TIMS 15th Transactions

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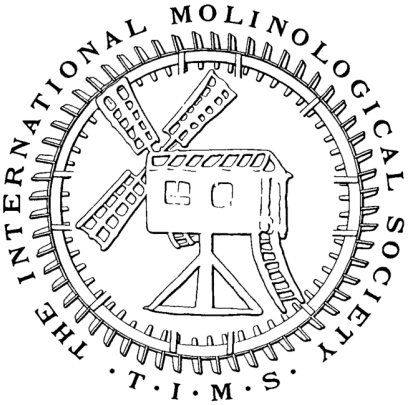
TRANSACTIONS

of the 15th International Symposium
on Molinology

— LESEPROBE —

Berlin, Germany, 18-24 August 2019



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Logo design: Christian Jammrath, Germany

Front cover photo: Britzer Mühle, Berlin (Gerald Bost)
Back cover drawing: Gearing of the Britzer Mühle, Berlin (Rüdiger Hagen)

ISBN 978-92-9134-031-6

By submitting one or more papers or other material for this volume, each author has agreed that his/her paper(s) or other material will be published in this volume.

TIMS Berlin e.V. is a charitable organisation to Molinology (NPO)
founded in 2018.

TIMS Berlin e.V. was set up in 2018 as a registered charitable body, raising money through donations for the fiancial promotion and support of objectives concerned with mills and milling that have an educational purpose. By creating a formally registered charitable organisation (eingetragener Verein), citizens of Germany have the benefit of their donations and bequests being tax deductible.
TIMS Berlin e.V. is registered at Amtsgericht Berlin-Charlottenburg – VR 36315 B

Tax Registration / Steuer-Nr.: 27/678/57219

TIMS Berlin e.V. is listed in the "Transparent Database of the Senatsverwaltung für Finanzen, Berlin.
Registration-Nr.: vr_036315

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INFORMAL PAPERS

Sponsors and supporters for the 15th TIMS Symposium 2019 – Berlin

Many thanks to the all sponsors who supported this event. Due to these donations, we were also able to invite TIMS members from abroad, who otherwise would not have had the opportunity to travel and to present their paper, due to the economic situation in their home countries.

Britzer Müllerei e.V., Berlin
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DGM - Deutsche Gesellschaft für Mühlenkunde und Mühlenerhaltung, Minden
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Landgasthof Jagstmühle, Heimhausen
Restaurant Lauenburger Mühle, Lauenburg
terra press GmbH, Berlin
Profiler-Bost, Consultant, Berlin

Acknowledgements

Thanks also to the many mill owners and mill associations who made our visit to the mills unforgettable through their hospitality. Many mill friends supported me in the preparation and during the symposium: Simone Titze, Benedikt Frie, Torsten Rüdiger, Rüdiger Hagen, Michael Schillhaneck, Johannes Härich, Jürgen Wolf, Dr Jochen Hennig, Manfred Lorenz, Philipp Oppermann, Bettina Böhme, Moslem Mishmastnehi, Reinald Pottebaum, Ansgar Rahmacher, Friedrich Rohlfing, Gundolf Scheweling, Monika Schillhaneck, Leo van der Drift and of course my family. Very special thanks to my brother Dietmar Bost, he was not only a great assistant for me, he also managed our mill excursion very well.

Dr. Ulrich Bleyer, former Director of URANIA, supported and encouraged me for the special event of our paper session at the URANIA. The simultaneous translation during our event at the URANIA was not easy, but the simultaneous translator was able to translate in several languages with confidence. Thanks to Julia Bittermann, Berlin.

Thank you to the Förderverein Deutsches Technik Museum, Berlin, who hosted our General Meeting at their conference room. They also provided access to some closed areas and mills.

Chairman's Message

These transactions are the outcome of the 15th International Molinological Symposium, held in Berlin, 2019. The objective of this particular event was to provide an update on the latest research on historic molinological issues. Over 100 mill enthusiasts attended, participating for a whole week in the discussions of the 27 formal papers and 11 short papers presented; the motto being "Mills in History and Archaeology".

Only every four years does a member of TIMS (The International Molinological Society) have the privilege of organising this event. During the previous event at Sibiu, Romania, in 2015, I presented an application for the 15th Symposium in Berlin. This was not only approved by the TIMS Council but passed unanimously by a vote of all TIMS members present at the General Meeting. Four years pass quickly with such a project and this was not the kind of job I could handle on my own; however, I already had the commitment of many mill friends and sponsors for support. By December 2018 I was in a position to present the final agenda and budget, and after calculating the price for the participants (checked again, and again) I sent out the invitation to all TIMS members.

Under normal circumstances the Symposium is for TIMS members only; however, the issue of protecting and maintaining historic mills is far too important to be kept only within this group. My second task was therefore to involve the public and having at least one day with excellent presentations on key subjects with very high scientific content. This took place on the August 18th 2019 at the famous URANIA conference centre in Berlin. This was the first time in TIMS history that we had held a public day for presentations on such a large scale, and the Governing Mayor of Berlin, Michael Müller, took over the patronage of the Symposium.

