

# MUSEOEUROPE

UPORABNA VREDNOST LESENEGA KOLESA  
THE PRACTICAL VALUE OF THE WOODEN WHEEL  
REGIONAL MUSEUM MARIBOR



The collected volume of the symposium 26. and 27. 9. 2014

**Zbirka / Collection MUSEOEUROPE 1**

**Uporabna vrednost lesenega kolesa / THE PRACTICAL VALUE OF THE WOODEN WHEEL**

Zbornik mednarodnega simpozija 26. in 27. 9. 2014 / The collected volume of the symposium 26. and 27. 9. 2014

Izdal: Pokrajinski muzej Maribor / Publisher: Regional Museum Maribor

Zanj / By: Mirjana Koren, direktorica / director

Glavni urednik / Editor - in - Chief:

Oskar Habjanič

Recenzenti / Reviewers:

Ddr. Verena Vidrih Perko, dr. Helena Rožman, dr. Katarina Čufar, dr. Leopold Toifl

Prevod in lektoriranje besedil v angleškem jeziku / English Translation and copy editing:

Robert Heričko, s. p.

Lektoriranje povzetkov v slovenskem jeziku / Copy editing of the Slovene summaries:

Mag. Darja Gabrovšek Homšak

Oblikovanje / Design:

Dejan Štampar

Maribor, 2014

Publikacija je dostopna na / The publication is available at:

<http://www.museoeurope.si>

CIP - Kataložni zapis o publikaciji

Narodna in univerzitetna knjižnica, Ljubljana

903(082)(0.034.2)

UPORABNA vrednost lesenega kolesa [Elektronski vir] : zbornik mednarodnega simpozija 26. in 27. 9. 2014 = The practical value of the wooden wheel : the collected volume of the symposium 26. and 27. 9. 2014 / glavni urednik Oskar Habjanič ; prevod besedil v angleškem jeziku Robert Heričko. - El. knjiga. - Maribor : Pokrajinski muzej = Regional Museum, 2014. - (Zbirka Museoeurope ; 1)

ISBN 978-961-93424-2-8 (pdf)

1. Vzp. stv. nasl. 2. Habjanič, Oskar

275653888

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## MUSEOEUROPE

**MIRJANA KOREN, Director of the Regional Museum Maribor**

The project **MUSEOEUROPE** of the Regional Museum Maribor has integrated the institution into the European Capitol of Culture Maribor 2012. The name of the project is composed of two terms. The first is the term *muzeion*, which had been used by the ancient Greeks to name the sites where the Muses have inspired the artists. The Muses were the daughters of Zeus and Mnemosyne (Greek: memory). With the help of her daughters, Mnemosyne had carried artists into a different time and space; she had connected them with their memory and enabled the birth of their inspiration. Europe is the second term that forms the word **MUSEOEUROPE** and is to be understood as a cultural term within this context. The association of the Maribor museum with other renowned European museums rests on the basis of its one hundred thousand museum objects and the one hundred thousand materialised connections between the past and the presence, all of which reflect different faces of Europe.

The foundation of the project **MUSEOEUROPE** is the mobility of the heritage. This means that a certain object is chosen from the permanent exhibition of the Regional Museum Maribor and temporarily exchanged with a similar object from another European museum. It is in this way that a multitude of new meanings, which encourage new reflections, is being brought to life. A consequence of this emergence is also the mobility of the guardians of the heritage. These guardians present the results of their researches at international symposia. There is talk of similar or different cultural, social, religious, political, economic, financial, producing, material, etc. motives for a certain concrete activity. These symposia are also a place where the comparisons between different social structures and phenomena are being created and where thoughts on what connects and what divides are being developed.

In the year of 2012 the project **MUSEOEUROPE** received the highest national prize in the field of museology - the Valvasor Award. ICOM Europe has assumed the long-term patronage of the project. The institutions with which the collaborations have already been carried out are the following: the Guardia Svizzera Pontificia (Vatican), the Bavarian National Museum (Munich), the National Museum (Warsaw), the Universalmuseum Joanneum (Graz) and the Zinnfigurenwelt (Vienna). This year the museum has joined its forces with the National Museum of the Romanian Peasant. The hosting of the museum objects from different renowned European institutions bears witness to the firm concept of the project. The concept has won over the Slovenian evaluators, who have awarded the project, as well as the foreign colleagues, who have participated in the project.

This year, the object, which had been assigned the role of the guest, is positioned in the part of the permanent exhibition of the Maribor castle where the wheelwright's craft is being represented. We have dismounted the spoked wheel from Kamnica, which had been used as a part of a cart in the transition period from the 18<sup>th</sup> to the 19<sup>th</sup> century, and replaced it with the wheel that was used by the villagers of Obîrsia in the Hunedoara County, a wider part of the multicultural region of Transylvania. So, the museum object of the Regional Museum Maribor was temporarily exchanged with the museum object of the Museum of the Romanian Peasant from Bucharest. The questions, which have sprung up during the exchange of the two aforementioned objects, have also arisen at the international symposium **MUSEOEUROPE 2014**. What lies before you is the collected volume of the papers that have been presented this year. I can only conclude with the words of the French historian Jaques Le Goff: *»The past does not impose, but proposes. The present is the result of coincidences and the human free will as much as continuity,«* and heartily recommend you to read this volume.

## THE PRACTICAL VALUE OF THE WOODEN WHEEL

**Oskar Habjanič, Regional Museum Maribor**

Within the framework of the symposium on the topic The Practical value of the Wooden Wheel the Regional Museum Maribor will represent the way in which the invention of the wheel, which had been invented 6,000 years ago, influenced and co-created the living environment throughout the time, reaching from the prehistory till today.

The articles reflect the posed fundamental questions, whether the wheel can still be regarded as the incentive of human progress, and whether wood, in the sense of a raw material, is representing the material that will enable the way out of the crisis and provide contemporary design- and technological solutions. One of the questions of great importance, which has also been raised, is the question concerning the kind of maintenance and preservation of wood in order to put it at the disposal of our successors.

The wheel is one of the most important discoveries in the history of mankind. The different ways of the use of the wheel are to be ascribed to the existential hardships of individuals respectively communities, who created within their dwellings an environment in which they were able to live respectively survive. The primary use of the wheel is most likely to be found in connection with the farming respectively production of food. The practical value of the wheel was additionally supplemented by the potter's wheel, which originated about 3,000 years B.C. The frequent changes of domiciles and migrations created the demand for means of transportation. To this day, numerous improvements and inventions have been ascribed to Mesopotamia, the area of the flood plain of the lower reaches of the rivers Tigris and Euphrates, where the Sumerian civilisation had emerged during the transition from the 4<sup>th</sup> to the 3<sup>rd</sup> millennium. That was the time when the first cities were formed, when the writing was invented, and when religious rituals were formed. The first wheels, the potter's wheels and the development of first paths, which have enabled a better communication, also arised in the middle of the 4<sup>th</sup> millennium.

Some thousands of kilometres away, in the subalpine territory of the today's Ljubljana Marshes, people have built pile dwellings under hard living conditions in the area of a uninhabited and flooded landscape, which had been overgrown with woods, and have survived. The natural conditions of the subalpine lands have forced the humans to search after possibilities for survival, socialization and contact with the environment. If we consider their environment, it stands to reason that the easiest way to travel was on water with the help of simple boats – logboats, which were up to 12 metres long and even longer. The travelling on land had posed a much bigger challenge. So it came to pass that already by the middle of the 4<sup>th</sup> millennium B.C., which occurred simultaneously to the thriving civilisation of Mesopotamia, people have been using two-wheeled carts – the barrow. The fascinating find of a wheel with an axle, dating back to 3,200 years B.C., reveals the use of ash- and oak wood. The journeys on land, where the cargo had been transported with the barrow, offered new opportunities to get in contact with the surroundings. The crossing of uninhabited landscapes had probably caused the gradual formation of the first transport routes. The article with the title *The wheel with an axle from the pile dwelling Stare gmajne near Vrhnika (around 3,200 BC)* from the author Irena Šinkovec from the Museum and Galleries of Ljubljana takes us on the journey to the first dwellings in the area of today's Ljubljana Basin. The challenging processes of the conservation and the preservation dilemmas of the wooden wheel have been represented by Katja Kavkler from the Institute for the Protection of Cultural Heritage of Slovenia and David Stopar from the Biotechnical faculty in their article with the title *Conservation of archaeological wooden objects from waterlogged sites*.

The existential solutions were soon met by the needs for expansion and conquest of new territory, and in connection to that with the use of new military tactics and the use of chariots, which date from around 3000 years B.C. The importance of a chariot had also transferred to burial objects, dating from around 600 B.C., that are to be located in the area of the alpine territory. The purpose of the objects was the contact with the gods or they served as a memory of the deceased. Apart from the human figures, which are mounted on the cult chariot from Strettweg, we can also find figures of animals that resemble a deer and a horse on the mentioned object. Dr. Marko Mele and Mag. Daniel Modl from the Universalmuseum Joanneum in Graz



discuss the finding of the cult chariot as well as some of the new dilemmas concerning the cult chariot from Stettweg in their article with the title *The cult chariot from Stettweg – and the wheels keep on turning*.

The Romans have turned the use of the wheel into a spectacle as well. In contrast, the medieval wheel consisted of a simple hub made of elm wood, which had been resistant to splitting, spikes made of hard oak wood and the felloe made of tough ash wood. The wooden wheel had been overlaid with an iron ring, which resulted in a strong resistant wheel. A very similar type of wheel had been used all until the late 20<sup>th</sup> century in the wider territory of the Pannonian realm. This fact is being supported by the wooden wheel that had been acquired in the Obîrsia village that lies in the Hunedoara County, a wider part of the multi-cultural region of Transylvania. The wheel, a component part of a cart, is made of oak wood with two metal rings, 12 spokes (11 of them are made of ash wood; one of the spikes is newer and is made out of acacia wood), and a hoop made of ash wood. The wheel is overlaid with a metal cover on its outer face, which provides it with additional protection and durability. In his article with the title *The wheel from Transylvania* the author Dr. Ion Blajan from the Museum of the Romanian Peasant represents the rootedness of the wooden wheel in the Romanian society.

It was already in the time of the Roman culture when the wheel, in the sense of means of transportation, had made travelling easier. The numerous trade routes and way stations in the late Middle Ages have once more enabled the mobility of the population. It was at the end of the 15<sup>th</sup> century when light and four-wheeled carriages, which were provided with a roof, started to be manufactured in Hungary. The bodies of the carriages had been fitted out with axles that were fixed on both ends. These carriages were initially reserved solely for the royal- and aristocratic elite. In the course of the next two centuries their use had then expanded onto the wider population. The invention of the bicycle had signified an outright revolution in the field of means of transportation. The first prototypes have already turned up in the first decade of the 19<sup>th</sup> century. A fundamental progress is made with the appearance of the velocipede with the high front wheel, which had been invented by the French Pierre and Ernest Michaux. It was not before the eighties of the 19<sup>th</sup> century when the bicycle received the form in which it is known today. The development of the bicycle synchronises with the appearance of the busy life of the clubs in the era of the Bourgeoise. The bicycle becomes one of the symbols of female emancipation; it causes the development of new traffic regulations, and gives, in combination with the car and the development of the railway network, new perspectives on the experience of time and space. In his article with the title *The Cycling in Slovenia in the Process of Modernisation* the author Dr. Borut Batagelj from the Historical Archives of Celje discusses the dilemmas concerning the middle classes of the 19<sup>th</sup> century.

The power of the water wheel had enabled a quicker development of the craftsmanship, the mining industry, the field of ferrous metallurgy (in ironworks), the field of smithery, the process of cloth production, the field of the papermaking industry, and of the sawmilling industry. The industrial revolution and the invention of the steam engine in the year of 1765 have caused the downfall of the older crafts on one hand, and the evolution of those crafts that were connected to the industrialisation on the other hand. In his article *The Power of the Water Wheel* the author Tadej Pungartnik from the Regional Museum Maribor approaches the topic of the development and downfall of the miller's trade with the emphasis on the area between the mountain ranges of Pohorje and Kozjak.

Nowadays, the rich tradition of the wooden wheel is being pointed out by numerous objects from the fields of traffic, agriculture, crafts, fishing, hunting, housekeeping, cloth production as well as children's play. The wooden wheel is also to be found in the archival sources, which is being pointed out by Olga Latinčić and Evica Micković from the Historical Archives of Belgrade in their article with the title *The Wooden Wheel and Its Use in the Documents of Historical Archives of Belgrade*.

The versatility and purpose of wood, in the sense of basic natural assets, is being emphasized by Miroslav Novak and Zdenka Steblovnik Župan from the Wood Technology School Maribor, Higher Professional College in their article *Wood on Wheels*. The article is highlighting the possibilities of the use of wood, not only as ecologically flawless raw material, but as well as the possible application within the field of contemporary design solutions concerning the production of vehicles of a higher surplus value.

The wheel as the development of progress, yesterday, today and tomorrow!

A special word of thanks goes to the group of reviewers, who were generously involved in helping to create the collective volume *The Practical value of the Wooden Wheel*: Ddr. Verena Vidrih Perko from the museum Gorenjski muzej, Dr. Helena Rožman from the Božidar Jakac Art Museum, Dr. Katarina Čufar from the Bio-technical faculty of the University of Ljubljana and dr. Leopold Toifl from the Universalmuseum Joanneum.

# THE WHEEL - 5,200 YEARS: THE WHEEL WITH AN AXLE FROM THE PILE DWELLING STARE GMAJNE NEAR VRHNIKA (AROUND 3,200 BC)

Irena Šinkovec, univ. dipl. arheol., curator for prehistory, Museum and Galleries of Ljubljana (MGML), Gosposka 15, Ljubljana, irena.sinkovec@mgml.si

## ABSTRACT

The need for precious raw materials and various products forced the prehistoric man to overcome distances across Europe. The safest and quickest way to travel was by water. It is only after the wheel with the axle had been invented when the land transport of heavier cargos was also made possible. It is generally considered that the first wheels were used in Mesopotamia, i.e. in the area of what is termed the Fertile Crescent, in the mid-4<sup>th</sup> millennium B.C. The 5,200-year-old wooden wheel with the axle, which had been found in the Stare gmajne pile dwelling near Vrhnika, is one of the world's most significant cultural heritage items in terms of its age as well as a technological accomplishment.

## KEY WORDS

prehistory, pile dwellings, wooden wheel with an axle, 4<sup>th</sup> millennium BC, waterlogged wood

## PREHISTORIC PILE DWELLINGS

Pile dwellings are a typical phenomenon of prehistory, which are to be found on the lakes and marshes of Alpine regions. There are around 1,000 settlements dotting the territory to the north and to the south of the Alps, i.e. ranging from eastern France, Switzerland, southern Germany, Austria and northern Italy to Slovenia.<sup>1</sup> It is precisely those locations, which have remained water-saturated until now, that have allowed this striking heritage to be preserved. The remains of wooden houses, tools and other implements, foods and even clothes are valuable sources for investigating the lives of these people who left no written records.



Photo 1: Pile dwellings on Ljubljana Marshes (MGML, Geodetska uprava Republike Slovenije: DOF050)

<sup>1</sup>MENOTTI, F. (Ed.) 2004; SCHLICHTERLE H. 1997; SCHLICHTERLE H., WAHLSTER, B. 1986; VELUŠČEK, A., SUTER, P., PELKO, S. 2009.



Since the discovery of the first pile dwellings in 1875, the Ljubljana Marshes have become a synonym for pre-historic villages on piles.<sup>2</sup> Only two decades after the first pile dwellings were discovered in Switzerland, this archaeological phenomenon put an indelible impression on the Slovenian landscape, filling both experts and laymen with enthusiasm and inspiring numerous artists. Over a period of slightly more than 130 years, extensive excavations in the late 19<sup>th</sup> century, systematic research during the 20<sup>th</sup> century along with state-of-the-art research methods supported with natural sciences, in particular, have generated reliable knowledge about the oldest permanent inhabitants of the Ljubljana Basin.<sup>3</sup> The last pile dwelling, which was to be investigated in 2010, out of the 42 pile dwellings that are known to this date, is located in the very centre of Ljubljana.<sup>4</sup> From the romantic idealism and fascination with pile dwellings typical for the 19<sup>th</sup> and early 20<sup>th</sup> century, over the 'problematic issue of pile dwellings' which in the 20<sup>th</sup> century gave rise to numerous questions about the environment, platforms, piles and houses located either on or above the ground, researchers have recently been intensively involved in the risks that the respective sites are exposed to as a result of the intense landscape utilisation and both local and global climate changes as well as in the possibilities for their preservation.



Photo 2: Archaeological research of a pile dwelling at Špica (photograph: G. Babič, MGML)

Marshlands saturated with water have allowed the preservation of organic remains which would normally disintegrate in dry environments. Plant and animal remains that were discovered during excavations in the layers of earth covering the demolished settlements can serve as an important source of information as regards the diet of prehistoric inhabitants, the way they prepared their food, and, in particular, as concerns the climate and environmental conditions of that time. Climate conditions were an important factor of survival, also affecting the size of the overall population.<sup>5</sup> Pointing to both construction methods and housing standards, the remains of wooden architectural elements also facilitate the precise dating of individual houses and objects. Astonishing artefacts bear witness to the remarkable knowledge of natural materials, their production and processing. Remains of textiles, wooden pots, tiny beads for necklaces along with larger objects such as boats and carts are indicative of the pile dwellers' skills.

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<sup>2</sup>DESCHMANN, K. 1875, pp. 227 – 278.

<sup>3</sup>BREGANT, T. 1996, pp. 18 – 46; GREIF, T. 1997; VELUŠČEK, A. 1997.

<sup>4</sup>ŠINKOVEC, I. 2012, pp. 251 – 258.

<sup>5</sup>ANDRIČ, M. 2009, pp. 317 – 331; BUDJA, M. 1995, pp. 163 – 181.

More than 150 years after the discovery of the first pile dwelling in Switzerland, extensive research and the occurrence of inspiring notions about the life of prehistoric pile dwellers on the fringes of the Alps, including those inhabiting the Ljubljana Marshes, the huge significance of the sunken and buried heritage was recognised by UNESCO, which included the pile dwellings on its World Heritage List. Intense landscape utilisation and considerable changes in the environment over recent years have caused researchers to focus on the protection and preservation of the Ljubljana Marshes and those precious sites.<sup>6</sup>

### THE WOODEN WHEEL WITH AN AXLE

In the year of 2002, during wood sampling in one of the drainage ditches of the Stare gmajne pile dwelling near Vrhnika, the archaeologists from the Institute of Archaeology ZRC SAZU (Research Centre of the Slovenian Academy of Sciences and Arts) came across a fascinating find.<sup>7</sup> In addition to numerous other finds and two logboats, remains of a wooden wheel were discovered on the bottom of the ditch. The wheel was partly damaged as a result of an earlier deepening of the ditch using construction machinery. After the ditch was broadened somewhat, an axle previously detached from the wheel was found. The wheel with the axle had formed a part of a two-wheeled cart.



Photo 3: Discovery of the wooden wheel, Stare gmajne (photograph: M. Turk, Institute of Archaeology ZRC SAZU)

The wheel consists of two ash wood planks held together by four oak wood dowels wedged into them. It has a rectangular opening in the middle, into which the axle was fixed. The wheel, which is 72 cm in diameter, is around 5 cm thick. Dendrochronological analyses revealed that the trunk of the ash tree, from which the planks are made of, was at least 40 cm in diameter, and that the tree itself was around 80 years old. The choice of wood was certainly not random as ash wood is tough and solid; it was abundant in the vicinity of the pile dwellings, and can generate dimensions that are necessary for large planks with no knots in them. The axle is made of a single piece of oak wood and is 124 cm in length. The end part of the axle has a rectangular cross-section, thus fitting into the hub of the wheel. The axle was fixed to the wheels by oak-wood wedges, implying that the axle rotated together with the wheel.<sup>8</sup> The precise and strikingly well-thought-out execution of both the wheel and its axle is astonishing. The regard for wood shrinkage and expansion, the manner of fixing together and joining the individual parts and other details all indicate a skilful master with excellent knowledge of types of wood.

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<sup>6</sup>VELUŠČEK, A., SUTER, P., PELKO, S. 2009.

<sup>7</sup>VELUŠČEK, A. 2002, pp. 51 – 57; VELUŠČEK, A. (Ed.) 2009.

<sup>8</sup>VELUŠČEK, A., ČUFAR, K., ZUPANČIČ, M. 2009, pp. 197 – 222.





Photo 4: The wooden wheel with an axle on the exhibition The Wheel, 5,200 years (photograph: M. Paternoster, MGML)

The dating of the wheel with the axle was established on the basis of stratigraphic data with dendrochronological analyses and radiocarbon dating. The wheel is around 5,200 years old and is contemporary to the Stare gmajne settlement in which it had been discovered.<sup>9</sup>

In the time of the pile dwellings, the area surrounding the Ljubljana Marshes was heavily overgrown. Prehistoric man did not build roads, overcoming distances via waterways instead. Boats made of one single tree trunk, i.e. logboats, were the most common means of transport. Around 60 logboats, dating to different periods, have been discovered and documented in the Ljubljana Marshes.<sup>10</sup> As some boats were even 12 metres or more in length, healthy and big trees were needed to make them. Waterways facilitated more rapid and safer movement. Moreover, transporting larger and heavier objects was made simpler. Distances ashore were covered on foot and, after the late 4<sup>th</sup> millennium BC, by cart. Carts were most probably pulled by cattle. As both moving and transporting cargos by land were limited due to the impassable environment, longer journeys were less convenient.

It is generally considered that the first wheels were used in pottery in Mesopotamia, i.e. in the area of what is termed the Fertile Crescent, in the mid-4<sup>th</sup> millennium BC. It is from there that it is supposed to have come to Europe together with other skills and products. Along with that, there are several theories arguing that the wheel was invented simultaneously in many parts of the world. Some theories attribute the invention of the wheel to prehistoric Europe.<sup>11</sup> However, the invention of the wheel with an axle meant a true revolution in the transport of heavier cargoes and in people's mobility. The oldest wheels dating back to the 4<sup>th</sup> millennium B.C. were disk wheels made of wood. It is only after various metals were discovered and the spoked wheel was invented that the mobility was improved and wheels started to be used on a large scale.

### PRESERVATION OF WOODEN OBJECTS

Wood and other organic remains which are constantly saturated with water and have no contact with the air can be preserved for several thousand years. The level of preservation depends mostly on the environment and the type of wood. The oldest artefact discovered in Slovenia so far is a point made of yew wood. It is between 45,000 and 38,000 years old and was unearthed in the riverbed of the river Ljubljanica.<sup>12</sup>

<sup>9</sup>ČUFAR, K., VELUŠČEK, A., TOLAR, T., KROMER, B. 2009, pp. 177 – 198.

<sup>10</sup>ERIČ, M., 2009, pp. 151 – 162; ERIČ, M., GASPARI, A., KAVUR, B. 2012, pp. 397 – 404.

<sup>11</sup>ZABERN von P. (Ed.), 2004.

<sup>12</sup>GASPARI, A., ERIČ, M., ODAR, B., 2012, pp. 231 – 238.

Such wood is called *waterlogged wood* since its characteristics have changed considerably. Due to the impact of bacteria and microorganisms, wood in wet environments decays slowly. The first to decompose are sugar and starch, followed by mineral salts and pigments. Cellulose disintegrates gradually, only leaving behind lignin. Since the wood is in the water, the disintegrated substances are substituted by it in the process. In contrast, such an object would have shrunk and decayed in a dry environment. As long as wood remains buried in earth, they are mainly exposed to the risk of being dried up as a result of a lower water level and, in seas and lakes, also to the risk of erosion. The major risk for an excavated object is to become dried out. If an object is not kept in a wet environment and is exposed to air, it can dry out in only a couple of hours, shrink, become deformed and disintegrate completely. The second risk, which is hidden to the eye, is the activity of bacteria and microorganisms that speeds up upon contact with air. Small-sized objects are usually lifted from the earth and prepared for analyses and conservation. An active conservation intervention, which will replace the water with another substance and facilitate the drying of the object, thereby ceasing the activity of microorganisms, is required. There are several conservation methods for waterlogged wood. The most often used methods in Europe are the PEG method in which the water is gradually replaced by a solution of polyethylene glycols, and the melamine method which is applied in the Romano-German Museum in Mainz. It is with the latter method that the wheel and the axle from the Ljubljana Marshes were successfully conserved.



Photo 5: The wooden wheel before conservation (photograph: M. Paternoster, MGML)

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# KOLO - 5.200 LET: KOLO Z OSJO S KOLIŠČA STARE GMAJNE PRI VRHNIKI (OK. 3.200 PR. N. ŠT.)

Irena Šinkovec, Muzej in galerije mesta Ljubljane, Slovenija

## POVZETEK

Kolišča so značilen pojav prazgodovinskega časa na jezerskih in močvirnatih območjih alpskega prostora. Severno in južno od Alp, od vzhodne Francije, Švice, južne Nemčije, Avstrije, severne Italije do Slovenije, se razteza okoli 1.000 naselbin. Ljubljansko barje je od odkritja prvih kolišč leta 1875 postalo sinonim za prazgodovinske vasi na kolih. Obsežna izkopavanja s konca 19. stoletja, sistematične raziskave v 20. stoletju ter z naravoslovnimi vedami okrepljene sodobne raziskave so v dobrih 130 letih močno razširili védenje o najstarejših stalnih prebivalcih Ljubljanske kotline. Danes je znanih že 42 kolišč. Od leta 2011 so kolišča okoli Alp uvrščena na svetovni seznam kulturne dediščine UNESCO.

Na kolišču Stare gmajne pri Vrhniki so arheologi z Inštituta za arheologijo ZRC SAZU leta 2002 pri vzorčenju lesa v enem od drenažnih jarkov naleteli na izjemno odkritje. Poleg bogatih najdb in dveh čolnov deblakov so na dnu jarka odkrili ostanke lesenega kolesa. Na mestu najdbe so jarek razširili in naleteli še na os, ki se je snela s kolesa. Kolo z osjo je pripadalo dvokolesnemu vozu – cizi. Kolo, ki v premeru meri 72 cm, je sestavljeno iz dveh jesenovih plošč, ki sta bili spojeni s štirimi hrastovimi zagozdami. Na sredini ima pravokotno odprtino, kamor je bila nasajena os. Ta je izdelana iz enega kosa hrastovega lesa in je dolga 124 cm. Kolo z osjo je bilo datirano na podlagi stratigrafskih podatkov, z dendrokronološkimi raziskavami in radiokarbonsko metodo. Staro je okoli 5.200 let in je sočasno z naselbino Stare gmajne, v kateri je bilo odkrito.

Danes na splošno velja, da so prva kolesa uporabljali v Mezopotamiji, na območju rodovitnega polmeseca, v sredini 4. tisočletja pr. n. št. Od tam naj bi se njihova raba skupaj z drugimi znanji in izdelki razširila tudi v Evropo. Obstaja več teorij o sočasnosti izuma na več območjih, nekateri pa izum pripisujejo prazgodovinski Evropi.

Les in drugi organski ostanki, ki so konstantno prepojeni z vodo in brez prisotnosti kisika, se lahko ohranijo tudi več tisoč let. Arheologi takšen les imenujemo »moker« les, saj so njegove lastnosti bistveno spremenjene. Metod konzervacije mokrega lesa je v svetu veliko. V Evropi se največ uporabljata t. i. PEG-metoda, s katero vodo postopno nadomestijo z raztopino polietilenglikolov, in melaminska metoda, ki jo izvajajo v Rimsko-germanskem muzeju v Mainzu in s katero je bilo zelo uspešno konservirano tudi barjansko kolo z osjo.

# THE CULT CHARIOT FROM STRETTWEG – AND THE WHEELS KEEP ON TURNING

**Dr. Marko Mele, Chief curator of the pre- and early history collection, Universalmuseum Joanneum, Archaeology & Coin Cabinet, Schloss Eggenberg, Eggenberger Allee 90, 8020 Graz, Austria, [marko.mele@museum-joanneum.at](mailto:marko.mele@museum-joanneum.at)**

**Mag. Daniel Modl, Research assistant, Universalmuseum Joanneum, Archaeology & Coin Cabinet, Schloss Eggenberg, Eggenberger Allee 90, 8020 Graz, Austria, [daniel.modl@museum-joanneum.at](mailto:daniel.modl@museum-joanneum.at)**

## ABSTRACT

In the year of 1851 a farmer named Ferdinand Pfeffer was ploughing his field in Strettweg near Judenburg and hit parts of a strange object that was made of bronze. At that time - more than 160 years ago - no one had expected that this small object on wheels would once become a Styrian symbol with an estimated value of 50 million EUR and that it would be protected by a decree of the Styrian government. Since that day the cult chariot of Strettweg visited some big exhibitions abroad and was displayed in the Joanneum. Nowadays it is the highlight of the archaeology museum in Eggenberg palace in Graz. In our paper we will present the restoration chronicle and historical development of this archaeological find from its discovery and up to its role of the today's museum superstar. This also includes a small discussion about the many different more or less scientific interpretations of its symbolic meaning for the iron-age society. Furthermore we will try to set our emphasis on the wheel symbols that are presented on the chariot and on other objects from the iron-age in Styria and Slovenia.

