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Reviewed Article:

The Attack on the Tooth Worm

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A unique approach to heritage interpretation; by analysing and reconstructing medieval dental treatments through research and re-enactment.

It is the year 1350 in Gravendam, the medieval town of Archaeological Open-air Museum (AOAM) Archeon in the Netherlands. There is a great deal of commotion on the street when the master cabinetmaker, John, screams out in pain and despair caused by a cavity in one of his molars. The sound of his scream is heard by everyone! His wife, Marte, tries to reassure him, at

the same time scolding him for not going to see the barber surgeon, Master William, sooner. She pushes him into the workshop of Master William, who is ready to examine the poor patient. A crowd has gathered outside the workshop, all curious to see what horrific scenes are about to take place.

> Medieval healers had no idea that dental caries was the cause of tooth decay, they were only concerned about the balance in between the humours. After all, they had no idea that there were bacteria causing caries because they were so small that they could not see them.

Master John has toothache (See Figure 1): the barber surgeon knows that the treatment will be very painful. Master William will proceed, just as he has been taught, with caution but also with determination. He knows that it is forbidden to just rip the affected tooth from the poor man's mouth because it is far too dangerous as you will see. How will he treat the unfortunate patient and how is the patient relieved from his pain? And what will be the best outcome of the treatment?

In this second article about medical medieval treatments in Archeon, the cause of a cavity (hole) in the tooth and the treatment of this medical problem is both described and interpreted.

Introduction

Archeon wants to preserve the cultural heritage of the Netherlands. Dressed in traditional costumes, archaeo-interpreters bring the local cultures of prehistory, the Roman era, and the Middle Ages alive for a wide audience. The archaeo-interpreters show how people lived, loved, worked, and interacted with their environment. Archeon has 43 reconstructions of huts and houses of the Netherlands and Belgium. The houses of Master John and Master William are both situated in the medieval Herenstraat. In the house of the barber surgeon the master gives the visitor insight into the 'medical' routines and techniques of the late Middle Ages, displaying the differences and similarities between past and present medicine and treatments (See Figure 2).

The theory of humors: the natural things

A treatment of a hole in a tooth in medieval medicine is based on the theory of the balance and relationship between the believed four bodily fluids and their importance for health. Leonard Rosenman, the writer of *The Major Surgery of Guy de Chauliac*, a famous French surgeon (circa 1300-1368) describes the ideas of the ancient masters Hippocrates and Galen (Rosenman 2005:24).

The four bodily fluids or humours are blood, yellow bile, black bile, and phlegm, which are present in the body of every person, but are mixed differently in each. The humours have the qualities of hot, cold, dry and wet, which are derived from the four elements. Phlegm is cold and humid; yellow bile is heat and drought; black bile cold and drought; blood is heat and humid. The body has to be in balance and there should be no disturbances in the body fluids. When

there is an imbalance caused by too much or to less of one of the humours in the body, it can cause rotting or dryness. Thus the cause of the disease is this imbalance and that means that it is a threat from inside the body.

The non-natural things

Besides these four bodily fluids, there are factors in behaviour of man that also affect the balance in the body. These six rules are mainly preventative measures to keep the bodily fluids in equilibrium:

1. The air we breathe;
2. The food we eat and drink;
3. The work and rest or proper use of exercise;
4. The rhythm of sleep and wakefulness;
5. The control of the excretion and retention of body fluids;
6. The control of the character and moderation in joy, anger, anger, fear and sadness.

More about the humours in the first article about medieval medical reconstructions

Reconstruction in Archeon

Re-enactment of the dental treatment carried out on Master John the cabinet maker was done twice: the first time as a dress rehearsal; the second time in front of an audience of visitors of Archeon who happened to be there at the time (See Figure 3)

The main Medieval source

For this re-enactment we used the handbook *Cyrurgia* written by the Flemish surgeon Jan Yperman (circa 1265-1335) who was born in Ypres, which is now in Belgium. The writer set out, in his own language, in seven chapters all the knowledge and experience he had gained during his working life. The book was dedicated to his son who succeeded him as a surgeon (van Leersum 1912). Not much is known about Jan Yperman because the archives of his native city were lost in the First World War. Therefore, it is not known where or how he was educated as a barber surgeon. We can speculate that he may have learnt his profession at the University of Paris under the surgeon Lanfranc from 1297 to 1303 (van Leersum 1912:11).

