USING THE DESIGN PROCESS
AS A MODEL FOR WRITING A
GUIDE TO MAKING MAILLE ARMOUR

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USING THE DESIGN PROCESS
AS A MODEL FOR WRITING A
GUIDE TO MAKING MAILLE ARMOUR

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Thesis

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ABSTRACT

.Maille Armour, also known as chain mail, is an intricate fabric of inter-linked metal rings which are passed through each other in a specific pattern to create a strong, flexible material. It has been used by many cultures throughout the ages and is still being used today. For an individual interested in making maille, it can be difficult to find instructional materials. This applied thesis utilized the design process as elucidated in Don Koberg and Jim Bagnall’s *The Universal Traveler* to design, write, and evaluate the process of creating a manuscript for an instructional book on making maille armour and other maille items. The process Koberg and Bagnall describe involves seven stages: acceptance of the situation or problem, analysis, definition, ideation, selection, implementation, and evaluation.
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Dr. Gunn for being my “Mom Away from Home.” You helped me get through life’s ups and downs and this thesis. I couldn’t have done it without you!

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The members of the Barony of Shattered Crystal for letting me take pictures of them and their maille.

I would like to dedicate this thesis to two wonderful ladies: Catherine Derrenbacher, my grandmother, and Flo Shoemaker, my aunt. I miss you.
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CHAPTER I
INTRODUCTION AND METHODS

Introduction

After much thought, I decided to do an applied thesis and to design, write, and evaluate a how-to book on the making of maille armour and other maille items. This handbook may be useful to anyone wishing to recreate maille items. The target audiences include those making historical replicas, medieval reenactors, costumers, jewelers, artists, and craftpersons. Maille has an appeal that reaches across the generations. Using the design process as described in Don Koberg and Jim Bagnall’s The Universal Traveler, I designed, wrote, and evaluated the process of writing a how-to book on the making of maille armour and other maille items.

Maille armour, also known as chain mail, is an intricate fabric of inter-linked metal rings which are passed through each other in a specific pattern to create a strong, flexible material. The Old French word maille was derived from the Latin term macula, meaning “a spot, a mesh of a net.” The spelling “maille” was chosen over “mail” for this paper in part to differentiate the maille armour from postal mail. The older spelling

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also imbues the word with the sense of a time and place long ago. It helps recall the great history of the woven metal links known as maille. The term “chain maille” was also not chosen as it is actually redundant. If translated, it would read as “chain chain.”

Maille armour has been used by many cultures throughout the ages. Ancient Romans wore it as they marched into battle, conquering much of Europe. Maille was used by European soldiers prior to the eleventh century. Viking warriors proudly wore their suits of maille into combat. It remained in use for several centuries, providing flexibility and protecting certain areas of the body not covered by the plate armour, which gradually replaced maille in popularity. Plate armour is a style of armour composed of rigid panels of steel shaped to fit the body. In Japan, warriors incorporated patterns of maille, unique to the Far East, into their armour. Despite its widespread use, maille is often seen as a “poor cousin” to the later plate armours. In most histories of armour, it is briefly mentioned and then quickly passed over to concentrate on the more impressive and popular plate armour.

In the late-nineteenth and early-twentieth centuries, maille reappeared, this time in ladies fashions. Tiny purses made of minute links were carried by fashionable women.

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These were often colorfully painted and as delicate as a suit of maille armour was strong.\(^6\) The example pictured in figure 1.1 belonged to the author’s grandmother.

As we embark on the twenty-first century, maille is still in use. Gloves of maille protect butchers’ hands from sharp knives, and entire body suits of maille protect divers from the sharp teeth of sharks. Members of medieval reenactment groups make and perform combat activities in maille armour as they attempt to recreate a time long past. Maille appears in the fashion arena, as well. Medieval reenactors and visitors to Renaissance Festivals wear maille fantasy fashion items at medieval events and fairs. It appears in high fashion, paraded down the runways, and splashed across the pages of fashion magazines including the cover of Sports Illustrated’s famous swimsuit issue.\(^7\)

The current trend of maille making and wearing appears to be a widespread phenomenon throughout the United States (and beyond its borders). Members of groups such as Regia Anglorum, a British organization that focuses on sixth- to eleventh-century Viking and Anglo-Saxon reenactments, and Die Landen van Herwaerts Over, a Dutch society that focuses on the Middle Ages (500 to 1500 A.D.), use maille armour. Shirts of maille can sell for $300 to $700 and up.\(^8\) Fashion items can range from simple bracelets and head dresses to entire body-covering dresses. Even teddy bears, each dressed in its own little chain maille hauberk and coif, may be purchased.


\(^7\) *Sports Illustrated*, Winter 1999, front cover.

\(^8\) Museum Replicas Limited, Catalog #76 (2003), 23.
Figure 1.1. Painted Mesh Purse. This painted mesh purse, early twentieth century, belonged to my grandmother. Collection of the author.
For an individual interested in making his or her own maille at home, it can be difficult to find instructional materials. When I started making maille in 1997, the only available printed instructions to be found were in an out-of-print book, *The Best of the Hammer.*9 Most of my original information was found on the Internet. Not always the source of the most reliable information, the Internet is difficult to wade through, constantly changing, and has no set of standards about what information is posted. Only recently, were instructions for basic maille techniques published in the children’s book *Chain Mail Armored Knight.*10

**Methods**

The design process is described by Don Koberg and Jim Bagnall in their book *The Universal Traveler.* The book first appeared in 1972 and has since gone through numerous revisions and editions. The format, text, and illustrations of the original edition reflect the typical light-hearted, happy feelings of the early 1970s. The slimness and simplicity of the volume belie the great value that is held within its pages. *The Universal Traveler* has stood the test of time, transcending its “hippy-era” beginnings to remain relevant through the past three decades and into the twenty-first century.

The process Koberg and Bagnall describe involves seven stages: acceptance of the situation or problem, analysis, definition, ideation, selection, implementation, and

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10 Claude Lamontagne, *Chain Mail Armored Knight* (Hull, Quebec, Canada: ADLM, Inc., 2001).
Each stage includes numerous techniques for achieving success. Koberg and Bagnall treat creativity as a journey, focusing as much on the steps of the process as on the end result. Though the stages may be followed in a linear fashion, they may also flow circularly, loop backwards using the feedback approach, branch, or naturally occur in all stages at the same time. As I trace the steps in the following chapters, I will identify each technique used by placing its title in quotation marks.

Each of the seven steps can be divided into one of three categories: analysis, concept, and synthesis. “Acceptance and analysis” fall into the analysis category. Analysis is the assemblage of necessary information through various methods of research gathering. The “define” stage falls into the concept category and becomes a bridge between analysis and synthesis. The remaining four stages, “ideation, selection, implementation, and evaluation,” fall into the synthesis category. Synthesis is where all of the research from analysis is brought together into a plan and used.

In the “acceptance” stage, a person makes a commitment to achieve a goal. This is the foundation for motivation. Koberg and Bagnall provide a variety of methods for accepting a problem, including “what’s in it for me?,” and to determine the potential benefits of a particular undertaking. This is the stage for setting personal priorities by “making room” in the designer’s life for the project or problem and all that it will

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12 Ibid., 27.

13 Ibid., 26.

14 Ibid., 42.
involve. They also suggest the provision of rewards and/or punishments for reaching or not reaching the goal.\textsuperscript{15}

“Analysis” is the research stage where information is gathered. A wide variety of methods are suggested by Koberg and Bagnall, including “look it up,” which is basic library research, and “traveler’s journal,” a record keeping of the research journey.\textsuperscript{16} Book research allows a designer or problem solver to explore the knowledge that is already available on the subject. It can help prevent the duplication of research that has already been done, potentially saving much time and effort.

In the “definition” stage, the information from analysis is distilled to find the fundamental meanings of each part.\textsuperscript{17} At this stage, the designer seeks to understand the problem or situation and its various parts and components, putting it clearly into words to better understand the situation. Determining priorities for the project and identifying key words are two techniques that may be used in the definition stage.\textsuperscript{18}

In the fourth stage, “ideation,” numerous ideas are generated, providing choices for a solution to the situation, problem, task, or goal. The focus in ideation is on quantity, not quality.\textsuperscript{19} Judgment is not passed on ideas at this stage. Ideation may be done

\textsuperscript{15} Ibid., 44.
\textsuperscript{16} Ibid., 54.
\textsuperscript{17} Ibid., 66.
\textsuperscript{18} Ibid., 68.
\textsuperscript{19} Ibid., 78.
through a variety of brainstorming techniques, applying manipulative verbs, or lateral thinking, to name a few methods.\textsuperscript{20}

In the “idea selection” stage, the designer takes the ideas generated in ideation and evaluates them, weighing and judging each choice. Sometimes, this stage may cause a designer to reevaluate the original goal, perhaps modifying it to make it work with a particularly good idea.\textsuperscript{21} The best fitting option or combination of options is chosen.\textsuperscript{22}

“Implementation” is the action stage where the chosen idea or ideas are put into effect.\textsuperscript{23} Acting as an enthusiastic advocate for a project can infuse it with the energy and life needed for completion.\textsuperscript{24} Larger plans can be broken down into smaller, more manageable pieces through performance specification.\textsuperscript{25} Eight popular action methods include translating and digesting, public speaking, group dynamics, writing, graphics, model-making, body language and role-playing, and assuming other points of view.\textsuperscript{26}

In “evaluation,” the previous stage or stages are reviewed and assessed. This should be an ongoing process, performed throughout the entire design process, not only

\textsuperscript{20} Ibid., 80.
\textsuperscript{21} Ibid., 93.
\textsuperscript{22} Ibid., 92-93.
\textsuperscript{23} Ibid., 102-03.
\textsuperscript{24} Ibid., 106.
\textsuperscript{25} Ibid., 107-08.
\textsuperscript{26} Ibid., 108-13.
at the end.\textsuperscript{27} To properly evaluate progress, one must first have quantitatively measurable goals, though achievements are measured qualitatively. Lastly, a plan should be made for improvements.\textsuperscript{28}

Koberg and Bagnall were not the only ones to write on the design process. In their book \textit{Designing Interiors}, Rosemary Kilmer and W. Otie Kilmer devote a chapter to “Design as a Process.”\textsuperscript{29} The eight steps they describe, “commit, state, collect, analyze, ideate, choose, implement, and evaluate,” clearly correlate to the seven steps outlined in \textit{The Universal Traveler}. Their “commit” stage relates to “acceptance of the situation or problem.” Koberg and Bagnall’s “analysis” stage is related to both Kilmer and Kilmer’s “analyze” stage and to their “collect” stage. The primary difference between the two processes is the placement within the structure of the design process. Koberg and Bagnall place “analysis,” the research phase, directly after “acceptance” and before “definition.” Kilmer and Kilmer place “analyze” later in the order, after “collect” and before “ideate.” This change is minor due to the fact that with both processes, the order of the steps can be changed to suit a particular situation. “Definition,” which occurs after the research of the “analysis” phase in \textit{The Universal Traveler}, relates to the “state” stage in \textit{Designing Interiors}. The synthesis stages relate directly to each other. Koberg and Bagnall used “ideation, selection, implementation, and evaluation.” Kilmer and Kilmer

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\textsuperscript{27} Ibid., 114.
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\textsuperscript{28} Ibid., 115.
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\textsuperscript{29} Rosemary Kilmer and W. Otie Kilmer, \textit{Designing Interiors} (Fort Worth: Harcourt, Brace, Jovanovich, 1992), 154-77.
\end{flushleft}
named their stages “ideate, choose, implement, and evaluate.” Despite the differences, the processes are essentially the same.

I surveyed journal articles that used the design process to see what others in the field of Clothing, Textiles, and Interiors had written using this research method. As far back as 1977, Susan M. Watkins, a design professor at Cornell University, used Koberg and Bagnall’s version of the design process to solve a functional clothing design problem. Her class evaluated the protective qualities of ice hockey equipment and created recommendations for changes for more mobile, comfortable, and protective equipment.\(^{30}\) Watkins later wrote about using the design process as a tool to teach functional apparel design in the classroom.\(^{31}\) In 1998, a group of researchers, which included Yi-bin Tan, Elizabeth M. Crown, Linda Capjack, Mark Y. Ackerman, and J. Douglas Dale, wrote two articles about the use of a design process to create and test a thermal protective flightsuit prototype.\(^{32}\) Though they did not use Koberg and Bagnall’s model, they still provided an example of accepted scholarly research using a design process.

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Acceptance was one of the most difficult steps for me. I like to be active. I am the sort of person who would rather build or create or do something. The idea of spending hours upon hours simply writing is not my idea of a good time. I can also be a terrible procrastinator at times. During the course of the eight years spent in the Master’s program, I found every excuse in the world not to work on my thesis. I was working. I was planning my wedding. I moved seven times. Despite the support of my thesis advisor, my parents, and my husband, I spent, literally, years avoiding writing my thesis.