## KEY WORDS

cult chariot, restoration, interpretation, wheel pendant, ceramic wheel, Strettweg, Kleinklein, Libna

## INTRODUCTION

In the year 1851 a farmer named Ferdinand Pfeffer stumbled over a very rich elite grave from the Hallstatt Period while he was ploughing his field in Strettweg near Judenburg (Styria, Austria). Beside the rests of bronze vessels, jewellery and weapons he also found components of a richly figural decorated cauldron-wagon (Kesselwagen), which became internationally famous as the *cult chariot* from Strettweg. For the next 150 years only this isolated elite burial was known from this site, until recent archaeological excavations from 2006 to 2013 had shown that there is a Hallstatt period hilltop settlement on the nearby Falkenberg and also a greater necropolis with several tumuli in the plain. Four of the tumuli were archaeologically investigated, amongst them the one with the cult chariot.

According to their geographic location, in the contact zone between the eastern and the western Hallstatt circle, the Strettweg graves contain elements of both cultural spheres. Long-handled iron nails and fragments of iron wheel rims as well as a pair of horse trappings allowed the conclusion of the gift, a 4-wheeled wagon of wood, which could be discovered in at least two of the graves of Strettweg (tumulus I and III).<sup>1</sup> This tradition is typical for the western Hallstatt circle (north-eastern France, southern Germany, the Middle Rhine area, Bohemia and Upper Austria), while the gift of a cauldron-wagon or saddle horses – archaeologically indicated by single horse trappings – corresponds to the grave rites of the eastern Hallstatt circle (Moravia, Lower Austria, Styria, western Hungary, Slovenia and northern Croatia). The most important object from the necropolis of Strettweg is the cult chariot (UMJ, AArchMk, Inv. No. 2000; photo 1). It belongs to the group of the so-called cauldron-wagons, which appear as burial gifts in the late Bronze Age (13<sup>th</sup> - 9<sup>th</sup> century B.C.) graves north of the Alps. The idea for the usage of the cauldron-wagons was imparted to the south and can be found at the beginning of the Hallstatt period at the southern edge of the Alps and in Italy, where numerous individually formed miniature chariots were found in graves.<sup>2</sup>

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<sup>1</sup>TIEFENGRABER, G., TIEFENGRABER, S., MOSER, S. 2013, pp. 47, 57, 68.

<sup>2</sup>PARE, C. 1987, pp. 223 – 226; EGG, M. 1996, pp. 28 – 34.



Photo 1: Cult chariot (UMJ, Inv.-No. 2000), bronze, Strettweg near Judenburg, tumulus I, later Hallstatt period, around 600 B.C. (photo: N. Lackner)

Because of its rich and almost entirely preserved figural decoration the cult chariot of Strettweg stands out from other cauldron-wagons. It reflects some influences of the Near East and Eastern Mediterranean in its representation of a sacrificial procession. Nevertheless, it is not the only example that is to be found in the southeast Alpine region. This is shown by the examples of two big bronze wheels, twisted bronze rods, and an axis fragment that were already found in 1830 in the Hallstatt period necropolis of the so-called brickyard (Ziegelschlägerei) near the town of Gornja Radgona.<sup>3</sup> Subsequently the authors want to use the cult chariot of Strettweg as a projection surface for different images and interpretations: its possible symbolic meaning for the early Iron Age society on one side and its role in connection to the modern public, which is also visible through numerous traces in the original substance that were left by its long restoration history, on the other side. At the end we will briefly discuss the symbolism of wheels in the Iron Age by presenting some objects from the Hallstatt- and Latène period in the archaeological collection of the Universalmuseum Joanneum.

### RESEARCH AND RESTORATION HISTORY OF THE CULT CHARIOT OF STRETTWEG

Based on letters, reports and photographs in various Austrian archives, published literature and several plaster and bronze copies in some European museums the discovery and restoration history of the cult chariot can be exactly reconstructed.<sup>4</sup> In September 1851 a farmer named Ferdinand Pfeffer (1820-1896) from Strettweg was ploughing his field and found an accumulation of big stones with different bronze and iron objects between

<sup>3</sup>EGG, M. 1986, p. 199, p. 211; TERŽAN, B. 1990, p. 340f.

<sup>4</sup>e.g. Ashmolean Museum of Art and Archaeology, Oxford; Austrian National Library, Vienna (Österreichische Nationalbibliothek, Wien); Museum of Natural History, Vienna (Naturhistorisches Museum, Wien); National Archaeological Museum (France), Saint-Germain-en-Laye (Musée d'Archéologie Nationale, Saint-Germain-en-Laye); Roman-Germanic Central Museum, Mainz (Römisch-Germanisches Zentralmuseum, Mainz); Styrian Provincial Archives, Graz (Steiermärkisches Landesarchiv, Graz); Technical Museum, Vienna (Technisches Museum, Wien); The German Hunting and Fishing Museum, Munich (Deutsches Jagd- und Fischereimuseum, München) and Universalmuseum Joanneum, Graz.



them. He collected the artefacts, but was unconscious about their age and importance. After some days and weeks chaplain Wilhelm Decrignis (1814-1865), who was working in Judenburg at that time, got the information about the discovery and contacted his colleague in Graz the university professor for church history Matthias Robitsch (1802-1895). With some help of Decrignis Robitsch acquired numerous objects from Pfeffer till Easter 1852. In August 1852 he undertook an archaeological excavation at the site. He found parts of the burial chamber as well as cremation remains, ceramics and other bronze and iron objects. A group of figures and technical components, like two wheels and several wheel parts made of bronze, stood out amongst the finds. The number and relatively good preservation of the chariot parts enabled Robitsch to undertake a first reconstruction of the object at the end of 1852. He could already identify the subconstruction of the chariot and the arrangement of the figures on the vehicle.

For the first publication of Robitsch,<sup>5</sup> which was published in April 1853, the reconstructed chariot and the figures were photographed. But due to typographical reasons they were only reproduced as expanded lithographies. A female figure with upraised hands stood in the centre of Robitsch's reconstruction. Based on the position of the figure's hands he supposed that she had once carried a vessel on her head. This figure was mounted on a bronze plate which was designed in cutwork technique and enclosed by two longitudinal strips and two axes. Unfortunately, the plate was broken several times. The axes were preserved only in fragments, as well as the axle holders with the representation of a hind head in the corners. Because of the identical pair of wheels and several wheel parts Robitsch assumed that originally four wheels have been fixed on both axes. The spoked wheels with eight spokes and a conical hub are modelled precisely after the big wheels on the chieftain wagons from the Hallstatt period.

In front and behind of the female central figure Robitsch had arranged different figure groups in the same way. A figure group with a deer was put in front, followed by a naked male-female pair with clear gender characteristics. This procession is flanked by two mounted warriors. The horse riders were armed with an oval shield, a short spear and a helmet. Robitsch had properly composed all parts of the cult chariot, which were available at that time, with the exception of the bowl-like vessel and the supporting twisted bronze rods.

It was in this form that the cult chariot was handed over in 1853 by the Historical Society for Styria (Historischer Verein für Steiermark) to the Joanneum in Graz where it had been displayed for the first time. It was at that time when the chariot had caused an active discussion among scholars concerning its age and ethnic origin. There were two opposing groups, one searching for the *Celtic* and the other for the *Slavic* origin.<sup>6</sup> Because of the publication written by Robitsch the cult chariot also attracted international publicity. So it came to pass that in the winter of 1860 the Roman-Germanic Central Museum (Römisch-Germanisches Zentralmuseum) in Mainz (RGZM) asked for a bronze copy of the cult chariot for its own collection. This copy was produced on the basis of the imprints of the original figures in the casting factory of Carl Haas (1825-1880) and Karl Schmit Ritter of Tavera (1832-1872) in Graz in 1862. The central figure of this copy, which is additionally supported by four twisted bronze rods, is already holding a small bowl on the head.

Other replicas were subsequently made in Mainz by using this copy and were offered for sale for the public in their own catalogues.<sup>7</sup> Many of them came to European museums and some of them are still preserved, like for example a plaster copy in the Musée des Antiquités Nationales in Saint-Germain-en-Laye, which was bought in 1870, and a bronze replica in the Ashmolean Museum in Oxford from around 1890.

In 1873 the Strettweg chariot was displayed at the world exhibition in Vienna. Several photographs from Leopold Bude (1840-1907) and Johann Reiner (1825-1897) document its visual appearance at that time. They also show how the single parts were fixed together on a wooden plate with copper wire, copper sheets and nails (photo 2). A specially arranged photograph of the cult chariot, which shows the cult chariot with a vessel in form of a broad-rimmed bowl (Breitrandschüssel), was exhibited alongside with the original in Vienna.

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<sup>5</sup>ROBITSCH, M. 1852, pp. 67 – 78.

<sup>6</sup>PRATOBEVERA, E. 1853, pp. 54 – 72.

<sup>7</sup>LINDENSCHMIT, L. 1889, Tab. XLII/6.

After some other parts of the cult chariot had been acquired by the Joanneum in the 1870's, like a horse and a twisted bronze rod, the engraver Julius Rennert (1844-1918) was commissioned with the integration of these pieces and a comprehensive restoration of the cult chariot in 1881. He disassembled the chariot and carried out supplements and strengthenings with lead on the base plate and the figures. What strikes us as remarkable within this context is that he tried – after he had applied an artificial patination on the cult chariot – to make the difference between the original and supplemental parts visible by using white and red lines on the figures and technical parts. This is visible on the photograph of Bude that was taken at the exhibition of cultural historical objects of Styrian origin (Culturhistorische Ausstellung) in Graz in 1883. A restoration was necessary after the wheels and some figures of the cult chariot were damaged at an exhibition of the Anthropological Society of Vienna, which was shown at the opening of the Natural-historical Museum Vienna. This was carried out in 1901/02 by the previously mentioned Julius Rennert who was ordered by Wilhelm Gurlitt (1844-1905), at that time the curator of the archaeological collections of the Joanneum, not only to repair the damages but also to produce a new base plate out of lead which should make the ancient cutwork designed base plate clearly visible. In addition, all antique rivets were removed and substituted with modern screw connections.



Photo 2: The cult chariot from Strettweg in the year 1873, Albumin, Johann Rainer, Klagenfurt. (Source: UMJ, AArchMk, photograph library)

Whereas the restoration of 1901/02 should ensure that the chariot could easily be dismantled, the following restoration, which had been ordered by the Graz university professors Walter Schmid (1875-1951) and Rudolf Heberdey (1864-1936) in 1919, should standardise the appearance of the cult chariot. They have not only inserted cross beams in the base plate, but have also exchanged the completely preserved wheel pair with copies made of lead. Schmid and Heberdey supposed that both wheels do not belong to the chariot,



because they have a smaller axis-gap diameter. A preserved axis fragment, which is not incorporated in the today's cult chariot reconstruction, shows the edge of an axle journal with a suitable diameter. In 1922/23 the folklorist Franz Ferk (1844-1925) gave some metal objects that belonged to the chariot to the Joanneum. Parts of the big bronze amphora were amongst those objects. This led to a monographic publication of the grave inventory by Walter Schmid.<sup>8</sup>

Another optical change of the cult chariot took place in 1963 when the museum's restorer Fritz Rath (1911-1977) underpinned the base plate and the bowl of the central figure with plexiglass. Since 1954 there is a lending ban for the cult chariot by a decree of the Styrian government. So it was not possible to show the original at the international exhibition *Die Hallstattkultur – Frühform europäischer Einheit* in Steyr in 1980.

Therefore Hilmar Staude, a restorer of the RGZM, made imprints for a synthetic resin copy in Graz. While working with the chariot the restorer noticed some discrepancies in its construction that were caused by the restorations in the first half of the 20<sup>th</sup> century. Because the RGZM could not modify the original the responsible officials decided to make another synthetic resin copy with the new corrections at the end of the 1980's. This copy represented the scientific ascertained original condition of the chariot and they have also put a hemispherical vessel with a double volute ornament atop the small bowl of the central figure. In 1991 a special exhibition had taken place in Graz. The restored grave inventory and also the new cult chariot copy were displayed on that occasion. Five years later the final monograph by Markus Egg followed.<sup>9</sup>

In 2006 the original cult chariot was given to the RGZM in Mainz for restoration. There the chariot was disassembled and all historical supplements were removed. According to preceding technological investigations the cult chariot was once again assembled using reversible supplements made of carbon fibre and fibreglass which were added as static additions.<sup>10</sup> In this form the chariot was shown on the international exhibition *Bronze* at the Royal Academy of Arts in London in 2012<sup>11</sup> and due to that insured for an estimated value of 50 million EUR.

When new archive material was found it threw new light on the restoration and reception history of the cult chariot. In 2013 Robert Fürhacker and Daniel Modl started a new research project that was supported by the Universalmuseum Joanneum and cofinanced by the Austrian Federal Monument Office (Bundesdenkmalamt). The results will be presented till the end of 2015.<sup>12</sup>

### AN ATTEMPT AT THE INTERPRETATION OF THE SYMBOLIC MEANING OF THE CULT CHARIOT

Shortly after its discovery, controversial discussions about the age, origin and symbolic meaning of the cult chariot started and have not stopped till this day.<sup>13</sup> Its astronomical relationships, biblical myths and folklore customs were overused and associated with the Celtic religion like for example the mother goddess Nerthus. In the meanwhile, most scientific researchers agree on dating the cult chariot about 600 B.C. and suppose that it was manufactured in a local south-alpine or southeast-alpine workshop. While the cult chariot with its symmetrical construction still reflects some late Bronze Age traditions, the rich figure equipment was probably made under influences of the Near East and Eastern Mediterranean.<sup>14</sup> The form of a cauldron-wagon just as the arrangement of the figures and the narrative concept suggest that it was used in a ritual context. For the interpretation of the shown scene both foremost figure groups are important, the so-called *deer group* and the male-female pair behind them. The deer group consists of two genderless figures that are leading a deer by its oversized antlers. A man and a woman follow this group. The man holds a big upraised hatchet in his right hand. Due to its long-stretched form this hatchet reminds of the bronze hatchet with a socketed axe (Tüllenbeil) that

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<sup>8</sup>SCHMID, W. 1934.

<sup>9</sup>EGG, M. 1996, about the cult chariot see pp. 14 – 61.

<sup>10</sup>EGG, M. et al. 2010, pp. 1 – 25.

<sup>11</sup>EKSERDJIAN, D. 2012, pp. 118, 257.

<sup>12</sup>FÜRHACKER, R., MODL, D. 2012, p. 17f.

<sup>13</sup>TERŽAN, B. 2011, p. 233.

<sup>14</sup>TERŽAN, B. 2011, p. 238.

was deposited in the same grave. Both groups are flanked and protected by two riders. An interpretation in the sense of a ceremonious procession with deer offering is one of the possible interpretations.<sup>15</sup> The mentioned figures form a group in front and at the back of the central taller figure. The central figure can be interpreted as a goddess<sup>16</sup> or maybe priestess and shows parallels with the Mediterranean representations of vessel carriers (Hydrophoroi). It is standing centrally on a solar or wheel symbol made in cutwork design at the base plate of the cult chariot. Accordingly, in the 19<sup>th</sup> century the central figure was also associated with the Slavic goddess of light Lada or Kollada. The use of such a cauldron-wagon for the purposes of libation rites, blood sacrifice or incense offering was probably reserved for a socially very high-ranking person who was part of the Iron Age elite.

The actual excavations and the analysis of the cremation remains provided proof that in the cult chariot grave a total of four persons were buried, among them two men, a girl and an adult woman. The exceedingly rich jewellery and dress equipment – among other things a collier with about 2,500 amber pearls, various garment applications and a belt set with wheel-shaped bronze pendants – suggest that the leading person who was buried in the grave was the adult woman. Based on the peculiar jewellery and garb equipment it can be concluded that the woman probably held a function in connection with a cult or religion and was maybe a priestess.<sup>17</sup>

### CULT ON WHEELS – RECEPTION HISTORY OF THE CULT CHARIOT OF STRETTWEG

As one of the »icons« of the Hallstatt period the cult chariot has been playing a central role, not only in archaeological research but also in the general public perception of prehistory. It belongs to a small group of prehistoric finds from Central Europe which has reached a worldwide prominence, found its way in different kinds of art (e.g. literature, sculptural art and film) and is broadly known by the general public. Descriptions and photographs of the cult chariot can be found in almost every standard work of prehistoric archaeology or art history as well as in countless school books for history and art education.

When we enter the keywords *cult chariot* and *Strettweg* in the searching engines in the internet we receive several thousand results that also contain, apart from numerous popular representations and scientific essays, many obscure and strange considerations. Especially the central female figure and deer offering find themselves in the sphere of esoterism, pagan religions or feminism.

Numerous artists in Austria and abroad created replications, revisions, alienations and new interpretations of the cult chariot motive or the main theme of a woman-animal-chariot. So for example two metal sculptures of the famous Swiss artist Alberto Giacometti (1901-1966), namely *Femme au Chariot* (The lady in the carriage) and *Le Chariot* (The carriage), were associated with the cult chariot of Strettweg by art historians.<sup>18</sup> Today the cult chariot is one of the main attractions of the Archaeology Museum at the Universalmuseum Joanneum in Graz and a symbol of Styrian identity.

### WHEEL SYMBOLICS IN IRON AGE

The wheel cross or spoked wheels are common components of the late Bronze Age and Hallstatt art period in Central Europe and were interpreted as *salvation signs* or *cosmological symbols*.<sup>19</sup> The wheel symbol was used twice on the cult chariot, firstly as a technical component in the form of the wheels, and secondly as the decoration of the base plate.

Other objects of the Hallstatt period, which are to be found in the archaeological collection of the Department of Archaeology & Coin Cabinet at the Universalmuseum Joanneum, also show the importance of the wheel motive for this period. For example the wheels with four to six spokes on the bronze cistae (Zisten) of the chieftain graves Kröllkogel and Pommerkogel of the necropolis of Kleinklein (e.g. UMJ, AArchMk, Inv.-Nr. 1986, 10.714, 10.715, 11.400, 11.401, 11.402).<sup>20</sup>

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<sup>15</sup>EIBNER, A. 2004, p. 629.

<sup>16</sup>TERŽAN, B. 2011, pp. 235 – 241.

<sup>17</sup>TIEFENGRABER, G., TIEFENGRABER, S., MOSER, S. 2013, pp. 55 – 58.

<sup>18</sup>WIESINGER, V., LEINZ, G. 2010, p. 116f.

<sup>19</sup>KOSSACK, G. 1954, p. 62; PARE, C. 1987, p. 232.

<sup>20</sup>PRÜSSING, G. 1991, pp. 86 (Kat.-Nr. 328-330), 89 (Kat.-Nr. 344, 346, 349); EGG, M., KRAMER, D. 2013, pp. 211 – 213, 226 – 230.





Photo 3: Reconstructed ceramic wheel (UMJ, Inv.-No. 14.790), ceramic, Altenmarkt near Leibnitz, *Kleiner Gollikogel* / tumulus A or I, early Hallstatt period, 7<sup>th</sup> century B.C. (photo: D. Modl)

A ceramic wheel of black-grey colour originates from the so-called *Gollikogel*, a tumulus of the Hallstatt period necropolis of Altenmarkt near Leibnitz in western Styria (UMJ, AArchMk, Inv. No. 14.790; photo 3).<sup>21</sup> This wheel had a diameter of approx. 14 cm and probably 12 spokes and a conical hub, which was worked out on one side. The inventory of the *Gollikogel*, which was excavated in 1916, has unfortunately not been published up to this day, in spite of its richness. Therefore the tumulus can only be dated approximately into the early Hallstatt period (7<sup>th</sup> century B.C.). Comparable ceramic wheels are known from Bavaria, but with the difference that they do not have an axis hole and that they have only four spokes.<sup>22</sup> The piece from Altenmarkt was probably not a component of a chariot, but rather a sort of application.

The wheel symbol was also used for pendants. At least three pieces from the excavations from 1852 and 2012 are known from the Strettweg grave that also contained the cult chariot, which perhaps belonged to a kind of belt set. The best preserved piece (UMJ, AArchMk, Inv. No. 6050) has a diameter of 7,6 cm and consists of a cylindrical hub, six short spokes and a very broad wheel rim, which is enclosed by a wreath of twelve dees with gutters.<sup>23</sup> A fragment of a wheel pendant with the application of a water bird stands out amongst the finds from 2012.<sup>24</sup>

<sup>21</sup>KOSSACK, G. 1953, p. 49; HEBERT, B. 2008, p. 17f.

<sup>22</sup>VOSTEEN, M. U. 1999, pp. 114f. (Tab. 54), 266f.

<sup>23</sup>EGG, M. 1996, pp. 222 – 224 (Ill. 112/5).

<sup>24</sup>TIEFENGRABER, G., TIEFENGRABER, S., MOSER, S. 2013, p. 73 (Kat.-Nr. 83), p. 56.

The *Kultstab* or *sceptre* of Libna (UMJ, AArchMk, Inv. No. 10.256, 10.257, 10.344-10.349), a grave field that is located immediately to the east of the town of Krško in eastern Slovenia, was also decorated with a wheel pendant and other symbols.<sup>25</sup> The pendant is a decorated five spoke wheel with a human head and bronze jangle plates (*Klapperbleche*). It was attached, together with other hand- and bird-shaped pendants and chains, on a cylindrical bronze spout, which again belonged to another conical spout. For a long time such ensembles were interpreted as *Kultstäbe* or sceptres.<sup>26</sup> But the new find of a bronze garland from the Kapiteljska njiva-necropolis of Novo Mesto leads us to conjecture that maybe it could be a type of breast jewellery for women.<sup>27</sup>

Wheel pendants were still a popular jewellery symbol in the following late Iron Age as another wheel-shaped bronze pendant shows (UMJ, AArchMk, Inv. No. 18.074; photo 4), which comes from a flat grave cemetery at Hart near Wildon in southern Styria and dates into a developed phase of the middle Latène period.<sup>28</sup> In 1962 several cremation graves were destroyed by a gravel quarry, but the finds could partly be rescued and later allocated to different graves. Among them was a five spoke bronze wheel with a plastically formed hub and a middle hole, which has a total-diameter of 5.6 cm. Such wheels are interpreted as amulets and were very popular in different forms and sizes from the end of the middle Latène period in Central Europe and were worn exclusively by women as a necklace or in combination with brooches / fibulas.<sup>29</sup>



Photo 4: Wheel-shaped pendant (UMJ, Inv.-No. 18.074), bronze, Hart near Wildon, middle Latène period, 2<sup>nd</sup> century B.C. (photo: D. Modl)

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<sup>25</sup>GUŠTIN, M. 1976, p. 45, 113 (Tab. 65).

<sup>26</sup>STARE, V. 1973, pp. 730 – 739.

<sup>27</sup>FREY, A. et al. 2010, p. 97.

<sup>28</sup>MODRIJAN, W. 1962, p. 59f. (III. 3); KRAMER, M. 1994, p. 32, 54 (Tab. 39,2).

<sup>29</sup>VAN ENDERT, D. 1991, pp. 15 – 18.

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dr. Marko Mele, mag. Daniel Modl, Universalmuseum Joanneum

## POVZETEK

Z zbiranjem velike količine arhivskega gradiva, mnogih fotografij, publikacij in časopisnih člankov ter z analizo številnih historyčnih kopij je bilo mogoče rekonstruirati zgodovino restavriranja kulturnega vozička iz Strettwega. Voziček je leta 1851 našel kmet Ferdinand Pfeffer, ko je v bližini Strettwega obdeloval polje. Leta 1853 je prešel v last Deželnega muzeja Joanneum, od leta 2009 pa je glavna atrakcija Arheološkega muzeja na gradu Eggenberg v Gradcu. Med letoma 1853 in 2009 je vrsta manjših in večjih restavratorskih posegov korenito spremenila podobo in izvirni material kulturnega vozička in ga tudi delno poškodovala. Restavratorska dela so se začela leta 1852, ko ga je Matthias Robitsch iz posamičnih delov prvič sestavil v celoto. Leta 1862 so za Rimsko-germanski muzej izdelali kovinsko kopijo vozička, po izdelavi te kopije pa so izvirnik dopolnili z manjkajočimi deli in ga ponovno sestavili. Julius Rennert je med obsežnim restavratorskim delom, ki je potekalo med letoma 1881 in 1901/02, dopolnil nekatere dele voza s svinčnimi ulitki in odstranil številne prazgodovinske zakovice. Leta 1919 so voziček ponovno pregledali. Ob tej priložnosti so odstranili izviren par koles in pozneje dodan podaljšek. V naslednjih desetletjih so bila opravljeni zgolj manjši lepotni popravki, med letoma 2006 in 2009 pa je bil voziček v delavnici Rimsko-germanskega muzeja v Mainzu dokončno restavriran.

Danes je kulturni voziček iz Strettwega simbol štajerske identitete in ikona halštatske kulture. Predmet pa ne fascinira samo znanstvenikov, ampak je prevzel tudi medije in javnost, kar gre pripisati njegovi bogati figuraliki. V preteklih 160 letih so tako nastale številne znanstvene in tudi nestrokovne interpretacije. Simbol, ki se velikokrat pojavlja na kulturnem vozu, je kolo – pogost motiv bronaste in železne dobe v Evropi. To ugotovitev podpirajo še druge izbrane najdbe z območij avstrijske Štajerske in Slovenije, ki so na ogled v zbirkah Joanneuma.



# THE WOODEN WHEEL AND ITS APPLICABILITY IN THE DOCUMENTS OF THE HISTORICAL ARCHIVES OF BELGRADE

## With a review of the collections of the Belgrade museum from the 14<sup>th</sup> to 20<sup>th</sup> century

**Olga Latinčić**, univ. dipl. philologist, counselor in the Historical Archives of Belgrade, Historical Archives of Belgrade, Belgrade, Republic of Serbia, Palmira Toljatija 1, [olgalatincic@gmail.com](mailto:olgalatincic@gmail.com)

**Evica Micković**, univ. dipl. historian, counselor in the Historical Archives of Belgrade, Historical Archives of Belgrade, Belgrade, Republic of Serbia, Palmira Toljatija 1, [arhivbeograda@sezampro.rs](mailto:arhivbeograda@sezampro.rs)

(Translation in English: **Tijana Kovčić**, univ. dipl. philologist, archivist in the Historical Archives of Belgrade, Belgrade, Republic of Serbia, Palmira Toljatija 1, [arhivbeograda@sezampro.rs](mailto:arhivbeograda@sezampro.rs))

### ABSTRACT

The essay about the wooden wheel that is mentioned in the documents of the Historical Archives of Belgrade, which is a result of the review of the Belgrade museum collections, illustrates everyday life in Belgrade and Serbia in the period between 14<sup>th</sup> and 20<sup>th</sup> century. Only the most representative documents have been selected to be used as the first class material for further researches. The data about the archival material has been classified according to the fonds and collections that they belong to. Each fond and collection is introduced with a short description and followed by selected documents.

### KEY WORDS

Belgrade, wheel, wheelwrights, wood, traffic, distaff, army

The thematic guide as a scientific finding aid, with the goal to direct the researcher to the specific archival material, was made especially for this occasion in 2014 as a result of our knowledge, experience and also additional researches. All information about the records is classified according to the fonds and collections to which it belongs. The introductory part of the paper contains data about all museum collections in Belgrade, which are holding a wheel as a part of their exhibits. In the conclusion we will summarize the whole paper.

### REVIEW OF THE MUSEUM COLLECTIONS OF BELGRADE WHICH CONTAIN A WOODEN WHEEL

A wooden wheel can be found within almost every museum's collection in Belgrade.

The Gallery of Frescoes of the National Museum in Belgrade preserves copies of the frescoes from Serbian monasteries that are depicting the wheel as a torturing device and as a part of a transportation vehicle – monastery Djurdjevi Stupovi, fresco *Torturing of Saint George*, monastery Visoki Dečani, *Apostle Philip and eunuch of Empress Kandakia*. The *Judgment day* – a fresco from the monastery Gračanica,<sup>1</sup> the most significant endowment of King Milutin Nemanjić (ruled 1282–1321) was painted in the period between 1318 and 1321. A fragment of the fresco called *The Personification of Water* shows a wooden wheel on the coach of a mythical sea creature.<sup>2</sup> The Gallery of Frescoes treasures a copy of that fresco made by Časlav Colić. The National Museum in Belgrade is preserving the painting of Stevan Todorović, *Death of Hajduk Veljko*,<sup>3</sup> which is depicting a wooden-wheel cannon that is standing next to the dead heroic outlaw, in its Collection of Serbian paintings from 18<sup>th</sup> and 19<sup>th</sup> century.<sup>4</sup> The Military Museum is keeping more exponents of cannons with wooden wheels, from which the oldest one originates from the year of 1655.<sup>5</sup> The Museum of Science and Technology treasures a rudder of the wooden ship Bohor<sup>6</sup> and a distaff with a wheel from the 19<sup>th</sup> century.<sup>7</sup>

<sup>1</sup>Monastery Gračanica is one of the most significant Serbian medieval monuments under the protection of UNESCO.