In this book Yperman described traumatic disorders and treatment of the human body, from the head to the toe. In the fourth chapter, which is about the mouth, he wrote about toothache and the causes and treatments of it. He also described a dental instrument and its use.

The reconstruction of the dental instrument

The manufacture of the instrument used in the re-enactment was based on the translation of the Medieval texts. Yperman described the instrument as follows: “Take a small iron pipe in which an iron pricker is inserted” (van Leersum 1912:113).

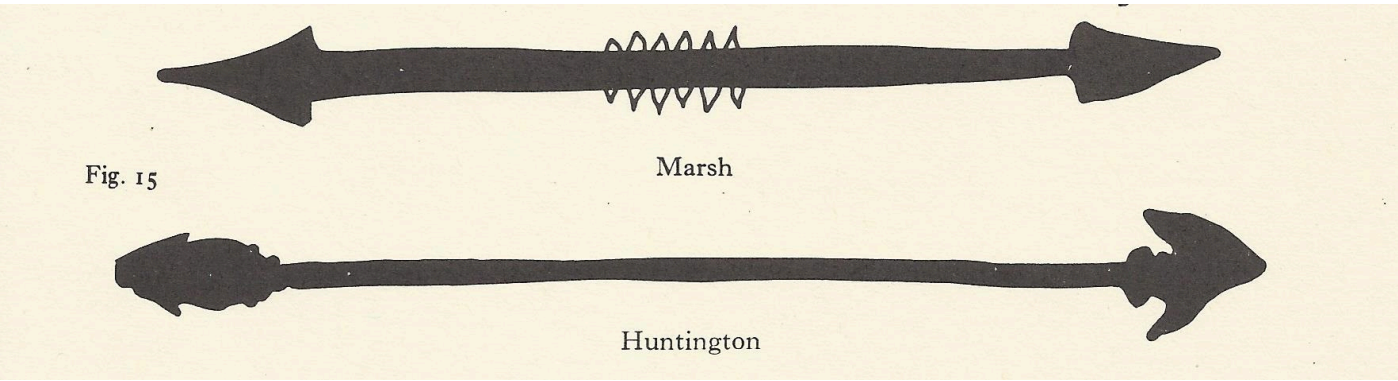

FIG 4. DRAWING XXXIV OF YPERMANS DENTAL INSTRUMENT (VAN LEERSUM 1912:290)

Interpretation

From this description we have an idea how this dental instrument might have looked. However, when the text was compared with drawing XXXIV in Ypermans book we were not sure anymore. We could not understand the meaning of the shape of the tube, which is round. We could not understand either the difference in color in the drawing (grey and black) and the dot in front of the needle. As far as we know there have been no archaeological finds of this or similar medical instrument by which we could make a comparison.

Therefore, we searched for other sources, and compared the Medieval text and drawing with information from the Arab physician Al-Zahrawi also known as Albucasis (936-1030) (Spink and Lewis 1973:66-68).

Albucasis described the treatment with a hot needle. (cauterization) Drawing 15 is the cauter (pricker) and drawing 16 is the tube in which the cauter is inserted.