Prior to the Symposium itself, we organized a Pre-Symposium Excursion Tour to the regions of Saxonia and Zittauer Gebirge, and 42 TIMS members participated. During the Symposium we had several excursions and tours to mills in and around Berlin, and we visited the Technical Museum where our TIMS General Meeting took place, on 22 August. I would like to say "thank you" to the management and staff over there. The last task of the Meeting was to hand over the 'Symposium gavel' to our colleagues from Poland, and we wish them "all the best for 2023!". Immediately after the last day of the Symposium we started the Post-Symposium Excursion Tour to Lower Saxony and the Harz region, with 33 participants. Rüdiger Hagen, who organized this tour, also acted as a great tour guide for us – many thanks.

Thank you very much to all supporters, all visitors, TIMS participants and those who presented their very interesting papers. Also, special thanks to our mill friend Dr. Moslem Mishmastnehi who presented part of his thesis on 'Technical and Archaeological Studies of Persian Windmills and their Millstones' to the large audience at the URANIA. This paper is not printed in these transactions because of work still in progress.

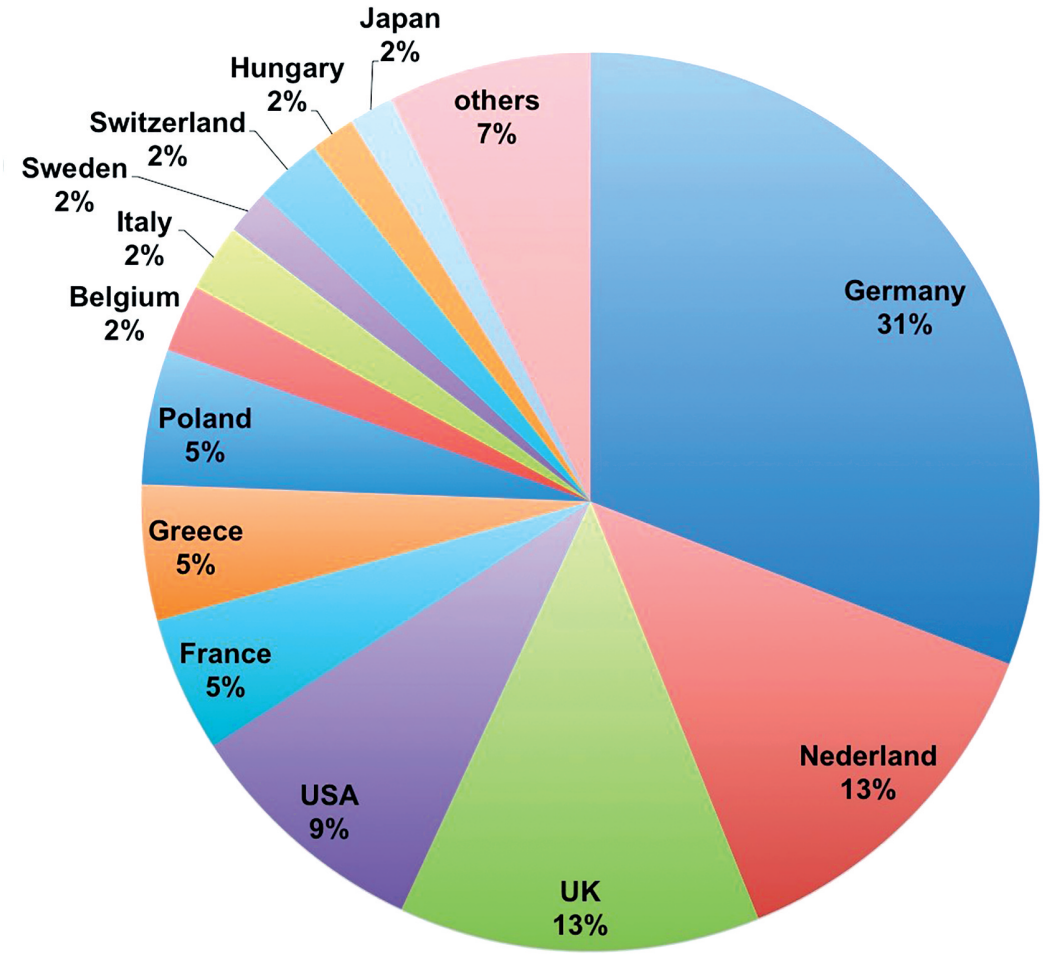
Today I have to say that I was very lucky to organise and run this event before the Coronavirus pandemic started. Enjoy reading the Transactions!