<sup>2</sup>RS, Monastery Gračanica, west wall of the naos; <http://www.narodnimuzej.rs/o-muzeju/prostori-narodnog-muzeja/galerija-fresaka/> (quoted: 6. 5. 2014); TODIĆ, B. 1989, pp. 208 – 209, The Gallery of Frescoes of the National Museum, copy, inv. No. 1279.

<sup>3</sup>Veljko Petrović, an outlaw, (1780–1813), one of the most notorious heroes of the rebellious army in the First Serbian Uprising.

<sup>4</sup><http://www.narodnimuzej.rs/zbirke/zbirke-narodnog-muzeja/novi-vek-i-moderno-doba/> (quoted: 6. 5. 2014).

<sup>5</sup>RS, Military Museum, Muzzle- loaded Austrian regiment cannon, Inv. Nr. 30604.

<sup>6</sup>RS, Museum of Science and Technology, Collection of river shipping T:18. 296.

<sup>7</sup>RS, Museum of Science and Technology, Collection of crafts' machines and tools, Inv. Nr. MNT T:135.104.

The Ethnographic Museum preserves a number of exponents with a wooden wheel which is used in multiple ways: in traffic, agriculture, crafts, fishing and hunting, housing, as a device for the production of textile and as a children's toy.<sup>8</sup> The Historical Museum of Serbia holds a transportation trolley with tree little wooden wheels (Gornja Badanja, Serbia).<sup>9</sup> The Museum of Pedagogy in Belgrade is also keeping a teaching aid meant for physics classes, which is demonstrating the transmission of energy and function of a lever, among its abundant teaching material.<sup>10</sup> The Railway Museum is in the possession of a wooden wheel that was used as a mould for making iron transmissions.<sup>11</sup> The Museum of Aviation is treasuring a photograph of Edvard Rusjan's (a constructor and aviation pioneer) aircraft EDA 1 with wooden elements in his memory as well as his premature death. The Jewish Historical Museum is in the possession of an oil painting of an unknown author, which is depicting the *Welcoming of Franz Joseph in Sarajevo* with the visible image of a wooden wheel, and a monotype paper *Majdanek* of Nandor Glid.<sup>12</sup> The Museum of Roma culture in Belgrade preserves photographs of coaches used by Roma people to travel around the world. We also have to mention that a red wheel with 16 spokes is the symbol of Roma exile.<sup>13</sup> The first Serbian motion picture from 1911, *Life and deeds of immortal vožd Karadjordje*, addressing the topic of the people's struggle for freedom with the leader Karadjordje against the Turks (1804), is treasured in the Museum of Yugoslav Film Archives in Belgrade. The search for this film lasted for decades. A wooden wheel is clearly visible in this film.<sup>14</sup>

The Belgrade City Museum treasures an extremely valuable collection of engravings,<sup>15</sup> which were made in big European centres that are representing Belgrade from the 16<sup>th</sup> to the 19<sup>th</sup> century. Apart from its artistic value, this collection represents a precious source of information about the appearance and topography of Belgrade during that period. The oldest engraving (from the earliest period) containing the wheel originates from 1688. It depicts *The conquer of Belgrade on September the 6<sup>th</sup> in 1688*.<sup>16</sup> That was the time when prince Eugene of Savoy conquered Belgrade for the first time from the Turks and held it until 1699. A wheel on a gig used for the transport of passengers, which was being pushed by a man, is especially interesting.<sup>17</sup> A woman with a baby and a child are in the gig. During the last Austro-Turkish war, at the end of the century, Belgrade was conquered in October 1789 by the field marshal Gideon Ernst Laudon. Numerous Turkish families have left Belgrade after this battle.

The collection of photographs of the Belgrade City Museum treasures photographs that represent the use of the wheel in the field of public utilities.<sup>18</sup>

The Bratislav Petković Collection in the Automobile Museum is in the possession of a Buick, model X 28–58, 1928, USA (car body number 7342), one of 11 models that were exported to the non American market.<sup>19</sup>

The Archives of the National Bank of Serbia hold a collection of about 500 digitalized copies of photographs from the 19<sup>th</sup> and 20<sup>th</sup> century, which were made by Marko Stojanović, a deputy governor of the National Bank (1890–1902, 1912–1923) and a photography lover. His photograph of a blacksmith with a wooden wheel was used in the background on the golden 20 dinar banknote from 1905.<sup>20</sup>

<sup>8</sup>RS, Ethnographic Museum, Collections: traffic, agriculture, crafts, fishing and hunting, housing, textile device, children's toy.

<sup>9</sup>RS, Historical Museum of Serbia, Ethnographic collection, Inv. Nr. of the record 542.

<sup>10</sup>RS, Museum of Pedagogy Collection of teaching aid, Inv. Nr. XI – 154.

<sup>11</sup>RS, Railway Museum of Serbia, Collection of the Foundry of the Sector for the maintenance of vehicles in Makis.

<sup>12</sup>RS, Jewish Historical Museum in Belgrade, Painting Collection, Inv. Nr. 13 and 176.

<sup>13</sup><http://www.romamuseum.rs/> (quoted: 6. 5. 2014).

<sup>14</sup>A film *Život i dela besmrtnog vožda Karađorđa*; Production: Svetozar Botorić; Belgrade 1911: Script Cira Manok, Ilija Stanojević I Savković; Directed by Ilija Stanojević (Cica Ilija); Camera: Luie Pitrolf de Beri; Cast: Milorad Petrović, Ilija Stanojević, Sava Todorović.

<sup>15</sup>Engravings, objects of our research are published in: ТОМИЋ, В. 2012.

<sup>16</sup>Same as footnote 15, the engraving was made in Amsterdam, in 1688, the author was Romeyn de Hooghe and the publisher was Aert Dirksz Oosaen; ТОМИЋ, В. 2012, p. 64.

<sup>17</sup>Same as footnote 15; the scene of the Turks leaving Belgrade, on the 12<sup>th</sup> of October in 1789, made in Zittau (Saxony) in 1791, and the author and publisher of this engraving is Jacob Friedrich Neumann, ТОМИЋ, В. 2012, p. 195.

<sup>18</sup>НОВАКОВИЋ, Б., ВУКОВИЋ, Љ., МАТИНОВИЋ, В. 1982, p. 99; ЋИРИЋ, Д. 2011, pp. 105; 249.

<sup>19</sup>МАРКОВИЋ, П...[и др.] 2002, p. 147; pp. 163 – 165; 171 – 172.

<sup>20</sup>ЈЕРКОВИЋ С, ИЛИЋ С 2009, pp. 1-3. The banknote does not depict the wheel.

## THE HISTORICAL ARCHIVES OF BELGRADE

The Historical Archives of Belgrade were established in the year of 1945. With its activities and existence the Archives bear witness to the history of Belgrade, Serbia and Yugoslavia, since Belgrade was the place where the most important events in the spheres of history, politics, economy and culture have taken place.

Today, the Archives are keeping 2,738 fonds and collections or about 13 linear meters of archival material.

## THE THEMATIC GUIDE FOR THE DOCUMENTS OF THE FONDS AND COLLECTIONS OF THE HISTORICAL ARCHIVES OF BELGRADE

THE ADMINISTRATION OF THE CITY OF BELGRADE (1839–1944); 1825–1944, fond No. 1

The fond Administration of the City of Belgrade provides information about the activities of the Belgrade police which had administrative and judicial authority for a certain period of time.

The fond preserves serial type material that is related to the wheel. The material can be divided into two thematic areas: traffic and crafts (wheelwrights). The material contains information about the traffic jams, accidents, abandoned vehicles, and wheelwrights. It is not often that we come across documents whose content would describe the use of the wheel more closely and precisely. The oldest document from this fond that contains information about the wheelwrights of Belgrade is from 1837 and contains a list of 12 taxpayers in guilds in the City of Belgrade.<sup>21</sup> We encounter a document where the wheel is used as a torturing device – for executions in the records from 1848. The document represents a Prince's directive to the Minister of internal affairs Ilija Garašanin, to take a dead convict off the wheel and to bury him. This event occurred during the rule of Prince Aleksandar Karadjordjević (1842–1858). While he was travelling from Belgrade to Požarevac (Serbia), the Prince saw an *ekmekluk*<sup>22</sup> with a wheel with a convict.<sup>23</sup> In 1863, according to the report of The District Court of the City of Belgrade that has been submitted to the Belgrade police, the wheelwright's craft was the most wanted trade in the city.<sup>24</sup> In those years, in 1863 to be more exact, two inventions had been demonstrated in Belgrade. The first was the invention of Stevan Ilijić, a miller from Senta in Bačka (Vojvodina, Serbia), who invented a vehicle that could move without horses or any steam.<sup>25</sup> The other invention was the creation of Aca Radak, a *hudožnik*<sup>26</sup> from Vršac in Banat (Vojvodina, Serbia), who invented a machine perpetuum mobile, a machine that would turn continuously by itself, using its own weight, and would also be able to set other machines, which were necessary for everyday life, like the mill, automobile, ships etc., in motion with its power.<sup>27</sup> The Instructions for the municipal chamber of the regular army, issued by the Artillery-technical department of the Ministry of War in 1891, explain which kinds of trees should be cut down when making certain parts of horse carriage or ox cart; can be found in the same fond. The Instructions include a letter containing a recommendation of standards concerning the time and way in which a tree should be cut. The letter says that the tree should be cut from the end of November until the end of January, because during that time period all the juices of the tree are withdrawn in its heart and the wood that is cut in this period does not crack later. The Lumber should be kept in a closed and dry place in order to dry out as good as possible. These Instructions specify that the trunnions on the front and back chassis should be built of young and hard ash, elm, oak, acacia or young beech wood, when dealing with the wheel. This wooden material should be carpentered in slabs or cut in half, it must not contain nodes, and it should not be sprinkled or rotten. The hub of the wheel is best made from young elm, then of ash and acacia, and if necessary it can also be made out of oak wood. The spokes for the wheel are best made from young and hard oak or acacia, and then of ash or elm wood. The material for the spokes should be cut or carpentered in such a way that the heart of the tree is removed. The wood should not contain sapwood and must not have nodes. The rims are best made from young and hard ahs, and then of elm, oak or acacia, and if necessary they can be made from mulberry wood. The wood is carpentered or cut in quarters or halves, so that the heart of the tree does not remain in any of the rims. It should not be sprinkled or crooked, but healthy and fresh.<sup>28</sup>

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<sup>21</sup>RRS, IAB, UGB, Inv. Nr. 1, record No.60.

<sup>22</sup>Serbian: екмеклук - Turkish loanword which means bakery, a place where bread was produced.

<sup>23</sup>RS, IAB, UGB, Inv. Nr. 87, f 1–159–1848.

<sup>24</sup>RS, IAB, UGB, Inv. Nr. 539, f. 12a–3478–1861.

<sup>25</sup>The invention was accepted by Belgrade police. RS, IAB, UGB, Inv. Nr. 689, f. 26-9-1863.

<sup>26</sup>Serbian: художник -hudoznik, a word taken from Russian language, meaning artist.

<sup>27</sup>The invention was accepted by Belgrade police, RS, IAB, UGB, Inv. Nr. 698, f. 31-125-1863.

<sup>28</sup>RS, IAB, UGB, Inv. Nr. 2053, order No. 43/1891.

## THE ADMINISTRATION OF THE CITY OF BELGRADE, THE SPECIAL POLICE DEPARTMENT (1941-1944); 1941–1944.

The records of the Special police department, which are to be found within the fond of the Administration of the city of Belgrade, are very important for the history of the Second World War. The Concentration camp Belgrade – Banjica, established in July 1941 and disbanded in October 1944, was a part of this Department. Over 30,000 camp detainees have passed the camp during this period. There were also 35 wheelwrights among the prisoners. They were arrested as participants in anti-fascist actions or because their craft was required by the Nazi authorities.<sup>29</sup>

## THE MUNICIPALITY OF BELGRADE (1839–1944); 1862–1944; fond No. 6

The archival material of the fond Municipality of Belgrade from 1839 follows all aspects of life in Belgrade. Together with other projects of buildings in Belgrade between the two World Wars, the Technical direction of the Municipality of Belgrade also treasures a project of a Buddhist temple that was finished in 1929. This temple was the only Buddhist temple in Europe in that period. It was built on the request of the Kalmyks of Belgrade, people of Mongolian origin, who have found refuge in Belgrade together with many other Russian refugees after the October revolution and were under the patronage of the Yugoslavian government. A symbol of Buddhist religion – a wooden *Wheel of Learning*, which is positioned between two lamas, was positioned above the main entrance of the temple. The temple was decorated with bells.<sup>30</sup>

## THE ZEMUN MAGISTRATE (1751–1934); 1749–1934; fond No. 10

The local government of the Zemun Magistrate was established in 1751. Zemun was a part of the Austro-Hungarian Empire until the end of the First World War 1914–1918, when it had become a part of the Kingdom of Serbs, Croats and Slovenes.

This fond preserves various documents that can be classified as postal traffic, since they have registered an attack on a postal coach. The fond of the Zemun Magistrate also treasures documents about the craftsmen of Zemun– wheelwrights; about the complaints about the work of certain craftsmen – fuser,<sup>31</sup> from 1825.<sup>32</sup> There are documents about Vencel Dombas, dating from the same year, a man that had learned the wheeler's craft well and who was in *vandroka*<sup>33</sup> for eight years. The will of the wheelwright Matijas Šurok from Zemun from 1825 is the most comprehensive among these documents. It contains, besides his will, a commission report and the positioning of a cooper craftsman named Leopold Okoviter as a guardian of the will of late *Šurok*.<sup>34</sup>

## THE PEOPLE'S COMMITTEE OF THE 1<sup>st</sup> DISTRICT OF THE CITY OF BELGRADE (1945–1952); 1944–1952, fond No. 42

The District People's committees were the first bodies of the new government and administration in Belgrade after the Second World War. In 1952 they were organized in municipalities.

The serial type material – claims of war damage of the 1<sup>st</sup> District People's Committee of the City of Belgrade also includes claims of the wheelwrights of Belgrade. In 1945 Ivanović Spasoje, a wheelwright from the village Slovak near Valjevo (a city in Serbia), claimed the damage he had suffered during the war. According to the data from the war damage report, this wheelwright was taken away by German authorities and subjected to forced labour for 18 months. On top of this, on May the 18<sup>th</sup> in 1944 his forest was damaged – 6 cubic meters of ash and elm trees. The damage was estimated at 210,000 dinars. His workshop, which was located in

<sup>29</sup>RS, IAB, UGB, SP, Books of the Concentration camp Belgrade-Banjica detainee 1-8.

<sup>30</sup>ЛАТИНЧИЋ О. 1988, pp. 212 – 214; [http://kakoNo.tripod.com/Kalmyk Buddhist Temple in. Belgrade \(1929 - 1944\)](http://kakoNo.tripod.com/Kalmyk%20Buddhist%20Temple%20in%20Belgrade%20(1929%20-%201944).htm). An exhibition. NEW VERSION, rel. date 2.2.2000 (quoted: 6. 5. 2014).

<sup>31</sup>Serbian фyшep - German word, bad handyman.

<sup>32</sup>RS, IAB, ZM, Inv. Nr. 2198.

<sup>33</sup>RS, IAB, ZM, Inv. Nr. 2199. Serbian вандрок – a German word, which initially stood for the apprenticeship under many master craftsmen, later – a drifter.

<sup>34</sup>RS, IAB, ZM, Inv. Nr. 2211 (translation of the document by Isidora Stojanović, an archivist in IAB).



the street Francuska ulica in Belgrade, were also destroyed along with all of his working material, tools and 20 litres of acetone. The damage was made in the period between the years of 1943 and 1944 by the German occupation authorities.<sup>35</sup> The wheelwright Antonović Stevan also reported war damage was on his workshop, tools, stall and 2 cubic meters of ash wood and 1,500 tenons, which were meant for the wheels that were made of acacia wood. This damage was estimated at 64,000 dinars.<sup>36</sup>

#### THE GUILD OF WHEELWRIGHTS, BLACKSMITHS AND SADDLERS OF BELGRADE (1844–1911); 1849–1911, fond No. 1046

The guilds were old associations that have existed in Serbian towns since the time of the Dahias.<sup>37</sup> The creation of the new state by Miloš Obrenović (1815 – 1839; 1858 – 1860) brought prosperity to the guilds and their class organization. Every guild had its master and a scribe – secretary. The master was bound to always represent the interests of his guild; he took care of the discipline in the guild and he resolved the disputes within the guild. A member of a guild would have been handed over to the state court only in the case, if he did not obey the verdict of the master. All questions were resolved during the convention with the mandatory presence of all members. The guilds had their stamps<sup>38</sup> and cash boxes. Schooling and practice of an apprentice and a journeyman were specifically determined by the guild's rules. The guilds of Belgrade played an important role in the bodies of the government, court, schools and church and were highly respected. The incomes of the guild were divided in three parts. The first was donated to the church, the second to the schools and the third part was kept for their own needs. The Act of the guilds, passed in 1847, regimented the customs of the guild within legal boundaries.<sup>39</sup> The archival material of the wheelwright's, blacksmith's and saddlers' guild contains books, minutes, financial registers, documents about the life and work within the guild, about schooling and about the masters. The oldest book is the Book for journeymen of the wheelwright's guild from 1850 to 1903. The book registered persons that were training to become journeymen. It also included basic information about the duration of the apprenticeship, the name of the master, the date of the completion of the apprenticeship as a journeyman and remarks. The first registered journeyman in a wheelwright's workshop was Vasilije Ivanović from Pančevo, Banat County (Vojvodina, Serbia). He was 18 years old, Orthodox, and spent 5 years in apprenticeship in the workshop of Djordje Grujić, who had been a wheelwright. He was promoted to a journeyman on May the 3<sup>rd</sup> in 1853. In the Remark section it was written without pay (he was studying the craft).<sup>40</sup> The first registered journeyman from Belgrade was Andrej Teović, 18 years old, 4 years in apprenticeship in the workshop of Vasa Vuković, and promoted to a journeyman in 1857.<sup>41</sup> The book reveals information about the salary of journeymen (some of them did not receive any money). In the following time period, as well as at the end of the 19<sup>th</sup> century, journeymen from the Austro-Hungarian Empire were coming to Belgrade. The training of the wheelwright's craft was received in a master wheelwright's shop or at the Blacksmith's society. After separating from the blacksmith's and saddlers' guild, the wheelwright's guild became independent in 1879. The guild had received incomes from investments, from its estates, and the taxes. The guild also had expenses concerning the church, school, lawsuits and complaints, office supplies and maintenance etc.<sup>42</sup> The documents of the wheelwright's guild – 121 records, comprise the preservation of the time period between the years of 1869 and 1910. They usually refer to the journeymen and master's exams. The certificate of Todor Šmit, a wheelwright, for the journeyman's examination in Merseburg (Merseburg, Saxony – Anhalt, Germany) in 1883 is also among those documents.<sup>43</sup> More documents refer to the continuance of the schooling in Serbia that had begun in Austria and vice versa.

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<sup>35</sup>RS, IAB, 42, K 301/16.

<sup>36</sup>RS, IAB, 42, K 311/85.

<sup>37</sup>Dahijas were renegade jannisaries, rebels against the Ottoman sultan.

<sup>38</sup>The wheel was on the wheelwright's stamp. It can be mentioned as a curiosity that this wheelwright's mark appears in the name and the tattoo of the famous Serbian rock musician Radomir Mihajlović Točak.

<sup>39</sup>МАРУШИЋ, Н. 1962.

<sup>40</sup>Two registers of the pupils are preserved, Inv. Nr. 100 and 100, (RS, IAB, 1046, Inv. Nr. 100, line 3).

<sup>41</sup>RS, IAB, 1046, Inv. Nr. 100, line No. 24.

<sup>42</sup>RS, IAB, 1046, Inv. Nr. 102.

<sup>43</sup>RS, IAB, 1046, Inv. Nr. 14, line 3a.

The number of wheelwrights in Belgrade during the period between 1890 and 1907 varied from 15 to 23 wheelwrights. They reached the highest number in the year 1902.<sup>44</sup> Their workshops were situated in the very centre of the city. The unique custom of the Serbs *krсна slava* was celebrated by families, churches, monasteries and craftsmen. The wheelwright's guild celebrated the *krсна slava* from its very beginning, whereby they have chosen the protector of the craftsmen – Saint Ilija the Thunderer, which is being celebrated on August the 2<sup>nd</sup>.<sup>45</sup> Many preserved documents illustrate the preparations for the *slava*. The same fond preserves one military card of Ivan Božić who was a wheelwright, a reserve sergeant and a participant of the Balkan wars in 1912–1913.<sup>46</sup>



Photo 1: Seal of the Wheelers'guild, RS, IAB, fond no. 1046, box: 14

#### THE BELGRADE ACADEMIC ATHLETIC CLUB *BASK* (1903–1944); 1903–1944 *BASK*; fond No. 1106

The club was established on April the 18<sup>th</sup> in 1903 as a football club *Soko*. The club changed its name to *FC BASK* (Belgrade Academic Athletic Club) in 1933. The fond preserves the photograph *Going onto the field* in an edition that was published for the 30<sup>th</sup> anniversary of the club's foundation. The photograph was taken before the First World War and depicts a trolley with wheels with wooden spokes. One athlete is pulling and another is pushing the trolley full of football balls.<sup>47</sup>

<sup>44</sup>RS, IAB, 1046, Inv. Nr. 14, line 89.

<sup>45</sup>Krsna slava - (svetosavlje) <http://www.svetosavlje.org/biblioteka/Obicaji/slaveiobicaji> (quoted: 3. 4. 2014).

<sup>46</sup>RS, IAB, 1046, Inv. Nr. 14.

<sup>47</sup>RS, IAB, 1106, Inv. Nr. 8, Споменица о тридесетогодишњици, 1903 – 1933, стр. 25.



The Belgrade family Glavinić originates from Mostar (Bosnia and Hercegovina). The data about the Glavinić family originates from the middle of the 18<sup>th</sup> century. All members of the family played significant roles in the political and cultural life. Konstantin – Kosta Glavinić (Belgrade 1858 – Belgrade 1939) was a construction engineer, a professor, a four time president of the Belgrade Municipality, a Minister of Economy of Serbia and a government commissioner in the National Bank of Yugoslavia. He was the founder of numerous societies and associations like the Association for the improvement of the production and sales of hand made products *Handicraft* LLC. The documents of Kosta Glavinić include an abundant quantity of the correspondence of the stated association. The horrible consequences of the First World War, which have affected all aspects of life in Serbia, as well as the economic crises caused that in the 1920's and 1930's numerous organizations, societies and individuals have stood up for the recovery of the traditional hand crafts such as hand spinning and weaving. For this purpose the association »Handicraft« was making, purchasing and dealing distaffs with wooden spinning wheels all over Serbia. The correspondence contains letters of support as well as printed material.<sup>48</sup> This activity inspired everyone to remember the traditional folklore creativity. In the article Let's dress the countryside the magazine *Economic Review*, from the 1<sup>st</sup> of January in 1938, reminds of a traditional poem, in a decasyllabic form:

Mother feeds her nine young daughters  
And the tenth is the fragile Stjepan  
With her distaff and her right hand

The correspondence as well as published material concerning the purchasing of distaff can also be found in the fond.<sup>49</sup>

THE SOCIETY OF YUGOSLAV FOLK COSTUMES – HOMEMADE – BELGRADE (1933–1941); 1933–1941; fond No. 1033



Photo 2: Distaffs for distribution, RS, IAB, fond no. 1033, box: 2

<sup>48</sup>RS, IAB, 1119, K 3, ЈОКСИМОВИЋ Ч. 1933.

<sup>49</sup>RS, IAB, 1033, K 2.



Mihailo S. Petrovic was a publicist and a journalist of the newspaper *Politika*. His personal fond preserves a rich collection of photographs taken by Mihailo himself in order to illustrate his articles in *Politika*. For this occasion we selected four photographs with clearly visible wooden wheels. The photograph *Arranging of the streets of Belgrade*, which was made in 1929 (sepia, format 23 x 18), shows a transport cart with wooden wheels on the left side. The wheels on the right side are taken off. The name of the second photograph is *The Moving on the 1<sup>st</sup> of May in 1929* (sepia, format 23 x 18). The photograph is depicting a wooden trolley that is loaded with things. The depicted cart with wooden wheels on the third photograph (sepia, format 23 x 18) from 1932 was a transport cart used for excursions on the mount Avala.<sup>50</sup> The last photograph (sepia, format 23 x 18) depicts a street sweeper in Belgrade who is pushing a trolley with a broom and a can.<sup>51</sup>

#### THE PHOTOGRAPH COLLECTION OF THE 19<sup>th</sup> AND 20<sup>th</sup> CENTURY, collection No. 1165

For this occasion, we have selected the photographs of the military priest Risto Šuković (1855 – 1939), who participated as a volunteer in the Balkan wars 1912 – 1913 and in the First World War 1914 – 1918, from the rich collection of the photographs. His collection of photographs, with documentary and also artistic value, was published in Sarajevo as a collection of postcards by Jakob Kapon. The photographs were taken in 1914 and 1915. They represented one of the most horrible events in Serbian history, occurrences from the Great War – abandoning the country, withdrawal and crossing Albania, reaching the shores of Greece. The Serbian army, King, administration, population, and children took part in this horrifying flight. Even in this situation His Majesty the Wheel has played a significant role in the transportation of people and their belongings. The photograph of the army and their cargo, when crossing the river Mata (Albania), on an ox carts with wooden wheels (sepia, format 15 x 10), is just one of numerous examples.<sup>52</sup>



Photo 3: Serbian army crossing the river Mata while withdrawing over Albania to Greece, 1915, photo: military priest Risto Šuković, published by Jakob Kapon, RS, IAB, collection no. 1165, photograph C3-0001

<sup>50</sup>A mountain near Belgrade.

<sup>51</sup>RS, IAB, 2156, K 8.

<sup>52</sup>RS, IAB, 1033, K 2.

This collection encompasses autobiographies, chronicles, monographs, genealogies and manuscripts. The manuscript of Milivoje Kostić, a merchant and chronicler from Belgrade, preserves a biography of Todor L. Milišić who was a merchant and the owner of the first Serbian workshop for baby trolleys. The main store for the production of the trolleys was situated on the King's Square (nowadays the Student's Square) in Belgrade.<sup>53</sup>

## THE LIBRARY FONDS

The specialized library of the Archives is preserving, among antique and rare books, a book by Felix Kanitz. Kanitz was an Austro-Hungarian writer, archaeologist and ethnologist and one of the best experts for the territory of South-East Europe (1829–1904). The book contains drawings of a wooden wheel that was used for the transportation of people and cargo on horse and ox carts, coaches, and trams.<sup>54</sup>

## BELGRADE ON WOODEN WHEELS

We have travelled on wooden wheels through Belgrade from the 14<sup>th</sup> to the 20<sup>th</sup> century, thus since the Middle Ages, the days when the Ottoman- and Austro-Hungarian Empire were fighting for Belgrade, the formation of the modern Serbian state, the two World Wars and all up to the period of Socialism.

The documents have revealed the presence of the wheel in the Historical Archives of Belgrade and in numerous museum collections. They have also pointed out the wide range of its use; primarily in the field of traffic, connected with the transportation of passengers by – car, coach, cart, tram, ship, aircraft and baby trolleys. It appears in the role of a teaching device as well as a toy. It was also present in the field of communal services, on wagons used for cleaning and washing of the streets, in the field of postal traffic, for the purposes of ice distribution or as a shop on wheels. It has been used, since the earliest times, on the battle fields by the army in order to pull the cannons or other military equipment. It was used as a torturing device – for executions in the early 19<sup>th</sup> century. But the wheel was also put in use in inventions. The most significant use of the wheel in the field of crafts was on the distaff that was used in spinning. It is also mentioned in the traditional poetry. The curiosity was the Learning Wheel on the Buddhist Temple in Belgrade, the wheel driven by a mythological creature on a fresco and the wheel on the Roma flag. This can be explained as a religious and philosophical function of the wheel. A wheel with the blacksmith that is depicted on the bill of the National Bank of Serbia from 1905 has a symbolic design function. We cannot forget the first Serbian motion picture as well as the use of the wheel in the most important of all unimportant things – football where the wooden wheel was attached on the trolley that had been used for the transportation of the football equipment. We have presented documents concerning the types of wood, which is to be used for the wheel production, as well as the wheelwrights – their life and work in Belgrade, in peace and in war.

The documents, which we have presented, represent the series of documents and we hope that new researches will bring new information about the wooden wheel and its use.

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- 1106- Belgrade Academic Athletic Club *Bask*, box: 8
- 1119- Family Fond Glavinić, box: 3

<sup>53</sup>КОСТИЋ, Миливоје М. 2000, pp. 53 – 55.

<sup>54</sup>KANITZ F. 1904.