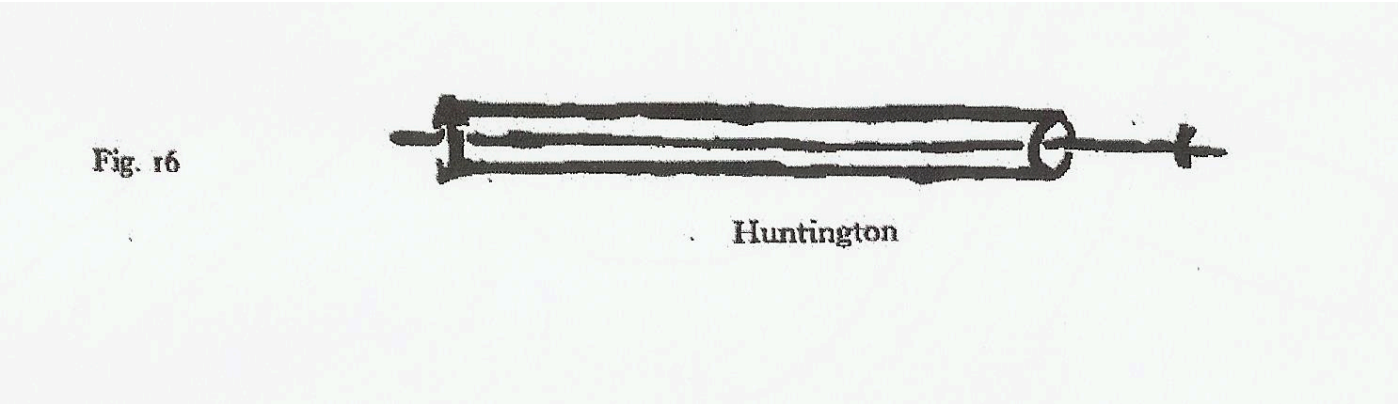

FIG 5. DRAWING OF ALBUCASIS DENTAL INSTRUMENT (SPINK AND LEWIS 1973:67-69)

He described the cauterization thus:

> *Take a pipe made of bronze or iron with a bulge in the middle so that the intensity of the fire does not reach the patient's mouth. Heat a cauter as shown in the drawing. Bring the cauter in the hole of the tooth and wait until it cools down. Do this several times, the pain*

will surely pass, the same day or the day after.
(Spink and Lewis 1973:68)

Interpretation: Albucasis described the pipe with a bulge, which may explain Ypermans drawing with bulge and nozzle. But Albucasis did not illustrate this bulge as can be seen in drawing 16.

In The Major Surgery of de Chauliac, Rosenman noted that de Chauliac used few illustrations in his work, and he therefore referred to the first accurate set of drawings of medical instruments, originally made by Hieronymus Brunschwig (ca.1450 - ca. 1512) (Rosenman 1912:680-682, figure 18 18a en 18b)