Gerald Bost
TIMS Symposium Chairman
15th International Symposium
Berlin, January 2021

TIMS 15th International Symposium on Molinology

18-24 August 2019, Berlin, Germany

Participants by Country



Number of participants: 123
Number of countries: 22

Belarus	1	Iran	1
Belgium	3	Italy	3
Bulgaria	1	Japan	2
Czech Republic	1	Poland	6
Denmark	1	Portugal	1
Estland	1	Romania	1
Finland	1	Sweden	2
France	6	Switzerland	3
Germany	38	The Netherlands	16
Greece	6	UK	16
Hungary	2	USA	11

*Others = Country with one participant only

KEYNOTE PAPERS

The mills of Konrad Gruter of Werden / Ruhr (1424)

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The mills of the Vatican manuscript, Vat. Lat. 5961

A major problem of mill history in the Middle Ages is, above all, the lack of systematic texts and the rarity of detailed illustrations. In a larger work on sources of energy history, prior to 1500, (which we actually prepared at Aachen University) the chapter called 'Drives of mills and other Machines in the Middle Ages' fills nevertheless some 150 pages. Energy resources in pre-industrial times are, as you know, muscle strength, hydropower and wind power. The Vatican manuscript 'Vat. Lat. 5961', dated 1424, gives us specimens for each one of these categories in a systematic manner. If I am not mistaken, this would hence be the oldest presentation of molinology in Western Europe. The systematic treatise is formed in three main sections and a total of 72 chapters. The second part concerns molinology; first watermills (chapter 28-32), second windmills (chapter 33-36), third what the author calls quite mystically *molendina terranea* (those driven neither by water, nor by wind), which are in fact mills driven by horses or donkeys and (mostly) humans. In this presentation I will sometimes change the sequence of the pages relative to the manuscript in order to take into account the technical evolution of the different types of mills. Illustrations are on pages 42-45.

Hydropower

Many medieval illustrations show watermills, starting around 1190 with a manuscript of Hildegard von Bingen; a representation you all know. Next, follows a vertical overshot wheel from a Catalan manuscript. Another famous figure is found in the Luttrell Psalter; we also have images of some overshot or undershot waterwheels and their mills; but these are images without text. In the Vatican manuscript there are good illustrations giving separate details and always more explanation to say where the author has seen what he is describing. In addition, the manuscript of 1424 was discovered only in 1998, and from that I have prepared an edition in two volumes, aided by two valuable colleagues, Horst Kranz and Ulrich Alertz. The German translation of the Latin text is that of Horst Kranz. This edition appeared in 2006. A re-editing in English could help perhaps to support my brief remarks.

Chapter 32 shows a small rural watermill from the mountains of Ancona in Italy, a region with little rainfall. Water is stored in millponds, it falls almost vertically onto a horizontal paddle wheel. The vertical shaft drives the rotor stone of the mill without gears. In Mediterranean countries this type of rural mill was widespread; probably since Roman times, if we believe a statement by Pliny the Elder, who says that all Italy (*tota Italia*) used this type of mills. The old conviction that horizontal wheels were not efficient and confined to high mountains should be abandoned. The horizontal wheel spared water.

The image of chapter 31 (fig. 1) compares two vertical water wheels made in the best carpentry work. The front wheel receives the water falling from above into its chambers or buckets, so it uses the weight of the water as a drive. The rear wheel is undershot, and receives the impact of the water on its blades; so it does less, but works even in a slow current. The depiction is pedagogically meant to show the difference between the two main types of mill wheels. On the same watercourse (as represented on the image) the operation of both wheels was not possible, unless the two facilities were located on a steep slope.

Chapter 30 represents a suspension mill (*molendinum pendens*) suitable for changing water levels on medium-sized rivers. By means of a strong winch, the level of the mill wheel could be

adjusted. This type of mill is attested in Tuscany (a region studied by John Muendel) since 1220-1240, and provided here with a great windlass on the shore. The author explains that he saw such mills in Germany, in his hometown of Werden an der Ruhr, but also in Italy on the Arno (Florence), on the Nero river (Narni) and on the Cerchio river near Lucca. Our colleague David Jones has been studying this kind of mill (for TIMS) for many years, and Joséphine Rouillard in 1996 announced a special study on the suspension mills belonging to the cathedral of Sens. However, the early date of such a mill on the Ruhr near Werden is new, and its depiction in the manuscript is probably the most beautiful and accurate from the Middle Ages. The suspension mill later becomes the German *Panstermühle*.

Chapter 29 shows a great vertical wheel under water, inside the stream of a large river. The author does not indicate a specific site, but he adds that you could design and build a very good mill in this form. Commonly, the earliest specimen of this mill type is given some two hundred years later, in Veranzio's *Machinae novae* of 1615. The date of 1424 is important. Apparently no one had realized such a mill in practice, but the huge amount of energy in a river offered a new perspective: "All the way down to the bottom you sink a wheel, which then turns, no matter if the water rises or falls".

The force of large rivers was in fact used for many centuries. You may remember the story of General Belisarius defending Rome in 537, using ship mills instead of the great water mills of Mount Gianicolo stopped by the Goths. Since that date ship mills prepared flour for bakers in many European and even Islamic cities. Our author had seen such mills on the River Rhine in Germany, on the River Po and on the River Tiber in Rome. In chapter 28 his waterwheel is particularly large, supported on two barges. This introduces the wheels of the so-called *Woensamprospekt* of the city of Cologne, 1531. Prior wheels in Cologne are given to be much smaller, and it cannot be ruled out that plans conceived in Cologne for larger wheels had come to the attention of our author. Again, the illustrator has done a good job. The author explains: "The boats of this mill are fastened at a suitable place with the help of iron chains or chained lengths of timber or ropes on the bank or with a stake or with anchors in the river".