It took several of the different methods for acceptance described in the *Universal Traveler* to finally motivate me. The methods which I found useful in this project were “Success At First,” “Role-Model,” “What’s In It For Me?,” “Making Room,” and “Mission Impossible.”

I began using “Success at First” fairly early. “Success at First” involves using positive visualization techniques as a motivator.\(^1\) I started visualizing myself in my cap and gown at graduation. I would wonder how I would look, what I would wear

underneath, what colors the hood would be. I had to find really cute shoes. I envisioned my family and friends in the audience, watching me as I made everyone proud. Sometimes, I would quietly compose in my head my list of people I would thank in my acknowledgements section and what I would say about them. It all sounds a bit silly. I felt a bit silly doing it, like I was a daydreaming school girl. I suppose I really was one. Until my confession here on paper, I never told anyone about my little dreams of success.

One of the most crucial steps in the Acceptance stage for me was finding a “Role-Model” to guide me through the process. I have many wonderful role models in my life. Both my thesis advisor, Dr. Gunn, and my father provided great moral support and wonderful examples of people who had lived through their own theses. Still, I was floundering.

As my deadline was approaching, my mother gave me a copy of Joan Bolker’s book *Writing Your Dissertation in Fifteen Minutes a Day.* It was a real break-through for me. Something in Bolker’s book inspired me. It may have been the gentle humor or the reassurances that writing a thesis is not an impossible task. Perhaps it was the step-by-step guidance along with its many flexible options suitable to any number of different personality and writing types. As I read her book, I found myself strangely motivated to work on this project like never before.

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2 Ibid., 47.

Following Bolker’s advice, I began with trying to write just fifteen minutes a day. Making the commitment to do just that little bit made the process seem less overwhelming. I found myself immediately able to go well beyond the fifteen minutes. The pages came pouring out onto the computer screen like never before. I was on a roll! What a wonderful feeling.

Bolker takes an unorthodox approach to writing. She recommends throwing out the neat outlines and careful planning we are all taught starting in grade school. Begin by making a mess. Begin by writing. Write whatever comes to mind, quickly and freely, ignoring spelling and grammar. Simply let the words flow onto the paper or computer screen. It is more important to keep the flow of words and ideas than to break concentration by worrying about technicalities. Get the ideas on paper, and later, you can come back and clean up what you have written. Writing like this gives a remarkable sense of freedom to an author.

“What’s in it for me?” is a technique for evaluating the benefits that will result from a particular project. In this case, I have a lot at stake. When I finish, I will have my degree. I will have the satisfaction of completing both the degree and the paper. My mom will stop nagging me to work on it. Though she means well and I love her for it, nothing can irritate me like my mother’s nagging. It will feel wonderful not to have this hanging over my head. I will know that I did not waste the last eight years, and thousands of dollars.

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4 Koberg and Bagnall, 44.
“Making Room” is one step I did not do as early as I should have. “Making Room” involves evaluating the amount of time it will take to perform the new task and the amount of time already committed to current activities, setting priorities.\(^5\) Between working as many as 60 hours a week at times and other commitments, I was not writing. I had to make myself stay home and work, removing myself from my social activities for a time. I decided to give up housework until I was done. As much as I dislike cleaning, I would still rather clean my kitchen or my bathroom than write. Housework is a treacherous form of procrastination. It is useful and practical and not really any fun, but it is still better than writing some days. I can trick myself into thinking it is acceptable to do housework instead of writing if I am not careful. I owe my husband a debt of gratitude for picking up the house cleaning slack.

“Mission Impossible” provides motivation by infusing a level of excitement to the project.\(^6\) Imagining how interesting and exciting it will be to solve this problem helps to keep my energy level up. Impossible certainly feels like the truth, though, sometimes I am scared that I will not finish what I have started. The deadline approaches, but I have made the commitment and accepted the mission. I will finish. I refuse to give up!

“Give It Up A Tragic Scenario” explores the possible outcomes of not finishing the project.\(^7\) Not finishing would be tragic for me. I would disappoint not only my

\(^5\) Ibid., 45.
\(^6\) Ibid., 46.
\(^7\) Ibid., 46.
family and friends, but also myself. If I did not finish, I would have felt like I wasted the last eight years of my life, not to mention thousands of dollars.

Though it does not fit neatly into one of the methods for acceptance listed in The Universal Traveler, I had one more motivator that was instrumental to my success. A few weeks before my first draft was due to Dr. Gunn, I began wearing a special necklace every day. It consists of piece of a fine gauge stainless steel maille an inch or so wide and about three inches long on a rigid neck wire. See figure 2.1. An unusual accessory, it helped to keep my topic fresh in my mind, serving as a constant reminder with every glance in the mirror and every touch of the supple mesh. My commitment to wearing it every day helped reinforce my commitment to write for at least fifteen minutes every day.

Fortunately, I chose a thesis topic of great interest to me. I have been fascinated by maille for many years and frustrated with the lack of available materials - particularly instructional materials - on the subject. Knowing that I was making a contribution that may assist aspiring armourers and artists in the future helped to motivate me.

Acceptance was an ongoing process. I never really reached the end of this stage. It was a constant part of everything I did during this project. Maintaining my level of focus and commitment to this project was a continual challenge.
Figure 2.1. *Maille* Necklace.
CHAPTER III
ANALYSIS AND DEFINITION

Analysis or My Affair with the Photocopier

Much of the analysis step involved Koberg and Bagnall’s “Look It Up” technique which is tried and true library research.¹ My study of the topic of maille began with my initial search on the internet as part of an undergraduate project. I discovered that there were no standards and no consistency in what I found from web site to web site. I also had no way of knowing if what I read had solid research behind it or if the author simply fabricated the information that was written. My initial library search left me frustrated. The only information I turned up on maille in my first foray into the stacks was in a few pages from Charles ffoulkes’s book The Armourer and His Craft.² I found myself frustrated with being able to find only one printed source.

I spent two months working at the Vassar College Library during the summer of 1997 and used much of my free time perusing the stacks and combing the computerized

card catalog. I began my affair with the photocopier there, making copies of everything I could find related to *maille*. Over the next several years, I continued to expand on this initial research. For each of the many books and journal articles I read, I searched through the citations to find more sources, tracing the evolution of research on *maille* backwards, step-by-step. I found it particularly interesting to read what was written by an author in response to another author’s work. In one especially notable exchange, E. Martin Burgess and Cyril Stanley Smith tersely yet politely criticized back and forth, making the reader wonder what it was that they really wanted to say to each other.³

During the “Look It Up” stage, I entered into “The Packrat and the Collector” technique. A packrat gathers lots of things, though much of it may be garbage. In contrast, the collector chooses selectively what she gathers, sometimes missing an important item.⁴ I gathered any and all information on *maille* from as many sources and from as many different points of view as possible, seeking information on history, uses, techniques, depictions, and more. I became an accomplished packrat.

“The Pack Rat and the Collector” stage led into “Lateral Thinking.” “Lateral Thinking” assumes that there is a relationship between all things and takes a broad look at the subject at hand.⁵ I branched out into other fields. From researching only *armour*, I expanded into the fashion world, both high fashion and fantasy fashion, into the modern


⁴ Koberg and Bagnall, 58.

⁵ Ibid., 60.
functional uses by butchers and shark divers, and into jewelry and metalsmithing. I also took two semesters of metalsmithing from the Art department at the University of Akron to better understand how to work with metals.

I also studied the how-to-books in my personal library, examining and comparing the formats and styles of various how-to-books on different subjects. I found that the best were clearly written with easy-to-understand directions and they had clear, colorful pictures to illustrate the instructions, and clean, concise diagrams to provide instruction. Visual information, i.e. photographs, diagrams, illustrations, seemed as important to me as the written text for conveying instructions, perhaps more so. I found colored pictures to be more engaging than black and white photographs. The books with few or no colored photographs seemed to be less interesting to view. Though color images in a book are more expensive to produce, I believe that the extra expense is worthwhile.

The how-to book I found that I would like most to emulate is the Reader’s Digest Complete Guide to Sewing. It combines color and black and white photos with many color-tinted drawings to illustrate the clear, easy-to-follow text. This book is a practical and comprehensive reference guide that covers virtually every technique one could reasonably need while sewing. Choice of tools and materials are covered, and it has a great index, making it quick and easy to find a desired technique.

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For this project, the end of the Analysis stage was determined by time, not an end of resources. Eventually, I had to take my focus from researching and shift it to synthesizing and writing if I wanted to finish this project. By this point, I had compiled a great deal of information on my topic -- more than enough to begin writing. Since I enjoy research more than writing, I think I probably spent more time here than I really should have. I am still discovering books and articles related to my topic. Designers are still incorporating maille in their designs. In all honesty, I will never truly reach an end to my analysis on the subject of maille.

**Definition or That’s What I Meant**

The definition stage gives meaning to the information gathered in the analysis stage. It helps to provide direction for the upcoming steps. Several techniques were used to provide definition: “Priorities,” “Recipes and Formulae,” “Boil It Down,” and “Mission Objective(s).”

Setting “Priorities” was vitally important. This four-step technique begins with the generation of a random list of anything and everything that pertains to the topic. I brainstormed to create lists of words and ideas that were relevant to maille. Next, I began to organize my list, making categories and deciding what went where. Once the lists began to make some logical sense, I proceeded to the third step, prioritizing to determine what should be included. At this point, the list looked something like the one in figure 3.1.

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7 Koberg and Bagnall. 69-70.
To conclude the process, I decided that my main focus would be on providing instruction for how to make *maille* items. Specifically, I chose to focus on the technique that would be usable by most people, butted *maille*. Because butted *maille* does not require a great investment in money, supplies, or a dedicated workshop and does not require exceptional physical abilities, it can be made by virtually anyone. It can be done almost anywhere, with a great variety of different tools, and at almost any skill level.

I wanted to include fine jewelry techniques and authentic blacksmith riveted *maille* techniques. The fine jewelry and blacksmith chapters were later eliminated due to time constraints and the large scope of the topic. Instructions for how to make riveted *maille* could be a book by itself and is a topic I would like to pursue in the future. It was important to me to write a history section because *maille* has such a rich past. No historic object exists in a vacuum, and the understanding of how a particular artifact was used in a certain place and time is an integral part of its value.

Setting “Mission Objective(s)” involves the creation of meaningful and measurable goals.\(^8\) From the start, I knew I wanted to write a book about *maille*, but I originally wanted to write about *everything*. Eventually, I narrowed it down to writing a guide book on how to make *maille*. I wrote and wrote, not really sure where I was going. Eventually, I stopped and examined what I was doing. I determined that I needed to set a definite goal, a stopping point. The major deciding factor was time. I was rapidly drawing near my deadline. I decided that I would have to eliminate the work I had begun

\(^8\) Ibid., 58, 75.
Figure 3.1. Early Outline. This was later rearranged and modified.
on the chapter on riveted maille. Though I had a blacksmith friend of a friend who had agreed to teach me, I had not yet learned blacksmithing. It would be too much in the time I had left to learn a new technique (an art form, really) and gain enough of an understanding of it to write about it. I decided to cover what was really important to me, what I knew and understood, and what would be of the most use to my target audience, the techniques of basic butted maille.

“Recipes and Formulae” involves finding definitions that are already in existence. I began by reading through the literature on the subject, tracing the evolution of the terminology by reading chronologically from the earliest works up to the more recent ones. The following is just a brief overview of some of the changes in the terminology over the years regarding maille. In 1821, Samuel Rush Meyrick wrote an analysis of the styles of armour worn in medieval England, assigning names to eight different styles. He called these styles trelliced, ringed, rustred, mascled, scaled, tegulated, single-mailed, and banded. Forty-six years later, in 1867, J. G. Waller reported his interpretation of Meyrick’s writings in the proceedings of The Royal Archaeological Institute. Waller claimed that, by using Meyrick’s definitions, single-mailed armour would have been prohibitively heavy. Meyrick referred to what is now considered the standard four-in-one maille as double mail. Double mail, as we know it

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9 Ibid., 74.


11 Ibid., 120.
today, a basic European 4-in-1 pattern where each ring is doubled, uses the definition Waller gave it. Waller also clarified what Meyrick termed banded *armour*. Meyrick was unsure of how banded *armour* was constructed. Waller asserted that strips of leather were laced through the rings for added stiffness and protection.\(^1\) Several years later, in 1880, another article in *The Archaeological Journal* explained that the illustrations of what Meyrick saw as ringed *armour* were actually just a stylistic representation of *maille*.\(^2\) In 1931, F. M. Kelly asserted that all of Meyrick’s classifications were, in fact, erroneous.\(^3\) In the end, it seems that most of the different visual representations of *armour* are all different ways of describing the same thing -- *maille*.

