

# Natural Mummification as a Basis for Forensic Interpretation of Time Since

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## Introduction

Natural mummification – or at least partial mummification – is far more common in our climate than usually assumed. Therefore the Hartmann case is a good example. In 1983 on October the 21st the partly mummified corpse of Reinhold Hartmann (Fig. 1) was found in a forest near



Fig. 1 - Partly mummified corpse.



Fig. 2 - right forehand of Reinhold Hartmann of Reinhold Hartmann.

Ulm, southern Germany. The body leaned against a tree and was partly covered by a dense sleeping bag. Although the forest conditions – especially humidity and insects supporting decomposition – are rather disadvantageous for mummification, in the mentioned case the right forehand (Fig. 2), both hands and feet, parts of the head and the abdominal wall were mummified.

Even for experts it is often difficult to assess time since death in such cases. Normally it can be only roughly estimated but determinations after the identification of the

person often give grossly different dates.

So the question is open whether the phenomenon of natural mummification could be used for a more exact determination of time since death, and how this could be achieved in practical

terms. However, for this purpose it is necessary to gain better insights into the process of mummification, and to identify the impact of individual factors.

It has been the aim of this project<sup>A</sup> to investigate the impact of various factors both in controlled experimentation and by assessment of autopsy records from the Institute of Forensic Medicine at the University of Erlangen. Experiments were predominantly focussing on the impact of temperature whereas the assessment of the autopsy protocols focussed on the impacts of sex, age and constitution, as well as cause of death, clothing and seasonal distribution of the cases.

## Material and methods

With this aim, we conducted drying experiments with parts of animals in a drying cabinet. Parallel to the experiments, available autopsy reports for the years 1995-1998 and 2003 at the Institute of Forensic Medicine at the university in Erlangen-Nürnberg were scanned for cases involving partial mummification of the extremities. Out of 3243 cases, 86 could be selected in which the state of dried soft tissue was explicitly described as «mummified», or at least «extremely desiccated». A data bank was set up, recording anonymously for each case not only sex and age, but also the month in which the corpse was found, clothing, cause of death, and previous health conditions. To analyse the influence of the temperature on the process of mummification we experimentally dried pig paws – hooves and bristles removed – in a drying cabinet. In each experimental run, three paws were dried on absorbent paper towels until their weight remained almost constant. After a test run of two weeks, four experiments were conducted at 30°C, 35°C, 40°C and 45°C, starting with the highest temperature. To avoid any influence of draught, the ventilation was set to maximum. The loss of weight was measured daily. Humidity, room temperature, experimental temperature as well as the temperature inside one paw were measured simultaneously.

## Results of the assessment of the autopsy protocols

Whereas assessed data do not permit an interpretation of the impact of clothing and seasonal distribution on natural mummification, tendencies are observable concerning sex, age, constitution, and cause of death. The ratio between males and females (1:0.83) shows a slight, but not significant, slant towards the male side though it might be expected that males should be less prone to mummification due to their more muscular constitution. But women have a denser social network than men, which would make it likely for female corpses to be found the sooner, at post-mortem intervals that are too short for mummification to set in. Evaluation of further autopsy protocols will make it more obvious whether social and constitutional differences cancel each other, putting cases that involve mummification in relation to the overall number of autopsies.

The age distribution shows a significant peak in the fifth decade which cannot simply be explained by age itself. Closer inspection of these cases showed that it is probably not so much the age but rather constitution that has an influence on mummification.

The results for physiological constitution meet expectations. Underweight has a positive influence on a possible mummification, as does a loss of fluids, e.g. from various diseases. Nonetheless, mummifications of overweight persons are recorded; they should be a result of favourable environmental conditions such as low air moisture or higher temperatures.

A less direct influence appears to be pertinent for the ratios for cause of death, as well. Data assessment found peaks for narcotic intoxication and cardiac failure. On the assumption that those of the deceased who died of narcotic intoxication had had a drug habit for some time before death, inflicting prior weight loss, it would again be the loss of weight that turns out to be the real factor for mummification.