Wind power

Let's start here with a brief look into the history of the windmill. If Mediterranean Antiquity did not use wind power for machine drive, the Byzantine Empire certainly did, especially on the islands of the Aegean Sea. Most of these islands lacked water courses; they depended on wind power. Buondelmonte in his 'Geography of Greece' (1420) gives a windmill symbol on almost every island. At Gallipoli on the Hellespont, one of the Buondelmonte copies gives the figure of no less than 50 small tower windmills from the first Turkish period. Windmills of this type could be seen everywhere in this part of the Mediterranean Sea. So I think crusaders on their way to the Holy Land could not fail to remark on them and search for analogous solutions to use wind energy even in their homelands. However, we know, the heavy stone towers of the Greek windmills were not suitable on the soft subsoil of coastal regions in north-western Europe (Flanders, Netherlands, East England) where wind power was desperately needed due to the lack of slope for hydropower. But what about the Mediterranean parts of Western Europe? Their coastal regions offered geographically the same conditions as in the East. No wonder that we find in the coastal regions of Southern France (Provence) windmills of an analogous design to those on the Greek islands. Take the famous illustration of 13 tower windmills built on the pier of the port of Rhodes (1484) and compare them with the windmills of Arles and Marseille from 13th to 16th century. Illustrations are given by Jean Orsatelli in his beautiful book of 1979 (*Les moulins*, editions Jean Laffitte).

Chapter 33 (fig. 2) of the Vatican manuscript shows such a tower windmill, as it was widely known in Mediterranean countries. The cap of the mill, painted in blue, turns on little rollers. In the foreground we see the individual mechanisms; on the left the brake, on the right the gearing/transmission. The text says: "One can build small or big mills of this kind. The highest part of the tower, the roof cap, is made rotatable by certain under-laid rollers, so that it can be turned easily in every wind direction. Inside the roof cap, the shaft crosses the tower, it extends with one end two to three feet far beyond the edge of the tower". Yves Coutant has found such rollers mentioned here (instead of slipping curbs) at the same time in the Flemish Archives of Flanders. The technology was certainly imported from the southern parts of France.

Chapter 35 of our manuscript shows a very old type of tower windmill found originally in the Eastern parts of Persia. Our engineer had received the drawing from workmen returning from a region north of the Black Sea, *Sarmatia*, now southern Ukraine. This horizontal windmill, made of wood, is shielded on the right side against the wind. On the left side you see wooden slanted board blades instead of wings or sails. The mill works with winds from all directions. In Nootebaart's book on Windmills (1972) such tower mills do not appear in the Don area at such early date; he found these mills only in 18th century. With the Vatican manuscript we understand better why they were able to radiate from the Black Sea area to Poland and Scandinavia.

In chapter 34 we finally get the well-known Western windmill, the so-called Post mill, an invention of the time around 1180. We see a sack lift on the right side. The author writes: "If you want to build a windmill in a place where it would be difficult and expensive to build a tower (apparently because of the insufficient foundations in the sands of coastal areas), proceed in the following way". It follows the classic description: strong post, rounded on top, then the rotatable mill house with four wings, wheels, oblique shaft and, of course, the millstones.

Muscle power

In my opinion, the most original section of the Vatican manuscript concerns the mills powered by humans or animals. You may ask: Wasn't muscle power the oldest propulsion form of grain mills and even the most primitive? That's for sure. In the 14th – 15th centuries, however, in places where water and wind were not able to help, manual and foot-operated mills offered an alternative. They were needed especially in fortresses, but they had to become more efficient. Windmills on the outer wall of castles (e.g. isolated crusader castles in the Holy Land) were at risk from enemy artillery. So it was necessary to grind inside the fortresses; that is with human or animal muscle power. It was essential to connect the crank and the connecting rod as shown here (fig. 3) and further elaborated on in chapter 42. The connecting rod is still made of wood here, and is the simplest version.

Chapter 39 adds two large flywheels. A German mechanic is said to have built them for the Doge of Genoa: "He was quite astute in that, saying, if a single gear drives the gearbox on one side only, the pins of the gearbox on the opposite side are loaded by friction and a partial resistance arises. But if one compares this gear with another gear, there is no friction on any side, so a fast and frequent turning of said mill becomes more comfortable and effortlessly succeeds".

Chapter 36 shows a horse mill. The large gear should have 400-500 teeth, and the millstones should not be too big. Horse mills had been frequent in Roman underground mills. It seems that they became rare or non-existent in the Dark Ages of the Early Medieval period. Since the 13th century they replace watermills fallen out of use by shortage of water, later on they become more and more frequent.

Chapter 41 (fig. 4): In this large treadmill the whole weight of the mill mover becomes efficient. According to the text also donkeys or horses could be used. The author adds: "I have seen such a mill under construction with master Anton of Bologna for the lord of Ravenna. This millwright even mounted several wheels on this one shaft for various other purposes to be done by the mill". He continues: "I also observed a similar mill in Lucca when I was staying with my lord Paul of Guinigi, the lord of Lucca. By running a donkey on the concave inner surface of the wheel one turned countless silk spindles".