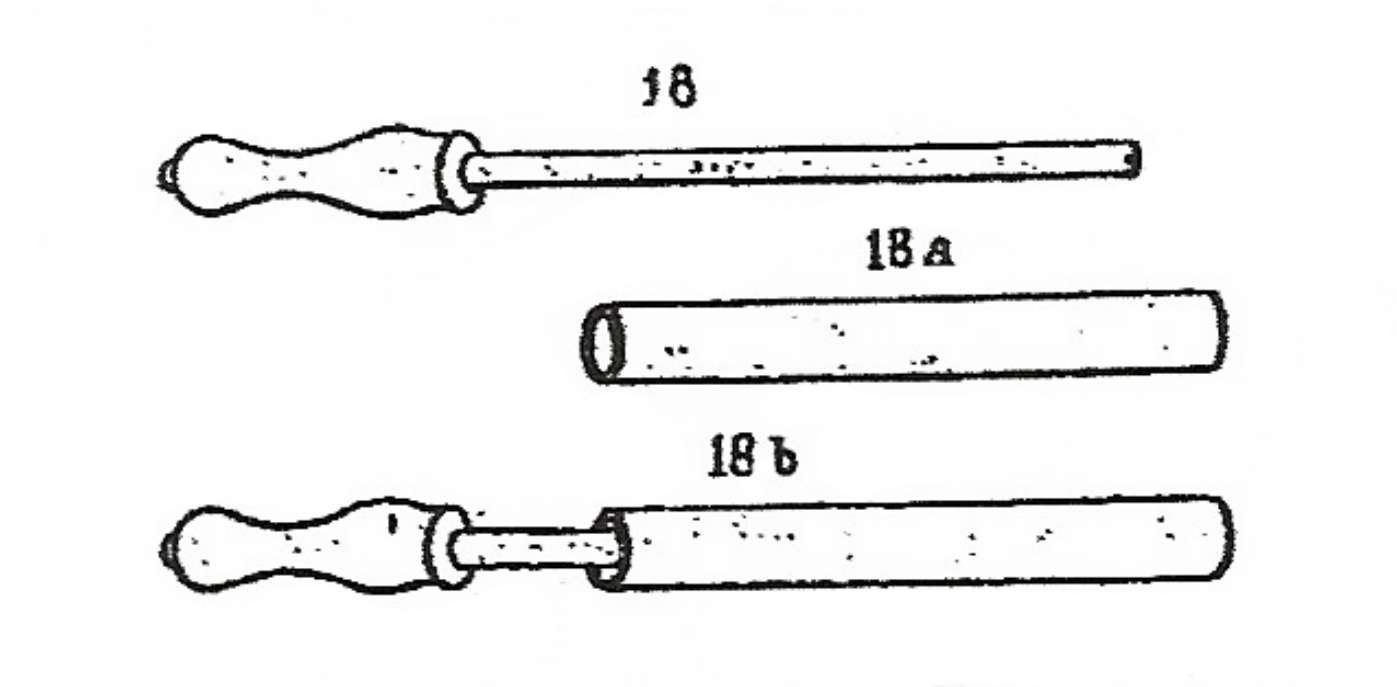

FIG 6. DRAWING OF BRUNSCHWIGS DENTAL INSTRUMENT (ROSENMAN 2005:692)

Final choice

In the final reconstruction the bronze dental instrument based on to the drawing of Brunschwig was chosen. The turner in Archeon made two tooth prickers with different centre lines. In the near future the instruments described by Albucasis and Yperman will be made and compared with each other (See Figure 7)

Diagnosis

"It often happens that there are gaps in the teeth that are caused by a flow of cold fluids, the rotten humours, this flow will result in holes in the teeth. Sometimes worms are growing in the jaw as you will know, when these worms lay still the teeth do not hurt. But if they are moving then it hurts"
(Translation of a Middle Age Dutch text about the mouth Van Leersum 1912: 113-114)
(See Figure 8)

Interpretation

Yperman mentions that one of the causes of cavities is the stagnation of the cold and wet

phlegmatic humour, expressed by mucus. Our interpretation is that this observation was similar to what he and others had seen in nature in stagnant water and wormy fruit. Phlegm is made in your head and if there is too much of it, it will descend and leave the body causing a cold, but the phlegm can also stagnate in the jawbone. Yperman wrote that he did not always observe worms in teeth. Toothache was caused by the movement of the worm when he is busy eating a way out of the jawbone into the tooth and peeping out through the cavity.

Warning about tooth extraction

> *If there are holes in teeth with pain and the teeth are not loose the teeth should not be extracted. In many people this resulted in a fatal outcome without healing, many are deceased in this.*

Interpretation

Extraction of teeth without proper anaesthesia or analgesia, and with primitive instruments is a traumatic and dangerous affair as is described in the following text:

> *And if they continue to live there is often a jaw abscess and bone splinters coming from the jawbone. Fistulas arise in the jawbone and the jaws remain forever thick. But if the teeth are loose then there is no problem. So pull the teeth and do not if they stuck yet.*

Treatment

> *Medication: If the teeth are fixed and you do not want to extract them, as the old masters warn us, then take olive oil 1. ʒ, marjoram and seed of hemlock (in Latin Cyuta or Conium maculatum) of each .½. ʒ. (GRD) and cook together.*

Interpretation

Marjoram (Majorana hortensis) was used in pain with spasms. Hemlock (coniine) was a popular and mythical poison; Socrates committed suicide with it. Both the Greek Scribonius Largus, and Dioscurides recommended the use of hemlock in the case of a tooth worm. (Kanner 1936:123-124) (Daems 1973:94-95) A pound is 12 ounces, an ounce into 8 drachms
https://en.wikipedia.org/wiki/Apothecaries%27_system