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# LESENO KOLO IN NJEGOVA UPORABA, ZABELEŽENA V DOKUMENTIH ZGODOVINSKEGA ARHIVA BEOGRAD

Olga Latinčić, Evica Micković, Istorijski arhiv Beograda, Republika Srbija

## POVZETEK

Na lesenih kolesih smo se popeljali po Beogradu od 14. in vse do 20. stoletja: od srednjega veka, obdobja bojev za Beograd med Osmanskim cesarstvom in Avstro-Ogrsko, oblikovanja moderne srbske države in časa obeh svetovnih vojn pa vse do obdobja socializma.

Prisotnost (lesenega) kolesa so razkrili dokumenti v Zgodovinskem arhivu Beograd in številnih muzejskih zbirkah. Predstavljen je širok razpon njegove uporabe, najprej v prometu, torej v povezavi s prevozom ljudi z avtomobilom, kočijo, vozom, tramvajem, ladjo, letalom in otroškimi vozički. Kolo se pojavlja tako v vlogi učnega pripomočka kot tudi v vlogi igrače. Uporabljalo se je pri komunalnih storitvah, torej na vozilih, ki so jih uporabljali za čiščenje in pranje cest, pa v poštnem prometu, pri razvažanju ledu, omogočalo je potujočo trgovino. Vojska ga je od nekdaj uporabljala na bojiščih, da je vlekla topove ali drugo opremo. V zgodnjem 19. stoletju se je uporabljalo kot mučilna naprava – za usmrtitve, svojo namembnost pa je dobilo tudi pri izumih. Na področju obrti je bilo najpomembnejše pri preslicah za kolovrate, ki so jih uporabljali za predenje, omenja se tudi v ljudskem pesništvu.

Med znamenitosti spadajo: kolo učenosti, ki je upodobljeno na prvem budističnem templju v Beogradu, freska, na kateri je upodobljeno kolo, ki ga poganja mitološko bitje, in kolo, upodobljeno na romski zastavi. Vse te upodobitve si lahko razlagamo z religiozno in filozofsko funkcijo kolesa. Kolo s kovačem, upodobljeno na bankovcu Narodne banke Srbije iz leta 1905, pa simbolizira funkcijo oblikovanja. Pri tem nikakor ne gre pozabiti prvega srbskega filma in seveda najpomembnejše postranske stvari na svetu – nogometa: v filmu je bilo kolo pritrjeno na tramvaj, ki so ga uporabljali za prevoz nogometne opreme.

Predstavili sva še vrsto drugih dokumentov. V njih so opisane vrste lesa, ki so jih uporabljali za izdelavo koles, ter življenje in delo kolarjev v Beogradu v času miru in vojne. Upava, da bodo nove raziskave prinesle nova spoznanja o lesenem kolesu in njegovi uporabi.

# THE WHEEL FROM TRANSYLVANIA

Dr. Ion Blajan, Head of Collection at Romanian Peasant Museum, Bucharest, Romania, e-mail address: ionblajan\_1@hotmail.com

## ABSTRACT

The documents and reports of foreign travellers allow us to get an idea of the means of transportation that were mostly built of wood and without iron that would bind them. Iron was expensive. A horse - drawn wagon bound with iron was a social statement which had been reserved for the rich people. In the second half of the 19<sup>th</sup> century the practice of iron binding of peasant carts, in our case meaning iron-bound wooden wheels, was widespread. Today, the old craft of wheelwrights is almost lost, the craftsmen are very old and nobody orders this kind of wheels anymore. We are supporting a change of the function of the wheel: the *utility cart* should become an element of decoration in the Romanian guesthouses.

## KEY WORDS

wooden wheel, cart, wagon

For centuries, before the industrial revolution, which had been determined by the invention of the steam engine, the European transports of commodities and passengers on land were made with horse-drawn wagons, carts, carriages, and later with stagecoaches. The loads were reduced due to the limited the size of the vehicles and the thrust of draught animals that were clearly inferior to the breeds of today. Several pairs of oxen, cows or horses were required to be harnessed to a single vehicle, which typically moved at a snail's pace.

The information on means of transportation issued from contemporary documents is rare, sparse, mentioning only the names of craftsmen and the tools which they were using, and supplemented by archaeological discoveries.

Based on these documents, we can say that since the 16<sup>th</sup> century the wheelwrights have already differed from those craftsmen who built carts. The wheelwrights were the ones who have supplied the wheels to the aforementioned. This situation has prevailed for a long time in the Romanian villages (the wheelwright's craft involves a technical endowment – a lathe and other tools that have only been affordable by very few people).

The first attestation of a lathe used to process wood, which was quite primitive, probably manually driven, but had at that time represented a high-tech facility, occurs in a registry of expenditures dating from 1508 – 1509.<sup>1</sup> The reports of foreign travellers about the Romanian countries are precious sources which allow us to get an overview of the state of means of transportation throughout history. The most numerous reports date from the first half of the 19<sup>th</sup> century. That is to be ascribed to the fact that before that the Romanian vehicles have not drawn the attention of foreigners because they were similar to those in their home countries. When the gap between the means of transportation in Moldavia, the Romanian Country and the Western European countries had increased it was natural that this had come into the attention of these travellers.

The mentioned reports are focused on the primitive character, the weakness of the wooden vehicles without springs and the disastrous state of the roads in the Romanian countries. We must not forget that these travel notes were generally written by western travellers who were used to travel comfortably, accustomed to the swinging of carriages with springs and to the softness of their pillows, and some of them had even witnessed the wonderful experience of travelling by train, whence the critical character of these remarks.

Undoubtedly, most of the reports are great stories of painful contacts with the unusual carts of the Romanian Post Office, which were according to the Thibault Lefebvre »*the most uncomfortable vehicles, most tragic and most primitive of Europe.*«<sup>2</sup> If we are to believe the reports of foreign travellers, the mail carts were built entirely of wood: »*My beautiful cart is held together only by the wooden logs and linked only by strings, and*

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<sup>1</sup>TOCILESCU, GR. 1905 – 1906, p. 471.

<sup>2</sup>BUȘĂ, D. 2010, p. 254.



*in addition, as the road from the border to Argeş is in very bad state, something is breaking every moment. It was at almost every stop on the road when the coachman would have to come down, about ten to fifteen times, to knot something to the horses' hams, or to fix back the detached wheel with a wooden peg, or to somehow assemble the broken wagon which is going to pieces.»<sup>3</sup>*

The wheels were small and with no iron hoops. Another traveller Xavier Hommaire de Hell found them - of course, exaggerating - *»rather pentagonal than round, they do not remain on their axle for the most part of time, but they will still remain on the road when running with speed.»<sup>4</sup>* The longest report was written by Stanislas Bellanger whose memories on the Romanian counties are simply called *The Cart*: *»Imagine a box without a roof, thirty fingers high (81 cm), two feet wide (65 cm), three feet long (97.5 cm) that is framed by four wheels made in one piece, rounded with an axe and mounted on two wooden axles, all without any nails, made of cheap material that was at hand.»<sup>5</sup>*

The advantage of such means of transportation was that they were quickly repaired and that they were very light. According to Heroque-Mellveile nothing seemed to disturb the coachmen of these *equipages/carriages*, a damage was quickly repaired with simple tools: *»If somehow, as a result of one of the many shortcuts they try, one of the axle breaks a solid branch maintains the balance of the vehicle and the coachman comes back on the horse continuing with the same speed.»<sup>6</sup>*

All foreigners agree: uncomfortable, poorly constructed, drawn by poky horses, yoked with no harness, just with simple ropes or strings, but still the Romanian stagecoach has no equal in Europe in terms of the speed with which it moves. Aurelie de Soubiran-Ghica considered, for example, that *The Wallachian Post* is a wonder that rivals the ship and brings honour to Europe. The German Post sleeps, the French Post dozes, but the Wallachian Post flies.<sup>7</sup>

The strength of this post carts was the speed of five miles per hour.<sup>8</sup> The road from Giurgiu to Bucharest that is 21 miles (84 km) long is covered in about 5:00 hours by these carts.<sup>9</sup> The only condition was, of course, that the road was dry. But on the other hand, rain had caused a very difficult travel.

If we look at the transport of commodities over land, we can see that, for centuries, it had relied on horse – drawn wagons and carts that were built with the minimum use of iron. They were slow, had a limited cargo capacity and could not travel in the rainy months during autumn and winter. Another traveller observes that *the freight*, especially grain which are forming the bulk of trade, is transported by wooden carts (their construction does not include a single atom of iron) which are drawn by two and up to six oxen. These carts travel in convoy. Around 12 to 15 km distance can be covered per day.<sup>10</sup>

The carts are made of wood without a single piece of iron, they are small, less solid, drawn by oxen they do not bear anything else than small loads, and they stick in the mud upon the first rainfall. They cannot travel during the period from October to May.<sup>11</sup>

The carriages were of lightweight construction, but several pairs of oxen were needed because of the disastrous state of the roads, or rather the lack thereof, the puddles, the mud and the deep grooves. *Horses that were harnessed by four to one wagon* were often used for the traction and there were too few to pull the vehicle over the roads, which had no smooth surface, up and down on the mountain. It often happens, in the worst places, that the coachman must also add five to six pairs of oxen.<sup>12</sup>

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<sup>3</sup>BUŞĂ, D. 2010, p. 705.

<sup>4</sup>BUŞĂ, D. 2007, p. 635.

<sup>5</sup>CERNOVODEANU, P. 2004, p. 627.

<sup>6</sup>BUŞĂ, D. 2010, p. 241

<sup>7</sup>BUŞĂ, D. 2009, p. 167.

<sup>8</sup>BUŞĂ, D. 2010, p. 241.

<sup>9</sup>Ibidem.

<sup>10</sup>BUŞĂ, D. 2007, p. 291.

<sup>11</sup>BUŞĂ, D. 2010, p. 268.

<sup>12</sup>BUŞĂ, D. 2010, p. 545; BUŞĂ, D., CERNOVODEANU, P. 2006, p. 471.

Based on these reports, it can be concluded that most Romanian carts had wheels that were made of wood. Iron was expensive and, therefore, wagons and carts with iron-bound wheels were expensive and were a symbol of high social status designated for the rich people.

The carts were often imported from Transylvania in Wallachia, from the town of Braşov, hence the name »*Braşoveancă*«. These carts originated from the same epoch when the quality was designating a solid cart with metal reinforcements, which were totally different from those described by the foreign travellers. The fame of the carts from Braşov has lived throughout the centuries, being known under various names: *Rădvan* = barouche, *Braşovene* or *Braşoveni* (carts specific for the Braşov region). They were used by *voivodes*- travellers or by the nobles and were being specially ordered from the craftsmen from Braşov. The *voivodes* had special orders, like for example Radu the Great in 1504 or 1507. He required two carts that had to be big; the wheels had to be bind with iron and all of their parts had to be new and of good quality.<sup>13</sup>

Centuries of experience have determined the choice of wood from which the wheels were made: ash was the most used kind of wood in order to make the best wheel hub, oak was used for manufacturing spokes and beech wood was used for the production of the rim. These carts were lighter due to the lack of iron, but they were extremely fragile and therefore subjected to all kinds of accidents.

It was at a later time, after the second half of the 19<sup>th</sup> century to be exact, when the practice of binding cart wheels with iron had generally asserted itself in the world of the Romanian villages.

The hardwood that was used for the manufacture of the wheels was carefully selected from the forests. It was autumn-cut and dried over the period of two years. In the first step of the procedure, which was required to make a wheel hub, the piece of wood was hewed with an axe. After that it was processed with the lathe in order to receive shape. The next step consisted of mortising the hub with a spoon bit (a flat bit). After that the surface area of the hub was divided according to the required number of spokes. The grooves in the hub were made by removing the material with a hammer and a chisel (12 spokes have been used at the rear wheels, like in our case and only 10 spokes have been used for the front wheels of a smaller diameter). They were positioned in those parts of the hub where the spokes were designated to be fixed.

The spokes were carved in compliance with the grooves. In the first phase the spokes were hewed with the axe. The final step of the processing was completed with the use of a drawknife (Romanian: *mezdrea*). A drawknife is a tool made of a straight metal blade with two handles. After that the spokes were driven into the hub, which was fixed in a shaving horse (see photo 1) with two semicircular yokes.

With the aim to insure the resistance of the hub and in order to reduce the friction of the hub on the cart's axle (at the inside of the hub) a metallic cylinder was inserted by hammering.

The last required procedure to produce a wheel consists of cutting and fixing the hoops. They were mostly made of beech wood, but in our case ash wood was used, and carved with an axe. The curvatures were made with chisels. Each hoop, which is six centimetres thick, is provided with two spokes.

The wheelwright used a special chair for carving – a shaving horse. The shaving horse was made of a hewed log, which had branched out into two independent and strong branches. Four legs were fixed on the bottom side of the log. The log had an opening, where the branches have separated from the trunk, into which the pieces of wood have been inserted. After carving, mortises had been cut in each hoop in order to secure the thin end of the spoke. At the end of each hoop, at the approximate distance of three centimetres from the outer edge, two holes were made where the tenons were placed in order to join the hoops together. Upon completion of the wheel rims, the hub together with the spokes was fixed into the shaving horse with two strings that were running over the heads of the hub and were fastened with hard wood tenons on the inner sides of the chair.

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<sup>13</sup>BOGDAN, I. 1902, p. 220.

Once this stage of the production of a wheel had been completed, a long plane (Romanian: *gealau*) was used in order to remove the differences in roughness and thickness between the hoops. A metal strip had to be fixed on the outer face of the hoops. The drawknife (Romanian: *mezdrea*) was used to provide the smooth outer surface of the hoops. When the wheel had been completed, it was taken to a blacksmith so he would fix the outer metal strip and the metal eyelets on the hub.



Photo 1: The wheelwright's workshop – image from the Romanian Peasant Museum

Today, the official census shows that there are about 730,000 wheeled carts in Romania. The wheels of these carts were for the most part exchanged with wheels that were taken from the cars of the Romanian national car brand Dacia. The wheelwrights who know how to make traditional wooden wheels for carts are old and are no longer receiving orders. They are regarded as a curiosity and are subjects of articles in the local, national, or international (National Geographic) newspapers. The old chariots and carts, which are rarely seen on the roads of the country, have found their way into the courtyards of the guesthouses in Romanian villages as a symbol of authenticity.

Sometimes, the old wheels of the carts are reused in the aforementioned guesthouses as candelabras, which are hung from iron chains.

The wooden wheel is not only related to the traditional transport but had also been used to draw water from wells. (see photo 2 Oroveanu 348 – The wooden wheel that was used to draw water from a well)





Photo 2: Oroveanu 348 – The wooden wheel that was used to draw water from a well, The Romanian Peasant Museum

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# KOLO IZ TRANSILVANIE

dr. Blajan Ion, Romanian Peasant Museum, Bucharest, Romania

## POVZETEK

Pred industrijsko revolucijo, ki jo je povzročil izum parnega stroja, so se v Evropi za prevoz blaga in potnikov po kopenskih poteh dolga stoletja uporabljali vozovi, cize, kočije in na koncu poštna kočije.

Podatkov o prevoznih sredstvih je v sodobni literaturi malo, omenjena so zgolj imena obrtnikov in orodje, ki so ga uporabljali, ti podatki pa so dopolnjeni z arheološkimi odkritji. Že v 16. stoletju so se od obrtnikov, ki so izdelovali vozove, razlikovali kolarji, ki so za izdelovalce vozov izdelovali kolesa. V romunskih vaseh se je ta praksa obdržala vrsto let (za opravljanje kolarske obrti je potrebna tehnična oprema – stružnica in drugo orodje, ki so si ga lahko privoščili le redki). Poročila tujih popotnikov o romunskih deželah so dragoceni viri, ki omogočajo zgodovinski pregled o stanju prevoznih sredstev. Največ poročil je iz prve polovice 19. stoletja. Razlog za to je, da romunska vozila pred tem niso pritegnila pozornosti tujcev, saj so bila podobna tistim iz njihovih domačih dežel. Na podlagi teh poročil lahko sklepamo, da je imela večina romunskih vozov lesena kolesa. Železo je bilo drago in zato so bili dragi tudi tisti vozovi, ki so imeli kolesa okovana z železom. Taki vozovi so označevali visok družbeni položaj in rezervirani so bili zgolj za bogate. V romunskih vaseh se je splošna praksa obdajanja koles z železom uveljavila v drugi polovici 19. stoletja.

Vozovi so v romunskih vaseh stalnica še danes, saj jih je v državi 730.000. Prvotna kolesa teh vozov so lastniki večinoma zamenjali s kolesi, ki so jih sneli z avtomobilov romunske nacionalne znamke Dacia (Renault 12). Kolarji, ki znajo izdelovati tradicionalna lesena kolesa za vozove, so stari, naročil pa tudi ne dobivajo več. Danes so samo še tema za časopisne članke.

Danes se zavzemamo za spremembo funkcije starih vozov. Ti so izgubili svojo prvotno uporabno funkcijo. Zamenjana je bila z dekorativno in tako so kot simbol avtentičnosti našli pot na dvorišča gostišč v romunskih vaseh. Tudi stara kolesa s tradicionalnih vozov imajo isto, dekorativno funkcijo, saj so jih preoblikovali v svečnike, ki visijo na železnih verigah.

Leseno kolo se je uporabljalo tudi za dvigovanje vode iz vodnjakov.

# THE POWER OF THE WATER WHEEL

Tadej Pungartnik, univ. dipl. ethnologist and cultural anthropologist, curator, Regional Museum Maribor, Grajska ulica 2, 2000 Maribor, Slovenia, E-mail: tadej.pungartnik@maribor.si

## ABSTRACT

The article is discussing the water wheel as a basic element of various water-powered devices, which have enabled a quicker development of the craftsmanship and after that the mechanisation of larger production plants throughout different periods of history. The first water wheels have been used to propel flour mills, whereby their use was not merely limited to the milling industry. The mills were also used in the mining industry, in the field of ferrous metallurgy (in ironworks), in the field of smithery, in the process of cloth production, in the field of the papermaking industry, and in the sawmilling industry.

The article is representing a summary of preliminary findings of various authors who have concerned themselves with this topic. The central part of the article is approaching the topic of water mills and represents the historic development as well as the downfall of the milling. The milling had been most closely connected to the essential human needs for foodstuff, but it had only rarely been an independent craft. In the territory of Slovenia the milling was mainly a secondary activity on the farms.

## KEY WORDS

water wheel, water power, craft, mills, sawmills, mines, ironworks, smitheries

## THE WATER WHEEL

The water wheel is a basic element of various water-powered devices, which have enabled a quicker development of the craftsmanship and thereafter the mechanisation of larger production plants throughout different periods of history. The first water wheels have been used to propel flour mills, whereby their use was not merely limited to the milling industry. The mills were also used in the mining industry, in the field of ferrous metallurgy (in ironworks), in the field of smithery, in the process of cloth production, in the field of the papermaking industry and in the sawmilling industry.

All of the listed commercial activities have developed in areas that were rich on natural sources like water, minerals and forests. The majority of ironworks and mining facilities were situated in secluded valleys, which were difficult to access. That is why the transport of the product from the mentioned workshops had always involved great expenses, which had resulted in the consequence that the products were not competitive. By reason of that fact, many of such workshops had fallen in ruins by the time when the industrialisation had still been in its initial stages.

The water wheels at the mills, sawmills, paper mills and weaving mills have solely been used to power the main work machines. The branches of the mining and ironworks were much more developed, since the hydropower had been used to propel various machines and devices, which were necessary due to the highly multipartite and diverse work processes.<sup>1</sup>

The famous book *De Re Metallica*<sup>2</sup> from the author Georgius Agricola precisely describes and illustrates all modern age work processes and devices from the mentioned fields. It is needless to say that, if we compare the described devices with the devices, which were to follow, they were very sluggish and in some cases even took up a lot of space. But we have to consider the fact that all until the 19<sup>th</sup> century the manufacturing of machines used to be connected to the very simple components, which were predominantly made out of wood. The machines and devices that are being depicted in the book of Agricola were also spread throughout the mining districts in our territory. One of the interesting facts, which cannot be overlooked, is surely that those machines and devices were used all until the end of the 18<sup>th</sup> century; in some areas even one or two decades longer.<sup>3</sup>

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<sup>1</sup>STRUNA, A. 1955, p. 66.

<sup>2</sup>AGRICOLA, G., *De Re Metallica*, Basel 1556

<sup>3</sup>STRUNA, A. 1955, p. 71.



The water wheels, which were being used for the pumping of water in the mines, were not only positioned outdoors but often in the mines themselves. Those first underground »engine rooms« were arranged in such a way that the fall of the water had been used in a number of levels, whereby the water from the last respectively lower level was flowing off through the tailrace.<sup>4</sup>

In similarity to the flour mills, which we will cover later, the water wheels that were used in the mines were also ran by water that was flowing under (undershot wheels) or onto (overshot wheels) the wheels. The undershot wheels require a greater amount of water than the overshot wheels. Larger currents of water that were located near the mines were very rare. That is why the use of overshot wheels had been predominant. We can find an example of a very well preserved wheel in Idrija, where we encounter the so called Kamšt (a pumping machine that was used in mining), which had been operating between the years of 1790 and 1948. This wheel is considered to be the greatest preserved wheel of that kind in Europe.

In cases where the wheels could not be positioned directly at the pump shaft, because of the remoteness of the water current, other parts and a drive linkage had to be added. In some parts of Europe we encounter individual cases where the drive linkage did not run only on the straight surface but also fractional, which was a result of the heavily diverse terrain. This drive linkage was quite intricate. Therefore it was above all of great importance that it had been precisely manufactured so the position of the lever would not be reduced. The friction between such parts was reduced by lubrication, whereby a mixture of tallow and tar was the one to be used the most.<sup>5</sup>

In the mines, which were situated in the alpine world, the power of water could not be used. That is why the so called whim had been applied in order to produce propulsion. The whim was being rotated with the help of man power or animal power. The wheels in the mines did not only propel pumps but also the ventilation appliances. Two kinds of ventilations had been utilised: on the basis of blowing air and on the basis of drawing air. In both cases simple bellows, which were made out of wood and leather, had been used. They were attached to pipes through which fresh air was blown into the pit. The execution of the »drawing method« was similar. The only thing that had to be done was the alteration of the valves. Because the use of such bellows did not enable the right effect the so called box bellows, which were a much more improved version, have gradually been developed. Simple wheel-shaped ventilators that were driven by man power have also been applied in addition to the box bellows.<sup>6</sup>

The water wheels, which were used in the mining, did not only drive the pumps and ventilation appliances but have also propelled the devices for the washing and crushing of ore. Such stamp mills were made out of a horizontal shaft with cams, a certain number of shod stamps and a water wheel. The ore was mainly flushed under the shod stamps by water. The crushed parts were falling through the sieve. The crushed parts had then been collected from the sieve and prepared for further processing in the melting furnaces.

The development of the mining was also closely tied to the ironworking,<sup>7</sup> which had been developing in multiple stages during the 14<sup>th</sup> and 19<sup>th</sup> century. In Slovenian lands the ironworking experienced its heyday in the 15<sup>th</sup> century. That was the time when more sophisticated work methods have already been used and when the manually driven bellows were replaced by those that were propelled by water. This change had enabled the workers to supply the furnaces with sufficient and even amounts of air which had been required. The water wheels in the ironworks were also driving various other machines apart from the bellows and hammers. Different types of devices that were used for rolling figured iron as well as scissors for cutting were placed in the rolling mills. The wheels were also propelling machines that were used for the rolling and drawing of wire. One of the first wire-drawing mills in Europe is mentioned in the year of 1508 in Nürnberg and is being referred to as the *Drahtziehmühle*. This wire-drawing mill had also been painted by the famous Albrecht Dürer.<sup>8</sup>

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<sup>4</sup>STRUNA, A. 1955, p. 81.

<sup>5</sup>Ibidem, p. 87.

<sup>6</sup>Ibidem, p. 97.

<sup>7</sup>The sites that were known for ironworking were: Borovlje, Bistrica v Rožu, Železna Kapla, Črna na Koroškem, Mežica, Guštanj, Mislinja, Bohinj, Jesenice, Kropa, Kamna Gorica, Železniki, etc.

<sup>8</sup>STRUNA, A. 1955, p. 103.

The production of cloth is also a craft that is connected to the water wheels. We are talking about the processing of woollen or flaxen fabric into cloth. Two kinds of cloth were differentiated; there was the so called *bukovina* (a rough cloth) and the sackcloth. The first kind was a fabric, which had been made out of woollen yarn. The second kind, the sackcloth, had been produced out of a mixture of woollen yarn and flax yarn. The so called *bukovina* was known under more than one name. The names that were famous in the Slovene lands were *the loden from Pohorje* and *the cloth from Mozirje*. A great centre of cloth production was also to be found in the region of Gorenjska where sheep farming had greatly been developed, just like in the territories of Pohorje and Mozirje.

The woven cloth was of uneven thickness and density. That is why it had to be rolled and compressed. These processes were taking place at the fulling mills.<sup>9</sup> A fulling mill was a simple stamp mill that had been driven by the water wheel. They did not need gear levels. That is why they are being described as simple. The shaft, with attached cams, was being rotated by the wheel. The cams were lifting the stamps, which were beating the cloth with hammers, the so called fulling stocks, in the troughs. According to Struna, two different kinds of stamp mills were used. The first version, which had found its way to Europe from the Netherlands, had been equipped with vertical fulling stocks respectively hammers. The second version had a lying construction where the head of the hammer was moving in a curved line. This type of stamp mill was predominantly widespread in England and France.<sup>10</sup>

The water wheels were also found to be used in the paper mills. In many cases the paper mills were simply rearranged flour mills that have been abandoned. The oldest paper mill in Slovenia is also the result of a rearranged flour mill in Fužine; a part of the city Ljubljana, in the year of 1580. The 16<sup>th</sup> century marks the time when quite a few paper mills have emerged in the alpine world. This phenomenon can also be ascribed to the appearance of Protestantism. When we talk about the paper mills in our lands we have to say that initially we are dealing with small workshops, which had employed only a few workers. It was not until the 18<sup>th</sup> century when some larger workshops, which were also of economic importance, have evolved.<sup>11</sup>

The paper mills were actually, very much like the fulling mills, simple stamp mills where the basis for paper had been crushed and prepared. The wooden or stone cylinders represented the core component of the mills. An iron plate was set into the bottom of the cylinders. Specially designed hammers, which were rising alternately with the help of cams that were placed on a long arbour, have reached into these cylinders. The mentioned cram- arbour was actually a prolonged arbour of a water wheel. The water wheel was directly driving the device without any special gears.<sup>12</sup>

In the territory of Slovenia such classic paper mills were used until the forties of the 19<sup>th</sup> century.<sup>13</sup> Jože Šorn is claiming that the downfall respectively the quick modernisation of the paper mills is to be ascribed to the foundation of the first mechanical paper mill in Vevče, which had been owned by the industrialist Fidelis Terpinč. The establishment of the mentioned paper mill had signified the gradual modernisation of the paper industry in our lands.<sup>14</sup>

## FLOUR MILLS

Throughout different periods of history the human race has learned how to control the nature and how to take advantage of the primary energy sources. As it had already been stated earlier, we have learned that the water power had been producing the power for the propulsion of various machines and devices. The machines and devices that were considered as the most widespread are those that have helped the humans to process food. The flour mills can surely be numbered among such devices. They have used the power of the wind and the water. We will be devoting our attention towards the water-powered flour mills. This kind had also been much more widespread than the one that was running on wind power.

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<sup>9</sup>BOGATAJ, J. 1989, p. 67.

<sup>10</sup>STRUNA, A. 1955, p. 64.

<sup>11</sup>ŠORN, J. 1954, pp. 87 – 88.

<sup>12</sup>STRUNA, A. 1955, p. 60.

<sup>13</sup>They are being mentioned in the regions of Radeče, Žužemberk, Ajdovščina, Podgora pri Gorici and Ruše (Šorn, J. 1954, pp. 87 – 117).

<sup>14</sup>ŠORN, J. 1954, p. 87.



Photo 1: A cash box of the guild of the millers of Maribor, 1671, Regional Museum Maribor

If we take a look at the historical development of the miller's trade, we can assert that, compared with other branches, it has the longest reach into the past. That is why the miller's trade is considered to be one of the oldest crafts. Historical research confirms the fact that the water mills were already known by the Romans, who were supposed to gain this knowledge from Asia Minor.<sup>15</sup> It is known that in the time of the emperor Augustus (64 B.C. – 14 A.D.) water mills were positioned along the river Tiber. The mills were depicted by the Roman civil engineer and architect Marcus Vitruvius Pollio in his famous encyclopaedia *De architectura libri decem*. He had described a mill that was being driven by an undershot wheel and scoop wheels, which were driven by pedalling, as well as wheels with paddles, on which the water was striking at the bottom of the wheel. In the year of 77 B.C. Plinius is mentioning overshot wheels. That is the time when the water-driven stamp mills have also been used.<sup>16</sup>

Even Rome had been using the water power in order to propel the mills. A group of mills is mentioned in the *Codex Theodosianus* from the year of 398. It is in this very context that the water mill, termed the *aquea molarum*, had appeared in the Roman code for the first time. Simultaneously to that the punishments of slave labour in the mills were abolished. The mills were positioned inside of the city walls for the purposes of providing for the inhabitants. The required water had been derived from the waterworks, which were built under the emperor Trajan (53 – 117 A.D.). Exact capability calculations of the mentioned mills were made. They would come in handy in the cases of eventual greater water shortages. Those calculations also gave the information about the number of people that could be provided with food.