For cases of cardiac insufficiency, considerations about properties of the entire autopsy database are valid in a way that is similar to the case of age distribution: cardiac failure is a quite frequent cause of death. Beyond that, however, sudden death may still be a cause of extended post-mortem intervals and thus indirectly favourable of mummification.

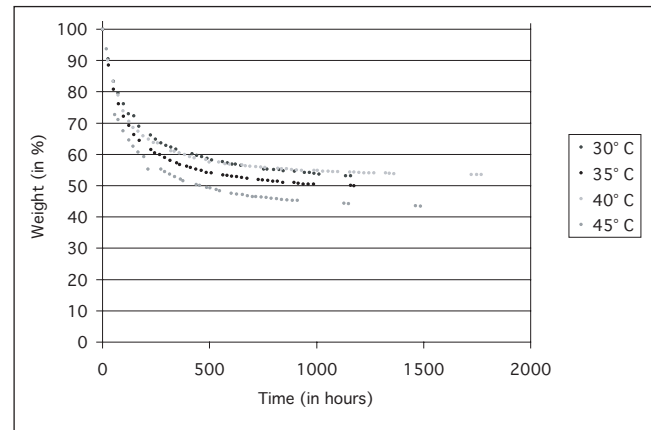
For cases of death through gunshot or suffocation, mostly as a consequence of suicidal intent, this category was found to provide a higher frequency of mummifications, as well. In these cases, it is more likely that the remote locations chosen for suicides are the reason of longer post-mortem intervals and so favourable for mummification than would be the cause of death itself.

## Results of the drying experiments

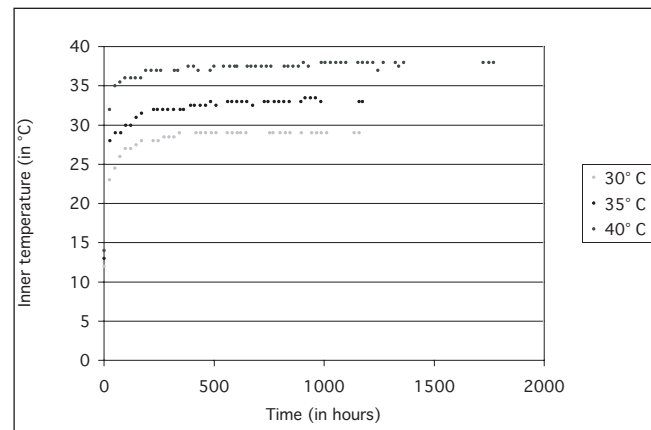
For better comparison, the results of the weight measurements were converted into percentages of initial

weight, and the mean values per experimental temperature were measured against time (Tab. 1). In principle, data show as anticipated that higher temperatures cause a faster and slightly higher loss of weight. The 40°C hyperbola differs noticeably from the others. It is flatter, the loss of weight is comparatively less. Right now the reason for this discrepancy cannot be explained.

In analogy with the loss of weight, the increase of inner temperatures measured during the experiments at 30°C, 35°C and 40°C was measured against time (Tab. 2).



Tab. 1 - Mean values of weight loss, measured against time.



Tab. 2 - Inner temperature, measured against time.

In all three experiments, inner temperature increases slowly, but never reaches experimental temperature. Moreover, inner temperature rises in increments. The reason for the slow increasing of temperature is the evaporative cold, which works against the warming of the samples to the experimental temperature as long as any liquid is evaporating.

As the mean values of humidity and room temperature were almost constant (38,8% and 23,8° C), the differences between the experimental runs could be led back mainly on the different experimental temperatures.

## Conclusion

The loss of weight and maybe also the difference between inner and outer temperature could be a suitable

A. Rauch et Al.

measurement of the degree of drying and therefore also for an estimation of time since death. Since classic methods to determine time since death are based on early changes of corpses, a statistical interpretation of the mummification process would be a valuable contribution and an efficient instrument for the resolution of cases that involve an extended post-mortem intervall.

But this study can only give a first glimpse on the process of natural mummification. For scientific implementation in human biology and forensic medicine, it will be necessary

to assess more file material and to conduct further series of experiments, varying factors beyond temperature.

### **Literature Cited**

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