I also searched for the terminology used today by surveying the many Internet sites about *maille*. After sifting through the terminology I found, I chose the terms and definitions that I believed were most accurate and appropriate. My thesis committee readers pointed out to me during my first thesis committee meeting that the terms and definitions I chose to use in my book could very well become the accepted terminology in this field. Therefore, it was very important to choose carefully.

Throughout the process, I “Boiled it Down.”\(^4\) Taking the information gathered in the Analysis stage, I continually sought to distill the information into its essential form or forms. I endeavored to find connections between the different parts and to determine


\(^3\) F. M. Kelly, “Chain Mail,” *Apollo*, November 1931, 267.

\(^4\) Ibid., 75.
what aspects should be given precedence.

In summary, my primary goal for this applied thesis project was to write a guide book on how to make maille. I originally decided, it should include the following:

Brief History: As nothing exists in a vacuum, it is important to know, at least roughly, where maille has existed in the past.

Pattern Instructions: I wished to provide a comprehensive listing of every established pattern currently known, along with instructions for creating each one.

Techniques: Instructions for making butted maille, riveted maille, and jewelry-scale maille should all be included.

Maille Products: As interesting as a simple sheet of maille is, seeing what can be created from it is fascinating. I wanted to include examples of finished products to inspire the reader.

Resources and Selected Bibliography: A comprehensive list of suppliers for necessary materials and a list of sources for continued reading should be provided to encourage further exploration of the subject.

As the guide book evolved, I modified my goals. Some changed slightly; others, like the section on riveted maille, were eliminated entirely. As a result of the Definition stage, I felt more confident about where I was headed with this book. I had clearer ideas about where I had been and where I needed, and wanted, to go. I still needed, however, to spell out my goals.
CHAPTER IV
IDEATION, IDEA SELECTION, AND IMPLEMENTATION

The next three stages, “ideation, selection, and implementation” are the start of the synthesis category. Synthesis is where all of the research from analysis is refined and brought together into a plan which is then used.

Ideation and Idea Selection or What Should I Do?

The Ideation step involves generating ideas for where to go next. The definitions created in the previous Definition stage help to provide the goal, and the ideas are possible pathways to reach the goals. In Idea Selection, the best idea or ideas from those generated in Ideation are chosen.

“Lateral Thinking” provided my primary method for Ideation. This is very similar to the “Lateral Thinking” technique used in Analysis. Rather than deeply pursuing one aspect of a subject, a broad look at myriad facets of a particular subject is taken to find different possibilities.¹

From the beginning, I had a difficult time choosing my topic. I knew I wanted to pursue research in the field of maille, but I did not know which direction to go. I began my initial studies on maille in 1997 during the last semester of my undergraduate degree as a part of a project for my costume crafts class. This is when I made my first maille item, a bikini top, lined with fake fur. It was a sampler project, utilizing three different styles of maille: European 4 in 1, Japanese 6, and Spiral. I also began a shirt of European 4-in-1 the same semester. After a summer of work, I produced a tube wide enough to fit loosely around my body and about a foot in length. I spent the summer after graduation working at the Vassar College Library in Poughkeepsie, New York, where I took advantage of Vassar’s large collection of books and of the interlibrary loan system to begin researching the subject. With this extensive collection, I was in research heaven!

Originally, I wanted to do purely historical research on maille. As I studied, I realized that I needed to select a different avenue for several reasons. First, I found that many others had followed this path before me. There was so much historical information already published that it would be difficult to make a unique contribution. Also hindering my way was the fact that I am only able to read in English, though many of the texts I would need are written in other languages. I did not have access to any historical examples which I might analyze. Additionally, many of the original historical texts and examples are located in Europe, making them virtually inaccessible to me without great trouble and expense.

I considered studying who was making and using maille in the modern day. I
found the following categories of uses: armour, both historical: replicas and medieval combat reenactment; fashion: haute couture and fantasy; and fetish. I found some resistance from more conservative members of my School when I suggested researching the fetish uses of maille. The subcultural fetish use of maille could be a study by itself, as could any of the other facets of modern use.

I considered studying how maille was traditionally made, using the riveted technique. I took two semesters of metalsmithing at The University of Akron to learn how to rivet and perform other metalsmithing techniques and to learn how different metals work and react to heat, to being worked, and so forth. While I loved metalsmithing, I was unable to continue into blacksmithing due to time constraints and the difficulties at the time in finding a blacksmith from whom to learn the art of smithing. Therefore I did not pursue this area of research. Again, this could be a complete area of study by itself.

I even considered choosing a completely different idea for my thesis. The most promising topic was to explore a new system for cataloging historic garment collections; however, I just could not keep myself from my first research love of maille.

For Idea Selection, I used the “Why Not Try ‘Em All?” technique where I tried several different ideas over time. I had some good ideas and was really stumped about which path to follow. I explored several subjects in depth. I even wrote a prospectus for the modern maille idea. In the end, I decided to create a guide book to teach others how to make maille. I wanted to write a book to fill the gap that was present when I first tried

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2 Ibid., 95.
to find a book about how to make maille. Since I enjoy teaching and sharing knowledge with others, this seemed like the perfect option.

To assist with idea selection, Dr. Gunn provided me with a list of questions to be answered as a part of a prospectus review process for the Costume Society of America as well as a list of additional items to ponder. Whereas before, I was floating in a nebulous state of half-formed ideas, these questions helped to provide a concrete foundation upon which to build my goals for this book. The following are some of the questions I asked myself along with brief answers.

1) What are the objectives of the book? My objective is to write a comprehensive, instructional guide book on all aspects of maille.

2) What will the contents of this book include? The guide book should include a brief history, instructions for the various patterns, techniques for construction, examples of maille products, a list of resources for tools and supplies, and a selected bibliography for further reading.

3) How will the book be organized? The outline in figure 4.1 is my plan for organizing the guide book.

4) What will the style of the book be? The book should contain clear, easy-to-understand instructions illustrated by numerous diagrams and color photographs. The book should be enjoyable to read and contain a touch of humor.

5) Who is my target audience, and how do they affect this book? My target audience includes those making or interested in historical replicas, medieval reenactors, armourers,
Introduction
History
Modern uses
Butted *Maille*
  Supplies
  Tools
  Techniques
Patterns
  European 4 in 1
  6 in 1
  Japanese 4
  6
  etc
Garment patterns
Riveted *Maille*
  Supplies
  Tools
  Techniques
    Riveting
Patterns traditional *armour* patterns (E 4 & 6, J 4 & 6)
Garment patterns
Traditional pieces of *armour*
  Hauberker
  Coif
  Camail
  Chauses
  etcetera
Glossary

Figure 4.1. Guide Book Later Outline.
costumers, jewelers, artists, and craftspersons. This handbook may be useful to anyone wishing to create or recreate maille items or to simply learn more about the subject.

6) Why is this book needed? As mentioned earlier, the instructional material currently available for learning to create maille is inadequate. The easiest source of instruction to access, in this world of advanced technology, is the internet, where I found most of my original information on the subject. There are no standards or guidelines for posting information in the internet, so it becomes the responsibility of the reader to determine the merit of each internet source, some more reliable than others. The internet can also be difficult to navigate and is constantly changing. There is no guarantee that a site will remain available from one week to the next.

7) Are there any competing books on this subject? Printed information on creating maille has been difficult to find. The out-of-print book, The Best of the Hammer, was the only available source printed instructions for many years. This hard-to-find book, actually a reprint of the first nine issues of the newsletter of the Armourer’s Guild of the Society for Creative Anachronism’s Middle Kingdom, contains about fifty pages on the subject of maille. Only recently were instructions for basic maille techniques published in the children’s book Chain Mail Armored Knight. Though this covered some of the same material I planned to use, I intended to target an adult audience with my book.


4 Claude Lamontagne, Chain Mail Armored Knight (Hull, Quebec, Canada: ADLM, Inc., 2001).
What unique or outstanding features will this book have? My book will be geared to an adult audience. I hope to inspire readers by encouraging creativity. I wanted to provide the basic skills needed to create maille and then challenge readers with in-depth projects better suited to an older audience.

The Ideation and Idea Selection Stages were long and difficult for me. I explored many different options in depth before I finally selected one. It was with great relief that I found myself ready to start down the path to actually writing the guide book.

Implementation or How I Did It

Now that I knew where I was going in my journey, I was ready to begin the Implementation Stage. In Implementation, all of the thought and planning from the previous steps are put into effect. Implementation is action. The principal methods I used for Implementation were the “Writing” and “Graphics” subsections of “Eight Popular Action Methods.”

“Writing,” one of the “Eight Popular Action Methods,” is essentially verbalizing ideas on paper in a meaningful and understandable fashion. The great majority of my guide book was implemented using the “Writing” technique. Though writing may sound simple, writing well is a challenge. I spent many hours chained to my computer as I wrote my guide book, trying to articulate the ideas in my head. This part was the most difficult for me, as I do not overly enjoy writing.

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5 Koberg and Bagnall, 102.
6 Ibid., 109.
When I began to write, I tried to start at the beginning, but I soon found that I was better off writing in a less-structured manner. I switched to writing whatever popped into my head, jumping from section to section in a haphazard manner. I would create small segments and later come back to connect them and put them in the proper order. My primary concern became getting ideas preserved on paper before they left my mind.

After I had written the majority of the text, I began the revision process. Once I had read and revised my paper, I sent it to Dr. Gunn, thus beginning a series of revisions that would continue for quite some time. I learned from Dr. Gunn that writing well is like weeding a garden. The first time through, you pull the large weeds, fix the big mistakes. On the next passes, you get the middle-sized weeds, and your work becomes more refined. Finally, you reach the stage of pulling the tiny weeds, the finishing touches and final polish is put on the work. The appendix contains my completed manuscript for the guide book.

“Graphics” are visual pictures that may be in any of a variety of forms such as photos, sketches, charts, or graphs. They are used to illustrate and further illuminate the text. The axiom “a picture is worth a thousand words” expresses the importance of graphics. It is often easier to express an idea with a picture than with words. Graphics also communicate more effectively to visual learners. The inspiration for “Graphics” used in the guide book were taken from a variety of sources. For the pen and ink illustrations featured in the guidebook, I recruited my friend Eric Kuehn, an art teacher, I...
to draw many of the illustrations in the guidebook. His talent far surpasses my meager skills with pen and paper. He was able to create beautiful illustrations in a fraction of the time it took me to create a barely-passable drawing. Some of the illustrations are redrawings of primary sources; others were inspired by my poor sketches. Many of the examples of maille used to illustrate construction techniques, tools, and supplies were photographed with a digital camera. Originally, my sister, Kendra Sweezey, helped me take the photographs, but as the project progressed, I became quite adept with the digital camera.

As even small samples of maille are quite time consuming to make and photograph, I knew that there was no way I was going to be able to make examples for all of the different styles of garments that I wanted to illustrate. It would have taken too many years and too many blisters and calluses. To solve this problem, I sought outside sources for photographic illustrations. I posted a request for illustrations on several internet forums related to maille or amour in general (see figure 4.2). Though I asked for photographs to be sent to me, I did not receive a single submission in the postal mail. Some pictures were posted in the forums, in response to my message. One maille maker, Mike Edelman, offered a link to photographs of his work on his web page. Many of the finished pieces illustrated in my manuscript are Mike Edleman’s work that he was kind enough to let me reproduce. My second contributing maille maker was Bill Love. Shortly before my first deadline, I found maille items for sale in a local game shop. When I explained my need for photographs, the shopkeeper provided me with the name and phone number of one of the maille makers, Bill Love. Mr. Love sent me several e-
Seeking photographs of chain mail items to use as illustrations for a book on the subject. I am looking for good color photographs of quality examples of finished maille products in the following categories

**Historic** hauberk or shirt, coif, camail, chauses, riveted, etc.

**Fantasy** headpiece, necklace, bracelet or anklet, handflower, bra, vest, belt, skirt, dress, other

All photographs will become the property of the author and can not be returned. If selected for publication, you will receive credit for your work but no financial compensation. So if you seek fame and immortality (or at least your name in print), please submit by May 15, 2003 your photographs and your name as you wish it to appear to Chain Maille Photographs [my address listed here].

Figure 4.2. Request for Illustrations.
mails full of photographs of his tools and his finished works along with helpful information about each photograph. I also recruited friends from the Barony of Shattered Crystal, the local Society for Creative Anachronism group to which I belong, to allow me to photograph their maille items.

The photographs from other maille makers allowed me to include more and better quality illustrations. Without their assistance, many of the illustrations would not have been possible. It would not have been feasible for me to construct all of the examples I was able to include in the guidebook in time to meet my deadlines. All artist and artisans are credited for their work within the guidebook.