(See Figure 9)

Treatment

> *Take a small iron pipe into which an iron pricker has been inserted and which has been heated in a flame. When the end of the pricker is hot enough then dip it in the described oil. Plug the tube seven times in the cavity, but be careful you do not burn the lips or gums. The patient is likely to produce a great deal of saliva when this is carried out.*

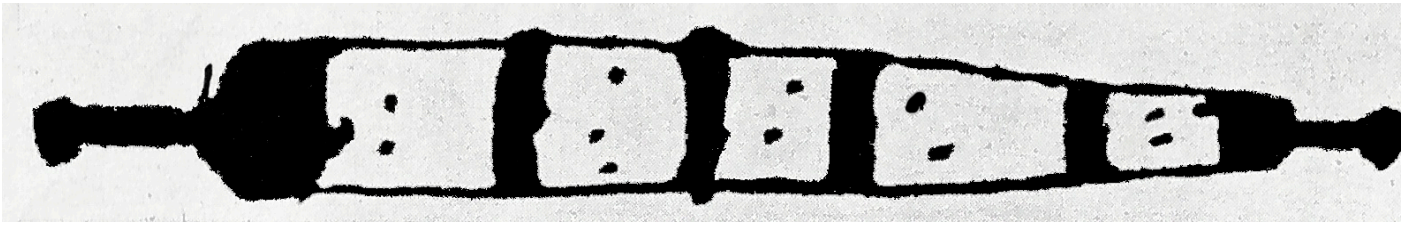

FIG 10. DRAWING XXXIV YPERMAN (VAN LEERSUM 1912:290)

Interpretation

A modern interpretation of the treatment could be that the nerve is destroyed by the red-hot needle. Ancient surgeons seem to have known nothing about this as it is not mentioned in the literature. When, after sometime, the tooth becomes loose it could be removed without the complications mentioned above.

Additional information

The cause of tooth decay

Medieval healers had no idea that dental caries was the cause of tooth decay, they were only concerned about the balance in between the humours. After all, they had no idea that there were bacteria causing caries because they were so small that they could not see them.

The prevalence of tooth decay in the Middle Ages

Statistical analysis was obviously not used in ancient medicine. The only way to get an idea of the prevalence of tooth decay is through archaeological research of exhumed skeletons. The bioarchaeological study of medieval burials on the site of St Mary Spital (Conell et al. 2012) describes more than 10.000 skeletons, with dates ranging between 1040-1539. The medieval priory and hospital of St Mary Spital was founded around the year 1197 and took care for the poor and pilgrims, elderly and sick people. The excavated bodies from the site were carefully studied for evidence of disease and injury. Burials were divided into four chronologic periods: Period 14, circa 1120- 1200; Period 15, circa 1200-1250; Period 16, circa 1250- 1400 and Period 17, circa 1400-1539 (Conell xix).

Diseases of the teeth, and therefore tooth decay, have also been studied and described. The large sample in this study provides a useful indication of the prevalence of dental caries and as such, have produced some notable figures (Conell: 40-46):

In all the four periods the caries rate was 8.6 to 13.3 %, averaging 9.2% being in 8040 of 87.315 teeth; In all the four periods the caries rate in adults was average 10.3 % being in 7604 of 71.883 teeth; In all four periods the caries rates in sub adults was average 4.1 % being in 636 of 15.432 teeth. Caries highest frequency occurred in the cheek teeth and the first molar, followed by the second and third molars. The number of caries cases in adults increased from 8.6 % in period 14 (c 1120-1200) being 558 of 6515 teeth to 13.3 % in period 17 (c 1400-1539) being 1198 of 9020 teeth. The number of caries in adults increased significantly from 10.3% in period 16 being 4047 of 39.143 teeth to 13.3 % for period 17 being 1198 of 9029 teeth.