Mills that were positioned on ships are being mentioned in the period when Rome was being besieged by the Ostrogoths, who were lead by the king Vitiges. The construction of those mills was supposedly ordered by the general Belarius (died in the year of 565) in order to enable the independent food supply of the city during the siege.

<sup>15</sup>BOGATAJ, J. 1982, p. 14.

<sup>16</sup>STRUNA, A. 1971, p. 110.



In the 4<sup>th</sup> century the Romans have also started to build flour mills at the river Rhine; from where they have then spread throughout all of Middle Europe. The flour mills are also being mentioned by different codes; for example the *Lex Salica* from the 5<sup>th</sup> century and the *Lex Baiuvariorum* from the 6<sup>th</sup> century.<sup>17</sup>

The Frankish historian Gregory of Tours, whom we can also mention within the framework of this short historic overview, writes that the Benedictines have built a large water mill in Dijon in the year of 580. After that, they have extended the construction of such mills to other areas in which their monasteries were situated. The Czech chronicle quotes that the first water mill in their territory had been constructed in the year of 718.<sup>18</sup>

The first references of mills, which were built on the Slovene ethnic territory, are already to be found in the early Middle Ages. Based on the past archaeological and historical research we can conclude that the ancestors of the Slovenians did not know the water mills. But the term had definitely been familiar to them before the time of the German colonialisation or their knowledge of it had to be leastwise independent of it. This fact is being confirmed by the Slovene word for a mill *mlin* that is of Latin respectively Romanic origin (*mulinum*). So the Slovene name is surely not derived from the German word *Mühle*. This means that the Slovene ancestors have gotten acquainted with the mills through the original inhabitants during the period when they populated the present territory of Slovenia respectively through their western neighbours at the Adriatic Sea. Admittedly, the naming of rivers and loci, like: *Mlino*, *Mlinarica* and *Mlinščica*, point to the fact that they are pretty old. However, it is certain that they had to be formulated later in the time when the manorial system had been introduced.<sup>19</sup>

The oldest mention of mills in our territory goes back to the Early Middle Ages. A few of those mills, which were being mentioned in the 9<sup>th</sup> century, are to be found at the river Glna in the present-day Austrian region Carinthia. The mills that are being mentioned at a later time are to be found in the territory between the rivers Drava and Mura, where the St. Paul's Abbey (founded in the year of 1091), an estate of the Benedictine monks, was situated, as well as those in the province of Prekmurje. Around the year of 1160 a mill was mentioned in the territory of Loško for the first time. The mills have experienced a faster development in the 12<sup>th</sup> and 13<sup>th</sup> century. Therefore we can find a record of the mills in the *Urbarium* of the nobility of Freising in the year of 1291. The sources from the 14<sup>th</sup> and 15<sup>th</sup> century, when the first floating mills respectively mills on ships are already being mentioned, provide us with even more details. In the year of 1525 we encounter a record of a wind mill, which had been standing at the castle Vurberk in Styria, for the first time.<sup>20</sup>

In his research Janez Bogataj claims that the data about the technology of the mills of the Middle Ages is very rare. The same can be stated about the descriptions of the mills themselves, the work, and the employment relationships. The scribes have devoted a little more of their attention towards the construction and the upkeep of dams. The sources, concerning the description of individual kinds of mills, dating from the 16<sup>th</sup> and 18<sup>th</sup> century are already more thorough. In this period we can also already discuss larger mills, which had more sets of wheels and were positioned at greater water courses. Naturally, smaller mills with one wheel were also positioned at the streams.<sup>21</sup>

The millers were one of the few craftsmen who were recognised and were permitted to carry out their craft during the period of the Middle Ages. That was the time when the cities have most opposed to the practice of crafts in the countryside. The miller's trade was the only craft that had its logical place at the end of the agricultural chain and had been a part of the agriculture itself. In those times the regions were entirely de-

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<sup>17</sup>STRUNA, A. 1971, p. 111.

<sup>18</sup>Ibidem, p. 112.

<sup>19</sup>BOGATAJ, J. 1982, p. 14.

<sup>20</sup>The millers from Vurberk were under the patronage of the guild of the millers of Maribor. The mentioned guild was, besides the millers from the city, also the patron of the millers from the regions of Lenart, Draženci, Polskava, Slovenska Bistrica and Fala. The oldest data mentioning the existence of the guild of the millers of Maribor originate from the year 1588. The guild laws from the year 1624 and the chest of the guild from the year 1671 were preserved (ŽIŽEK, A. 2012, p. 243).

<sup>21</sup>BOGATAJ, J. 1982, p. 15.

pendent on the products of their own agriculture. The mills were positioned in all agricultural parts where the basic conditions for their existence had been given.<sup>22</sup>

The larger mills have mostly been in the possession of the seigniors. That is why, for the most part, they have been situated close to the castles and feudal estates. The majority of the mills was represented by the smaller ones respectively the mills of the bondsmen. When we talk about the mills of the bondsmen we need to differentiate between the mills that were determined for the trade and the ones which were meant for the farms. The farm mills were used solely to grind for private needs. The mills that were in the possession of the seigniors have also mainly grinded for private needs, but also for the bondsmen. At this point, we should mention that the mills owned by the seigniors did not have any priority rights, on the basis of which the bondsmen would be obliged to grind in the mills of the lordship. But the mills in question and the appertaining devices for the water inflow and dams were built and maintained by compulsory labour. A typical example of such a mill is being represented in the encyclopaedia »*Die Ehre des Hertzogthums Crain*« (The Glory of the Duchy of Carniola), where the author Johann Weichard von Valvasor depicts the castle Soteska and a mill with four sets of stones and stamp mills.<sup>23</sup>

The business activity of the mills was determined by the Guild laws. The region of Styria already got its first Guild law in the year of 1346, while the region of Carniola did not get it until the year of 1770. The Guild laws have determined the hygiene measures, the ways of charging, the payments, the technical upkeep, etc. By the time the Guild laws of Carniola were issued, it had already been prohibited to measure the cereals with measuring instruments. The millers were ordered that weighing is the only just way of earning the payment in kind. Despite that, later researches show that the Guild laws or later decrees did not break the millers of the habits of the use of measuring instruments. And so it came to pass that, in spite of the mandatory annual inspections and hallmarking, the measuring glasses, which amounted to one-sixteenth of a bushel of not ground cereal, were always causing problems. The lordship has taken up the supervision of the compliance with the Guild laws. All of the mentioned regulations prove that those inconsistencies were actually happening and that they defined the particular character of the miller's trade. This is also the place where we can search for the reason for a whole series of denotations, poems and proverbs that are depicting the relations between the community and the millers.<sup>24</sup> The next decree was issued in the year of 1814, which was during the reign of the emperor Francis I. The decree had precisely regulated the business activity of the mills respectively tightened all the rules a little more. The millers had to mill for their clients in accordance to the order of their arrivals to the mill and they were forbidden to mix the ground products of different customers.

The beginning of the 19<sup>th</sup> century also marks the time when the modernisation of the mills, which had been taking place until the middle of the thirties of the 20<sup>th</sup> century, had started. In the year of 1850 the first roller mill started to operate in the city of Ljubljana. In the year of 1859 the first steam mill had followed. The first steam mill in the city of Maribor had been built by Karl Scherbaum in the year of 1872. This was the time when the more powerful tradesmen were starting to engage in the miller's trade and larger milling companies started to evolve. The consequence of such developments was the gradual downfall of smaller farm- and commercial mills that were positioned near the cities.

2,000 smaller water mills, which were used for the needs of their surroundings, were situated in the province of the Drava Banat around the year of 1930. Approximately 40 mills, which were determined for the trade, had existed in addition to the mentioned water mills. The crisis of the miller's trade started to appear in the last years before the Second World War, because it was then when too much wheat had been processed, but the consumption of the flour decreased due to the use of other foods. The nationalisation, the industrialisation of the countryside, and the introduction and modernisation of milling factories, which were to follow the Second World War, have caused the final ruin of the miller's trade.<sup>25</sup> The water mills that have been preserved up to this day were rarely renovated during the period of the last two decades. Nowadays, they are operating merely for the needs of tourism.<sup>26</sup>

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<sup>22</sup>BOGATAJ, J. 1982, p. 15.

<sup>23</sup>Ibidem.

<sup>24</sup>Ibidem, p. 16.

<sup>25</sup>Ibidem, p. 19.

<sup>26</sup>The Babič mill on the river Mura and the Polhov mill in Šentanel are examples of such mills.

## THE CHARACTERISTICS AND TYPES OF MILLS

In regard to the drive, we differentiate two basic types of mills: The horizontal mills with a vertical shaft and a horizontally mounted water wheel, and mills with a horizontal arbour, and a vertical wheel. The latter type is further divided regarding the type of the water inflow. We distinguish between mills powered by undershot wheels (wheels with peddles) and mills which are powered by overshot wheels (wheels with dippers).<sup>27</sup>

First, let us take a closer look at the overshot wheels. The water was flowing into the dippers, causing movement with its weight. The water remained in the dippers until it had reached the lowest point. A wooden channel (headrace) was needed to divert the water from a riverbed or a dam. The wheels with peddles were positioned in such a way that they were as close as possible to the bottom of the stream bed, where the water was flowing and causing them to rotate. The wheels with dippers came in handy at greater drops of water. The wheels with peddles have proven to be more useful where the drops are smaller and also at the banks of lazier rivers like the rivers Krka, Kolpa and Sava.

A shaft made out of oak wood was the component which had been used for both types of wheels. The shafts had quadratic, hexagonal or octagonal shapes. Their length was dependent on the distance between the mill stone and the mill wheel. The thickness of the shaft was dependent on the size of the water wheel.



Photo 2: A mill on Pohorje, located between the settlements Skomarje and Resnik, 1955, Regional Museum Maribor, Photographic library of the Regional Museum Maribor

A large cogged gear wheel (called the great spur wheel), which was made out of acacia- or beech wood, had been mounted at the other end of the shaft in the interior of the mill. The big cogged wheel was driving a smaller cogged wheel respectively stone nut. The stone nut had been mounted on top of the vertical axle on which the runner stone had been spinning. The bedstone was thinner and stable. The diameter of ordinary stones was 1 m. The small stones were around 80 cm of diameter.<sup>28</sup> They were made out of sand stone or fine-grained conglomerates. Both stones were enclosed with a wooden case (the vat).

<sup>27</sup>BAŠ, A. 2005, p. 331; LAUSEGGER, H. 1985, p. 81.

<sup>28</sup>RIHTARIČ, I. 2000, p. 8; SGERM, F. 1991, pp. 189 – 190.



We can also differentiate the mills in regard to the amount of water wheels and mill stones. The majority of mills had possessed only one wheel and a set of stones. Larger mills were equipped with a larger number of water wheels and several grinding stones, which were used to grind various grains, nuts and rhizomes. The larger mills were also equipped with stamp mills, which have stamped respectively processed different kinds of cereals: barley to pearl barley, buckwheat to pearl buckwheat and millet to millet groats. The drive of the stamp mills was the same as the mill drive. The only difference was that the stamp mills were using »heads« respectively stamps for stamping instead of stones, which have been used in the mills.

### THE OPERATION OF A FLOUR MILL

The majority of farm mills used black stones for grinding. The grinding device consisted of feed shoe, a set of stones (which were encased with a wooden rim), boxes and a turning mechanism (which rotated the runner stone with the help of water power). The miller poured the cereal (around 20-25 kg) into the feed shoe from which the cereals have slowly been guided between the stones. Then he released the water on the outer stone. The rotation of the mill wheel was transferred over the horizontal arbour respectively shaft, the transmitting cogged wheel, and the distaff with the vertical spindle onto the runner stone. The ground cereals fell through a hole in the rim into the box, from which it had been scooped up with a wooden flour-scoop by the miller and then stored in a sack or skin.

The milling process with white stones was similar. The only exception was that the flour, which was falling from the rim, was poured into a tube-shaped sieve in the box. The sieve was constantly being shaken by a »two-horned« wooden stick. The flour was gathering in the box. Another sieve, which had separated the semolina from the bran, was attached at the exit hole of the box. The semolina was falling through the sieve into a wooden box and the bran into a wooden pail.<sup>29</sup>

The estimates on the daily amount of flour that had been ground by the miller are very different. It is however necessary to consider the size of the device and the quantity of water that was used. Janez Bogataj states that, given normal quantities of water, a miller needed two hours to process one bushel of wheat, an hour to process a bushel of buckwheat or barley and an hour and a half to process a bushel of oats. The process was repeated a few times. The repetition of the process resulted in different qualities of flour (different quality in every stage), reaching from coarser to finer flour or from whiter to darker flour.<sup>30</sup>

The sharpening or dressing of the stones was a special task. The quality of the flour was dependent on the surface roughness of both stones. The frequency of the sharpening depended on the quantity of the grinding. The stones were sharpened with the help of a special hammer. The process took up around two hours. A regular renovation of the wooden parts had also been required.

### THE OPERATION OF THE STAMP MILLS

The stamp mills were used to remove the harder hull. The stamp mills were, just as the flour-mills, driven on water power. They consist of a wooden frame, stamps, a block (made out of oak wood and fitted with holes for the cereal) and a rotating shaft with handles. The miller poured a quarter of a bushel (around 6 kg) into the hole of the wooden block. Then he released the water onto the wheel, which rotated the shaft with handles. The handles were hitting on the handles that were attached to the stamps. This had caused the stamps to go up and down. A metal head had been attached at the end of the stamp. This head was used to stamp the cereal in order to separate it from the husk.<sup>31</sup>

The stamping in the stamps was a longer lasting process than the grinding. The processing of one bushel of millet required around three hours, only if at least four stamps were applied. The processing of one bushel with only one stamp could even take up to sixteen hours. But if the millet, which was to be stamped, was moist the process could last up to two days. A bushel of barley was stamped in the course of five to eight hours.<sup>32</sup>

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<sup>29</sup>ŠIFRER BULOVEC, M. 2010, pp. 7 – 8.

<sup>30</sup>BOGATAJ, J. 1982, p. 102.

<sup>31</sup>ŠIFRER BULOVEC, M. 2010, p. 10.

<sup>32</sup>BOGATAJ, J. 1982, p. 102.

### THE MILLS ON POHORJE AND KOZJAK

The first mention of the water powered flour mills, which were located in the Drava valley between the mountain ranges Pohorje and Kozjak, appears in the documents that date back to the 12<sup>th</sup> century. It is presumed that in the 2<sup>nd</sup> half of the 12<sup>th</sup> century Ortolf Trušenjski was given a mill at the stream Suha as a part of a granted fief. In the year of 1278 the Marenberg Dominican Monastery for women was given a field with a mill, which had been positioned at the Royal Road at the settlement Spodnja Vižinga. Both of the first known mills were located in the area of the left bank of the river Drava, thus at the foot of Kozjak. The first mills that were to be found on Pohorje have been mentioned a bit later.



Photo 3: The mill at Zgornja Vižinga, 1955, Regional Museum Maribor, Photographic library of the Regional Museum Maribor.

According to Franjo Sgerm, the information in the Urbarium of the St. Paul' Abbey in Lavanttal bear witness to the fact that in the year of 1290 two mills were operating above the settlement Ruše and two more in the settlement Smolnik. In the 13<sup>th</sup> century seventeen mills were operating in the wider territory of the settlement Lovrenc na Pohorju. The annual tax of a mill amounted to 5 pence. The administrative centre of the St. Paul's estate (the part which was situated in the above stated territory) was located in Fala. The centre had been founded in the year of 1245. The first water powered smithery, which was located at the river Lobnica, is mentioned in the year of 1372. In the year of 1381 two stamp mills were noted in the settlement Lovrenc.<sup>33</sup>

More than two decades later, in the year of 1403 to be exact, a saw mill, which had been built by the St. Paul' Abbey at the stream Velka (located above the today's Podvelka), is being mentioned. In the year of 1408 Ulrik Hawz was granted the saw mill as a fief. It appears that there were two more saw mills, which have been built in this territory during the second half of the 15<sup>th</sup> century, since there is a master sawyer from the settlement Kumen, who was being mentioned in the Urbarium of Fala from the year of 1463 and another master sawyer from Lovrenc who was mentioned in the year of 1482.<sup>34</sup>

<sup>33</sup>SGERM, F. 1991, p. 178.

<sup>34</sup>Ibidem, p. 198.

The lordship of Fala was the feudal landowner of the territory between the streams Velka and Lobnica, and later also Bistrica. At the beginning of the 17<sup>th</sup> century the mentioned lordship had obstructed the construction of farm mills in the settlements Ruta and Činžat. The reason was that the lordship wanted to secure a larger tax income from all milled bushels of flour, which would be produced by their own mill.

Eleven the mills that were located in the territory of the lordship of Fala were listed in the *Josephinian land register* in the year of 1787. Four of these were positioned at the river Radoljna, five at the stream Slepница, one at the stream Lamprehtov potok and one at the headwaters of Velka. Four of the listed mills were registered as the so called bushel mills and seven as farm mills. A look in the *Land Register of Francis I* reveals that in the year of 1825 forty-two mills were already operating in the territory of Lovrenško Pohorje. Nine of them were in Činžat, nine in Rdeči breg, three in Lovrenc, seven in Recenjok and fourteen in Kumen. It was already in that time when the mills and other devices were removed from the Radoljna riverside and placed at the artificially channelled millrun on the left bank.<sup>35</sup>

The construction of mills in the territory of Lovrenc na Pohorju had been taking place from the beginning of the 20<sup>th</sup> century. So it came to pass that in the period before the Second World War there were altogether eighty-seven mills that were located in this area. Statistically speaking, one third of those mills was placed at three main streams and two thirds of the mills were located at affluents, which were located closer to the farms. The time during the war and the post war period were followed by the standstill of mills. After that the economical and social changes lead to their ultimate downfall.<sup>36</sup> After the electrification of farms had been carried out, some people have constructed smaller roller mills directly on their farms. But by the time of the sixties of the last century those mills were also used less and less due to the modernisation and the changes in the field of agriculture.<sup>37</sup>

The mills in the broader territory of Kozjak have suffered the same fate. Today, only lone small traces bear witness to the fact of the existence of the mills concerned. One of those remains is the watermill Vrtičev mlin that can be found in Šturmov jarek. Another example is located in Kapla. We are talking about the lake Odomovo jezero, which is developed from the former water catchment that was used to provide water for the propulsion of the mill and the saw mill.

## CONCLUSION

The human race has learned how to control the nature and how to take advantage of the primary energy sources. The water power was one of those sources that had produced the power needed for the propulsion of various machines and devices. The machines and devices, which have helped the humans to process foodstuff, are the ones that are the most widespread. Flour mills that were run on water can surely be numbered among such devices. This type of mills did not undergo many changes in the course of history. The majority of mills in the Slovene territory were farm mills. That is why we rarely define the milling as an independent craft and tend to characterise it as a secondary activity, which has helped to generate a part of the income of the peasant families. On account of modernisation and the changes in the society after the Second World War the water mills have fallen into ruins. Nowadays, the rare examples, which have been preserved, are renovated and serve merely for the needs of tourism.

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## POVZETEK

Vodno kolo je osnovni element različnih vodnih pogonov, ki so v zgodovini omogočili hitrejši razvoj obrtne dejavnosti in kasneje mehanizacijo večjih proizvodnih obratov. Prva vodna kolesa so uporabljali za pogon žitnih mlinov, vendar njihova uporaba ni bila omejena samo na mlinarstvo, temveč so jih uporabljali tudi v rudarstvu, fužinarstvu, kovaštvu, suknarstvu, papirništvu ter žagarstvu.

Vse omenjene dejavnosti so se razvile na območjih, ki so bila bogata z naravnimi danostmi, kot so voda, rudnine in gozdovi. Večina fužin in rudarskih obratov je stala v samotnih in težko dostopnih dolinah, zato je bil transport proizvodov iz teh obratov vedno povezan z velikimi stroški. Posledična nekonkurenčnost je bila tudi razlog, da je veliko takšnih obratov propadlo že na začetku razvoja industrializacije.

V mlinih, žagah, papirnicah in suknarnah so vodna kolesa praviloma poganjala le glavne delovne stroje. Rudarska in fužinarska panoga sta bili pri tem mnogo bolj razviti, saj je vodna sila poganjala najrazličnejše stroje in naprave, potrebne zaradi zelo razčlenjenih in raznolikih delovnih postopkov.

Glede na zgodovinski razvoj sega mlinarstvo v primerjavi z drugimi panogami najdlje v preteklost in sodi med najstarejše obrti. Zgodovinske in arheološke raziskave potrjujejo, da so vodne mline poznali že Rimljani, ki naj bi to znanje prinesli iz Male Azije. V 4. stoletju so Rimljani začeli žitne mline graditi tudi ob Renu, od tam pa so se razširili po vsej srednji Evropi. Prve omembe mlinov, ki so bili zgrajeni na slovenskem etničnem ozemlju, lahko zasledimo že v zgodnjem srednjem veku. Na podlagi dosedanjih raziskav lahko sklepamo, da predniki Slovencev pred naselitvijo na to ozemlje vodnih mlinov niso poznali, pojem sam pa je bil Slovincem vsekakor znan že pred nemško kolonizacijo.

Mlini so se skozi stoletja v svoji osnovi zelo malo spremenili. Modernizacija se je začela šele na začetku 19. stoletja in je potekala do sredine 30. let 20. stoletja. Po drugi svetovni vojni so nacionalizacija, industrializacija podeželja ter uvedba in modernizacija mlinarskih tovarn povzročile propad mlinarske obrti. Tisti zelo redki, ki so se ohranili, pa danes obnovljeni služijo kot turistična atrakcija.

# THE CYCLING IN SLOVENIA IN THE PROCESS OF MODERNISATION

Dr. Borut Batagelj, higher archivist, director, Historical Archives of Celje, Teharska cesta 1, SI-3000 Celje, b.batagelj@guest.arnes.si

## ABSTRACT

In his article the author deals with the role of the bicycle in the process of modernisation of society in Slovenia in the time when the bicycle turned from a toy of the elite into a symbol of progress of the middle classes, at the transition from the 19<sup>th</sup> to the 20<sup>th</sup> century. The text approaches the bicycle through the dioptra of the development of the societies for cyclists, which have left an imprint on cycling as a national activity and through various views that have postulated the bicycle as the symbol of social life, mobility, progress and female emancipation.

## KEY WORDS

cycling, modernisation, society, emancipation, the history of sport

## INTRODUCTION

The end of 19<sup>th</sup> century is characterised by the bicycle. It is at that time when, even in Slovenia, the society and the era of the middle class went crazy for the bicycle. Even if the first writings about the bicycle, like the one in the newspaper *Triglav* from the year 1869, make it more than clear that we are dealing with a snobbish toy from the promenade of Ljubljana and where the article in the *Velociped Studien* is prophetically guessing about its future,<sup>1</sup> the meaning of the bicycle is starting to reveal itself two decades later in its full extent. The bicycle becomes a societal phenomenon. Due to the production growth and to the numerous technical improvements, in particular, the bicycle is being more and more accessible and easier steerable, which enables it to become a trend and a requisite of fashion as well as conviviality. During the nineties of the 19<sup>th</sup> century the bicycle stands for the mobility of the society. *The bike*, which is the common name that it was given, is a symbol of youth as the motor and change of society. It inspires new views about the world, about the body and the nature; and consequently about the experience of space, distances and time. It stirs up the imagination, but it has to engage the services of physicians, lawyers, and teachers and so forth in order to shape and regulate the public image at the same time. After the cycling had been mainly introduced in the collective spirit of the gymnastics organisations of the *Sokol* and the *Turnverein*, a serious announcement of the formation of a new sporty lifestyle in the sphere of individuals had followed. Even though the sceptic does not sit on it, it is impossible to escape from the bicycle in the streets of the city. Until the turn of the century; the cycling is already a synonym for a smaller sport movement of the middle classes, due to the fact that it has surpassed other summer sports in its appearance on Slovene territory, like tennis, football and rowing. Above all, the middle classes experience the cycling as a new sort of getaways, trips and also fun. The leisure time of quite a few citizens is being reorganised – and yes, of the women as well! – because the cycling becomes the symbol of female emancipation. Intoxicated by its progress, the bicycle is being declared as a new stage of civilization. Even more, the effects of the cycling are audaciously being characterised as the healers of the »nerviness of the era«, which had been caused by the erratic pace of the economic and social progress.<sup>2</sup>

## THE EVOLUTION OF THE CYCLING WITHIN THE SPORTS SOCIETIES

The frame of the modest historiography of the Slovene sport is mainly represented by the history of the sports societies, due to the fact that the clearly laid out institutional development of Slovene sport, including the cycling, is best established through the overviews of the formations of societies. The history of cycling in Slovenia is not solely a history of societies for cyclists and their activities. The history of societies for cyclists (as the history of cycling) in Slovenia was contemporaneously bounded by a narrower, (one) national view in its interpretation of the past. In its past examinations the history of cycling in Slovenia had mostly been recognized as a history of Slovenian societies for cyclists and not as a history of the societies, which have (co) created and to some extent even inspired the evolution of cycling (within societies). Such a narrowed view has created a *borderline-network* of the cycling history and established an inchoate framework of its understanding. Drago Stepišnik, who had also thoroughly researched the history of cycling, marks the review at the

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<sup>1</sup>Triglav, 20. 4. 1869, 27. 4. 1869.

<sup>2</sup>BATAGELJ, B. 2009, p. 39.



90<sup>th</sup> anniversary of the history of cycling in Slovenia not until the year 1887, when »the Slovenian patriots in founded *Klub slovenskih biciklistov Ljubljana* (The Club of Slovenian cyclist Ljubljana).«<sup>3</sup>

This club was not the first one in Ljubljana. Ljubljana was also not the first city with a cycling club in Slovenia. Let us take a look at the beginnings of cycling in some larger centres in their basic outlines.