I decided to focus my time and energies into preparing a manuscript suitable to send to a publisher, instead of into a complete, fully formatted book. Rather than placing the pictures within the text, the manuscript would simply be typed and all of the photographs included on separate pages. This decision was made for three reasons. First, the decision was made based on the time available. I chose to devote the time I had to making the text and the accompanying illustrations as strong as possible. If I had decided to undertake the formatting as well, I was afraid the rest of the project might suffer. Second, I have no formal experience with formatting a book. There was no time to learn a new skill. Third, I do not have the necessary computer applications to format a book. This would have required a considerable investment of both time and money.

At the end of the Implementation stage, I felt a great deal of relief and a certain sense of accomplishment. This major undertaking was now behind me. Now I could put it in the past and be at peace with the project. No longer was the guide book the sword of
Damocles, hanging over my head. I could focus on creating a finished book of which I could be proud. In a sense, it was like giving birth to a child: many months (years, actually) gestation period, a great many hours of labor, and in the end, a great sense of relief and pride when I held my progeny in my arms.
CHAPTER V
EVALUATION

The “Evaluation” stage is the chance to take stock of the work that has been done and to see how the results compare to the original objectives. In a sense, this entire thesis is an “Evaluation” of the process of writing a guidebook and the final result. But “Evaluation” did not only happen at the end of the project. Every choice I made, every word I wrote was evaluated before, during, and after I wrote it. I asked myself numerous questions. Did I do enough research? Did I use enough of the Analysis techniques during the course of writing my book? Is what I have written clear and easy to follow? Did I cover enough? Too much? Through the course of “evaluation,” I sought to answer these questions and many others.

I used “A Plan for Improvement” to help measure my progress and accomplishments. In this technique, three steps are taken in order to measure the success of a project “Goals, Achievements, and Plans for Improvements.” “Goals” are the desired end result, the destination of a journey. But how to know when a goal has been reached? Goals must be defined clearly and quantitatively in order to measure them.

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“Achievement,” another measure of success, is measured qualitatively, evaluating feelings about the success of the project. The final step is making “Plans for Improvement.” After evaluating how closely the goals were met and measuring the levels of achievement, certain areas where improvements could be made in the next endeavor should be obvious. Even if the level of potential improvement is small, it is still significant.2

In Chapter 3, I stated that my initial goal for this project was to write a comprehensive guide book that covered every aspect of how to make maille and its uses past and present, including a brief history, instructions for the various patterns, techniques for construction, examples of maille products, a list of resources for tools and supplies, and a selected bibliography for further reading. This goal changed numerous times through the course of the project.

In the end, my goal was to write an easy-to-use guide book for constructing butted maille, beginning with a brief historical introduction. I had to distil my ideas and desires to find the core essence of what I really wanted to cover in this book and to determine what would truly be of most practical use to my audience. See Guide Book Final Outline, Figure 5.1, for the topics selected for the book.

I included a brief history, as I had planned, though I did not go into as much depth as I originally desired. The limited historical information works well in a twofold manner. One, it helps keep the reader from being bogged down by too much technical

2 Ibid., 116-17.
Introduction
History
Modern uses
Butted Maille
  Supplies
  Tools
  Techniques
  Patterns
    European 4 in 1
    6 in 1
    Japanese 4
    6
    etc
Garment patterns
  Traditional *armour* patterns (E 4 & 6, J 4 & 6)
    Hauberk
    Coif
    Camail
    Chauses
    etcetera
  Fantasy patterns
    Belt
    Dress
    Bracelet
    Vest
    etcetera

Figure 5.1. Guide Book Final Outline.
reading at the beginning of the book. Personally, I have put down books, never to return, because I was so bored by the introduction to the book. I would like to keep this from happening to my readers. Two, for a reader truly interested in the historical aspects of maille, it should provide enough information to whet their appetite for more. They can use the selected bibliography to find more sources for further reading.

Instructions were provided for the patterns I originally intended to include: European 4-in-1, European 6-in-1, Double Maille, Japanese 4, Japanese 6, Spiral, Box, Bird Cage, and Triangle. As I continued my research, I began to find some more obscure maille patterns, in particular the family of Persian maille patterns. Though I wanted to include them in this guide book, I knew that I could not with my current time constraints. I decided to keep my focus on the more commonly used patterns, the ones I anticipated being of most interest to my audience.

I originally planned to include instructions for three different techniques for constructing maille: butted, riveted, and fine jewelry. In my guide book, I was able to include information on butted maille, as I planned. I anticipate this technique as being the most useful to and most desired by my readers. The chapter on riveted maille was eliminated because I did not have enough time to learn the art of blacksmithing well enough to write authoritatively on the subject. Though I am more knowledgeable in metalsmithing, the chapter on fine jewelry/metalsmithing was also eliminated to keep the focus of the book on the basic techniques of butted maille. Also, in my opinion, techniques like blacksmithing and metalsmithing are best learned in person, with an
experienced smith for a teacher, though a book may certainly provide effective supplemental instruction.

The section on products that may be constructed from *maille* was divided into two main categories: historical and fantasy. The historic section included instructions for the three most commonly made items: the shirt, the coif, and the *camail*. Though not originally planned, in addition to the first three items, I also covered mitten gauntlets and *chauses*. The mitten gauntlets were included to provide a smaller, more easily completed project in the *armour* section. The *chauses* were included to provide the opposite extreme, a very challenging, time- and skill-intensive project.

In the fantasy category, there were many more choices, as the current uses of *maille* are only limited by the maker’s imagination. Instructions were included for the following items, as planned: headpiece, necklace, bracelet or anklet, handflower, bra top, belt, decorated stuffed animals, and decorated bottles or other objects. The items included were chosen for one of two reasons. First, I chose items that I have commonly seen made from *maille*. This category included bracelets, belts, and necklaces. Second, I wanted to include some of the more unique uses I have encountered to provide a launch pad for creativity. This category included decorated stuffed animals and decorated bottles. I stressed that the *maille* maker should use his or her imagination to design whatever they desired.

The resources section, while small, should provide a good starting point for locating tools and materials. If the manuscript is published, I like the idea of leaving
extra room in the margins for the reader to personalize the resources section by adding notes and their own sources, truly making it his or her own.

Rather than including every source I had read, I chose the sources I found the most useful on maille and other related subjects for the selected bibliography. This should make it easier for anyone wishing to do further research to find quality sources. They will not necessarily have to pour through every book and journal article that may - or may not - have any information on the subject, unless they really want to do so.

I also thought about my “Plans for Improvement.” I think I bit off more than I could easily handle with the guide book project. If I were to write a guide book again, for a different topic, I think I would try to narrow down the subject to a more manageable scope in the early stages or do it in a series of smaller pieces. I have a tendency to want to take on big projects in most things that I do. Sometimes my grand ideas leave me in the middle of an overwhelmingly large project. In all honesty, though, I still wish I had been able to include more in this book.

At the end of the Evaluation stage, I felt more comfortable about what I had written. I had more confidence in my end product. The final evaluation also gave me a sense of closure with the project. Also among my achievements was a great sense of lightness as the pressure of finishing this project was lifted off of my shoulders. I had an extraordinary feeling of accomplishment. I was bouncy, light, happy -- a truly wonderful feeling.

It could be considered ironic that someone who hates to write as much as I do
would chose to write a book and then write about writing the book for her thesis paper. I found that my biggest problem was getting motivated to write, not the writing itself. Once I was actually at the computer, writing, I was able to continue with little trouble. My difficulty was in getting myself to sit down in front of the computer in the first place. I like having written this guidebook, but I do not think I can say I really liked writing it.

This thesis has been a candid and unflattering look at some of the worst parts of myself. I am not proud of how I come across in these pages, but I have evaluated myself and my work with honesty and candor.

It is hard to say if this was a wise choice for my thesis topic, but for me, it was really the only topic that truly captured my attention. I saw a need for this guidebook and wanted to help others avoid the frustration and confusion I faced with first trying to learn how to make maille. I would like to pursue publication of this guidebook in the future. I think that there is a need for this book and a market looking for it. I still need to conduct a formal market research study that I could present to a publisher.

The design process was a great tool for writing a book. The orderly steps helped to guide me through the process. When I hit a spell of writer’s block, I went back to the Universal Traveler for guidance. By following one or more of the ideas contained within the pages, I was able to find a path back into writing. Clearly, I did not follow the steps in order, beginning at Acceptance and ending with Evaluation. I traveled through the steps moving from one to another in different orders, sometimes performing more than one step at a time. The extremely flexible nature of this process is largely responsible for its success throughout the years.
CHAPTER VI

SUMMARY

Also known as chain mail, maille is an intricate fabric of inter-linked metal rings which are passed through each other in a specific pattern to create a strong, flexible material. Maille armour had been used by many cultures throughout history. Maille armour was worn by ancient Roman, European, and Japanese warriors. Delicate maille purses were carried around the turn of the twentieth century. Late-twentieth and early twenty-first century uses of maille include protective clothing for butchers and shark divers, armour and fantasy fashions for medieval reenactors, and mainstream fashion items. Maille, as a subject, is currently experiencing great interest from various different groups. Instructional material on maille, however, can be difficult to find.

This applied thesis involved the planning and implementation of a manuscript for a guide book on making maille armour. I chose to use the design process outlined in Don Koberg and Jim Bagnall’s The Universal Traveler as a guide for creating my book. The process is comprised of seven steps: acceptance, analysis, definition, ideation, idea selection, implementation, and evaluation. The steps may be performed linearly, circularly, loop backwards through feedback, branch, or occur naturally in more than one stage at a time.
Acceptance and commitment to the project was a constant struggle for me. I used several different methods of acceptance to keep me both motivated and interested. I employed positive visualization exercises with the “Success At First” method. Important role-models including my father and my thesis advisor helped to motivate me. Especially helpful were the suggestions, some unorthodox, from the book *Writing Your Dissertation in Fifteen Minutes a Day* by Joan Bolker.

The analysis stage of this project consisted primarily of library research, as I collected any and all information I could find related to the subject of *maille*. I studied and analyzed various how-to books to ascertain the key elements of successful and unsuccessful how-to books. I also attended two semesters of metalsmithing classes at the University of Akron to better understand how metals work and to improve the process of writing my guidebook.

I began the definition stage by setting “Priorities” for what I wanted to include in my guide book. Though the outline of the actual guide book has changed from the original outline, sometimes out of necessity, the original is still very apparent in the finished product. Using “Recipes and Formulae,” I explored the research already done on *maille*, to determine the terminology related to the subject and to see how it had evolved over the years. Setting “Mission Objective(s)” helped me to focus my project on the writing of a guide book for *maille*. I “Boiled Down” the information gathered in analysis to determine what information was important and appropriate enough to include and what should be saved for a later project.
The definition stage flowed into ideation, the generation of multiple different ideas. With “Lateral Thinking,” I looked at many possibilities for the particular avenue I would take with my research into maille. Beginning with a desire for purely historical research, I shifted my focus to the modern day uses and users of maille. I considered learning how to blacksmith and then studying the traditional, historical construction technique of riveted maille. I eventually selected the idea of writing a guide book for how to make butted maille. As a self-taught maille-maker, I was frustrated by the lack of instructional materials available on the subject and decided to fill the gap. Rather than produce a fully-formatted, ready-to-print book, I decided to prepare a manuscript suitable for sending to a publisher for review. This decision allowed me to devote my time to the substance of the book and to leave the aesthetic design and formatting to a professional with the proper tools and training.

I implemented my guide book project primarily through writing, one of the “Eight Popular Action Methods” listed by Koberg and Bagnall. Graphics, another popular action method, were used to more clearly convey the message of the text. I created samples and photographed many of my illustrations with the help and instruction of my sister. With the time frame with which I was dealing, there was no way that I could construct examples of everything I wanted to illustrate. To solve this problem, I sought help from other maille-makers by posting a request for examples on several internet forums related to maille or to armour, by contacting another maille-maker whose work I found for sale in a local store, and by seeking examples from members of a local Society.
for Creative Anachronism group. I also recruited a friend to draw some illustrations for
the guide book.

I continually evaluated my work throughout the project and also at the end. Using the “Plan for Improvement” technique, I reviewed my goals and achievements and made plans for improvement. Though I originally wanted to cover much more in my book, I eventually, throughout the course of writing, narrowed my goal down to the writing of an easy-to-use guide book for constructing butted *maille*.

The design process as presented in Don Koberg and Jim Bagnall’s *The Universal Traveler* was an excellent tool for designing a guide book. The flexibility and variety of methods provided make this book an invaluable resource for helping to achieve success in any creative undertaking. I plan to use it again.
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APPENDIX

CHAIN MAILLE GUIDE MANUSCRIPT
CHAIN MAIL:
A BEGINNER’S GUIDE BOOK FOR MAKING MAILLE

by
Gwendolyn Sweezey Lindsey
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CHAPTER I
INTRODUCTION

Why maille and not chain mail?