Chapter 42 shows two cranks driven by pedals on both sides. The designer has adopted the solution of the foot driven potter wheels or the foot drives of spinning wheels. The author met with such mills with foot drives in Venice, but originating from Friuli, and in Toscana (here with horizontal wheels), there (Friuli) with vertical. He adds: "Thus, according to the modifications of the wheels, there are infinitely many types of water, wind, and hand-driven mills, so that an end to their construction has hitherto not been found, nor is there any actual end to such constructions in the future".

Fig. 1. *ms. Vat. Lat. 5961 fol. 33r: Overshot and undershot waterwheels in comparison.*

Fig. 2. *ms. Vat. Lat. 5961 fol. 34r: Mediterranean tower mill, rotatable cap, gears and brake.*

Fig. 3. *ms. Vat. Lat. 5961 fol. 40v: Hand mill with crank and connecting rod for grinding in fortresses.*

Fig. 4. ibid. fol. 41r: Large treadwheel from Ravenna, two wheels on the shaft for various purposes.

II. The manuscript, its date and its author

The luxurious manuscript on parchment arrived in the Vatican Library in 1620. There it sat unused for almost 400 years. Philologists did not publish the text as they did not like the technical contents, and the technical historians hesitated because of the minuscule script and the extensive Latin texts. In 1998, the Berlin Professor Bernhard Schimmelpfennig sent me a little manuscript note that gave the 17th century catalogue description:

"*De AQUARUM conductibus, molendinis aliisque machinis et aedificiis, liber sine nomine.* About water conducts, mills and other machines, a book without the name (of the author)".

Schimmelpfennig wrote: "That might interest you", and it really did. Above all, the statement *de molendinis* – "About mills" was very tempting, because systematic treatises on mills in the Middle Ages were unknown to me until then. We had only studied mills in documents from certain locations and without further technical details. An employee of the Vatican Library informed me that all 72 pictures of the manuscript are framed in gold. He added: "The author has worked in many different places in Italy: Rome, Modena, Ferrara, Padua, Camerino, Lucca; he was visiting Florence, Venice and Ravenna". That sounded seductive, so I ordered a microfilm, first black and white, later also a coloured one. Most important was a message I read on fol. 31, a commentary to the picture of the hanging mill:

"*Talia enim molendina primo vidi in patria mea, in Werdena supra flumen Ruram.*
I first saw such mills in Werden on the Ruhr river, my home."

So the author came from North Rhine-Westphalia! We decided to prepare a print edition of the manuscript and obtained funding from the German Research Foundation (DFG). Dr. Horst Kranz prepared a careful transcription of the Latin text and translated large parts of it. I, myself, wrote the commentary and the introductory volume, and Dr. Ulrich Alertz gave commentaries to the illustrations and some digital reconstructions. The printing costs were borne by the Vatican Library. The cardinal librarian argued an 'editio princeps' had to appear in one of their book series, so the edition was published in volumes 428-429 of the series 'Studi e testi'. This explains why the edition was only available in the Vatican bookstore and not in the German book trade.

What was still missing was the name of the author. In the old catalogue of the Vatican Library we could read "book without name", it meant without the name of the author. We chose *Anonymus von Werden* or *Anonymus Rhenanus* - Rhenish anonymus, and this denomination remained, until everything was ready to print. Then I wanted to check once again details on the original manuscript. We drove to Rome, Dr. Alertz and myself. In the Vatican Library we had the little red-bound manuscript on the table, and I said to Alertz, "Check everything in the introduction what is said about the manuscript". He started to observe the golden letters on the first pages and copied them. At the beginning of many of the 72 chapters, these golden letters appeared in various numbers. Sometimes there was only one, sometimes two or three letters in gold. An explanation of this phenomenon I still had not found, so Alertz wrote the golden letters next to each other and found Chapter 1 ***Con***, Chapter 2 ***Ra***, Chapter 3-4 ***DuS***, did that mean ***Con-ra-dus***? He continued. Chapter 5 resulted in ***Gr***, chapter 6 in ***Ut***, chap. 7 in ***er***. Was that the surname ***Gr-ut-er***? So it went on. The rest was read together: ***Conradus Gruter de Werdena scripsit***. – "Konrad Gruter from Werden wrote that". That could no longer be a coincidence. We had found the writer or even the name of the author. The latter proved to be effective. The hidden information in the gold letters is called acrostic, which means "top stichon". As a rule, such acrostics are known from poems; in a technical manuscript I had not expected them. The complete acrostic of the first part reads as follows: CONRADUS GRUTER DE VVERDENA SCRIPSIT

With the surname Gruter resulted further research possibilities. Thus, in the accounts of the Abbey of Werden, we found information about the family. Likewise, the matriculation of the newly enrolled students of the University of Cologne, which dates back to 1391, reads: "*Conr. Fermentator de Werdena*". *Fermentator* - fermenter is the Latin translation of the Rhenish *Grutbierbrauer*, a job title that became a surname. *Grutbier* was a sweetish, short-lived, typically Rhenish beer that was later replaced by the more durable, transportable hop beer from northern

Germany. So much for the name of the Gruter family, but we have only discussed the first part of the encrypted information. In the second part of the acrostic there was the place name 'Venice' and the year '1424', which we had otherwise been unable to open up (Fig. 19): ANNO DOMINI MILLESIMO QUADRINGENTESIMO VIGESIMO QUARTO VENETIIS