Comment

It is difficult to compare information about tooth decay in the Middle Ages and to the present. A recent Wikipedia article has this to say about about dental caries in the 21st century:

> "…. w*or ldwide, approximately 2.43 billion people (36% of the population) have dental caries in their permanent teeth. In baby teeth it affects about 620 million people or 9% of the population. The number of cases has decreased in some developed countries, and this decline is usually attributed to increasingly better oral hygiene practices and preventive measures such as fluoride treatment. Nonetheless, countries that have experienced an overall decrease in cases of tooth decay continue to have a disparity in the distribution of the disease.* https://en.wikipedia.org/wiki/Dental_caries#epidemiology

Conclusion

Reconstruction with re-enactment

The reconstruction of this medical treatment from the Middle Ages cannot be viewed as an accurate archaeological experiment, as described by Yvonne Lammers (Lammers-Keijsers 2005). The treatment could not obviously be performed on people. However, the medieval texts were translated and interpreted, the scenes depicted by those texts were faithfully reconstructed, and the treatment was re-enacted using the knowledge and insights that were gained from the textual research.

These activities have brought us a lot of fun, knowledge and understanding by which we are able to transfer the medieval treatment to the contemporary visitors of Archeon. Through these experiences the differences and similarities of the medical treatment in past and present will be explained. In the near future reconstructions of the medical instrument by Yperman and Albucasis will be made

Live interpretation

I would like to quote my Archeon colleague Marc van Hasselt, who is also chairman of the International Museum Theatre Alliance. (IMTAL)

> *Demonstrating skills and knowledge of our ancestors in an attractive way, through live interpretation, is important. A personal connection to another person will leave a lasting impression with the audience. They are invited to not only assimilate information, but to experience what it was like to live in bygone days. Everyone knows what a tooth ache feels like, but the treatment places this feeling in a new context. Through a well-researched script, a theatrical performance can be given that invites those present to place themselves in the shoes of their ancestors, in this case those who had tooth aches. It goes beyond demonstrating skills, it is about the mental world and personal experiences of people from the past. That personal connection makes the experience special and memorable.*
> (HASSELT, M van, et al. 2015. *Live Interpretation in Archaeological Open-Air Museums*)

(See Figure 11)

Acknowledgements

I would like to thank Dr Mike Young, BA BDS MSc, a former dentist and now author, and Dr Kirsti Hänninen, archaobotanist, specialised in the material groups of seeds and fruits, and wood and charcoal, working for BIAX Consult, for reviewing this article.

The experiment was teamwork
I would like to thank my colleagues for their participation in the preparation of the reconstruction and assistance in writing this article: Fokko Bloema, Evelien de Haan, Marc van Hasselt, Marloes Keereweer, Roelof Knijpstra, Yvonne Lammers, Paula Perquin, Jan Rebergen and Joerie van Sister.

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Country the Netherlands

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WIKIPEDIA "Dental caries" https://en.wikipedia.org/wiki/Dental_caries#Epidemiology

