely unverifiable, misleading and inherently fraudulent. No scientifically substantiated evidence allowing such a claim has been presented to the public. C. Moraes and his team have created a vivid image of an average Central European male with general metric characteristics based on a severely deformed skull fragment of unconfirmed origin. Such a conclusion to the work would probably not have been received by the media with the same enthusiasm as the one promoted by the authors. We venture to suggest that the public interest in such a result would be marginal, commensurate with its quality. It is to be hoped that the Czech museums concerned are involved in the whole affair rather indirectly and in good faith, and that they will reflect the facts we have presented in their outputs.



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