In the third part too, the statements of the gold letters appeared completely new. It was Gruter's dedication to the client of the expensive manuscript, none other than an eminent European ruler, the King of Denmark, Norway and Sweden; at the same time he was Duke of Pomerania and therefore called Erik of Pomerania in the official census of the kings of Denmark Erik VII: SERENISSIMO DACIE NORWEGIE ET SUECIE ET POMERANIE DUCI ET CETERA

Many questions remain: when, where and why did the king of Denmark order this precious manuscript, why the gold frame, why the golden letters? Why did we find the manuscript in the Vatican Library and not in the King's Library in Köbenhavn (Copenhagen)? Why didn't the king acquire definitely what he had ordered? And how did the manuscript finally arrive in the Vatican? All this, however, has little to do with the mills of interest for TIMS. At best, one might ask why the king wanted not only to have a weapon book created (the third part), but also in addition to that, twenty-three chapters on pumps (leading the water upwards) and, in the second part, 18 chapters on mills and eternal wheels. Answers to all these questions can be found in the introduction of our edition with the necessary evidence.

This article is based on the volume by Dietrich Lohrmann, Horst Kranz and Ulrich Alertz: *De machinis et rebus mechanicis. Ein Maschinenbuch aus Italien für den König von Dänemark. 1393–1424,* 2 vol.,Città del Vaticano, 2006 (Studi e testi 428-429).

Discussion. None recorded.

SYMPOSIUM TOURS AND EXCURSION

Fig. 3. *The vertical gang saw, in a very crowded saw mill! (G. Hackney).*

with fast and loose pulleys in the basement connecting to the chain drive and rollers, which pull the logs through. The electrically driven horizontal saw was run for us, demonstrating the belt drive and friction wheels set at right angles to control the speed and power. The walls of the sawmill were enhanced with 'erotische fotografie' by Andreas Funke; perhaps a reminder of the calendar art that might have dressed the walls when in it was in operation.

The oil mill was producing flax seed (linseed) oil, with our group being treated to an expert demonstration by the operator. One litre of water is added to every 10 kg of seed to remove the bitter taste, which is then heated to 60° C for 30 minutes before being placed in circular pans for pressing in a hydraulic horizontal machine at 300 bar. The 10 kg of seed thus produces 2.5 litres of 'cold pressed' oil, sold at the mill. The remaining cake is sold for animal feed and when crushed is used as a crunchy outer coating when rolling out dough. Lunch was an interesting meal of baked potatoes added to a plate of a sort of whipped cream holding a lake of the flax seed oil and garnished with pickles and chopped onions.

Fig. 4. *Cooking the flax seed (G. Hackney).*

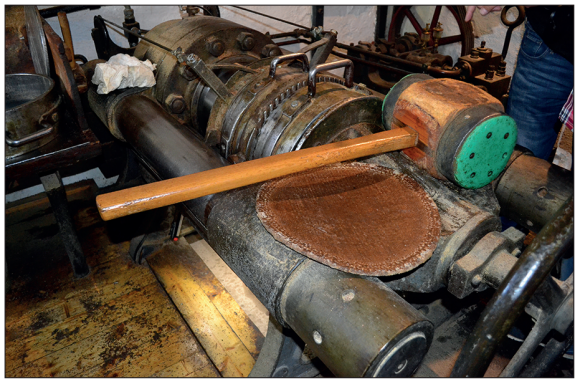

Fig. 5. *The horizontal press with pans in place; the huge hammer is used to knock the pan lids on tight (G. Hackney).*

We continued on southward to Zittau and the Hotel Riedel, a welcoming modest place that specialises for motorcycle riding patrons… and now a new specialty for them, mill aficionados! A copious and delicious dinner was enjoyed with diets forgotten. This area was renowned for its textile factories, but these closed following unification creating unemployment. We discovered that we were only a few hundred metres away from Poland and not far from the border with Czech Republic.

Wednesday 14 August.

Day two was fully packed and mostly centered around the town of Oderwitz. On route we started at Fehrmann-Mühle, Coblenz. We received a warm welcome by the miller after walking down a narrow drive which paralleled the water way. With a long history, since 1626, this large

Fig. 6. *Roller mills in Fehrmann-Mühle, Coblenz (G. Hackney).*

multi-storey watermill operated in its first phase until it burned down in 1826. In 1832 it was rebuilt, then bought by Mr. Ferhrmann in 1921, when it was modernised with roller mills and a 12.4 hp Francis turbine. It then received further work in 1942 and again in 1948 when a bakery was added, specialising in pumpernickel and breadcrumbs for schnitzel. It is now a treasure house of old mill works, auxiliary machinery, stones, and ancient carpentry. The turbine can be used to generate electricity, and the miller kindly set the mill running for us. Upon Fehrmann's death, a group was formed in 1989 to preserve the mill and clarify water rights, but it has been on the market for three years at a price that, to a Californian, seems like a give-away.

Fig. 7. *The complicated system of gears, levers and cams which operate the dust extractor socks from above (G. Hackney)..*

Our timetable revised, we went straight to a lunch of soup and beer in a restaurant in Oderwitz, a village with many attractive slate wall-covered houses, formed in creative patterns.