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Gallery Image

FIG 1. “WE HAVE TO TREAT YOUR PROBLEM, MASTER JOHN,” THE SURGEON SAID. PHOTO BY VERA BOS

FIG 2. MASTER WILLIAM IS WAITING FOR A PATIENT IN MEDIEVAL ARCHEON. PHOTO BY HANS SPLINTER

FIG 3. THE SURGEON WANTS TO AVOID THE EXTRACTION OF THE TOOTH. PHOTO BY VERA BOS

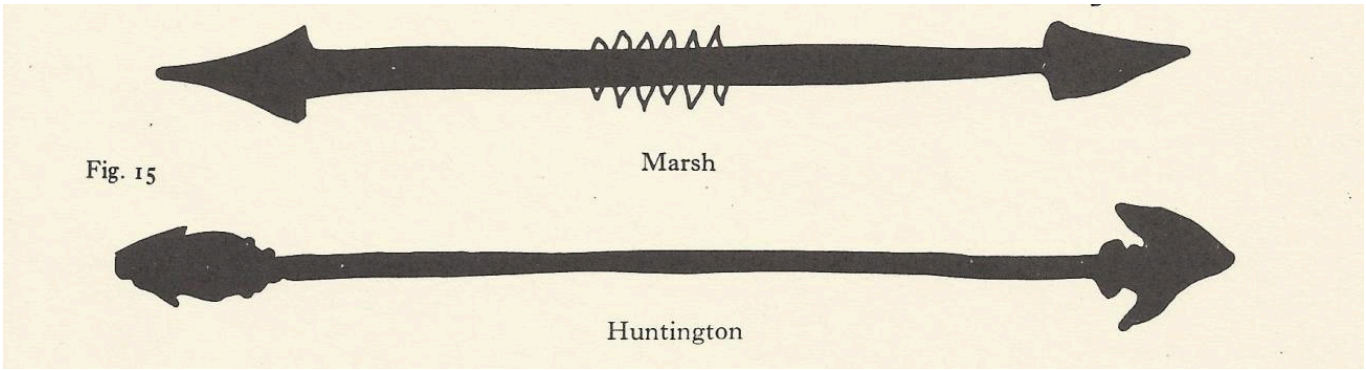

FIG 4. DRAWING OF ALBUCASIS DENTAL INSTRUMENT (SPINK AND LEWIS 1973:67-69)

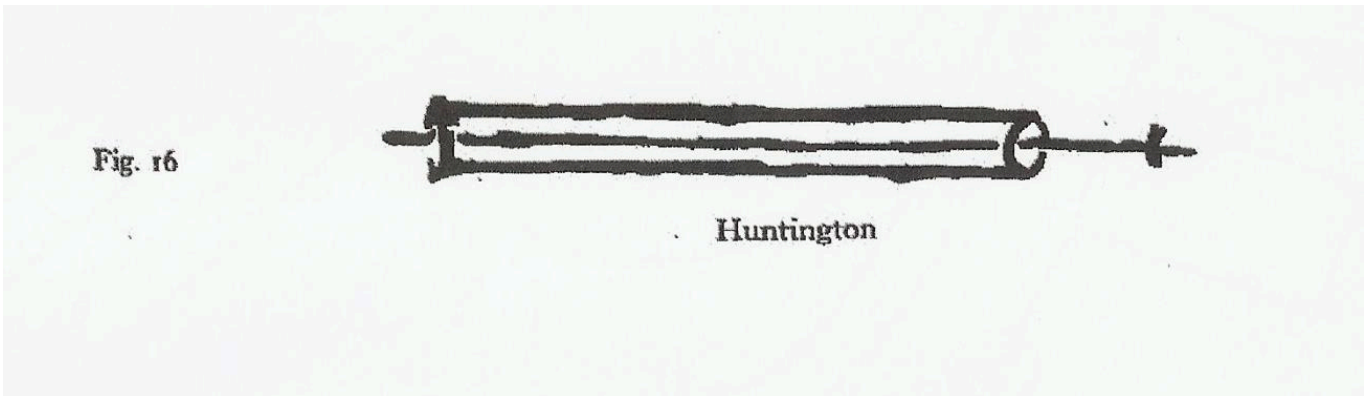

FIG 5. DRAWING OF BRUNSCHWIGS DENTAL INSTRUMENT (ROSENMAN 2005:692)

