

# Cremins, what remains

Citation for published version (APA):

Krap, T. (2022). *Cremins, what remains: Heat induced changes of biophysical properties of human bone, introducing new parameters and concepts for forensic anthropological analysis*. [Doctoral Thesis, Maastricht University]. Gompel&Svacina. <https://doi.org/10.26481/dis.20220610tk>

## Document status and date:

Published: 01/01/2022

## DOI:

[10.26481/dis.20220610tk](https://doi.org/10.26481/dis.20220610tk)

## Document Version:

Publisher's PDF, also known as Version of record

## Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

## General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.umlib.nl/taverne-license](http://www.umlib.nl/taverne-license)

## Take down policy

If you believe that this document breaches copyright please contact us at:

[repository@maastrichtuniversity.nl](mailto:repository@maastrichtuniversity.nl)

providing details and we will investigate your claim.

# Impact paragraph

## Context

Forensic anthropology deals with the dead to serve society, both the relatives and governmental agencies, by salvaging and subsequently identifying deceased. Salvaging human remains can be a challenging task, for example when dealing with hazardous working conditions, commingled and fractured human remains. Under such challenging conditions not all remains might be retrieved (chapters 1 and 7). Forensic anthropology also serves the department of justice, and thereby society, by providing information on the possibility of foul play (chapters 1 and 7). It is therefore of importance that the applied methodology by the forensic anthropologist is sound, has a high success rate, yield and accuracy (chapter 7). The forensic anthropological investigation needs to meet standards in order to provide useable results to be applied in criminal law. These standards are: the method has to be empirically tested, peer reviewed, have acceptable error rates, and generally accepted within related scientific fields (these are the *Daubert* criteria, chapter 7). The National Academy of Sciences called out for improvement on these standards, and to develop methods that are less subjective, in 2009, see “*Strengthening forensic science in the United States: a path forward*”. The studies presented in this dissertation aimed to improve the investigation of thermally altered human skeletal remains, while also aiming on improving the methodology in light of the *Daubert* standards (chapter 7).

## Products

Based on a questionnaire amongst forensic anthropologist, on the estimation of the exposure temperature of bone, it became clear that the current (subjective) methodology had to be improved (chapter 2). Therefore, a measurement based method, based on colourimetric analysis, combined with a cluster model, was developed (chapter 3). The proposed method proved useful for estimating the exposure temperature with a known error rate, and is easily applicable in practice (chapters 3 and 4).

Aiming on standardizing fracture analysis, a collection sheet for the analysis of fracture features was developed. Followed by a statistical analysis on the fracture features for differentiation between fractures caused by blunt force impact and heat. Most discriminating features were colour of the fracture surface and the morphology of the surface (chapter 4).

To aid the investigative team, a method was proposed to create contrast and improve recognition of thermally altered human skeletal remains by means of the light emitting characteristic of human bone (luminescence). This method has the potential to improve the yield of retrieved osseous material from the scene (chapter 5). By improving the yield the changes on identification are also improved. Furthermore, a novel finding was that thermally altered human bone also has a lasting glow in the dark (phosphorescence, chapter 6). By combining the data from the luminescence studies with the colourimetry study the estimation of the exposure temperature can be further substantiated.

## Scientific impact and relevance

The results of the different experiments included in this dissertation have been published in open access peer reviewed journals, and have been, and will be, presented at (inter)national scientific conferences. Furthermore, the presented methods have been implemented in education in the form of practical's and workshops for forensic, anthropological, and medical students and professional practitioners. The proposed methods can be easily applied in practice and related scientific studies (chapter 7)

## Societal impact and relevance

The findings presented in this dissertation impact the work of the forensic anthropologist in various areas. By improving the investigation of thermally altered human skeletal remains, more human remains can be salvaged from construction debris after a fire and more information can be extracted from the remains. When applying the methods and insights presented in this dissertation the analysis of the relation between the fire and the thermal damage is improved, and conclusion are better substantiated (chapters 3, 4, 5, and 6), strengthening the position of the forensic anthropologist and better aiding both society and the justice department

(chapter 7). Improvement of information collected during the investigation and subsequent interpretation can lead to a higher chance on identification of a deceased in difficult comingled cases and possibly an improved workflow, less criminal cases being missed and, possibly, miscarriages of justice can be prevented (chapter 7).