Maille armour, also known as chain mail, is an intricate fabric of interlinked metal rings, which are passed through each other in a specific pattern to create a strong, flexible material. The Old French word maille was derived from the Latin term macula, meaning “a spot, a mesh of a net.”¹ The spelling “maille” was chosen over “mail” for this book, in part to differentiate the maille armour from postal mail. The older spelling also indicates an art from times and places long ago. It helps to recall the great history of the inter-twined metal links known as maille. The term “chain mail” is actually a redundancy. If translated into English, it would read as “chain chain.” Because maille is more commonly known as chain mail, however, this was chosen for the title of this book in order to make it easier to find in a search for materials on the subject.

Armour is a “covering worn to protect the body against weapons.”² The traditional British spelling, “armour” was chosen because much of the early maille armour is European in origin. Despite its widespread uses, maille is often

² Ibid., 76.
seen as a “poor cousin” to the later plate *armour*. Plate *armour* is a protective covering comprised of rigid panels of iron. This is what most people visualize when they hear the word *armour*. In most histories of *armour*, *maille* is briefly mentioned and then quickly passed over to concentrate on the more impressive and popular plate *armour*.

*Maille*’s flexible nature made it possible for a shirt of it to fit any number of warriors. It was of such value that it was found bequeathed in wills, passed from generation to generation.³ Later, *maille* shirts were probably taken apart and pieces of them used to bridge the gaps between plates during the transitional period into full plate *armour*. Due to the large exposed surface area inherent in the structure of *maille*, it was highly susceptible to rust. For all of these reasons, it is very rare to find examples of *maille* that have survived to this day. This may, in part, account for the relative lack of attention to *maille* when compared to plate *armour*.

**Creating Your Own Maille**

For an individual interested in making his or her own *maille* at home, it can be difficult to find instructional materials. When I started making *maille* in 1997, the only available printed instructions were to be found in an out-of-print book, *The Best of the Hammer*.⁴ Most of my original information was found on the Internet - not always the most reliable source, difficult to wade through, and

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constantly changing. Since there are no regulations governing the posting of information on the Internet, the viewer must determine the reliability and validity of each individual page. Erroneous information is all too common, and it is rare to find a long-lived web site. All too often, web sites come and go, leaving dead links.

This book will begin with a survey of the uses of maille throughout history and its many uses in the current times. We will then progress to construction techniques for butted maille, including the most common patterns, and a sampling of some of the various items that may be made from maille. Though historically, maille was constructed of either riveted links or a combination of riveted and solid links, butted maille is the easiest style for beginners. A list of resources for the maille maker and a bibliography are included to provide additional information for those who wish to pursue maille-making further.
CHAPTER II
BRIEF HISTORY

Though there are differing viewpoints on who first invented maille, there is no question of its widespread use. Maille armour has been used by many cultures throughout the ages and has been used for many different purposes.

Ancient Romans wore maille as they marched into battle, conquering much of Europe (see figure 2.1). Ancient Roman military statues generally show a soldier wearing a short-sleeved, thigh-length maille tunic. The maille is generally depicted as either an all-over series of dots or rows of semi-circular curves. The rows are shown running vertically along the body, which would create a stiff shirt. It would be quicker to construct than one with the rows running horizontally. Due to the fact that the links are held in their most open position when the stretch of the maille runs in a vertical direction, the maille covers a greater surface area when in an open position. One excellent source for images of ancient Roman armour is Trajan's Column, a pictorial record of the

---

Figure 2.1. Gallic officer late first century B.C. Illustration by Eric Kuehn.
Dacian War. A small number of fragments of ancient Roman *maille* are still in existence. Made of either bronze or iron rings, the examples are either of all riveted rings or of alternating rows of riveted rings and solid rings.

Viking warriors proudly wore their suits of *maille* into combat. *Maille* is mentioned in the Norse sagas, the traditional tales and legends of medieval Scandinavia. In these sagas the *maille* tunic is usually called a *byrnie* or *brynja*, two of its numerous names. *Saxo Grammaticus: The History of the Danes* contains numerous references to *maille*. The warrior-king Frothi was reportedly given a “coat of impenetrable steel” under the weight of which, he was smothered to death. Høther is said to have fought the gods in a “sword-proof tunic.”

*Maille* was used by European fighters prior to the eleventh century and continued in use for several more centuries (see figure 2.2). Entire suits of *maille* were worn by the warriors and knights who could afford it. *Maille* armour’s flexibility made it a popular choice. Designed to stop the slashing and thrusting

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6 Ibid., 72.
Figure 2.2. Detail from a miniature from the Westminster Psalter c. 1250.

Illustration by Eric Kuehn.
attacks from an enemy’s weapon, maille’s main drawback on the battlefield was its inability to protect the wearer from crushing blows delivered by a blunt weapon such as a mace or flail. Technology progressed, creating weapons such as the English longbow that could pierce a suit of maille, and armour had to adapt. Solid plates replaced the large panels of maille around the beginning of the fourteenth century.\(^7\)

Long after it fell out of favor in western Europe, maille continued to be used in Japan and Turkey. In Japan, warriors incorporated patterns of maille, unique to the Far East, into their armour. Beginning in the Nambokucho period, 1336-1392, Japanese armourers constructed armour out of small rigid plates, either square or hexagonal, joined together by the Japanese patterns of maille.\(^8\) This created a flexible, semi-rigid armour that was used primarily to cover the arms or legs (see figure 2.4). This maille was backed by leather or fabric for support and to protect the wearer from the links.

In the nineteenth century, scraps of maille were reportedly still in use by brewers for scrubbing brew kettles and were, quite probably, used long after that.\(^9\) In the late-nineteenth and early-twentieth centuries, maille reappeared, this time in women’s fashions. Tiny, delicate maille purses were carried by


Figure 2.3. Japanese *tsutsu-gote*, eighteenth century. Illustration by Eric Kuehn.
ladies (see figure 2.4). The minute links were often beautifully painted and as
delicate as a suit of *maille armour* was strong.\(^{10}\) Whiting and Davis, one of the
foremost makers of ladies' purses, originally made its mesh by hand. By 1912,
however, Whiting and Davis produced its mesh by machine.\(^{11}\) At a recent
antique show and sale, I found a total of seven varied examples of these small
mesh purses ranging in price from $98 to $325. During World War I, some
British soldiers were outfitted with face veils made of *maille* that hung from the
brim of a helmet. This “Cruise” veil severely limited the wearer’s vision, though it
was able to protect the wearer from flying shrapnel.\(^{12}\)

During the twentieth century and into the twenty-first, butchers used
*maille* for protective gloves and aprons. The flexibility and strength inherent in
stainless steel *maille*, or mesh as it is now called, make it an excellent choice for
handling sharp objects such as knives. Remarkably, the primary manufacturer of
these butchers’ supplies is Whiting and Davis, the same company that once
produced ladies’ mesh purses. A promotional pamphlet from Whiting and Davis
suggests that the current generation of *maille* products may be useful for

\(^{10}\) Lynell K. Schwartz, *Vintage Purses at their Best* (Atglen, PA.: Schiffer Publishing Ltd., 1995),
53-60, 70-90.

\(^{11}\) Whiting and Davis, "Metal Mesh Fabric." (Promotional Pamphlet, 2002), inside back cover.

\(^{12}\) Robert Woosnam-Savage and Anthony Hall, *Brassey’s Book of Body Armour* (Washington
DC: Brassey’s, 2000), 120.
Figure 2.4. Ladies *maille* purse, early-twentieth century. Collection of the author.
numerous applications including veterinary services, law enforcement, sheet metal work, woodworking, and garment manufacturing.13

In the 1970s, marine biologist Jeremiah Sullivan pioneered the use of full suits of strong, flexible maille to protect shark divers from the sharp teeth of their underwater companions. He wanted to safely interact with sharks in their natural environment without the use of large cages or electro-reception devices which might harm or affect the normal behavior of sharks. Maille was an ideal choice for protecting the human body from the sharp teeth of sharks.14

Members of medieval reenactment groups make maille and perform combat activities in maille armour as they attempt to recreate a time long past. Founded in 1966, the Society for Creative Anachronism (SCA) is the largest such group active in the United States. With over 24,000 official members and an estimated three to four times that number of “active participants,” the SCA involves people in over a dozen countries.15

Maille is used in the fashion arena, as well. It appears in high fashion, paraded down the runways, and splashed across the pages of fashion magazines including the cover of Sports Illustrated’s famous swimsuit issue.16

In 1998, Givenchy Haute Couture designed a coif-style neck piece based on a

13 Perfect Fit Glove Co., LLC, “The Ultimate Glove Source” (Promotional Catalog, 2002), 29.
14 Jeremiah Sullivan, San Diego, to Gwendolyn R. Lindsey, Edwardsville, IL, 29 August 2002, personal e-mail.
Japanese pattern of maille. Over the years, numerous other designers have also incorporated elements of maille in their fashion designs. People wear maille fantasy fashion items at Medieval reenactment events and Renaissance festivals. Fantasy items such as maille bra tops and smaller jewelry items such as necklaces and handflowers, one or more rings connected across the back of the hand to a bracelet, are also popular. Even the well-known jewelry company Tiffany & Co. includes selections of exquisite precious metal mesh jewelry in its catalogs. The Summer 1999 catalog featured an 18k gold and diamond collar necklace, while the Fall 2003 catalog included diamond-shaped mesh earrings available in sterling silver or 18k gold.

The current trend of maille making and wearing appears to be a widespread phenomenon throughout the United States (and beyond its borders). Members of groups such as Regia Anglorum, a British organization that focuses on sixth- to eleventh-century Viking and Anglo-Saxon reenactments, and Die Landen van Herwaerts Over, a Dutch society that focuses on the Middle Ages (500 to 1500 A.D.), use maille armour. Shirts of maille can sell for $300 to $700 or more. Fashion items can range from simple headpieces to full dresses. Functional items such as furniture and sculptural works of art break the traditional boundaries of maille usage. Even teddy bears, each dressed in its

\[17\] Vogue, April 1998, 270.
\[18\] Museum Replicas Limited, Catalog #76 (2003), 23.
own little *maille* hauberk and coif, may be purchased in specialty shops.
CHAPTER III

BUTTED MAILLE

Tools and Supplies

This book focuses on the technique of butted maille. Though it is not historically accurate for most European armour, it was traditionally used by the Turks and the Japanese. Most modern maille makers use the butted technique. When compared to riveted maille, it is easier to make, is less time consuming, requires less equipment, and is more portable. Thus, it fits modern needs.

To start creating maille, you must gather together needed supplies and tools. This book will provide several alternatives for needed tools, but each individual should choose the ones that will work best for himself or herself. You will need to experiment and to try new methods. Find ways that work best for you. Most of the needed supplies can be easily found at a hardware store or farm supply store.

Wire

For armour, 14 gauge galvanized steel electric-fence wire is a good choice (see figure 3.1). It can be purchased in 1/4 mile spools at farm supply stores and some hardware stores. Aluminum wire, a light-weight but more
Figure 3.1. Spool of galvanized steel electric fence wire.
expensive alternative, is a popular choice for fashion pieces. It may even be
anodized into a variety of different colors. Choose 12 to 14 gauge wire if you are
using aluminum. Stainless steel, also more expensive than galvanized steel, will
not rust and retains a bright, shiny appearance. It is also heavier than other
steel. Brass or copper wire can be used for decorative effects. Both are softer
than the steel, so they are best used only on the borders of finished pieces, as a
decoration within a section of stronger metal, or for items that will be under little
stress.

Gloves

Gloves are very important for protecting your hands from the wire,
especially if you decide to use an electric drill to wind your coils (see figure 3.2).
Gloves that have rubber gripper dots on the palms to help keep your hands from
slipping are a good idea.

Safety glasses

Safety glasses are essential for protecting your eyes, especially if you
use an electric drill to wind cut pieces of steel wire into coil (see figure 3.2).

Steel rod

Select a rust-resistant stainless or galvanized steel rod. This will
become your mandrel for winding the wire into coils (see figure 3.3). The rod you
select will determine the inner diameter (ID) of your rings. For 14 gauge
wire, a 3/8” diameter rod is a good size. The general rule is the thinner the wire,
Figure 3.2. Safety glasses and gloves.
Figure 3.3. Mandrel.
the smaller the ID must be to maintain the strength of the armour. Your steel rod should be around 18" long.

To prepare the mandrel for the electric drill, use a file or a bench grinder to file a couple of flat planes an inch or two in length at one end of the mandrel. This will help to keep the mandrel from spinning in the chuck (the part of the drill that tightens to hold the drill bit or your mandrel). Next, fit the filed end of the mandrel into the drill chuck and mark a spot about 1/4" from the end of the chuck. Remove the mandrel from the chuck and secure it in a vise. Using your metal drill bit, drill a hole at your mark straight through the rod.

**Drill bit**

When drilling through metal, be sure to get a drill bit designed specifically for metal, not wood. Make sure the gauge of your bit is a little bit larger than the gauge of your wire. For example, for 14 gauge wire, choose a 12 gauge bit. When drilling through metal, it is advisable to use a small amount of machine oil such as 3-in-1 oil or WD40, to lubricate the bit.