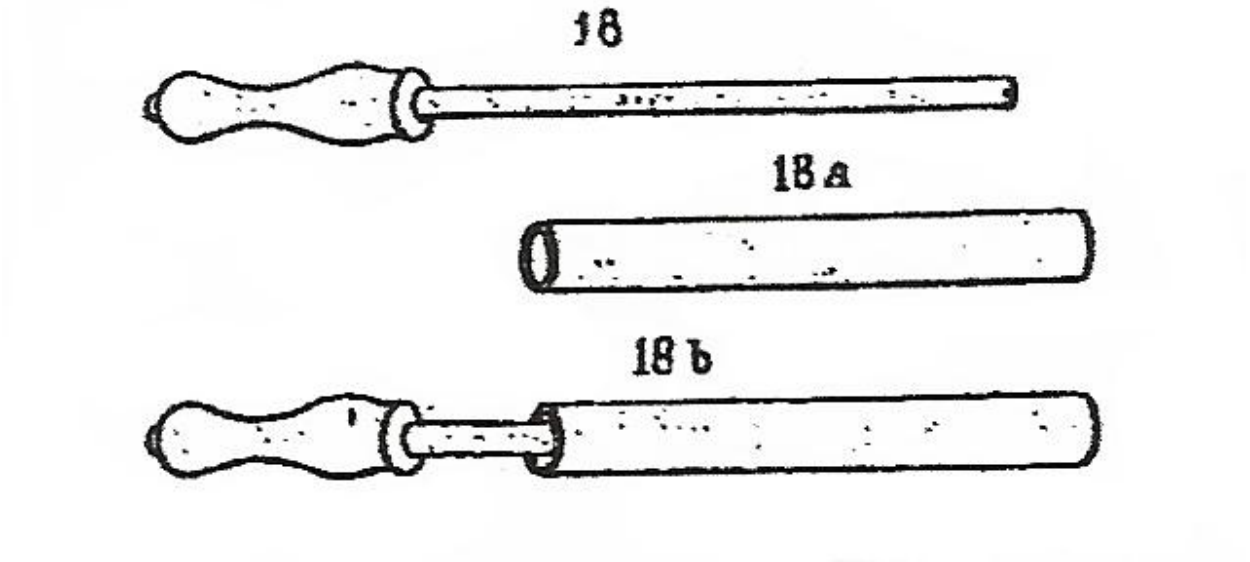

FIG 6. DRAWING OF BRUNSCHWIGS DENTAL INSTRUMENT (ROSENMAN 2005:692)

FIG 7. THE ARCHEON RECONSTRUCTION OF THE DENTAL INSTRUMENT PHOTO BY ROELOF KNIJPSTRA

FIG 8. THE HORROR OF THE TOOTH WORM. IVORY CARVINGS: "THE TOOTH WORM AS HELL'S DEMON", SOUTHERN FRANCE, 18TH CENTURY; THIS ARTISTICALLY DESIGNED CARVING IS CONTAINED IN A MOLAR, 10.5 CM IN HEIGHT, WHICH CAN BE SEPARATED INTO TWO HALVES OF EQUAL SIZE. IT OPENS OUT INTO TWO SCENES DEPICTING THE INFERNAL TORMENTS OF TOOTHACHE AS A BATTLE WITH THE "TOOTH WORM".

FIG 9. JUST ADD A DROP OF HEMLOCK. PHOTO BY VERA BOS

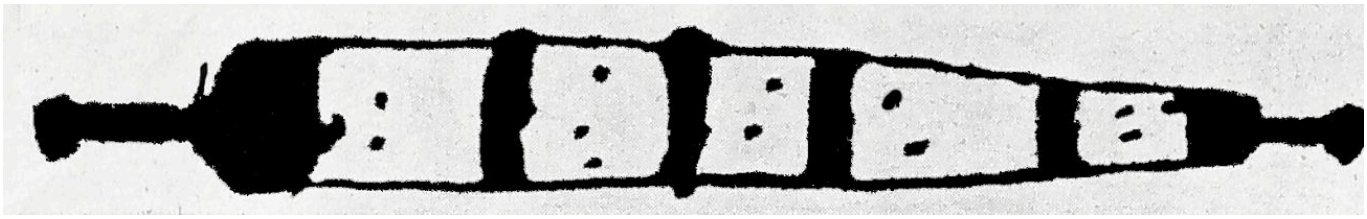

FIG 10. DRAWING XXXIV YPERMAN

FIG 11. ALSO THE MODERN AUDIENCE IS EAGER TO SEE THIS PAINFUL TREATMENT. PHOTO BY VERA BOS