Photo 1: Vid Murko on velociped, photo: Heinrich Krapek, 1890, Regional Museum Maribor

## MARIBOR

The *Marburger Bicycle Club* was founded in the year of 1883 a half year after the one in Graz, which had also been the godfather of its emergence. A publicity campaign had been executed at its foundation during which twenty members of the club from Graz have cycled to Maribor, where they staged group- and solo rides for the Maribor public. The club counted 35 members when it had been founded and it seems that they did not tackle the cycling as a shenanigan. It was already in the year of 1884 when two members Anton Götz and Englebert Jäger have cycled a rather enviable tour from Maribor over Salzburg to Munich. The return journey led them over Upper Austria and Vienna. During the period previous to the First World War, Maribor was predominantly of German character and therefore the societies for cyclists also revealed a number of German features – some were more, the others less nationalistic. The only activity of Slovene cyclers within the society was the cycling section, which had operated inside a society that had been established in the year of 1900. But aside from that, if we only look at the number of registered societies, we see that Maribor had been a great city of cyclers. The second society for cyclists simply used the year of its foundation, 1887, in its name. In the year of 1890 there is one more club in the city that is active, the *Schwalben*. The first three clubs are united in the year of 1890 for a short period of time, which is most likely due to the creation of a special cycling racecourse that had been opened between the streets ulica Franca Jožefa and Obrtna ulica just a year later. At a later time the *Stahlrad* club is founded. Another important club in Maribor is the *Wanderlust*. But

<sup>3</sup>STEPIŠNIK, D. 1957; STEPIŠNIK, D. 1979.

the *Radfahrerverein Edelweiss* (Society for cyclist Edelweiss) that had been established in the year of 1900 is even of greater importance. At the beginning of the century the first two clubs of Maribor the *Bicycle club* and the *1887* still played an important role. The member of the Landtag Franz Neger, who assembled bicycles in Maribor, had also been a member of the *1887*. One of the main development indicators of the cycling in the city by the river of Drava had definitely been the very early spreading of the cycling activity beyond the prosperous middle class stratum. Maribor as an arising industrial centre was also one of the first nuclei of working class cycling, because already in the year of 1897 a working class society for cyclists had been founded in the city as a part of the Styrian workers cycling federation. In the year of 1910 the club *Drauradler* had been established in the Maribor city district Studenci.<sup>4</sup>



Photo 2: The Maribor cycling club Swallow, 1892, Regional Museum Maribor

## LJUBLJANA

The authorities have confirmed the rules of the *Laibacher Bicycle Club* in the year of 1885. The Slovenian cyclers did not feel at home in this club, so in the year of 1887 they went and founded a club of their own named *Klub slovenskih biciklistov* (The Club of Slovenian cyclist *Ljubljana*). In the winter time the German club gave cycling lessons in the Kolizej. During the cycling season the club organised trips to the surroundings and races, which had not only been races between Germans, all until the last years of the 19<sup>th</sup> century when the club started to gain a more and more German nationalistic image. In the year of 1887 the first race that was held on the route Prevoje-Domžale was won by Peter Majdič. Incidentally the mentioned club in Ljubljana had surely been one of the main cores of German cycling in our lands. It was the centre of the cycling district of Karst (Karstgau), which had united the German cyclers from

<sup>4</sup>TOBRUL, R. 2003, pp. 405 – 451.



the territories of Carniola (Kranjska) and Primorska, but its influence reached beyond that. In the year of 1890, on the initiative of Oskar Gratzy and Josef Binder a cycling club was founded in Villach and in the year of 1893 the Club from Ljubljana acted as the initiator of the establishment of the German cycling club in Gottschees.<sup>5</sup> The *Laibacher Bicycle Club* gives the impression of one of the gathering places for the noblesse of Ljubljana, due to the fact that it had also been organising events in the company of the highest members of the court in Opatija. Immediately after the *fin de siècle*, the club overshadowed the cycling with the beginnings of the activation of tennis (after the year of 1903 also rowing). The names of the members of the club can also be found amongst those who have been the first motorised citizens of Ljubljana. The club did not last long enough to see the zenith of its activity once again, like it had been reached in the middle of the nineties era of the 19<sup>th</sup> century. One of the greater achievements of the club was in the year of 1895 when a travel guide for cyclists for forays into Carniola and Primorska was edited in 3,000 copies.<sup>6</sup> The travel guide that had been sponsored by the saving bank Kranjska hranilnica wandered as a free gift for societies for cyclists across the whole monarchy and also to Germany. The gift that had been proclaimed a »patriotic work« was refused solely by the club named *Klub slovenskih biciklistov Ljubljana* (The Club of Slovenian cyclist Ljubljana) due to the dedication for the German cyclists, which had caused a perturbation. But regardless to that the club was progressing nicely and had taken an advantage of the circumstances when Ljubljana was dominated by the Slovenian politics. And thus it came to pass that the municipality of Ljubljana has assigned a plot of ground, on the edge of the park Tivoli, to the Slovenian club for rent. It was there where in the year of 1897 a ceremonial opening of a race course had taken place.<sup>7</sup> Nobody was bothered by the fact that by then the cycling race courses were believed to be quite unprofitable investments. The focus was on the prestige and the manifestation of the Slovenian cycling (in the year of 1895 *Zveza slovenskih kolesarjev* (The Federation of Slovenian cyclists) had been established in Ljubljana), on the Slovenian culture in general and on the Slovenian brotherhood. According to the reports »fellow« cyclists from the cities of Trieste, Gorizia, Celje, Kamnik, Kranj, Novo mesto, Zagreb, Samobor, Varaždin, Karlovac, Sisak, etc. have attended the opening ceremonies with processions, parades of adorned bicycles and races. In this context, the members of the societies for cyclists can be considered as eager representatives of national ideologies, not withstanding that the cyclists were above all great convivial companions. With the rotation of their foot pedals they proclaimed that they are shedding sweat for a »national cause« when they attended cycling races, when they visited friendly clubs and during trips. But it was at the parties, which have followed, when they had truly, sincerely and zealously taken positions regarding the national questions. It was also the place where the calories and fluids, which they lost during the cycling, were more than replaced. There has not been a funfair without cyclists from then on. The cyclists were cliques of men who have shared similar interests, especially those that have concerned socialising and enjoying the company amongst equals. A waggish song that describes the emergence of the club named *Klub slovenskih kolesarjev* (The Club of Slovenian cyclist) in Ljubljana depicts the cyclists as a clique where fun is a priority. Why did the chaps establish the club in the first place? »All is good, all is nice, / yet it's hard for the bachelor / always sitting by himself, / good company is what he desires. / Therefore a club shall be established! / And a pub shall be picked! / Also a president shall be elected! / And the statutes detected! / A pub, where? Only there, / where they pour good wine, / where the food is fine / and the waitress fit.«<sup>8</sup> The Twelve, as the equals have named themselves, were served drinks in completely identical tumblers, each one bearing a different number, by the waitress Rezika in a special room in the pub Kamničan. It is more than obvious that the members of the cycling club knew all too well how to enjoy themselves. When they hosted their first dance night the press reported that at 4 o'clock in the morning there were 24 couples on the dance floor, who were still dancing the night away. There were also some other cycling clubs, which were registered in Ljubljana during the years previous to the First World War; the *Club Ljubljana*, *I. Splošno kolesarsko društvo* (The I. General society for cyclists), the society for cyclists named *Ilirija*, the cycling club *Edelweiss* and the club of *Slovenian cyclists Slavec* (Nightingale).

<sup>5</sup>Der Laibacher bicycle - klub 1885 – 1905.

<sup>6</sup>ACHTSCHIN, A. 1895, Wegweiser durch Krain u. Küstenland für Radfahrer.

<sup>7</sup>Slovenski narod, 4. 10. 1897.

<sup>8</sup>Slovenski kolesar, 1938.



## CELJE

The situation in Celje, where the national relationships between the German and Slovenian cyclist were coming to a head, was different. But that does not mean that there were- due to exactly those national aggravations – fewer parties, which were being held. The German cyclists have established the club *Cillier Radfahrer Verein* (The cycling club Celje) in 1886. The Slovenians on the other hand have initially, since 1891, practiced the cycling sport within the society *Sokol* in Celje and after the foundation assembly in the year 1903 as an independent society for cyclists named *Klub slovenskih kolesarjev v Celju* (The club of Slovenian cyclists Celje). They were throwing clubs between the »wheels« to one another from the very beginning. The matters got complicated when the Slovenian club was registered and the symbol of the club should have been determined, whereupon many years of legal disputes have followed. The Slovene cyclists have chosen the coat of arms of the city Celje as the basis for the society's emblem, which had been strongly opposed by the city's municipality with a German administration. The Slovenians have complained to the district board, later on to the governorship in Graz, they have intervened at country representatives and then, after suffering failure, they have even complained to the ministry of internal affairs, arguing that the symbol of Celje cannot be worn solely by the German society. Obviously they did not succeed but that did not discourage them to continue their work. Even during the crisis of the cycling sport when things like »the bicycle has lost its formal sporting value and is nowadays used only for practical purposes« and »at the present day, the former cycling competitions, the grand races and other similar events are nothing more than a pleasant memory« could be heard during a session of the club in the year of 1907 the club did not agree to the dissolution and retorted: »*This is the only Slovene society of its kind on the hot historic soil of Celje.*«<sup>9</sup> It was their national duty to endure and remain, and so it came to pass that the rural municipality chaffed the Germans, just like the municipality of Celje chaffed the Slovenians. In the year of 1900 the rural municipality demanded a prohibition of assembly of the German cyclists in Celje from the district commission and the governorship in Graz. That is because they have found out that »*German cyclists from all over the world have the intention to come to Celje and demonstrate their Germanity and the German character of the city of Celje...serious riots must be feared, regardless to the part of the surroundings of Celje where the German cyclist are to appear.*«<sup>10</sup>



Photo 3: The stamp from Celje cycling club, Historical Archives of Celje

<sup>9</sup>SI\_ZAC/0974, Klub slovenskih kolesarjev Celje.

<sup>10</sup>Ibidem.

## THE CLUBS IN THE PRIMORSKA REGION

Already in the year of 1886 a cycling club was established in Gorizia. The members were predominantly imperial-royal officials who have mainly taken sides with the Germans. The Italians have also established a club at a later time. The Slovenians got their club in the year of 1895. The governorship in Trieste was reluctant to instantly verify the society's rules of the *Slovensko kolesarsko društvo Gorica* (The Slovenian society for cyclists Gorica). The cooperation between the Slovene and German and particularly Italian clubs in the Primorska region was also far from exemplary. They operated asunder and it was a part of standard practice that nails were scattered on the roadways at the races, which were being held by one or the other club. In the year of 1896 the society *Slovensko kolesarsko društvo Gorica* (The Slovenian society for cyclists Gorica) did not receive an invitation to the celebration of the tenth anniversary of the first cycling club in Gorizia, which was attended by clubs from near and far. The Primorska region was not deeply affected by the development crisis of the cycling sport in the first decade of the 20<sup>th</sup> century, which has followed the flourishing years of the nineties of the 19<sup>th</sup> century. This is portrayed by the heyday of cycling clubs at the countryside and especially by the activity of the new society *Kolesarsko društvo Danica* (Society for Cyclists Morning Star), which was established in the year of 1908. The noted assembler of bicycles Fran Batjel and Edvard Rusjan have both played an essential role in this club. The club *Gorica* counted between 40 and 50 members, while Batjel gathered a proud number of 250 for *Danica* within one year. In the first decade of the 20<sup>th</sup> century the societies for cyclists have sprung up like mushrooms after the rain in the backcountry of Gorizia, in Solkan, Dobrovo, Ajševica, Kojsko, Vrtojba, Miren, etc. In the field of the Slovene cycling Batjel is justifiably being ascribed a great significance regarding the organisation of societies and the production of bicycles (also due to his move to Ljubljana at a later time), although he was not the first manufacturer of bicycles in Gorizia. It was already in the year of 1896 when the bicycles Ilirija with the emphasised Slovene pedigree were advertised in the newspaper *Soča* as a product of the workshop Saunig&Dekleva – »the only Slovene company of this sort«. The clubs from Gorizia had a fruitful cooperation mainly with the clubs from Trieste, due to the accordance of the nationalities. The society *Kolesarsko društvo Balkan* (Society for cyclists Balkan), which was founded in the year of 1907, is the one that should be pointed out amongst the Slovene clubs in Trieste. The cyclists in Trieste were active prior to that. The club *Klub biciklistov tržaškega Sokola* (Cycling club of the Sokol in Trieste) has operated as their core from the year of 1983 onward. After 1908 the club *Balkan* swiftly expanded its activity and has formed departments in the backcountry in the settlements Prosek, Nabrežina, Sežana and Komen. The cycling in the Primorska region grew into an unusually strong branch of a national movement; physical participations were followed by the manifestations, which together with funfairs attracted thousands of nationally minded inhabitants of the Primorska region. In the year of 1908 the cycling clubs *Gorica* and *Balkan* have organised a race at the city's racecourse in Gorizia, which actually grew into a political manifestation when a crowd of 5.000 has gathered at the racecourse. In the political sense the societies for cyclists of the Primorska region have referred mainly to the idea of the Yugoslavs.<sup>11</sup>

## OTHER SOCIETIES FOR CYCLISTS IN SLOVENIA

The foundation of clubs was, as we could see, dependent on the initiative from larger city centres or closely linked to the activity of keen individuals in a certain environment. The club *Dolenjski klub kolesarjev* (The Cycling Club of the Dolenjska region) is most definitely such an example. It was established in the year of 1898. The activity of the club has mainly lied on the shoulders of Karl Grossman; the activity of the club has come to a standstill after he has moved from the city of Novo mesto. The Slovene club in the city of Kranj followed the example of the club in Ljubljana in its activity. The latter should have encouraged the activity of the club in Kranj already in the year of 1888. In the city of Idrija a society for cyclists *Sloga* (Concord) had also evolved from the society *Sokol* at the beginning of the century. We encounter several other societies in the literature and sources: *Klub biciklistov v Škofji Loki* (The cycling club in Škofja Loka), *Klub slovenskih biciklistov Ribniška dolina* (The club of Slovenian cyclists of the valley Ribniška dolina), *Klub kolesarjev Vrhnika* (The cycling club Vrhnika), *Kolesarsko društvo Borovnica* (The society for cyclists Blueberry), *Klub savinjskih kolesarjev iz Mozirja* (The cycling club of the Savinjska region from Mozirje), *Klub kolesarjev v Dolnji Lendavi* (The cycling club from Dolnja Lendava); the Germans have established a cycling club in Brežice. Every one of those societies has its own story to tell. It is quite possible that further intensive studies would result in an even greater number of cycling clubs.

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<sup>11</sup>STEPIŠNIK, D. 1979.

We can say that, seen from this angle, the cycling sport with the cliques of men, united in the societies who have regularly gathered in the club's venues, created and consolidated the patriarchal male image. But on the other hand the cycling became, due to its technical improvements and its rapid spreading that has brought it on the level of widespread fashion, very accessible and therefore also at hand for women who paid no heed to the prejudices. In the feuilleton from the year 1898, which was published in the newspaper *Slovenski narod*, the Slovene poet Anton Aškerc who used the pseudonym *Antikolesarjevič* (Anti-cyclist) has reviled himself to the public as someone who is full of prejudices.<sup>13</sup> He was fended off with the rejoinder of *Kolesarica* (Lady Cyclist) and her defender Fran G-č. We can hold the believe that in regard to the polemics and the widespread of the preconceptions, quite a few people would gladly agree with the words of the Viennese Rosa Mayreder who in 1905 stated that the bicycle has done more for the emancipation of women from the upper class than all the aspirations of the women's movements altogether. Freedom is above all what the bicycle has offered to women. The main argument was its popularity that was mainly referred to the practicality, in the context of which the emphasis was laid on the positive effects on the health. In the first newspaper for women from Trieste Slovenka Marica Strnad depicted the bicycle as one of the main means for »the enhancement and strengthening of women's health«.<sup>14</sup> She has also recommended the use of the bicycle against obesity. At the same time she added that the family doctors have never advised women not to use the bicycle, even more, it is believed that they have recommended it to the ones who were weakly. The *Kolesarica* (Lady Cyclist) replied gruffly to the reproach of *Antikolesarjevič* (Anti-cyclist) Aškerc that she is damaging her health: »I and my acquaintances are healthier since we have taken up cycling. – And after all, everything is never for everyone!«<sup>15</sup> Aškerc, who was aiming at the health of female genitalia when using the word health, had also been well aware of the fact that everything is not for everyone. He did not differ from the then generally accepted opinion that a woman can harm herself if she would subject herself to excessive use of the bicycle. In his book of etiquette from the year of 1899 Jože Valenčič is also issuing a warning »especially for women« about the excessive use; even more, the experience supposedly teaches us that long trips are »fatal for her health and even lethal.«<sup>16</sup> The interpretation that the cycling causes pressure on the pelvic area, which increases the endangerment of the female reproductive system, has terrified women and supported the doubts of men. Some people even associated cycling with *the dirty sin* - with masturbation. The object that caused unease was the seat, which supposedly offered the opportunity for masturbation that was hidden from the eyes of others. The woman was allegedly forced to get aroused by the position on the bicycle itself, the tiresome pedalling supposed to excite her even more and a fresh breeze of air was supposed to do the rest. In some cases the women have reportedly reached *an outrageous level* of arousal. Such standpoints were – to the advantage of the women's cycling – for the most part rare. Many doctors did not believe that a woman would free her lust with cycling and that she would enjoy the vibrations of the roads on top of the seat. A certain gynaecologist had even undertaken a study amongst his trustworthy patients. Within the study they have confided to him that not a single one of them had experienced such a thing on the bicycle. Another doctor claimed that the body, which is leaned forward, cannot cause masturbation. The cyclists were supposed to pay attention to the road to such extent that they would not be able to focus on other reactions of their body. The mentioned reasons are the causes for the fact that special women's models can be found among the models of seats, which were on offer at the end of the 19<sup>th</sup> century.<sup>17</sup>

The opponents of female cycling were also disturbed by their wardrobe. The clothes revealed more than desired, or better said, more than one would expect of women while they were riding the bicycle. The cyclists were getting rid of the impractical and imperative corset and of – the skirt. It was still too audacious that at the turn of the century a woman would put on a pair of practical trousers. Due to the non-practical skirts women were supposed to drive tricycles instead of bicycles. The tricycles were models with one front wheel and two rear wheels, which made the pedalling easier for the ladies (and had hidden the legs). Finally a model of female

<sup>12</sup>BATAGELJ, B. 2004, pp. 40 – 53.

<sup>13</sup>Slovenski narod, 6. 8. 1898.

<sup>14</sup>Slovenka, 1/1897, nr. 21, p. 11.

<sup>15</sup>Slovenski narod, 20. 8. 1898.

<sup>16</sup>VALENČIČ, J. 1899, p. 240.

<sup>17</sup>BATAGELJ, B. 2004, pp. 40 – 53.



bicycle had caught on. It had a different frame, the seat was in a different position, the chain drive was hidden in a special casing and the rear wheel was protected, so that the dress did not get caught between the spokes. Although the fashion of the female cyclists remained true to the skirt, it did have adjusted cut outs respectively the system for buttoning up. The wardrobe of the cyclists aspired to be as light as possible and more comfortable on one side and of course, fashionable on the other hand. Judging by the pictures, the carefully chosen little hat with soft lines or the simpler beret, with a ribbon that matched the dress if possible were what has best expressed the elegance of the female cyclist. The women have gradually entered the societies for cyclists. Although individual women were present at the activities of the clubs it was, for example, not until the year of 1896 when the *Laibacher Bicycle Club* had officially admitted women as active members at the extraordinary assembly. Even then the principle of kinship respectively of good connections has pertained. Despite the strict rules concerning the admittance, the membership of women grew persistently and thus it happened that in the year of 1900 their membership represented the third of all active members -33 out of altogether 101. The club also disposed of a special room for women. In the wintertime, during the off-time for the cycling and when the people at the club have devoted themselves mainly to singing and music, the women had the opportunity to learn and make small rides on the bicycles in the club's hall in the Kolizej. This way they entered the season better prepared and some of them covered a quite enviable distance in the time from spring until autumn. The registers of the club's book show that 21 female cyclists have covered a distance of all together 26,791 km in 1.038 rides from the year of 1898; Miss Pini von Ruehling was the one to cover the grates distance – a substantial sum of 3.917 km. Our women did not establish an autonomous cycling club like it was the case in Graz in the year of 1893. But the club in Graz was acclaimed in Ljubljana, because it should have contributed to the overcoming of prejudices concerning the female cycling, which were surely heavily felt. One of the features of the cycling club in Graz was the spreading of female cycling, but only in the sense of strengthening the body and health of the woman.<sup>18</sup> The female cyclists have participated at the public meetings. Five of them have collaborated at the celebration of the tenth anniversary of the German cyclists of Celje in the year of 1896. One of the main characteristics of the female cyclists was that they were fundamentally opposing female cycling races.

## CYCLING RACES

The races represented an important part of the cycling sport within the male circles – all from serious races over short distances, distance races or races at the racecourses, all up to the less serious and more amusing competitions. Competitions in precision-driving with the performance of exercises respectively tricks (*artistic cycling*) were also typical but they did not enforce themselves and were carried out only occasionally like a curiosity. The cycling races experienced such a boom that in the year of 1896, at the opening of the velodrome in Ljubljana, the newspaper *Laibacher Zeitung* already wrote about three categories of cyclists: amateurs, professional cyclists and cyclists who race exclusively for prize money. The first ones race for honour, a laurel wreath and recognition; the second ones are much like the artists in the circus, they earn their money due to their skills and the entertainment of the audience; while the third ones used to receive gifts, albums, coffee sets, cigarette cases, table clocks, etc. at the races; but because of their honour did not sell their prizes, which slowly started to restrict them in their apartments. An American cyclist – who was allegedly nowhere near musically talented – earned a staggering number of 28 pianos at the races. Later they started to race for gift vouchers but that also did not work, so that at the end they were racing only for money. Such cases were not common in our parts; in spite of that, our cycling contestants did not race solely for honour and a laurel wreath from the very beginning. Even though, declared as amateurs, they received gifts at the competitions. It was already at the first race of the *Klub slovenskih biciklistov Ljubljana* (the Club of Slovenian cyclists Ljubljana) in the year of 1888 at the four kilometre long distance Št. Vid-Ljubljana (there were two separate race categories on high- and on low bicycles), when a silver tobacco box, a golden tie pin, a silver cigarette holder, a golden ring, and a gold piece in the amount of 10 Cronae were divided among the winners. One of the prizes was even a revolver with ammunition.<sup>19</sup>

The races were not just a sports event but have also greatly reflected the national-political mindset of the organisers. The races, with their routes that run over certain cities, have rounded up the politically divided space. The spinning of the pedals across the predestined territories has connected and expressed the belonging to the imagined communities. In the year of 1897 the German societies for cyclists have carried out a

<sup>18</sup>HARRER, H. 1998, p. 112.

<sup>19</sup>Slovenski kolesar, extra issue, May 1938.

relay race in multiple stages from Trieste to Hamburg. The supervision and the ride on the sections were territorially assumed by the German cycling clubs respectively their cyclists. The route was covered in 61 hours and 16 minutes. The German clubs have clearly indicated the political programme of the Pan-Germanism, which conceived the territory beneath the Alps as *a bridge to Jadran*. A part of the realisation of the political ambitions has also been represented by the opposing clubs that were strongly marked by the idea of the Yugoslavian brotherhood. It was quite often that the races have taken place in close connection with the events of the Sokol organisation and other national manifestations. There had hardly been a larger event without the attendance of the cyclists from Zagreb at least – and vice versa. The plans with the Croats concerning a mutual cycling federation had also come very far but they were admittedly heavily hindered by the administrative hindrances of the Dual Monarchy. Etbin Kristan was the one who was working on the idea of the Slovenian-Croatian connection in Zagreb. The result was the realisation of a cycling race in the year of 1893, which took place on the route Zagreb-Celje-Ljubljana.

It would have been ideal, in accordance with the political ideas, if the route would have been prolonged to Trieste. However it seems that, considering the level of the cycling sport at that time, this would have been a nut that would be too hard to crack. This portrayal should serve for a better notion of the race, which was entered by 36 cyclists who have set off from the coffeehouse *Narodna kavarna* in Zagreb at 6 a. m. The race that was not short of all admixtures of *doping*, massages, but also collegiality was won by Zmagoslav Bohinec, who had finished the route in Ljubljana at ten minutes past 5 p.m. For those times Bohinec had been an excellent cyclist, the best in our lands, which is also proven by other records. Even though some sources record him as Viktor the Slovene press all the more liked to use the name Zmagoslav. Bohinec has won numerous long distance races. He had finished the race, which had been held by the organization *Zveza slovenskih kolesarjev* (Federation of Slovenian cyclists) from Ljubljana to Novo mesto in the year of 1896, in two hours and 44 minutes. The newspaper *Slovenski narod* added to the achieved result: »...so approx. 59 minutes faster than the passenger train. The second to finish the race is Mr. Fran Gombač within 2 hours and 49 minutes and the third Mr. Jakob Gorjanec within 2 hours and 53 minutes.«<sup>20</sup> A record from the *Slovenski narod* of the same year where it is stated that Bohinec had been invited to the grand international race Paris-Bordeaux, bears testimony to the fact that he had outgrown the native cyclists and was ready for the international competition. The role of Slovenian cyclists as *domestiques* among the international competition can already be recognised at the end of the 19<sup>th</sup> century when Bohinec had been appointed as the »domestique« for the racer Franz Gerger from Graz.

The members of the German cycling clubs were no competition for the best Slovenian competitors, since they have usually been beaten by the Slovenians at the races, which were organised by their own clubs. If we compare two records: 18 members of the *Laibacher Bicycle Club* have ridden 104 km from Ljubljana to Trieste within 7 hours in the year of 1890, which means that this ride was more of a pleasure trip; in the year of 1894 Bohinec had covered a distance of 100 km within 4 hours and 13 minutes. It is out of the question that there had surely been an individual from the German club who would have been capable of achieving a better result, but it is obvious that the German clubs did not put such an emphasis on racing as the Slovenian clubs. But it was also by far the not case that all Slovenian clubs have subordinated their activities to the interests of the sporting competitions. The club named *Klub slovenskih kolesarjev v Celju* (The club Slovenian cyclists in Celje) did not even organise races over longer distances, although they were discussing it. A greater classic distance race was carried out in the year of 1897 at the opening of the *Narodni dom* (National hall), but apart from that they have always reached the conclusion that a race to Ljubljana would be too expensive. That is the reason why the members in Celje have rather organised trips to the outskirts of Celje. It was there where they have organised special competitions, which were accompanied by funfairs. The club of Celje especially liked to have the so called *snail races*. The first had been organised in the year of 1905 in Gotovlje. A book of rules for the *snail races* has also been established. The start line of the *race* was at the finish, riding backwards or zigzag riding was not allowed, but one should ride as straight as possible, without stepping of the bicycle. It was forbidden to obstruct the other contestants. The winner was, of course, the one who was the slowest.<sup>21</sup>

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<sup>20</sup>*Slovenski narod*, 21. 9. 1896.

<sup>21</sup>SI\_ZAC/0974, Klub slovenskih kolesarjev Celje.

## THE BICYCLE IN THE EVERYDAY LIFE

The bicycle has spread rapidly. Doubts regarding the integration in to everyday life were arising from the very beginning, especially after the societies for cyclists had also lost the control over the cyclists. The cities started to fill up with the so called *speeder* cyclists who had not learned the basic skills within the framework of the societies and were recklessly rushing in the city streets. The truth of the matter is that the first velocipedes at the end of the sixties have brought restlessness to the city, not to mention the boom of the »wild« cyclists in the nineties of the 19<sup>th</sup> century. The first outburst involving a cyclist was caused by the tradesman Albert Zeschko. He had scared the teams of horses and was also accountable for the first victim of bicycle accidents, when a coachman injured himself by the fall from the carriage. Due to these excesses, the city council of Ljubljana had banned the ride of velocipedes in the streets and promenades of the city in the year of 1896. Nevertheless the clique of the velocipedes was expanding, getting stronger and became more and more influential. Thus it happened, that already a year later a request was submitted to the city hall to allow riding velocipedes in the city. Numerous influential and established citizens of Ljubljana have signed this request. If something like that was possible in other big cities, why not in Ljubljana? In the year of 1890 the city council officially admitted the cyclists the riding in the streets of the city and of the suburbs on the tarmac parts, with the exception of pavements, pathways, boulevards, including the Lattermann's avenue and the park of the castle Podturn. But the abrupt increase of the number of cyclists had lead to conflicts once again, particularly with pedestrians. Boris Brovinsky writes that in the year of 1989 there were more than a thousand bicycles in Ljubljana, which was not an inconsiderable factor for the city traffic.<sup>22</sup> Quite a few people were knocked down by a cyclist and many pedestrians have asked themselves, if they can still feel safe in the city. The first accidents with the cases of death have most definitely contributed to the anti-cycling atmosphere in the Slovene cities. According to the newspaper *Soča* it had already occurred in the year of 1895 in Gorizia that a lawyer had run over an elderly tradesman, who died after eight days. Ten years thereafter a 32-year old blacksmith Vincencij Stosar from Solkan met with an accident in the same city. He crashed into a carriage and died within a few minutes. At the street Viška cesta in Ljubljana two medical examiners have confirmed the death of Jakob Kogovšek, »when he fell of the bicycle, he cracked his extremely strong skull and died, because the blood had poured out of it and into the spinal marrow and partly into the brain.«<sup>23</sup> The city authorities have tried to settle the matters with regulations for cyclists. In the year of 1896 a state law for the duchy of Carniola was passed. The law was in the form of traffic regulations and had also concerned the cycling. Such regulations, a part of them had also regulated the »riding of bicycles«, were also passed by the municipal council of Ljubljana in the year of 1897. The regulations have imposed that the bicycle can only be ridden by those who are versed in riding. »It is forbidden to ride on walkways, hallways, between plantings and everywhere where it is forbidden for other drivers. The public streets, roads and squares are not to be used for racing and practising how to ride a bicycle.«<sup>24</sup> An especially important rule has prescribed the obligatory equipment of the bicycle: »Every bicycle is to have a braking device, a bell; the registration plate with the number is to be attached at the front part of the bicycle and is not to be lent to another person. The shape of the plate is determined by the municipality. The expenses concerning the manufacture are to be covered by the cyclist himself. From the time of the public street lights or in case of heavy fog only those bicycles are to be ridden, which have a bright, white light, facing in the direction of the drive and already visible from a distance. Lights of colour are implicitly forbidden.«<sup>25</sup> How should a cyclist ride his bicycle in the city? »The cyclist must drive throughout the entire city with a slow paste, meaning in the same way in which a carrier is allowed to drive in a slowly gallop. A fast ride, meaning such a ride which prevents the cyclist to immediately stop the bicycle, is generally forbidden. The cyclist must ride really slow, meaning in such a way that the pedestrian can keep up, in narrow streets, curves and cross-roads, and then when parades or processions are passing the streets and roads, or when a vast multitude of people is gathering.«<sup>26</sup> The provisions concerning the movement and overtaking of cyclists are interesting, since they are different as we would expect them to be today. »Cyclists must always stay on the left side of the road and must always avoid to the left; and overtake on the right, if overtaking is at all possible, and

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<sup>22</sup>BBROVINSKY, B. 2005.

<sup>23</sup>Slovenski narod, 25. 8. 1896.

<sup>24</sup>KAMBIČ, M. 1989, pp. 218 – 225.

<sup>25</sup>Ibidem.