**Mandrel box**

A mandrel box can be used to hold the mandrel during coiling. While this is an extra piece of equipment, it can help to stabilize the mandrel, creating more regular coils. The mandrel box can be used with an electric drill or turned by hand. To create a simple mandrel box, you will need a 12 to 18" piece of 2x4" wood and two eye pins (see figure 3.4). Make sure that the inner diameter of the eye pins is slightly larger than the size of your mandrel. Screw the eye
Figure 3.4. Mandrel box. Illustration by Eric Kuehn.
pins into opposite ends of one side of the board, making sure that the distance between eye pins is less than the length of the mandrel. The eye-pin holes should line up when the mandrel is inserted through both holes. If you plan to coil by hand, be sure to choose an extra long mandrel and make a handle either by creating a series of bends in the mandrel or by attaching an extra piece to the end. A mandrel box can also be used with an electric drill.

**Electric drill**

An electric drill makes coiling the wire go very quickly (see figure 3.5). Your drill does not have to be the most expensive one available. Choose one within your budget. Make sure the drill chuck will open wide enough to take a 3/8" bit (or whatever size inner diameter (ID) you choose). For safety, choose a variable speed drill which will go faster or slower depending on how hard you press the trigger button. Also be sure that the drill can go in both forward and reverse directions. A drill with a keyless chuck is a good choice because, as the name implies, it has no chuck key to lose. Drills are powered in two ways: electric (plugs into an electrical outlet) and cordless (uses rechargeable batteries). Table 3.6 compares the advantages and disadvantages of each type.

**Cutting Tools**

The selection of your cutting tool is very much subject to personal preference. When choosing a cutting tool, look for one that makes a clean cut that leaves the cut edges as straight as possible. Some hardware stores will let you try the tools before you buy, so be sure to bring a coil of wire with you when
Figure 3.5. Electric drill and cordless drill.
<table>
<thead>
<tr>
<th>Electric</th>
<th>Cordless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires electrical outlet</td>
<td>Can be used anywhere</td>
</tr>
<tr>
<td>and possibly extension cord</td>
<td>(portable)</td>
</tr>
<tr>
<td>(not portable)</td>
<td></td>
</tr>
<tr>
<td>Lighter weight</td>
<td>Heavier due to weight of battery pack</td>
</tr>
<tr>
<td>Less expensive</td>
<td>More expensive</td>
</tr>
<tr>
<td>Can work indefinitely</td>
<td>Batteries can run out and take time to charge</td>
</tr>
<tr>
<td>More powerful</td>
<td>Generally not as powerful, unless quite expensive</td>
</tr>
</tbody>
</table>

Figure 3.6. Comparison of electric and cordless drills.
you shop. You may choose from a variety of cutting tools including: wire cutters, hacksaws, or jeweler’s saws.

Wire cutters

Cutting pliers are nice because they are very portable and require minimal investment; however, they work by pinching the wire and always leave an angled cut. Both 6” and 8” diagonal pliers can cut 14-gauge steel wire, but the 8” are much easier on the hands (see figure 3.7). Try different kinds of cutters and see what works for you. A special tool, called Bernard pliers, combines a cutter and pliers, enabling a maille maker to cut and manipulate links without switching tools (see figure 3.8). Some other cutting pliers to try: end nippers, side cutters, airplane shears.

Hacksaw

A hacksaw with a metal-cutting blade will create a straight, clean cut, though some material will be lost to the kerf (thickness) of the blade (see figure 3.9). Due to the amount of metal lost while cutting with a hacksaw blade, the links will not form perfect circles when closed. The finished rings will be slightly oval.

Jeweler’s Saw

This is my personal favorite for cutting links cleanly. The jeweler’s saw has a deep U-shaped frame with a handle at one end (see figure 3.10). The thin blade removes very little metal from each link, and it cuts quickly and cleanly. Though you may find this at a traditional hardware store, you might have to go
Figure 3.7. Two pairs of diagonal pliers.
Figure 3.8. Bernard pliers.
Figure 3.9. Hack saw.
Figure 3.10. Jeweler’s saw.
through a jeweler’s supply shop or catalog. Buy lots of blades. You will break them. Choose a size 0 or larger blade for cutting the 14-gauge wire. Ideally, three teeth of the blade should be in contact with the metal at any one time.

**Wooden dowel rod**

This rod should be the same size as your stainless steel rod. You will only use it if you are cutting your links with a jeweler’s saw or a hacksaw.

**Wax**

A small chunk of beeswax or an old candle can be used to lubricate the blade of your hacksaw or jeweler’s saw. Jeweler’s supply shops also sell a product called Bur Life for the same purpose. Lightly run the saw blade once or twice across the surface of the wax. It will make the cutting smoother and quicker and make your blades last longer.

**Vise**

A bench vise mounted or clamped onto a stable surface can be used to hold the mandrel box for coiling or to hold the coils for cutting with a hacksaw.

**Bench Pin**

A jeweler’s bench pin is a wedge-shaped piece of wood that is used by jewelers to support the item on which they are working. Notches and grooves may be present in a bench pin as a result of repetitive actions or deliberate modifications, such as a V-shaped notch at the front edge cut by many jewelers (see figure 3.10). Bench pins are traditionally attached into a slot on a jewelers
Figure 3.11. Portable jeweler’s bench pin.
bench, though models are available that clamp onto any work surface with a vise-like fastening system.

**File**

A small metal file can be useful for cleaning up burrs in the cut edges of the metal. To keep the file sharp, be sure to use the file with a pushing motion, not a back-and-forth or pulling motion.

**Two pairs of pliers**

Pliers are used to open and close links. Some prefer two pair of needle nose pliers. Others prefer one pair of needle nose pliers and one pair with a thicker jaw (see figure 3.12). The size of the pliers should be large enough to provide a secure grip but small enough to not get in the way. It is possible to close the links with only one pair of pliers, but it tends to distort the shape of the link.

**Duct tape or tool dip**

If your pliers have teeth in the jaws, they can be padded with duct tape, gaffers tape, or tool dip to protect the metal from the pliers. Your finished piece will be much smoother and nicer looking if you protect the wire from your tools.

**Sponge**

A piece of basic kitchen sponge can be used to pad your hand when cutting with your diagonal pliers. It can also be used to protect the floor or other surface from the end of your mandrel if you use an electric drill.
Figure 3.12. Two pair of needle nosed pliers. The teeth of the pliers are covered with duct tape to protect the metal from their rough edges.
Band aids and sports tape

Accidents can happen. Be prepared for them and for blisters. As you continue to work through the blisters, calluses will develop to protect your hands. Consider them badges of honor for an armurer.
CHAPTER IV

BUTTED MAILLE: TECHNIQUES

There are many variations in techniques for making maille. Try several of the alternatives, then choose what will work best for you. Be willing to experiment and to try new techniques. Find what way or ways work best for you. There are three basic steps to creating butted maille: coil, cut, and link.

Coil

The first step in making maille is to coil the wire into springs by winding it around a mandrel. See a finished coil and links in figure 4.1. You can do this using an electric drill or by hand with a mandrel box. The electric drill is quicker, but accidents are more likely. Get a friend to help you with this part, if possible. It will make the winding go more smoothly and evenly.

Using a mandrel box to coil

Secure the mandrel box to a stable surface. Screw it down to a work bench, clamp it down, or secure it in a vise. Take one end of your wire, slide it into the hole in the rod, extending about an inch or two past the hole, and bend the wire at a right angle, parallel to the mandrel, or wrap it gently by hand around the lower end of the mandrel to secure it. You will control which direction the coils wind by either turning the handle clockwise or counterclockwise or by
Figure 4.1. Coil of wire and cut links.
the direction you set your electric drill. I find it easier to wind across the top of the mandrel. Since I am right handed, I place the wire on the left and wind my wire clockwise. You can reverse this if you are left handed. As you wind, keep the coils tight and even. Stop coiling when you have filled the mandrel. The coils have a lot of kinetic energy built up in them from the winding. Be careful as you prepare to end each coil, as it can unwind with great force when released. If you have a friend to help, have him or her turn the handle or operate the drill while you guide the wire onto the mandrel, or vice versa (see figure 3.4 in previous chapter.).

Using an electric drill to coil

First, slide the filed end of your mandrel into the drill check (see tools and supplies: stainless steel rod for preparation instructions) and tighten the chuck. Take one end of your wire, slide it into the hole in the mandrel rod, extending about an inch or two past the hole, and bend the wire at a right angle, parallel to the mandrel or wrap it gently by hand around the lower end of the mandrel to secure it. You will control which direction the coils turn by selecting forward or reverse on your drill. I find it easier to wind across the top of the mandrel. Therefore, as I am right handed, I place the wire on my left, hold the drill in my right hand, and wind my wire clockwise, in the forward direction. Reverse this if you are left handed. You may choose to do your coiling from a sitting or a standing position. The standing technique is easiest, and safest, if you have a helper.
Safety

Make sure you wear your safety glasses and gloves. If you have long hair, secure it out of the way. If you are going to coil while sitting, wear a pair of jeans or other heavy pants to protect your legs.

Sitting

Sit cross legged on the floor. In your primary hand, hold the drill and brace your elbow against your thigh. Brace the other end against the floor, padding the end (and protecting the floor) with a sponge, if desired (see figure 4.2). Use your off-hand to guide the wire off of the spool and onto the mandrel as you begin to slowly power the drill. Be careful. It is easy to pinch your fingers. Wind slowly, keeping the coil as tight and even as possible. Don’t be discouraged when your first - or even your fiftieth - coil comes out with some spots where the wire got out of control. Simply cut away these parts and use the good sections. The coils do not have to be long. Coils 6” - 8” in finished length are common. The coils have a lot of kinetic energy built up in them from the winding. Be careful as you prepare to end each coil, as it can unwind with great force when released. Remember, it is very difficult to make maille with broken fingers.

Standing

To coil wire while standing, hold the drill in your primary hand and brace the other end against a stationary object (work bench, table, door, etc.), padding the end of the mandrel with a sponge, if necessary (see figure 4.3). If possible,
Figure 4.2. Winding with electric drill while sitting.
Figure 4.3. Winding with electric drill while standing.
find an L-shaped angle in which to secure the end of the mandrel. Either way, be sure to pick something that will not get you in trouble if you accidentally gouge or scratch it. Use your off-hand to guide the wire off of the spool and onto the mandrel as you begin to slowly power the drill. Be careful. It is easy to pinch your fingers. Wind slowly, keeping the coil tight and even. Don’t be discouraged when your first - or even your fifty-first coil comes out with some spots where the wire got out of control. Simply cut away these parts and use the good sections. The coils do not have to be long. Coils 6” - 8” in finished length are common. If you have a friend to help, have him or her power the drill slowly while you guide the wire onto the mandrel, or vice versa.

**Cut**

After removing coiled wire from the mandrel, you are ready to use your jeweler’s saw, hacksaw, or cutting pliers to cut the coils into individual rings. Cuts should be made perpendicular to the edge of the wire, creating a right angle cut. The cutting tool should be placed as flush against the last cut as possible to create as complete a ring as possible. Some armourers like to gently stretch the coils before cutting them to pre-open the links. Be careful not to over-stretch and distort the links. Keep a bucket or bowl handy to catch the rings as you cut them. You will need thousands of rings, so get comfy. This is a great place to put your friends to work. Historically, master armourers had apprentices who would perform this sort of preparation work for them, so you are in good company if you have helpers. Your friends will probably be fascinated by the cool stuff you are
making and be eager to try it too. When I first started, my friends cut hundreds of links for me. It became a contest to see whose hands were strongest, based on how many links they could cut in one sitting.

**Pliers**

Before cutting with pliers, trim off the ending tails off of your coils so you have neat ends. Line up the edge of your pliers with the last loop in the coil. Squeeze, cutting through only one link at a time (see figure 4.4). Experiment with butting each side of your cutters up against the end of the coil to see which one gives the cleaner cut. If you choose not to stretch your coils before cutting, you will only be able to cut with the very tips of the pliers. You may wish to file the tips off of your cutters to allow you to take advantage of the greater leverage nearer the fulcrum of the pliers. Be cautious not to heat the pliers when filing, as this may ruin their temper (strength).

An easier method than cutting all the way through each link is to score and snap each link using cutting pliers. First, score the metal to break the surface tension by cutting part way into the wire with your cutting pliers. Then snap the link off of the coil by grasping it with a pair of needle nosed pliers and bending the wire at the score until it snaps. This technique keeps the cut ends of each link more squared, unlike the angle cut left my most cutting pliers.