Next, we were off to the Berndt-Mühle post mill (photo page 18), quite tall, built in 1787 and which operated up to the 1950s, with beautiful wood works. We were welcomed by Jürgen Berthold, a professional miller. With four tapered patent sails on an iron cross, the main shaft brake wheel drove the last single pair of stones, but previously there were two more. The striking rod for operating the shutters only went so far into the windshaft, to a cross-piece which joined with two rods, one either side of the shaft, before joining again by the neck bearing. This was a set-up we were to see in other post mills. It has been modified for auxiliary power, and the drive went down to a layshaft in the basement down by the quarter bars. This drove belts to another 'high grinding' system with trieur, bolter, elevator etc.

Fig. 8. *Berndt-Mühle – an elevator in a post mill! (G. Hackney).*

The Berthold-Mühle, visited next, was originally a water-powered mill, but no longer. Like many mills we were to see, water supplies have diminished over the years (climate change or over-abstraction?), requiring a change to electricity.

First documented in 1600, it is now a commercial modernised operation with grinding via a number of roller mills (as many as 16 passes), and all the meal transported by vacuum tubes, a forest of white pipes in the upper level.

Both wheat and rye are processed, creating a range of flours for the local bakery market; they prefer the different flours available as an alternative to the mass market. The son of the owner (the 7th generation since 1769!) gave a good lecture on the stages of grinding showing the changes as the process progresses. We were treated to tasty homemade cakes from the personable proprietors of two generations and finished with a group photo.

Fig. 9. *Berthold-Mühle; Jurgen operating roller mills (G. Hackney).*

Fig. 10. *The Pre-Tour group outside the Berthold- Mühle watermill (G. Bost).*

We walked uphill from the Berthold-Mühle through orchards to the final mill of the day, Neumann Mühle, another hilltop post mill which operated until 1950, and has since been kept in excellent condition thanks to a good roof, good paint and love. Again with patent sails on a 'coffin cross', and double striking rods. The large mill body rides on four wheels over a circular set of rails, so is described as a 'paltrock mill' (though very different from those we saw in Holland). It is also equipped for staged milling, with three sets of stones.

Fig. 11. *Neumann Mühle, a post mill 'retro-fitted' as a paltrok mill (G. Hackney).*

Fig. 12. *Neumann Mühle, the rail for the four supporting wheels (G. Hackney).*

The first one is for cleaning, then to a roller mill, then a boulter, then finally two stages of stone grinding. Unusually, the main windshaft has three large gear wheels, the middle one containing the brake; the smallest of these has a friction gear to drive the elevator. There was also a tiny miller's room, insulated from the cold by wattle and daub.

A big day over, with four interesting mills, we climbed to the bus and back to the Hotel Riedel, our fixed base for remainder of the Pre-Tour.

Mike O'Shea

Thursday 15 August

This day was going to be somewhat more adventurous and different. We left our hotel at 8.30 am but this time not by bus; instead we walked the five minutes to the railway station of Zittau Süd, so we were all there to welcome the traditional narrow-gauge steam train entering the station at 09.01. An hour later we arrived at Kurort Jonsdorf station, and close by was the city wall where we all met the Mayor who welcomed us and gave a talk about the area.

The Jonsdorfer Millstone quarry is a most important site for molinology and was vital to the village as it offered work to a large number of the habitants. The people of Kurort Jonsdorf are very proud of their museum, located to the south at an elevation of 480-560 m. There were two routes, the easy path and a harder one which most of us followed.

Fig. 13. *The enormous 'black quarry', 50 m deep (K. Toutouza).*

Fig. 14. *A typical quartzite millstone from the Johnsorf quarries (G. Hackney).*

The use of sandstone in the Zittaü mountains for the production of millstones began in the 16th century. In the whole region there were 40 quarry sites; the one in Jonsdorf produced millstones with diameters up to 2.70 m. The sandstone has been awarded because of its good quality, the result of volcanic action some 30 million years ago. This caused metamorphosis in the surrounding Cretaceous sandstones, turning them to quartzite. They hewed out one thick layer of rock and sent sections down slides to the lower levels of the quarry where the full processing was carried out. From 1850 millstones were assembled from several pieces as there were no longer sufficiently large and homogenous sandstone blocks. Production was maintained until 1917, then brought to a halt by an embargo placed on German millstones by Lenin. In 1950 the site was restored in order to make the four largest quarries accessible, and in 2002 they built a demonstration workshop.

We observed rock openings which were formed by the flow of the volcanic lava; the rock nearest these was the hardest and of a better quality. Small holes in the rock were filled with water, made in order to clean and cool their tools. Some millstones, with small entrained pebbles (conglomerates), were used to grind bones for making glue. We noticed a cupboard carved in the rock, where the workers used to keep their explosives. A little further on we

visited the Steenbruch Schnied Museum which was the old smithy, before arriving at the 'black quarry'; 50 metres deep, and the biggest of all.

Since we had been walking for almost two and a half hours it was time for lunch; 'barbeque time' in the mountains and we all enjoyed the cool beer and food. We had to be strong (!) to continue walking through the Zittaü mountains to observe some very interesting rock formations with names like the 'little organs' and the 'lion', amongst others. After admiring the stunning views we walked down to meet the other group and get our bus.