<sup>26</sup>Ibidem.

not disturb the traffic. The cyclist is to give way on the road to the imperial-royal army, funerals and other processions.«<sup>27</sup> The regulations demanded special »caution« in curves and crossroads and when overtaking, where »the cyclist must be particularly vigilant about the pedestrians, riding horses and draught animals and must forewarn them that he is approaching with the bicycle with the bell. Likewise, provided that the cyclist would cross their path with teams or horsemen, he is bounded to pay heed to the brute and to avoid it. If he notices that the brute is scared or when the leader gives him a sign that agitation is to be feared, he must immediately alight from the bicycle.« It is needless to say that the rules did not change the behaviour of the »wild« cyclists over night. In the same year the newspaper *Laibacher Zeitung* had expressed the wish that the saying of Goethe *Mehr Licht* (More light!) would catch on amongst the cyclists. The reason was that, despite the rules, quite a number of people were supposedly cycling without a light after the darkness had fallen and way too fast. Nevertheless, a great step forward, which had concerned the efficient regulation of the traffic for cyclists, had been made. This applies in particular in the case of accidents because taking action and the search for perpetrators was made a lot easier, due to the determination of obligatory registration plates and the obligatory registration of foreigners, who were passing the city with their bicycles, at the city hall.

The newspapers especially liked to complain about the foreigners, who have travelled through our cities, due to their inappropriate driving. But then again, because of the increasing transit of tourist cyclists through the cities, quite a few inconsiderate locals who have fled the accident scene were liberated of their responsibility. The cycling had, without a doubt, opened a new niche in the tourism and had mentally reshaped the sense of the perception of distances and the related temporal distance in the context of the effects of the structural changes. The cycling had encouraged the idyllic ideas of the townspeople about the countryside and the nature and had also increased the feeling of freedom and time management, which were independent of the railway schedules. The thriftiness of the townsfolk, in the sense of a virtue, had led them to the discoveries of the cheap rural restaurants and places, which were sidestepped by the railway. The turning of the pedals was for free, quick and it vested new physical strengths to the people from the cities for the increase of their work efficiency, which had ultimately also been noticeable in their wallets. The cycling became more and more a part of a recognisable lifestyle that had strengthened the belonging to the social class.

Apart from the outskirts of the city, the faraway places were also the ones that were to be discovered by the bicycle. Although it did not reach such a great extent but still, the cycling offered another new hobby for the middle classes – travelling. Due to the printed travel guides quite a few cyclists, who were caught up in the spirit of touristic and adventurous experiences, went on vacation by bicycle. Considering the times, it is safe to say that some individuals have covered an enviable tour. Josip Jakopič for instance, had set off to Italy, Rome and back in the year of 1891. That same summer two of his club mates were drawn to Bosnia. In the year of 1900 the cyclists Gombač and Peterlin have set out from Ljubljana, over Carinthia (Koroška), the Italian province Trentino and have been taken themselves to Turin, Monaco, Nice, Toulouse, Bordeaux, Havre, Paris, Nancy, Strasbourg, Basel, Zurich, Innsbruck and then returned over Jesenice to Ljubljana. They have covered a distance of 3,000 km.<sup>28</sup>

It goes without saying that not everyone could afford such travels. The physical condition alone represented the main issue as well as the absence from the workplace for a longer period of time in particular. At the end of the day it was the income that had constituted the precondition, whether someone was in the position to afford a bicycle. Even though it had been widely disseminated, the bicycle still represented a status symbol in the time before the First World War. Drago Stepišnik writes that the prices were not low, well at least at the beginning, and that only the well-heeled could afford a bicycle. So in the year of 1886 in Ljubljana the bicycle had cost around 200 Cronae which was considered to be a huge expense, if we consider that a beginning teacher was given a monthly salary of just 50 Cronae. The conditions were by no means better at the turn of the century. The theft of a bicycle was quite a severe blow for its owner.<sup>29</sup> Only the emerging bicycle rentals have slightly increased the accessibility of the bicycles.

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<sup>27</sup>KAMBIČ, M. 1989, pp. 218 – 225.

<sup>28</sup>Slovenski kolesar, extra issue, May 1938.

<sup>29</sup>STEPIŠNIK, D. 1957.



The bicycle reflected the social differences, which had mostly manifested itself in the relations between the city and the countryside. The circumstances, as they were being portrayed in a news story by the newspaper *Slovenski narod* in July 1896, were quite surprising. The countryside of Ljubljana had supposedly been full of *friends* of the cycling, who stereotypically considered the trippers as corrupt and unwelcome townspeople. »Almost every day complaints are to be heard that here and there the cyclist received a warm welcome with stones or that the boys have set the dogs on them.«<sup>30</sup> The only road that had been completely safe was the one leading to the city of Kranj, which was the most frequent destination. The ride on the sparsely populated sideways was much more risky and therefore the complete opposite. The naughty boys from the countryside have regarded the townspeople, who have all of the sudden swamped the scenery on their bicycles, as too liberal, faithless, usurious and snobbishly superior townspeople. Therefore it had to appear to them as completely natural, »that they are performing a godly deed, if they attack the cyclists with stones and if they set the dogs on them.«<sup>31</sup> It appears that it was not always the most agreeable thing to be a cyclist at the turn of the 20<sup>th</sup> century.

If the bicycle had represented the reflex of the social inequality in relation to the lower classes on one side then, in regard to this logic, it had to enable the rise of the individual to a higher social class on the other side. Such pathways were most definitely less ordinary, but it greatly stirred the imagination of the coevals. The fact that the bicycle had found its way into artistic texts is an evident manifestation of presence of the cycling in the society at the turn of the 20<sup>th</sup> century. In her short story with the title *Biciklistinja* (The Lady Cyclist), which had been written in the year of 1902, Zofka Kveder had worded an interesting realistic situation, in which the *Biciklistinja* (The Lady Cyclist) and two of her admirers find themselves at a holiday resort. »Damn, such chick, such grace within every move! Indeed, never have I met such a dapper lady cyclist!«<sup>32</sup> When the beauty steps off the bicycle the men admire her sophisticated gestures, while smoking and resting. The cyclist is portrayed as the symbol of a cultivated lady that would gladly be caught by every successful man, but who is not aware of the fact that the bicycle could solely serve as the requisite for deception and for the rise to the society of the sophisticated holidaymakers at the Wörthersee. Talking to an officer, who had been accompanied on his afternoon walk by the lady, the men were to find out that in reality the madam is a waitress from some den in Ljubljana.<sup>33</sup> What a disappointment!

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Dr. Borut Batagelj, Zgodovinski arhiv Celje

## POVZETEK

Konec 19. stoletja je v znamenju kolesa. Tedaj tudi na Slovenskem kolo obnori družbo in zlasti meščanstvo. V prvih zapisih o kolesarjenju, ki jih na Slovenskem zasledimo leta 1869, je kolo še stvar snobovskega igrakanja, a že čez dobri dve desetletji se začne razpoznavati pomen kolesa v vseh njegovih razsežnostih. Kolo postane družbeni fenomen. Z rastjo proizvodnje in posebej s številnimi tehničnimi izboljšavami postaja dostopno in lažje vodljivo, kar mu omogoči, da postane trend, rekvizit mode in družabnosti. Kolo je simbol mladosti kot gibala in sprememb v družbi. Spodbudi nove poglede na svet, telo in naravo, posledično pa tudi na doživljanje prostora, razdalj in časa. Buri domišljijo, hkrati pa mora v oblikovanju in reguliranju javnih podob že angažirati zdravnike, pravnike ... Do preloma stoletja je kolesarjenje sinonim za ožje športno gibanje meščanstva, saj v pojavnosti pri nas prehiteva druge poletne športe. Športna tekmovalnost, ki je na Slovenskem zrasla predvsem z razvojem prvih kolesarskih društev, se pri nas v veliki meri uveljavlja prav s kolesarjenjem. Obenem je kolesarstvo tudi poligon za nacionalno zaostrovanje in združevanje, saj so bila kolesarska društva tedaj na Slovenskem v največji meri organizirana prav na nacionalni osnovi. Za meščane je kolesarstvo predvsem nov vzorec za izletništvo, potovanja in tudi zabave. Na novo se organizira prosti čas marsikaterega meščana, obenem pa je značilnost razvoja še to, da postane kolesarjenje tudi simbol ženske emancipacije. V začetni fazi celo številni svetovljani opozarjajo na nevarnosti kolesarjenja za ženski spol, a ta opozorila ženske same z ukvarjanjem s kolesarstvom v največji meri odbijejo. Velik razcvet kolesarjenja privede tudi do tega, da so zaradi številnosti (in nesreč) kolesarjev oblasti prisiljene tudi v pravno reguliranje varnosti v prometu kolesarjev. V opitosti nad napredkom kolesarjenja se na prelomu v 20. stoletje kolo razglaša za novo stopnjo civilizacije; še več, učinki kolesarjenja se drzno napovedujejo kot tisti, ki utegnejo pozdraviti »nervozo dobe«, ki jo je povzročil skokovit tempo ekonomskega in družbenega napredka.

Miroslav Novak, univ. dipl. inž. les., acting principal, lecturer at Wood technology School Maribor, Higher Professional College Lesarska ul. 2, 2000 Maribor, e-mail: miroslav.novak2@gmail.com

Zdenka Steblovnik Župan, univ. dipl. inž. les., spec. manag., lecturer at Wood technology School Maribor, Higher Professional College, Lesarska ul. 2, 2000 Maribor, e-mail: zdenka.szupan@gmail.com

## ABSTRACT

The first means of transportation in the history of road and railway traffic were mostly made out of wood. The use of wood was superseded by the newly developed metals and polymers. The technology of extracting metals and polymers has created new problems, which we are witnessing today, and by the use of which we are causing harm to the planet and its atmosphere. This paper addresses the problem of the CO<sub>2</sub> emissions and climate change, as the results of human influence, and presents arguments for tackling the problem by using more wood. Even in the field of the production of vehicles we encounter many new technological opportunities that show us how to combine impeccable ecological advantages of wood with a prestigious design. Such vehicle projects are also being greatly supported by the fact that we are slowly but steadily re-turning back to nature.

## KEY WORDS

CO<sub>2</sub> emissions, climate change, natural substitute, use of wood, wooden touch, wooden car, future development

## 1. INTRODUCTION

In the past we have experienced our first contact with wood by touching our wooden cradle or buggy, which was constructed as a cot that was placed on big wooden wheels. The contact with wood did not harm our health; it had a pleasant and unobtrusive scent, which had a beneficial effect on the welfare of the child. Wood is never cold to the touch, even within colder days. It also never heats up to the temperatures that would cause us to get burned, when we would touch it, during the hotter days. Wood is always pleasant to the touch and also a good insulator. Being hygroscopic it adapts to the climate and provides a pleasant microclimate in its surroundings. Adjusting to climate means changing its water content according to different equilibrium moisture in balance with the temperature and relative humidity of the surrounding air.

The industrial development and the development of plastics and metals throughout the last century have unfortunately produced large quantities of products in a wide variety of colours and designs, which are produced and sold at affordable prices and also guarantee a good profit. The manhood has forgotten about all the good qualities of wood and our generation is paying the price difference and this difference will continue to be paid by our successors. Why? That is because all »modern« materials have a particular impact on our environment and living beings as well. This impact was never taken into account in the calculations above.

## 2. GLOBAL WARMING<sup>1</sup>

Nowadays, we can all witness the undoubtful effects of global warming that is caused by the increasing levels of greenhouse gases in our atmosphere, mainly CO<sub>2</sub> which is emitted through pollution.

CO<sub>2</sub> is the main greenhouse gas – its share represents 55-70% of the atmosphere. Other gases that compose our air are water steam (H<sub>2</sub>O), methane (CH<sub>4</sub>), nitro oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs) and sulphur hexafluoride (SF<sub>6</sub>).

Since the industrial revolution in the 18<sup>th</sup> century, we have managed to increase the concentration of CO<sub>2</sub> in the atmosphere by 30%. The result of this increase is the increase of global temperatures, which are forecasted to go up from 0.1 to 0.4°C every decade in the first half of this century. Currently, the temperatures are increasing by 0.5% per year. By the year of 2100 the increase will have doubled.

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<sup>1</sup>WARD, R. 2009, pp. 5 – 16.



The effects are already evident:

- The ice caps are shrinking – which, for example, had caused that the surface of the North Pole has shrunk by 20% since the year of 1950.
- Solely in the 20<sup>th</sup> century the sea levels have risen by 15 cm.
- The number of Natural disasters has significantly increased (hurricanes, droughts, earthquakes and floods)

The prognoses for the near future are even worse:

- The sea levels will continue to rise, with catastrophic consequences for the residents of coastal towns or for the areas of river deltas and low-lying areas.
  - The changes in natural habitats will result in the extinction of some plant and animal species.
  - The temperature rise will enable the spread and migration of the mosquitoes, which transmit malaria and other infectious tropical diseases, to the areas on the north of their current environment.
- If we want to leastwise maintain the current level of the CO<sub>2</sub> concentration in the atmosphere, we must immediately reduce global emissions by more than 40%!

### 3. THE ROLE OF WOOD IN THE REDUCTION OF CO<sub>2</sub> EMISSIONS AND MITIGATING THE CLIMATE CHANGES<sup>2</sup>

In comparison to other materials, the processing of wood into products requires little energy. What is even more important is the fact that wood products store CO<sub>2</sub> throughout the whole primary and extended (as re-used products and materials) period of their application and use. Finally, the worn-out wood products can still be used in an environmental friendly way – to generate bio-energy – instead of burdening the environment like other garbage and waste.

In the final calculation of the contribution to the reduction of the CO<sub>2</sub>, which is to be found in the atmosphere, one cubic meter of wood products is equivalent to two tonnes of carbon dioxide. In the times of economic and environmental crisis, wood processing and the utilization of wood products are obviously paramount. We have to solve the economic crisis in relation to the climate change and the environment. The abundance of timber in Europe in general, and also in Slovenia in particular, enables the immense potential for economic conversion to energy-saving and environmentally friendly (green) industry.

Wood is a gift of nature that is generated by the process of photosynthesis with the help of sun and CO<sub>2</sub>. It is naturally renewable and fits all principles of sustainability. The manufacturing of wood requires the least amount of energy amongst all of the materials for the construction of buildings and products. Thus, timber products significantly reduce the greenhouse gas emissions and their presence in the atmosphere and therefore largely contribute to the mitigation of the climate change on Earth.

#### 3.1 Two ways to reduce CO<sub>2</sub> in the atmosphere

There are two possible ways to reduce the quantity of CO<sub>2</sub> in the atmosphere - either by removing the existing CO<sub>2</sub> from the atmosphere and its storing or by reducing its emissions into the atmosphere. In other words:

- by increasing the »carbon sinks« and
- by reducing the »carbon sources«.

Wood happens to be the only material which has the unique ability to do both.

##### a) Increasing carbon sinks

Carbon is present in our environment in a variety of different carbon reservoirs: dissolved in our oceans; in the biomass of plants or animals (whether living or dead), in the atmosphere (mostly as CO), in rocks (limestone, coal...), etc.

This carbon is continuously being exchanged between the different carbon sources and sinks in a process that is called the *Carbon Cycle*. Due to the fact that most carbon exchanges involve CO<sub>2</sub>, which are commonly

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<sup>2</sup>BEYER, G. et al. 2006, pp. 10 – 16.

known as carbon sinks, but are in reality sinks of carbon dioxide – we need to ask us, if those elements in the cycle are able to capture the CO<sub>2</sub> and reduce its concentration in the atmosphere.

Due to the ability of photosynthesis the trees in a forest can trap large amounts of CO<sub>2</sub> and store it in the wood. Around 0.9 tons of CO<sub>2</sub> is being trapped in every cubic metre of wood. The total amount of carbon, which is stored in the forests of Europe, excluding the Russian Federation, is estimated at 9,552 million tonnes. Since the area of the EU forests is constantly increasing, the carbon storage in the EU woods is also annually growing in the amount of 115,83 million tons. Additional 37,000 million tons of C is being stored by the vast forests of the Russian Federation, which is also annually increasing by 440 million tons.

Another fact is that managed forests are more efficient carbon sinks than forests which are left in a natural state. Younger trees, in vigorous growth, absorb more CO<sub>2</sub> than mature trees, which will eventually die and rot, returning their storage of the CO<sub>2</sub> to the atmosphere. Most of the CO<sub>2</sub> from the trees, which were harvested from a managed forest, continues to be safely stored throughout the lifespan of the resulting wood product.

Each year the mankind contributes 7,900 million tons of carbon to the atmosphere. The carbon sinks absorb 4,600 million tonnes from the mentioned amount, which leads to an annual net increase of 3,300 million tons (see table 1).

This imbalance is so acute that it will not be enough to simply reduce the carbon sources, as it is being required by the Kyoto Protocol, but we will also have to increase the amount of the carbon sinks. One of the simplest ways to increase carbon sinks is to increase the use of wood.

<b>Emissions</b>	<b>Billion tonnes of carbon annually</b>
Combustion of fossil fuels	6.3
Deforestation in the tropics	1.6
Total	7.9
<b>Absorption</b>	<b>Billion tonnes of carbon annually</b>
Seas & lakes	2.3
Afforestation & increased biomass	2.3
Into the atmosphere	3.3
Total	7.9

Table 1: The global carbon balance on the annual level<sup>3</sup>

## b) Reducing carbon sources

The energy that is used to create the materials which are used to create a building is usually 22% of the total energy that is expended over the lifetime of the building, thus it is worth paying attention to the materials specified, as well as to the energy-efficiency of the structure.

There is no other commonly used construction material that requires so little energy to be produced than wood. Thanks to the photosynthesis, the trees are able to capture the CO<sub>2</sub> in the air and combine it with the water they are getting from the soil in order to produce the organic material - wood. The process of photosynthesis also produces oxygen; in fact all the oxygen that we breathe and on which all animal life is relying comes from the photosynthetic activity of plants and trees. So, from every molecule of CO<sub>2</sub>, the photosynthesis produces two key components that are essential for life: one atom of carbon around which all living materials are built, and one molecule of oxygen on which all animal life is dependent on.

The production and processing of wood is not merely highly energy-efficient, which gives wood products an ultra-low carbon footprint – but wood can also often be used as a substitute for materials like steel, aluminium

<sup>3</sup>BEYER, G. 2006, p. 14.

um, concrete or plastics; all of which require large amounts of energy to be produced and processed as well. In most cases wood goes even further - the energy that is necessary for the processing and transporting of wood is of a lesser quantity than the energy that is being stored in the wood by photosynthesis. Thus, every cubic metre of wood that is used as a substitute for other building materials reduces the CO<sub>2</sub> emissions to the atmosphere by an average of 1.1 tons. If this is added to the 0.9 tons of CO<sub>2</sub> that has already been stored in wood, we may easily conclude that each cubic metre of wood saves a total of 2 tons of CO<sub>2</sub>. Based on these figures, only a 10% increase in the percentage of wooden houses in Europe would produce sufficient CO<sub>2</sub> savings that would account for about 25% of the reductions prescribed for the EU by the Kyoto Protocol! It is needless to mention that wood demonstrates a significantly better result in the thermal insulation – it is 400 times better than steel and 1,770 times better than aluminium – therefore it contributes to reduce the heating energy and fuels consumptions, if used as a substitute construction material.

### 3.2 Wood products as carbon sequestration

Wood products are carbon storages, rather than carbon sinks, because they do not capture CO<sub>2</sub> from the atmosphere. But they take an important part in the enhancement of the effectiveness of the forest sinks by extending the period within which CO<sub>2</sub>, captured by the forests, is kept out of the atmosphere and also by encouraging forest growth. If we consider the fact that Europe disposes of an estimated wood product stock of about 60 million tons of C, we come to the conclusion that the carbon storage effect of wood products is playing a significant role in the reduction of greenhouse gases.

The 0.9 tons CO<sub>2</sub>, which is stored in a cubic metre of wood, continues to be kept out of the atmosphere throughout the actual life-span of a wood product and even beyond, through re-use and recycling (as wood panels or reconstituted wood for instance). Finally they are returned to the atmosphere through incineration for energy or decomposition.

According to recent estimates, the average life-span of wood products varies between 2 months for newspapers and 75 years for structural wood. The longer the life-span, the better it is for the environment. Not just because it enables a better use of forest resources, but also because it reduces the necessary energy, which is needed for the replacement of the products concerned. It does not matter how long the CO<sub>2</sub> is being stored in the wood, every increase in the global volume of “wood storage” will help to reduce the CO<sub>2</sub> in the atmosphere.

### 3.3 The role of wood products in the support of forests<sup>4</sup>

Although it may be in contrast to the commonly held belief that there is a direct causal link between the use of wood and the destruction of forests, it is a fact that the increased use of wood makes a positive contribution to the maintenance and growth of forests. Clearly there is a distinction to be made between tropical or sub-tropical forests and temperate forests. In the case of tropical forests the forest cover is indeed being reduced due to a number of reasons that are connected with the population growth, poverty and institutional deficiencies. However, the increase of the use of wood is not a contributory factor. On the contrary, it creates a market value for the forests which makes it a powerful incentive to preserve them.

The situation concerning temperate forests, particularly European forests, is completely different. The cover of the forest in Europe is annually increasing by 510,000 ha, whereby only 64% of the annual growth is being harvested. The amount of available wood in Europe is growing continuously. This is as a result of under-harvest on the one hand and of the increase of forest cover on the other hand. The standing volume of forests in Europe (even without Russia) is growing by 346 million m<sup>3</sup> every year which is almost the equivalent of the wood required for the construction of a single-family wooden house, that is for the construction of one house per second. This means that a very little amount of wood needs to be imported to Europe, considering that over 97% of softwood and over 90% of all wood used in Europe is being sourced from European forests. The European forest-based sector is well aware of the fact that its own future is linked to the future of its forests. The stated facts, together with the regulations that require reforestation of harvested trees and the

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<sup>4</sup>BEYER, G. 2006, p. 17.



development of certification schemes, provide the necessary stability that is needed for the forests to continue to thrive. The saying that *a forest that pays is a forest that stays* may be a simplification, but it illustrates a simple truth: the survival of a forest depends, broadly speaking, on its value to the local community.

»As was noted during the Earth Summit of Rio in 1992, conserving tropical forests is more often considered by the countries concerned as an obstacle to their own development rather than an ecological necessity. In providing energy, arable or pasture land, or simply more space, deforestation is frequently seen as a solution rather than a problem. Developing a market for wood helps the owners and the governments to see forests in a different way, recognizing their contribution to local and national economies. As soon as the prosperity of a local community is seen to be associated with the presence of a forest, the principles of sustainable management begin to be respected.«<sup>5</sup>

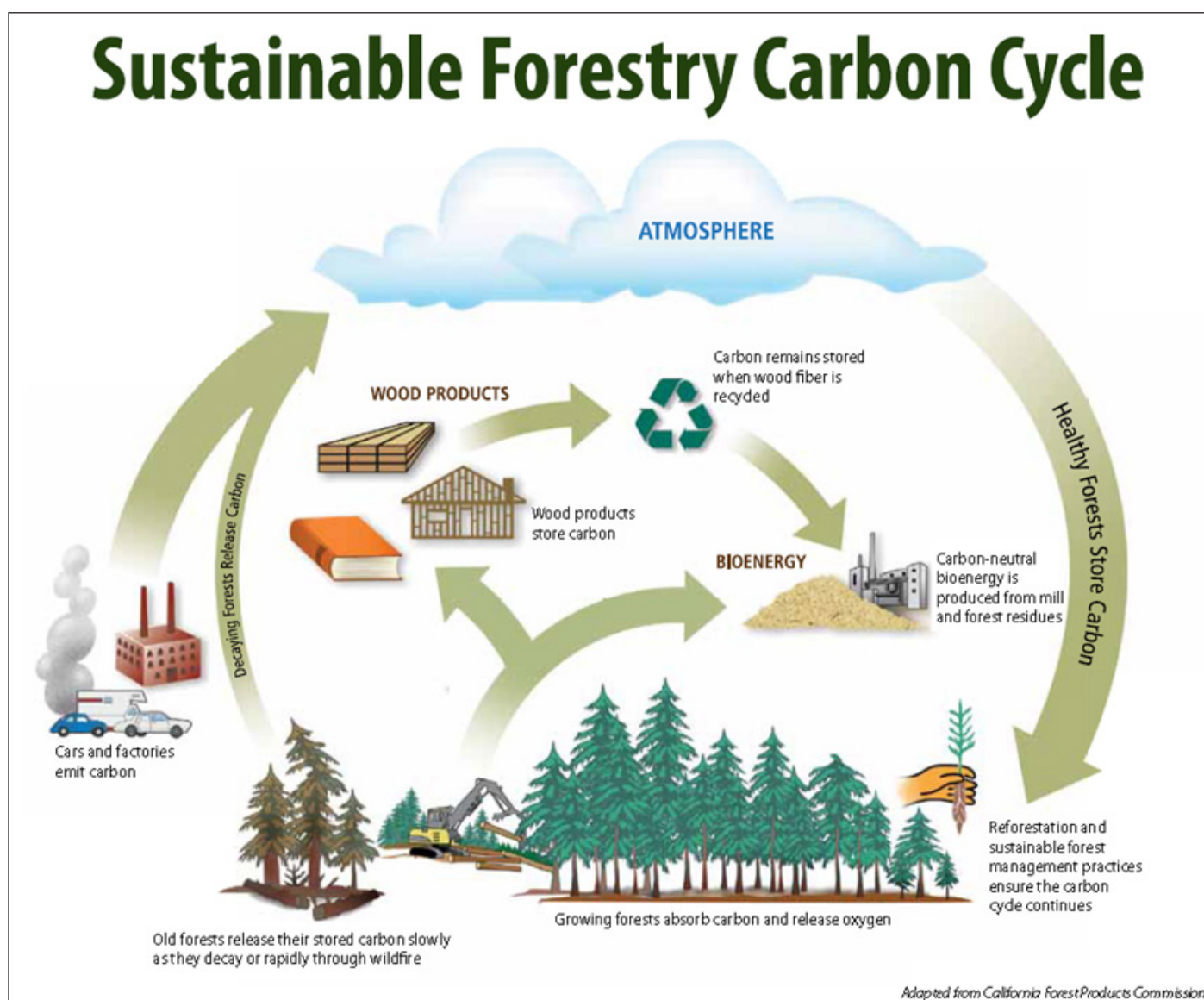


Fig. 1: Sustainable forestry carbon cycle<sup>6</sup>

## OFFICIAL RECOGNITION FOR WOOD AND FOREST PRODUCTS CONTRIBUTIONS TO THE REDUCTION OF CO<sub>2</sub>

DG Enterprise - Unit 4, COMPREHENSIVE REPORT 2002 – 2003 states the following in regards to the role of forest products for climate change mitigation:

»The decision to include forest sinks at the 2001 Conference of the Parties to the UN framework Convention on Climate Change opens the way for the possible inclusion of wood products as of 2013-2017 (second com-

<sup>5</sup>BEYER, G. 2006, p. 17.

<sup>6</sup>WARD, R. 2009, p. 12.

mitment period of the Kyoto Protocol). Since wood products store the carbon that was initially trapped in trees, carbon is removed from the atmosphere as long as the wood product remains in use and beyond, when the product is re-used, or recycled for secondary material, or energy recovery. Besides, the more wood products replace other materials, the further the so-called 'substitution effect' reduces CO<sub>2</sub> in the atmosphere. CO<sub>2</sub> reductions achieved by wood products are eligible under Art. 3.4 of the Kyoto Protocol and the woodworking industries may be granted carbon credits in the framework of the emissions trading scheme, at the EU and international level, if and when decisions and procedures are put in place.«<sup>7</sup>

The graph below (by Dr A. Fröhwald) shows what the combined effect of carbon storage and substitution means - that 1 m<sup>3</sup> of wood stores 0.9 tons and substitutes 1.1 tons of CO<sub>2</sub> - a total of 2.0 tons of CO<sub>2</sub>. The comparison between different materials is based on the lifecycle of the CO<sub>2</sub> emissions which are a result of their production and use. Only wood, which is a carbon sink as well, shows negative influence to the CO<sub>2</sub> emissions.