**Hacksaw**

When cutting with a hacksaw, slide the coil onto a short length of wooden dowel rod. This will keep the links from collapsing under the pressure of
Figure 4.4. Cutting links with diagonal pliers.
the vise. Hold the supported coil in a vise with a small piece of wood, leather, or other material on each side to protect it from scratches. Lubricate the saw blade by rubbing the teeth of the blade with wax. Supporting the coil from underneath with your off hand, saw at an approximately 45 degree angle through the first link. The first time sawing, you will also saw into the dowel. Before you finish the first link, you will begin sawing into the second link. This is normal. Slide the dowel up through the coil as you work. Place a bucket or tray under the coil to catch the links as they drop.

Jeweler’s saw

Before you can begin to cut links with a jeweler’s saw, you have to prepare the saw. To properly mount the blade in the saw, first loosen the wing nuts that will secure the blade. Carefully run your finger along the teeth of the blade. In one direction your finger will catch on the teeth. From the other, it will slide more smoothly. The end from which your finger will slide smoothly is the top of the blade. Place the top end of the blade in the blade holder opposite the handle, teeth pointing out from the frame, and tighten the finger screw. If this is the first time you are using your saw, you will need to adjust the length of the frame opening. Loosen the frame screw and move it so that the loose end of the saw blade just barely overlaps the blade holder nearest the handle. Tighten the frame screw. Brace the top end of the saw frame against a table or desk. With your hip, press the handle end toward the top, compressing the frame a small amount. Position the bottom end of the blade in the holder and tighten it. The
blade should be taught in the frame, twanging like a guitar string when lightly plucked. Though all this may seem complicated, it is really quite simple in practice. If your saw came with directions, you can reference them for further instructions.

When cutting with a jeweler’s saw, you may wish to slide the coil onto a short length of wooden dowel rod for support. Be certain to lubricate the blade with wax before cutting. It is wise to wear safety glasses to protect your eyes from broken saw blades. When cutting links with a jeweler’s saw, it helps to support the coils on a jeweler’s bench pin. To cut with the saw, hold the handle, perpendicular to the ground, with the frame rising above your hand. For your first stroke, slide the blade upward, creating a small groove. Then, begin to saw up and down, keeping the handle nearly perpendicular to the ground (see figure 4.5). Slide the saw gently up and down, lightly gripping the handle. Take long, even strokes and DO NOT force the blade, as this may cause the blade to snap. If it sticks, stop, relubricate the blade, wiggle it gently, and if it is still stuck, loosen the saw blade in the frame and slide it out of the coil. It takes me approximately 30 strokes up and down to saw through each link. The first time sawing, you will also saw into the dowel.

Slide the coil down the dowel as you work. If your coil is tightly wound, the links may begin to build up at the base of your saw blade. Gently shake the saw and most will come off of the blade. If a link is really stuck, simply unfasten the saw blade and slide off any remaining rings. Place a bucket or tray under
Figure 4.5. Cutting links with a jeweler’s saw.
the coil to catch the links as they drop. Be sure to unfasten one end of your saw blade when you are done, or completely remove the blade from the frame. It will be less likely to break than if stored under tension.

**Link**

Now that you have a big pile of links, it is finally time to combine them into *maille*. Select whichever pattern you desire from those listed in chapters 5 and 6. The basic techniques for combining them are essentially the same, no matter which pattern you choose.

You will need your links and two pairs of pliers. In your dominant hand (right for most people), hold one pair of pliers with the jaws facing upwards. In your other hand, hold the second pair of pliers. The links tend to warp less if you hold this pair with the jaws pointing downward (see figure 4.6). It is important that you use two pairs of pliers. If you try to close the links with only one, the links will become distorted.

Use your pliers to pick up the links. You will save much time if you do not have to put down and pick up the pliers each time you need to pick up a new link. As you open and close your links, make sure to twist them perpendicular to the plane of the ring, being careful not to warp the roundness of the ring. This will put less stress on the metal and keep the rings from distorting. Some *armourers* like to make a pile of closed links and a pile of open links before they begin combining the links into *maille*. 
Figure 4.6. Holding two pairs of diagonal pliers.
Now that you have begun to pick up your links, start to interlink them into your chosen pattern. Practice with a simple pattern such as the simple chain until you are comfortable using the pliers. Close each link after you put it in its place. It is easier to open or close each link as you go. This way, you only deal with each link once. Repeat a few thousand times.

**Specialty Techniques for Japanese Maille**

Creating double links

I have yet to find an efficient way to cut a double ring without a special tool. I challenge you to experiment with different techniques to find one that works. You can substitute two rings placed side by side for a coiled double link or purchase small, pre-made split rings (see resources).

Creating oval links

You may find that you want to make oval links for the Japanese style maille to allow the maille to sit more closely to the body. You will need a steel rod with an oval profile instead of a round profile. Prepare it the same way as you did the regular mandrel. When you are ready to cut the links, be sure to make your cut on one of the longer sides of the oval and not at the tighter part of the curve. This will help maintain the strength of the links.
CHAPTER V
OVERVIEW OF BASIC PATTERNS

To create maille, rings of metal are passed through each other in a specific pattern to create a strong, flexible material. The following patterns are particularly useful. These patterns fall into two categories, which we will call chain and armour.

Chains

Simple chain

The simple chain is often overlooked, but beauty can be found in simplicity. A pretty variation can be achieved if some or all of the individual links are doubled or even tripled (see figure 5.1).

Spiral or rope chain

The spiral is a chain pattern well suited for decorative use. It is easy to make, but it can also be considered one of the most elegant designs (see figure 5.1). The spiral can be used to make beautiful necklaces, bracelets, or straps for non-armour items.
Figure 5.1. Chain patterns (top to bottom): Simple chain pattern, Spiral chain pattern, Box chain pattern, Reversed box chain pattern.
**Box chain**

The box is another decorative chain pattern with a square cross section. (see figure 5.1).

**Reversed box chain**

The reverse box is a variation on the box chain (see figure 5.1).

**Netted chains**

The simple netted chain style is a great way to cover large areas with little effort (see figure 5.2).

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**ARMOUR PATTERNS**

**European 4-in-1**

The European 4-in-1 is the traditional *maille* pattern. In it each ring passes through four others (see figure 5.3).

**European 6 in 1**

The European 6-in-1 is a denser, heavier knit/mesh in which each ring passes through six others (see figure 5.4). Traditionally, it does not appear to have been used for armour. European 6-in-1 is handy for reinforcing the neckline of a shirt of *maille* or for other high-stress applications. It can also be used to create entire pieces. When working with the European 6-in-1 pattern, be sure to take into account added weight and stiffness inherent with this pattern.
Figure 5.2. Netted chains. Illustration by Eric Kuehn.
Figure 5.3. European 4-in-1 pattern.
Figure 5.4. European 6-in-1 pattern.
So gusari (Japanese 4)

In the Japanese 4 pattern, known as so gusari, the rings are combined at right angles to each other. In the plane parallel to the body, each ring passes through four others. Perpendicular to the body, each ring passes through two others (see figure 5.5). Traditionally, these rings are given an oval profile to permit them to lay closer to the body. So gusari may also be made with double rings in the perpendicular positions, strengthening the links. In this case it is called seiro gusari. With either style, the end effect is of a network of squares. It was most commonly used to combine rigid, square plates into a flexible, protective armour.¹

Asa no ha gusari (Japanese 6)

The Japanese 6 pattern, known as asa no ha gusari, also combines the rings at right angles to each other. In the plane parallel to the body, however, each ring passes through six others. Perpendicular to the body, each ring passes through two others. As with so gusari, these rings may be given an oval profile to permit them to lay flatter. They may be made with either single or double rings in the perpendicular positions. The end effect is a network of hexagons (see figure 5.6). If you plan to use the asa no ha gusari (Japanese 6) pattern, you will need to carefully plan your garment pattern, planning it with

Figure 5.5. *So gusari* pattern (Japanese 4). Illustration by Eric Kuehn.
Figure 5.6. *Asa no ha gusari* pattern (Japanese 6). Illustration by Eric Kuehn.
triangular or hexagonal sections instead of using the rectangles generally used in
the European patterns.\textsuperscript{2}

\textsuperscript{2} Ibid.
CHAPTER VI

PATTERN INSTRUCTIONS

CHAIN PATTERNS

The following patterns are all chain patterns. Though not traditional
armour patterns, these are often made by the same people and from the same
materials. Since the simple chain can be used as the starting point for several of
the armour styles, that is where we will begin. When making decorative chains,
be sure to experiment with the size of your wire and with the inner diameter of
your links. Brass or other colored wire can create beautiful effects when mixed
with steel or by itself.

Simple chain

The simple chain is very easy. Take two closed links and join them with
an open link. Close the open link with your pliers. Pick up another closed ring
with another open ring. Slide the open ring through one of the closed rings at the
end of the chain (see figure 6.1). Repeat until you achieve the desired length.
Interest can be added to this style by doubling or even tripling some or all of the
individual links.
Figure 6.1. Starting a simple chain pattern.
**Spiral chain**

Fasten a twist tie, small ribbon, or other marker to a closed ring. This will be the starter ring. Slide a second open ring through the starter and close it. Take a third open ring and pass it through the first and second rings and close it. The fourth ring will go through the second and third rings (see figure 6.2). Continue this pattern, passing each new ring through the previous two, until you have reached the desired length. This pattern requires tension be kept on the chain to keep the spiral pattern visible. You will need to twist the chain for the spiral pattern to appear. To finish the chain in a loop, secure the ends to each other, leaving enough twist in the chain to keep the pattern visible. You will have to add one more ring to fill in the gap left and keep the pattern even.

**Box chain**

To begin the box chain, slide four closed rings onto an open ring and close the open ring. Bind two of the adjacent closed rings together with a twist tie or a bit of ribbon or other marker. Double the center ring by adding another link parallel to it. When held by the marking tie, you should have a double chain three links in length. Take the last pair, furthest from the marker, and fold the links back to the sides. This is the tricky part. Slide an open link through the center of the two rings, in the space left between the center pair of rings, close it, and add a second ring next to the previous one. Attach one more set of two links, continuing the chain. Fold back the last pair and slide a ring through
Figure 6.2. Starting a spiral chain pattern.
the center of the two rings. Add a second, making it a double ring (see figure 6.3). Each pair of rings that is folded backwards can be considered a turn-back. Repeat the pattern, continuing until you have reached the desired length. When you complete the circle and fasten the start to the finish, be careful to align the chain so that there are no twists in it. This pattern has a tendency to collapse back on itself, making it difficult to pause during its construction. If you want to set it down before it is finished, attach another twist tie or other marker to the last pair of links.

Reversed box chain

The reversed box chain is a variation of the box chain. See the previous instructions for the box chain. Begin constructing a box chain, working until you have a set of three turn-backs, to chose an arbitrary number. Make your final ring a single - not a double - ring. Secure the ends with marker ties. Make another set exactly the same as the first. Join the two sets together by reopening the single rings and re-closing them so that together they make a double pair. They will naturally align so that the box links all appear to converge or diverge from the center pair of links (see figure 6.4). Repeat this until you have achieved the desired length. Experiment with different numbers of turn-backs in each set, but remember that odd numbers are generally more visually pleasing than even numbers of rings.
Figure 6.3. Starting a box chain pattern.
Figure 6.4. Starting a reversed box chain pattern.
Netted chains

Use any of the chain patterns you like to make a netted fabric from chains, but more delicate chains tend to work better for this technique than bulky ones. Experiment with thinner gauges and smaller inner diameters than you might normally use. For example, try a 1/4” mandrel and 16- or 18-gauge wire. Netted chains work well when used on the bias. If chains are linked in a grid pattern, with each chain intersecting the others at right angles to each other, this can be considered to be on-grain, to use textile terminology. If the grid is turned 45 degrees, it is considered to be on the bias; the form will collapse into diamond shapes and have a great deal of stretch and collapsibility. It will mold to fit the body when used this way.

Armour Patterns

This section discusses four different armour patterns: European 4-in-1, European 6-in-1, so gusari (Japanese 4), and asa no ha gusari (Japanese 6). Refer to the previous section for instructions for the simple chain, the starting point for several of the armour styles. Feel free to experiment with the size of your wire and of your links’ inner diameter. Brass wire can create beautiful effects when mixed with steel or by itself. Try it on the edges of a shirt or create a decorative symbol on the front or back of a shirt.

European 4-in-1

Though there are several different methods for constructing European 4-in-1 pattern maille, all of them produce the same final result. Try them all and
see what works best for you. Switching from technique to technique may help to keep you from getting bored as you work. Creating small patches and then linking them into the larger piece can also keep you from being encumbered by a heavy, bulky piece while working.