Fig. 15. *The group has a well-earned lunch (K. Toutouza).*

At 15.45 we arrived at Kottmarsdorf windmill. This working postmill, situated on a hill with a wonderful view, was built in 1843, and produced flour until 1943. The mill once had four patent sails (now with boards), and the striking rods either side of the windshaft remain as evidence of this. It originally had three pairs of stones; two used for grinding (one of these is now missing) and the other one for peeling the husk from the grains. The metal gear trains are contemporary with the building. It used to grind 400 kg per day, and the flour was transferred to two 'hopper boys' (one for each pair of stones) to cool, before screw conveyance to the sifting machine. Downstairs is a roller mill; all this 'high grinding' technology seemed strange in a traditional postmill (for the full story see BM20 'Ganzel and Wulff - The Quest for American Milling Secrets' by D. Ogden and G. Bost). The mill also has a sack cleaner, and the miller's room, complete with bed!

Fig. 16. *Sail details at Kottmarsdorf (T. Derbyshire).*

Fig. 17. *Leaving Kottmarsdorf windmill in the evening light (K. Toutouza).*

Fig. 18. *The pair of hopper boys in Kottmarsdorf windmill (G. Hackney).*

In order to enjoy as much as we could of this attractive place we had dinner at a mill restaurant next door, treated to huge amounts of regional specialities. Above the restaurant we also visited a local museum, where the visitor gets an impression of the lives of those who once depended on the mill. After a very interesting day we returned to Zittaü, and whoever still had the strength could enjoy a movie in the lobby of our hotel.

Friday 16 August

The next morning was rather rainy as we left our hotel at 9 am for our first visit, to Sohland Mühle. This windmill's first miller was Gottlob Berthold. In 1912 the mill was given an electrical supply so it could work even in calm weather. From 1931 until 1944 the Bachmann family owned the mill, which stopped working in 1963 for economic reasons. The sails became heavily damaged, so the owners sold the mill and a piece of land to the municipality of Sohland who completely restored the windmill (1995-96). However, a little later the mill stopped working because of the high cost of maintenance.

Fig. 19. *Sohland Mühle (G. Hackney).*

This is a four sail postmill (but never with patent sails) with original machines for cleaning the grain (trier and aspirateur), husker, breaker/oat roller, one pair of millstones, bran removal then a second grind with rollers before sifting. The brake system is not the original one. At the end of our visit, the mayor of the area welcomed and thanked us and they also offered us regional drinks.

Fig. 20. *A Schälmaschine (shelling machine) in Sohland Mühle (G. Hackney).*

Our second visit was to the watermill(!) at Rennersdorf, namely the Gustav Ritter-Neumühle. The owner and his wife were there, waiting to provide information about their property. There was a windmill in the village years ago but when it collapsed the villagers decided to construct a watermill. In 1763 it was used for grain, as an oil mill, a saw

Fig. 21. *The enormous Gustav Ritter-Neumühle at Rennersdorf (G. Hackney).*

mill? and a stamp-mill (for tanning products). In 1880 it suffered a massive flood. The complex belonged to the municipality and was rented out to the millers, but in 1904 they sold it to four new owners. From that time on the mill has been working, and it used to operate even during the Second World War.

There have been many changes but it finally ended up solely as a flour mill with a more 'professional production' of 10 tons per 24 hours. There is also now a small oil mill in the basement, but a completely modern one which is used to grind walnuts. Until 1972 it was water powered but was then changed to electricity, due to high cost and lack of water. In the turbine room there used to be the waterwheel of 7 m diameter, 0.80 m width (up to 1950). The water, with 7 m head, entered from two ports generating the power of 30 hp.

On the ground floor are a bank of seven roller mills and on the first floor the flour storage and packaging. There is also a room for the grain cleaning and peeling machines. One very unusual machine was for wetting grain using a small noria-type lifting wheel. The bakers make their collections by trucks, loading the flour sacks using a crane. Neumühle has been awarded as the "cleanest mill in the world", which we could easily notice! After shopping for some of their products we got to our coaches for a completely different visit, to the Moravian Christmas star factory at Herrnhuth. There we were guided through the history and production of the Moravian star, an enterprise which started in 1897. We also enjoyed some coffee and cakes for our lunch break.

Fig. 22. *The banks of roller mills, immaculately presented (K. Toutouza).*

Our next visit was the Hetzemühle windmill. Currently without sails, this five bladed postmill was built between 1775 and 1780 by the miller Johan Gottfried Eichhorn. The body (buck) of the mill is truly massive, the result of extensions in all directions, and with a crowntree measuring 67 cm x 71 cm! In 1864 in order to increase the performance they installed six sails but in 1869 removed one of them; five sails gave better results. The date of 1865 is incised into the wattle and daub that insulates the little miller's room on the first floor. Up to 1877 it used to be a mill and also a bakery. In 1929 the postmill stopped working and was declared an historic monument. Some years later, in 1944, three sails were damaged by a bomb. The gearing is quite amazing, with a spur wheel driving four pinions and a belt to the hopper boy (which was the second to be installed in Germany).