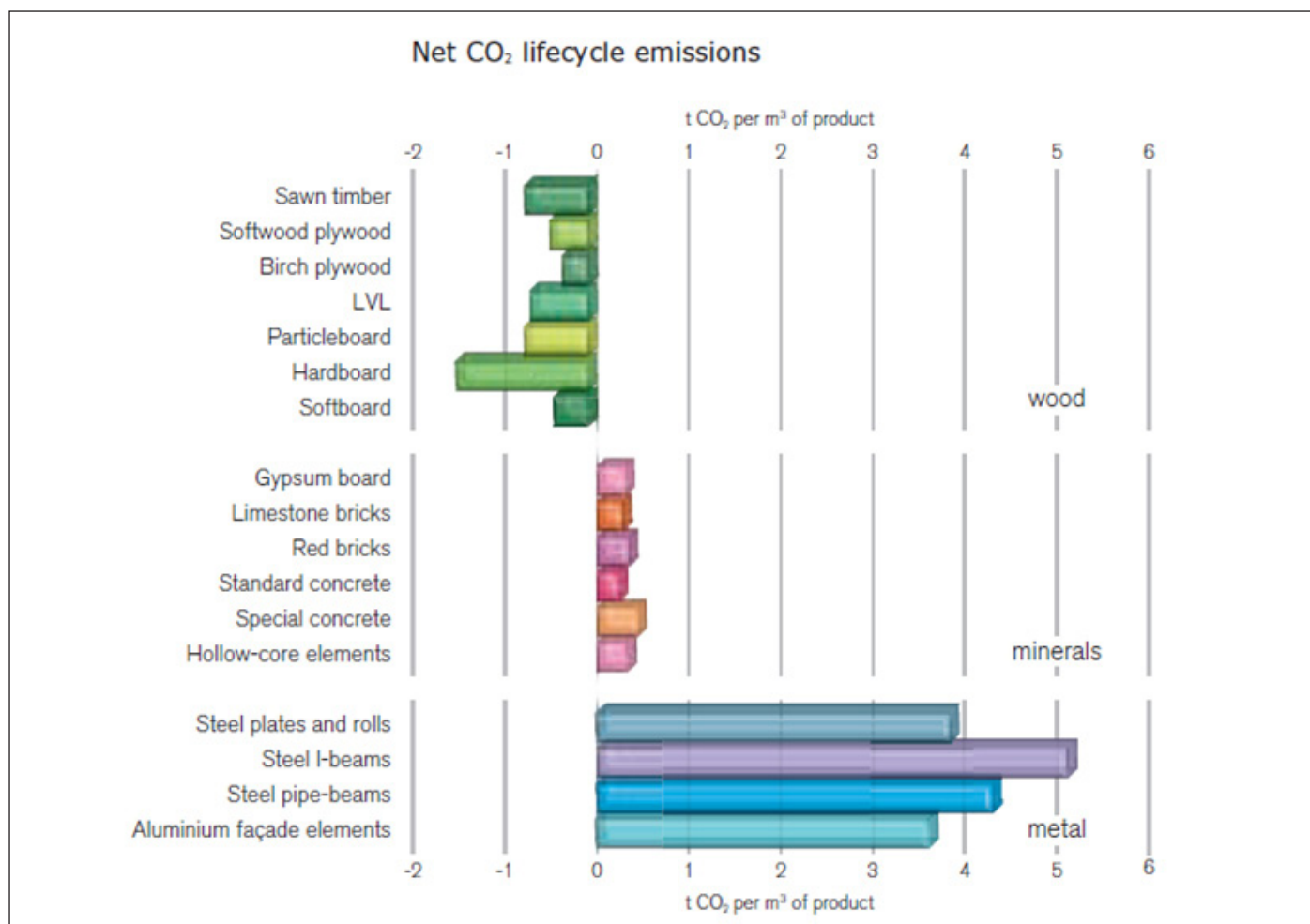


Fig. 2: Net CO<sub>2</sub> lifecycle emissions for different materials<sup>8</sup>

## 4. THE IMPORTANCE OF THE WOODEN TOUCH

### 4.1 Playing with wood

Many manufacturers of equipment and toys for babies and children are getting aware of the positive effects of wood on the babies when they touch it for the first time. They try to adapt their production programs and search for new ways how to use wood. Of course, a lot of merit for the return of wood is also to be ascribed to environmentally aware individuals, who want the best for their child. If the product is not yet present on the market, they manufacture it out of wood by themselves.

Play is an important part of childhood and if we already have a positive experience with wood in the stage of

<sup>7</sup>BEYER, G. 2006, p. 39.

<sup>8</sup>Author: A. Fröhwald, in: BEYER, G. 2006, p. 38.

life when we were not yet mobile, thus it may also be possible that we would also appreciate that the toys are made of wood. Wooden toys, apart from their excellent characteristics, are in many cases also the ones that help us to build awareness and environmental attitudes. Other types of wooden toys allow creativity, because we can create and build (thus realize our ideas), strengthen our imagination, logic and innovation. Many toys are wheel-based toys. This means that their base is attached to the wheels. The wheel is used for the toy's mobility or as a steering device: e.g. wooden doll-prams for girls, wooden cars for boys, or wooden rocking horses which are partly or completely mounted on wheels.

## 4.2 Mobility and wood

When our desire for mobility is realized and we make our first steps, it is followed by the desire for speed. As we grow up, we are longing for faster movement and wheels satisfy this need. We have solved the problem of balancing by employing the tricycle. This was followed by the use of a balance bicycle, a child-bicycle, a kick scooter, all leading to the desire of every child - to ride a real bicycle.

The awareness of the fact that wood is a friendly, firm but also light material encourages more and more designers and producers to use contemporary adhesives in the development of proper technologies that would produce such means of mobility for children. This is largely being supported by the growing market demand. It is in this way that we are getting closer to nature and to being friendlier to the environment as well as to ourselves. This may be rewarded in the form of friendlier weather and a smaller climate change.

## 5. WOOD WITH AN ENGINE

Our desire for speed is enhanced by the invention of the motor engine. It can be an internal combustion engine in various implementations which is using fuel from the finite resources of energy such as gas or liquid fuels from oil for its operation. But we can also use fuel derived from natural and renewable resources such as alcohol from sugar cane and other crops, biofuels in the form of oils from oil-containing plants, liquefied biomass, algae products, and various gaseous fuels.

Fuels can also be obtained from wood through the thermal treatment process named pyrolysis. Needless to say, the future lays in electric motors and environmentally friendly batteries. In recent years, researches were done by several institutions where one of the elements of the battery is made from wood in the form of black carbon, which makes the battery very light and allows extremely high capacity of the stored energy.

If a two-wheeler is made out of wood, it means that we have used wood as a substitute for materials from which the vehicle is usually made of. By doing that we have preserved greenhouse gases emissions and additionally stored CO<sub>2</sub>. So, now we are really speeding towards new victories, wearing a wooden helmet!

## 6. WOOD ON WHEELS

### 6.1 Wooden cars

To be mobile is really fancy, but having a roof over one's head at the same time makes it even better. Wood was largely used in the beginnings of the automobile production as well as the production of railway wagons since it provided good mechanical characteristics, while being light and solid, well tolerating dynamic loads and not hard to process. Today it is mostly used solely for the production of decorative accessories in most cars of prestigious brands, but the demand is rising. The development of technologies for wood processing and treatment, development of adhesives, such as poliuretan and epoxide glues, development of protective and coating materials are greatly increasing the use of wood. The development is heading in the direction of adhesives that are obtained from natural materials which will make automobiles even more eco-friendly.

Some designers and manufacturers still prefer solid wood, even in the production of constructive parts of a car – e.g. MORGAN model. Some of the automobiles that have been developed were mostly made out of wood – e.g. SPLINTER model (see Photo 2). New technologies allow the production of laminated wood, use of plywood, creation of 3D formed veneer and solid wood through the procedure of hydrothermal treatment or high-frequency bending. CNC technology enables the precise production of different car parts. The soft-



ware allows simulations of loadings of individual parts and of the influence of external air currents on the vehicle's aerodynamics. All of the above is facilitating the research and development of vehicles with larger energy-efficiency.<sup>9</sup>



Photo 1, 2: Innovation in building cars – SPLINTER, a car completely made of wood<sup>11</sup>

## 6.2 Wooden house on wheels

In the case of caravans and motor-homes wood is present in the constructional part as well as in the interior design. The share of wood in various forms may be further increased due to the fact that these vehicles must be particularly lightweight and spacious at the same time. Wood pulping technology enables the production of good heat-insulating panels with a low density that can be used for the outer walls, such as the manufacture of

<sup>11</sup>Author: Joe Harmon, in: LiveOAK Staff, 2009, p. 1.; LiveOAK Staff, 2009, p.1.



the furniture elements, and which can be combined with solid wood, veneer or plywood as well. The various forms of wood can also combine the various composites with the desired properties. Fibreboards allow the density to be two to three times greater than the density of the tree species from which the fibres are produced. But it may also be up to ten times smaller. To make a long story short, wood allows and also provides an extremely wide range of its use because it is multifunctional, unlike other materials which possess only one or two good qualities.

## 7. CONCLUSION

The increase of the use of wood is undoubtedly one simple way of reducing CO<sub>2</sub> emissions and mitigating the climate change. This is being largely supported by the recent technological research and innovations. This includes the numerous possibilities in the development of vehicles that can also be made of wood and can even be run on fuels which are produced from wood. Using more wood will, as strange as it may sound, also contribute to sustainable management and preservation of forests since *a forest that pays is a forest that stays*.

Finally the most important initiative is the growing change in human awareness that is slowly bringing us back to nature. So, by returning back to nature and prioritizing wood we could renew that cosy feeling at the beginning of our lives on this planet that we all unconsciously like to remember. This feeling that may also influence our very essence of being human.

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## POVZETEK

V zgodovini razvoja prevoznih sredstev je bil les osnovni material za njihovo gradnjo. Uporabljal se je tako za izdelavo plovil na vodi kot letalnih naprav. Prva prevozna sredstva v cestnem in železniškem prometu so bila lesena. Les se je uporabljal kot univerzalen material z dobrimi vsestranskimi lastnostmi. Odlikujejo ga odlične mehanske lastnosti v primerjavi z njegovo gostoto, primerna cena in dostopnost, dobro razvita tehnološka oprema za njegovo obdelavo in razpoložljivo znanje. Je proizvod narave, obnovljiv in najboljši akumulator sončne energije, ekološko neoporečen, naravno razgradljiv in ogljično nevtralen. Je trden in elastičen, odlično prenaša dinamične obremenitve, je lahek, izolativen, topel na otip in se lepo obdeluje.

Z razvojem kovin in polimerov so ti materiali počasi, a vztrajno iz izdelkov izrinjali les, s tem pa so se pojavili novi problemi, ki smo jim priča danes. S tehnologijo pridobivanja kovin in polimerov smo ranili planet in njegovo ozračje. Podnebne spremembe so vse bolj opazne, saj potekajo po potenčni funkciji, tako kot narašča količina CO<sub>2</sub>, ki trenutno na letni ravni za dvakrat presega zmožnost planeta, da jo absorbira in predela. Zaradi povečevanja izpustov toplogrednih plinov, pri čemer CO<sub>2</sub> predstavlja kar 70 %, se dviguje temperatura na planetu, posledice tega pa so: taljenje ledu na obeh polih, izginjanje ledenikov, dvigovanje gladine morja s katastrofalnimi posledicami za prebivalce, izumiranje ali selitev rastlin in živih bitij v ugodnejše razmere, s tem pa tudi rušenje ekosistemov in posledično epidemije nekaterih bolezni. Pojavljajo se vremenski ekstremi, ki smo jim zadnje čase priča vse večkrat (močni vetrovi, spremembe zračnih in morskih tokov, ekstremne temperature, obdobja obilnega deževja in poplav, obdobja suše. Tehnološki razvoj sodobnih materialov, ki nadomeščajo naravne, je sokrivec za nastalo situacijo, saj z izdelavo 1 m<sup>3</sup> plastike izpustimo v atmosfero 5 t CO<sub>2</sub>, 1 m<sup>3</sup> jekla 17 t CO<sub>2</sub> in 1 m<sup>3</sup> aluminija kar 27 t CO<sub>2</sub>. Po drugi strani pa les v 1 m<sup>3</sup> svoje mase skladišči 0,9 t CO<sub>2</sub>, in če ga uporabimo kot nadomestek za danes uporabljene materiale, smo z 1 m<sup>3</sup> lesa prihranili 1,1 t izpustov CO<sub>2</sub>.

Tudi avtomobili so bili v preteklosti pretežno leseni, pri njihovem razvoju pa smo zašli v skrajnost pri uporabi kovin in plastike. Sedaj se les vedno bolj uporablja kot dekorativni element v vozilih višjega cenovnega razreda, pojavljajo pa se že tudi vozila, ki so v pretežni meri izdelana iz lesa. Novi načini obdelave in pomožni materiali (lepila, lesni kompoziti) prispevajo k ohranitvi ali celo izboljšanju njihovih tehničnih lastnosti v primerjavi s kovino in plastiko. Počasi, a vztrajno se torej vračamo nazaj k naravi. Planet in sebe lahko rešimo z lesom.

# CONSERVATION OF ARCHAEOLOGICAL WOODEN OBJECTS FROM WATERLOGGED SITES

Dr. Katja Kavkler, Institute for the Protection of Cultural Heritage of Slovenia, Restoration Centre,  
Poljanska 40, 1000 Ljubljana, Slovenia, [katja.kavkler@rescen.si](mailto:katja.kavkler@rescen.si)

Dr. David Stopar, University of Ljubljana, Biotechnical faculty, Department of Food Science and Technology,  
Večna pot 111, Ljubljana, Slovenia

## ABSTRACT

Waterlogged wood objects are frequently found in the Ljubljana moor. The oldest wooden wheel with an axle recovered at Stare gmajne stimulated the experts to think about the most appropriate method for long term waterlogged wood preservation. Two approaches have been considered: (i) the passive conservation of wooden objects in an underwater depository, (ii) an active conservation with different methods (e.g. conservation of the wheel and the axle with a melamine resin method).

## KEY WORDS

waterlogged wood, conservation, depository, active treatment, the oldest wooden wheel with an axle

## 1. INTRODUCTION

During archaeological excavations mainly objects made of inorganic materials are recovered. Organic materials, on the other hand, are preserved only in dry locations or in environments with low temperatures or low oxygen levels. The main reason is that organic archaeological material is a good source of nutrients for organisms, especially fungi and bacteria. Archaeological artefacts of organic origin (wood, leather, hair, skin, textiles etc.) are usually found in locations where microbial activity is severely restricted, such as waterlogged environments (marshes, rivers, lakes, seas). The oxygen supply is limited in these environments, and consequently, the microbial activity is low. The mentioned facts, together with stable environmental conditions, which prevent chemical deterioration, lead to the preservation of archaeological wooden objects for up to several thousand years. Upon excavation oxygen is allowed to diffuse in the archaeological wood, microbial activity and consequently the rate of nutrient cycling increases significantly. Parallel to microbial deterioration, excavated objects are also subject to chemical and physical changes (i.e. through UV light radiation or pollutants). If the archaeological wood is allowed to dry out during excavation or transport, it cracks, shrinks and disintegrates. This behaviour has been experienced by archaeologists through time, and conservation treatments have therefore continuously been developed in order to stabilize the wood so that damage to the integrity of the surface and dimensional changes are minimized upon drying.

The oldest wooden wheel with an axle in the world, found during excavations of a pile dwelling at Stare gmajne in Ljubljana Moor in 2002<sup>1</sup> opened several questions considering its preservation. Stratigraphic, radiocarbon and dendrochronological dating techniques date the origin of the wheel to 3,360 - 3,080 B.C.<sup>2</sup> The wheel and the axle were part of a prehistoric two-wheeled carriage.<sup>3</sup> The wheel and the axle were initially kept in waterlogged clay environment in the storage rooms of the City Museum of Ljubljana. After a couple of years they were cleaned and moved to a water pool. The rate of microbial deterioration increased due to a relatively high oxygen concentration and favourable temperatures.<sup>4</sup> Different methods have been considered for the preservation of the wheel, the most relevant are described below.

## 2. WATERLOGGED WOOD AND ITS STRUCTURE

Wooden objects from waterlogged environments often look surprisingly well preserved as judged by the naked eye, especially when regarding their shape. The well-preserved appearance is in sharp contrast to the fact that the same piece of wood is very soft and spongy when pressed. When the structure of waterlogged wood is

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<sup>1</sup>VELUŠČEK, A. 2002, p. 52.

<sup>2</sup>VELUŠČEK, A. et al. 2009, p. 221.

<sup>3</sup>Ibidem.

<sup>4</sup>STOPAR, D. et al. 2013.

observed under a microscope, in spite of substantial decomposition and disappearance of constituents of the cell walls, the structural characteristics are usually well enough preserved so that the type of wood can be identified.<sup>5</sup> Although the components of the cell wall have decomposed, the appearance of wood did not change beyond recognition. New voids appear in those places where cell wood components have disappeared. Newly formed voids are quickly filled with water from the environment, which stabilizes the degraded cell walls due to its low compressibility.<sup>6</sup> The ratio between water content and dry wood mass, gives the information about the state of degradation of the wood.<sup>7</sup> The larger the ratio, the more the wood is degraded.

Cell walls are layered structures, composed of cellulose, lignin, hemicelluloses and other minor components. Cellulose, the main component of cell walls, is a filament molecule, giving the wood flexibility and resistance for longitudinal breaks. Hemicelluloses are highly branched polysaccharides that are hydrogen-bonded to the surface of cellulose microfibrils. It cross-links the cellulose microfibrils into a network of tough, fibrous molecules, which is responsible for the mechanical strength of the plant cell walls. The other important cell wall component is lignin, a three-dimensional aromatic structure, which provides support and rigidity of wood. When the decay of wood in a waterlogged environment is progressing, hemicelluloses and pectins are the first to be degraded, followed by cellulose.<sup>8</sup> Lignin is a structure, which is the most resistant to biodegradation processes,<sup>9</sup> therefore the ratio of the wood constituent changes in favour of lignin during the deterioration.<sup>10</sup> The progression of wood deterioration gives the waterlogged wood specific properties. Wood loses its flexibility and resistance to breaks. It becomes soft and spongy when wet, or brittle and powdery when dried. As long as the object is waterlogged, the water is providing the support for its shape. However, when the water evaporates, the deteriorated cell walls cannot hold their own weight and they collapse.<sup>11</sup> The object loses its shape, it shrinks and cracks.

### 3. CONSERVATION OF WATERLOGGED WOOD

Several measures can be implemented in order to preserve very sensitive objects of archaeological waterlogged wood. Broadly they can be classified into two classes. Objects can either be passively conserved (i.e. they are kept under waterlogged conditions after their recovery), or actively conserved by consolidation with different natural or synthetic materials.

#### 3.1 Passive conservation

Passive conservation encompasses a class of methods where the archaeological artefacts are kept under waterlogged conditions, in situ, reburied in soil or sediment, or submerged in water. Usually, if the excavated place is safe, the objects are documented, protected and kept in situ in the excavated position. Alternatively the objects can be reburied in a different place under environmental conditions, which are similar to the original excavation site. When objects have to be transported from the original excavation site they can be kept in humid and cold conditions, wrapped in foil to prevent contact with oxygen. Unfortunately, this method has not proved to be suitable for many wooden archaeological artefacts, due to anaerobic microbial degradation.

Recently we have started a new innovative project to permanently immerse archaeological wood in freshwater in a abandoned clay pit near Vrhnika. Test samples from different historical periods, deterioration stage and wood type have been placed in the submerged depository. The preliminary results of the environmental monitoring; where 18 physicochemical and microbiological parameters are regularly measured in the abandoned clay pit indicate that the environment is oligotrophic – poor with nutrients. The environment enables slow biodegradation of organic matter. The presence of oxygen, which would normally accelerate biodegradation, is offset by a lack of nitrogen, phosphorus and allows only a limited biodegradation of wood. The long-term monitoring that is now in place will provide us with more information about the suitability of the submerged depository.

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<sup>5</sup>VELUŠČEK, A. et al. 2009, p. 221; ČUFAR, K. et al. 2008, p. 58.

<sup>6</sup>KOZUMA, Y. 2004, p. 4.

<sup>7</sup>WITTKÖPPER, M. 2010, p. 27.

<sup>8</sup>KOZUMA, Y. 2004, p. 3.

<sup>9</sup>ČUFAR, K. et al. 2002, p. 73.

<sup>10</sup>KOZUMA, Y. 2004, p. 3.

<sup>11</sup>ČUFAR, K. et al. 2002, p. 69.



It is generally accepted that passive methods are cheaper compared to active preservation methods and more appropriate for excavations, where several similar bulk objects are found (e.g. piles in pile dwellings), from which usually not all can be stored in storage rooms of museums. The methods of passive conservation are often considered as the method of choice to keep intact non-contaminated objects. Active methods, on the other hand, introduce foreign material into the structure of wood and in this way *spoil* the wood structure, which prevents further investigations of wood chemistry or dating. The influence of different consolidants on wood structure, stability and ageing are usually not known in advance. If the objects are not endangered by environmental conditions or human interventions, the passive method is therefore an appropriate solution, keeping in mind that further generations might have more knowledge and will be able to preserve those objects better. The obvious downside of the passive conservation methods is that the artefacts are not easily presented to the general public. In addition, passive conservation makes the accessibility and research difficult. Since the years of passive storage, first in clay and later in water environment did not prove to be suitable for the conservation of the oldest wooden wheel,<sup>12</sup> active conservation methods have been considered and are further reviewed.

### 3.2 Active conservation

For valuable objects of national importance, which are endangered in a waterlogged environment (e.g. the oldest wooden wheel with an axle), active conservation methods are to be applied. When applying these methods, a restorer actively interferes with the objects, by cleaning, consolidating, filling and gluing. Waterlogged wood is a highly susceptible material, which demands special methods of consolidation. Unfortunately, so far there is no general agreement about the most appropriate method, which would have been found. Several different methods, which consider different aspects of conservation ethics and demands, have been developed.

#### 3.2.1 Freeze drying

Freeze drying (or lyophilisation) is a process, where no consolidant is used. Waterlogged objects are deeply frozen in vacuum.<sup>13</sup> When the pressure is lowered the temperature is increased. Under these conditions, the water is allowed to sublime from the objects. The shape of the object does not change, since it is frozen. However, special care needs to be taken when the object is warmed to the room temperature. The method can be used on its own, but is usually combined with previous consolidation with polyethylene glycol (PEG). The main advantage of the method, when not used in combination with PEG, is that the object is not *polluted* with consolidants and can be further investigated. However, the method can be used only with objects, where the wood is not severely deteriorated. The wood is not protected against humidity or temperature changes, which can cause dimensional changes. Heavily deteriorated wood cannot hold its own structure and can be easily mechanically damaged.

Freeze drying was used with two broken pieces from the oldest wheel and the axle, respectively. Samples for determining the wood species as well as dendrochronological and radiocarbon dating of the wheel and the axle were taken<sup>14</sup> before freeze drying. The freeze-dried samples are stored in storage rooms of the Ljubljana City Museum for eventual further investigations. When handling such pieces a special care is needed as they are very light and fragile, especially the piece from the axle threatens to fall to pieces.<sup>15</sup>

#### 3.2.2 Water insoluble consolidants

The active conservation methods using consolidants can be divided into two groups. The first group comprises water-soluble consolidants, whereas the consolidants of the second group are soluble in organic solvents. The method of active conservation is selected according to the deterioration state of the object as well as the equipment of the conservation workshop. Water insoluble consolidants are mainly (natural) resins, soluble in different organic solvents. The pre-treatment process is always dehydration of the object with organic solvents. First ethanol is applied to replace the water. Ethanol is then substituted by acetone or diethyl-ether.

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<sup>12</sup>STOPAR, D., DANEVČIČ, T. 2007.

<sup>13</sup>WITTKÖPPER, M. 2010, p. 48.

<sup>14</sup>VELUŠČEK, A. et al. 2009, pp. 218 – 221.

<sup>15</sup>ŠINKOVEC, I., 2012.

The resin is dissolved in the latter solvent.<sup>16</sup> The drawbacks of the methods are high costs and health risks. Another method is the consolidation of waterlogged objects using silicon oil, introduced in the 1990's. The materials are expensive, volatile and noxious, and the treatment is totally irreversible.<sup>17</sup>

### 3.2.3 Water soluble consolidants

The most widely used water-soluble consolidants are polyethylene glycols (PEG-s) of different molecular weights. They can be used alone as a bulk consolidant to fill all empty spaces in the wood or in combination with freeze drying, where only cell walls are strengthened, whereas cell volume remains empty. If PEG is used as bulk consolidant, the object appears very dark, plastic-like. However, in combination with freeze drying, the appearance of conserved objects is more similar to aged wood. In the past, a very common consolidant was sucrose. Sucrose (common sugar) is very appropriate when the compatibility with cellulose is considered. Due to shorter molecule chains, it is soluble in water and can be used as a consolidant for waterlogged wood. However, shorter molecular chains mean also that it is easily accessible by microorganisms and even by larger animals (insects, rodents).<sup>18</sup> Therefore it should be applied with a sufficient amount of biocide to prevent biodeterioration.<sup>19</sup>

Relatively recent consolidants are melamine resins, first used for waterlogged wood conservation approximately 40 years ago.<sup>20</sup> These are water soluble resins, which become insoluble in water when polymerized. They are widely used for industrial applications. Only low solution (up to 25 %) is used for conservation purposes, which prevents plastic appearance of the conserved object. After the conservation processes are finished, the objects are light and usually the structure of the wood as well as the traces of original working tools can be observed.<sup>21</sup> Since the melamine resin polymerizes, it becomes strong enough to hold the structure of even the most strongly deteriorated objects, even if the wood cell cavities are not completely filled with resin. Due to small molecule size of monomers it can penetrate to small crevices and can be used for less deteriorated woods as well. The penetration of small molecules is relatively fast and the typical time periods in the baths are much shorter than with PEG-s.<sup>22</sup> The resin becomes hydrophobic after the polymerization and prevents the object from environmental influences (especially those of air humidity). The drawback of the method is its irreversibility.

Considering all the properties of above-described methods, as well as the properties of the oldest wooden wheel and the axle from the Ljubljana moors, the decision was made to conserve it by using melamine resin. The process was carried out at *Römisch Germanisches Zentralmuseum* (Roman German Central Museum) in Mainz, Germany. Both objects were cleaned by immersing them in deionised water for several months. The water was regularly cleaned. The pH and conductivity of each water bath were regularly measured. When the values of pH and conductivity have stabilized, the objects were considered to be clean. They were immersed into 25 % melamine resin solution for few months. When the osmose processes stopped, the objects were wrapped in cellulose and plastic foil and were allowed to polymerize at 60 °C for three days. The cellulose soaked the excessive resin, whereas the plastic prevented the objects from drying too fast. When the polymerization was finished, the objects were let to dry very slowly, to prevent cracks and deformations, wrapped in plastic foil for several months. Finally the objects were treated with drying oils and the pieces were glued together. After the process of conservation was completed the objects appeared in the colour of wood, they are lightweight, and have clearly visible tool marks.

## 4. CONCLUSIONS

It is not the question whether archaeological wood will degrade. The only uncertainty is the rate of the degradation. From the description of the methods we can infer that none of the methods is without a flaw. Either they irreversibly change the object or render it non-accessible to the public by reburial. Methods dif-

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<sup>16</sup>GRATTAN, D. W. 1982, p. 132.

<sup>17</sup>GRAVES, D. J. 2004, p. 14.

<sup>18</sup>Ibidem, p. 13.

<sup>19</sup>NEMEC, I. 1981, p. 125.

<sup>20</sup>Kauramin-Methode.

<sup>21</sup>WITTKÖPPER, M. 2013.

<sup>22</sup>Ibidem.

fer in terms of equipment used, financial support, time of conservation, irreversibility, and most importantly in the appearance of the final product. The selection of the appropriate method for conservation of a given archaeological wooden artefact is still not an exact science. Several parameters should be considered such as the environment in which it will be stored, financial resources, accessible equipment and expertise. However, even if passive or active intrusion into the archaeological object may slightly increase the risk of future degradation, it is a preferable mode of action to the possible complete unrecorded loss of the resource.

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**dr. Katja Kavkler, Zavod za varstvo kulturne dediščine Slovenije, Restavratorski center, Ljubljana**  
**dr. David Stopar, Univerza v Ljubljani, Biotehniška fakulteta, Oddelek za živilstvo, Ljubljana**

## **POVZETEK**

Območje Slovenije s številnimi rekami in jezeri, predvsem njen osrednji del z Ljubljanskim barjem, je bogato z najdišči lesenih arheoloških predmetov. Arheološki mokri les je v prvi vrsti biorazgradljiv material, ki služi naravnemu kroženju snovi in energije. Leseni predmeti so se ohranili v okoljih, v katerih je zelo upočasnen biološki razkroj. Po izkopu takšnih predmetov se spremeni okolje in mikroorganizmi v dragoceni najdbi vidijo predvsem vir hrane. Na primeru najstarejšega lesenega kolesa se je pokazalo, da že kratek čas neprimernega hranjenja lahko naredi nepopravljivo škodo. Predmete je zato treba konservirati bodisi aktivno bodisi pasivno. Razvite so bile številne metode aktivnega konserviranja, ki omogočajo, da arheološki mokri les ostane čim dlje na voljo za raziskave in je obenem lahko postavljen na ogled zainteresirani javnosti. Vsaka metoda ima določene komparativne prednosti in slabosti. Uporaba izbrane metode je odvisna od vrste arheološkega mokrega lesa in zlasti njegove ohranjenosti. Trenutno najbolj zanimiva metoda je konserviranje mokrega lesa z melaminskimi smolami; metoda je bila uporabljena tudi pri najstarejšem najdenem lesenem kolesu. Zaradi različnih vzrokov aktivna konservacija ni vedno mogoča. Ker predmetov (npr. najdb nacionalnega pomena, kot so kolo, deblak, rimska ladja, puščična ost) velikokrat ne moremo hraniti na mestu najdbe, je bila predlagana nova, inovativna rešitev za hranjenje mokrega arheološkega lesa. Pripravljen je bil podvodni depozitorij v opuščenem glinokopu na Ljubljanskem barju, ki pa skriva nove, doslej nepoznane pasti hranjenja arheoloških lesenih najdb.



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