Chain

Begin by making a modified simple chain eleven links long, starting and ending with a double link (i.e. two separate links side by side) and with every other link being a double link. Eleven is an arbitrary number chosen for ease of counting. Feel free to work with whatever length chain you are comfortable. Keep making chains in your given length until you are bored or you have ten sets of chains, to choose another arbitrary number. Lay two rows of chains side by side aligning the links so that the double links all face the same direction and all the single links run the opposite direction from the doubles. In the first row of single rings, slide an open ring through the four closest rings in the adjacent double rows. Repeat this with each set of single rings in the chain (see figure 6.5). Incorporate each chain into the growing piece of maille in this manner. Create smaller patches in this manner and then link them together using the same technique to create a large piece of maille.

Five-sets

Begin by making a large number of five-sets. To create a five-set, slide four closed rings onto an open ring and close the open ring. Now that you have a large number of five-sets, lay two of them in a row, so that the double rings all
Figure 6.5. European 4-in-1, starting from a chain.
run the same direction and the single rings run the opposite direction. In the first five-set, slide an open ring through the four closest rings in the adjacent double rows (see figure 6.6). Incorporate each five-set into the growing piece of maille in this manner. Create smaller patches in this manner and then link them together using the same technique to create a large piece of maille.

Rows

Begin this method by sliding a number of closed links onto a piece of wire (a coat hanger works well) or twine. This will become the top horizontal row. Next slide two closed rings onto an open ring. Working from right to left, link the first two rings on the right together with your open ring and close the open ring. Next, link the left most link from the previous pair to the next free link with an open ring. Repeat this until the row is complete (see figure 6.7). This technique may be used to add links to an existing piece of maille, as well as being used as a starting technique. Continue to build rows in this manner until the piece is the desired size.

Shaping the European 4-in-1

To achieve a better fitting garment, it is possible to shape the maille by increasing or decreasing the number of links from row to row. For example, a full-length sleeve can be tapered down gradually from the wider upper arm to the narrower wrist. This helps to eliminate unnecessary bulk and weight. All major increases or decreases are done gradually over the course of a large number of
Figure 6.6. European 4-in-1, starting from a five set.
Figure 6.7. European 4-in-1, starting from rows.
decreases as is done in knitting. In fact, the linking of maille is sometimes referred to as knitting.¹

Increase or decrease in width

The same technique is used to make a section of maille wider or narrower, creating a flared effect vertically. The only difference between an increase and a decrease is which end is considered up.

At the point where an increase is desired, add an extra ring (sometimes referred to as an idle ring) in the row. This will cause one ring to have 5 instead of 4 rings passing through it. In the next row, continue the European 4-in-1 pattern, linking the rings as normal. The increase has been made (see figure 6.8). Additional increases may be made in subsequent rows, gradually changing the shape of the maille. Be sure to stagger the position of the added links to keep a noticeable line from appearing in your work.

A decrease is done in the same manner. Simply place one fewer link in the row where the decrease is desired. In the next row, continue the European 4-in-1 pattern. Changes are usually made symmetrically. If these changes are done on the back of a shirt, for example, two V-shaped rows are formed, one angling down each shoulder blade. To create an increase for a camail or the shoulders of a coif, be careful to stagger the position of the idle rings to keep a line or ridge from appearing in your work.

Figure 6.8. Increase in width - adding an idle ring. Idle rings are marked with pins in the lower picture.
Decrease a row

Somewhat less common, a decrease in rows actually removes two horizontal rows at a time. Rather than a vertical change, the increase or decrease is seen horizontally. This technique was used historically in Europe to fit the maille to the body, but it is not commonly employed by many modern maille makers. A decrease may be created using one of two techniques. E. Martin Burgess refers to these as the “hole” and the “knot.” Burgess describes these advanced techniques in his article “Further Research into the Construction of Mail Garments.” It is worth reading for those interested in some of the more complex and historical techniques for shaping maille.

Triangle

A triangle is a simple form to construct. It only requires the ability to subtract. Start with an odd number of links in the top row. In the next row, eliminate one link from each side. Continue to remove one link from either side in each successive row. The final row will be a single ring, the point of the triangle (see figure 6.9). Triangles are useful in forming dagged edges and for use in shaping.

To create a dagged edge, simply form triangles side by side, one after another. To create an evenly-spaced dagged edge, count the number of links in the bottom row, and make sure that the number of links is evenly divisible by the

\[ \text{\textsuperscript{2}} \text{ Ibid.} \]

\[ \text{\textsuperscript{3}} \text{ Ibid.} \]
odd number of links you have chosen for the top of the triangle. If the numbers
do not work out according to your design, it is also possible to add some extra
idle rings, evenly distributed throughout the row, into last row before the dagging
begins to make the daggs even. The edges may be done with brass rings, one
or two links deep, for a decorative effect. Dagging may also be done with other
repeated shapes such as scallops or crenellations (see figure 6.10). A scallop
can be created in the same fashion as a triangle, ending the decreases before
the point is reached.

European 6-in-1

The European 6-in-1 is created in a similar manner to the European 4-
in-1, except that each link must pass through six others instead of only four. The
easiest way to link the European 6-in-1 pattern is to begin by making a seven-
sets. To create a seven-set, slide six closed rings onto an open ring and close
the open ring. Next, slide an open ring through four of the outside links on one
side. Add two more closed rings to the open one, and close the ring. At this
point, the pattern will appear to have a gap in it. Slide another open ring through
the four of the outside links on the side with which you are working. Add two
more closed rings to the open one, and close the ring (see figure 6.11). Now that
the dense European 6-in-1 pattern is established, continue adding to the pattern
until you have reached the desired size and shape. You can create smaller
patches in this manner and then link them together using the same
Figure 6.9. Triangle. Photograph by Gwendolyn Sweezey Lindsey. Illustration by Eric Kuehn.
Figure 6.10. Dagged edges. Triangles, crenellations, scallops. Illustration by Eric Kuehn.
technique to create a large piece of *maille*, or use the same row technique as used in creating the European 4-in-1 pattern to add onto the existing piece.

**so gusari (Japanese 4)**

The easiest way to begin the *so gusari* pattern is to form a long simple chain. Next make a large pile of open links. Working from left to right, take the first ten links in the chain, to choose an arbitrary number, and place them in a straight line. Fold the eleventh link down at a right angle and fold the twelfth link back parallel to the first straight row. Join the third link from the right in the top row to the corresponding link in the next row down. Continue linking the rings in the top row to the corresponding links in the second row (see figure 6.12). A pattern of squares should be emerging. When you reach the end of the row, fold down the next link in the chain and continue the pattern. Continue to build the pattern until you have reached the desired size.

**asa no ha gusari (Japanese 6)**

The *asa no ha gusari* (Japanese 6) pattern is similar in construction to the *so gusari* (Japanese 4) pattern. The easiest way to begin this pattern is to form a long simple chain. Next, make a large pile of open links. Working from left to right, take the first ten links in the chain, to choose an arbitrary number, and place them in a straight line. Fold the eleventh link down at a 60° angle and fold the twelfth link back parallel to the first straight row. Join the third link from the right in the bottom row to the last ring in the top row and to the third link from the left in the top row (see figure 6.13). Continue linking the rings in the top row.
Figure 6.11. Starting the European 6-in-1 pattern.
to the corresponding links in the second row. Each ring parallel to the body will have six rings linking through it. A pattern of hexagons should be emerging. When you reach the end of the row, fold down the next link in the chain and continue the pattern. Continue to build the pattern until you have reached the desired size.

**Inserting metal plates into the gusari (Japanese) patterns**

If you wish to insert metal plates into the Japanese patterns, begin by selecting either the *so gusari (Japanese 4)* pattern or the *asa no ha gusari* (Japanese 6) pattern. You will need one or more rigid metal plates to cover the area you wish to *armour*. You may choose to curve the rigid plates to better conform to the body underneath the *armour*. If you are working with *so gusari* (Japanese 4), it is easiest to work with square or rectangular pieces. The *asa no ha gusari* (Japanese 6) is best suited to hexagonal plates. The hexagonal plates can be slightly more complicated to incorporate into your design than the right angled square or rectangular plates but are certainly not impossible.

Arrange the plates in whatever pattern you choose. Keep in mind that your design will need to be based fundamentally on a rectangular grid if you choose *so gusari* (Japanese 4) or a hexagonal grid if you choose the *asa no ha gusari* (Japanese 6) pattern. It may help to create a pattern or template of your *armour* piece out of poster board or fabric first. This can help to determine the fit as well as the layout of the plates before you begin to create your *maille*. After
the plates are arranged in the desired pattern, you will begin to create a network of *maille* that will connect the plates.

Alternatively, simply leave an open space in the *maille* that is the desired size of the plate. To then determine the correct size for the metal plate, measure the space left by the opening, at the smallest point, and subtract the outer diameter of the rings that will be used to attach the plate. Place the plate in the opening. After the first plate is measured to fit into the *maille* grid, you can make multiple identical plates and incorporate them into the *maille* as you work.

To prepare the metal plates, mark a spot for each linking ring on the plate with a scribe or permanent marker. The marks should be in line with the grid of rings and, from the edge of the plate, half of the measurement of the inner diameter of the rings used to join the plate to the *maille*. For safety and comfort, carefully file all sharp edges off of the plates and round the corners. Use an open ring to link each hole in the plate to its corresponding ring in the *maille*. If desired, the rings parallel to the plane of the body may be formed as ovals instead of circles to allow the *maille* to lay flatter to the body (see figure 5.6 in previous chapter).
CHAPTER VII

MAILLE PRODUCTS

This section provides some ideas for items that can be made with maille. Feel free to adapt or design your own styles. The historic styles are those that were traditionally made from maille in the middle ages. Steel is by far the most common choice for the historic styles. The fantasy styles are modern day applications of maille. These are popular at Renaissance Fairs and for costumes. The fantasy items may be made of aluminum as well as steel.

Historic

Hauberker, Shirt, or Haubergeon

The hauberker is the basic maille shirt that most people think of when they hear “chain mail” (see figure 7.1). It traditionally has long sleeves which sometimes terminate in mitten gauntlets. The skirt (the part below the waist) is generally long and often split fore and aft for ease of movement, particularly useful when sitting astride a horse. The haubergeon is a smaller version of the hauberker. The sleeves are generally shorter, as is the length.

A maille shirt can be constructed in a variety of manners, depending on personal preferences. The two styles that will be covered here are the set-in sleeve and the raglan sleeve (see figure 7.2). For both styles, the body is
Figure 7.1. Maille shirt with dagged edges. Photograph courtesy of Bill Love.
basically the same. The principle difference between the two styles is the way that the sleeves are attached. Most frequently, the stretch of the maille wrapped around the body and around the arms. Only the ancient Romans appear to have constructed their shirts to orient the stretch of the maille vertically. All of the illustrations here will show the stretch of the maille running horizontally around the body. The sleeves may be short or long, depending on several factors including the amount of time you have available and are willing to devote to the project, aesthetic preference, other armour that will be worn (i.e. vambraces, a rigid forearm covering of thick leather or steel), or amount of weight that the wearer can reasonably bear for a sustained period of time.

The length of the skirt can vary from waist length to below the knees. Longer skirts may be supported by a thick leather belt worn around the waist and should be split fore and aft or on the sides to allow for movement. The length of the skirt may be determined by the same options that decided the length of the sleeves: amount of time to devote to the project, aesthetic preference, other armour that will be worn, or amount of weight that the wearer can reasonably bear for a sustained period of time.

The set-in sleeve style has the sleeve attached in the same manner as a sleeve is set into a basic T-shirt. Typically, the stretch of the maille runs around the body and around the sleeve. The front and back panels may be made in two flat pieces later joined at the sides or the body may be constructed as a tube. A potential problem to the set-in sleeve is the bulk that is formed
Figure 7.2. Comparison of a set-in sleeve versus a raglan sleeve. Illustration by Eric Kuehn.
under the arm when it is lowered. This is the hardest area to put together. The angles that result when the body meets the arm do not line up neatly. A good deal of finagling is often required. You can leave the underarm open to allow for movement and ventilation or use a diamond shaped gusset in the underarm to provide added protection without sacrificing comfort or mobility (see figure 7.2).

The raglan sleeve is attached with a seam that extends diagonally from the underarm to the neckline. As in the set-in sleeve method, the body may be constructed with front and back panels joined at the side seams or as a tube. With this style, the stretch will run around the body and around the sleeve. The sleeve will join to the body with a diagonal seam (see figure 7.2).

For any style of hauberk, the neckline may be constructed with a European 6-in-1 for extra strength or edged with brass rings for a decorative effect. For the truly advanced maille maker, information on the construction of a more complicated and carefully fitted hauberk can be found in the article “A Mail Shirt From the Hearst Collection” by E. Martin Burgess.¹

Coif

A coif is a complete head covering of maille, extending down to or over the shoulders (see figure 7.3). It was worn over a padded arming cap, which further protected the head both from an opponent’s weapon as well as from the maille itself. Though it traditionally had a movable flap called a ventail that

Figure 7.3. Coif. Coif courtesy of Mike Fuchs.
protected the lower part of the face, most modern coifs leave the face open for the comfort of the wearer. The coif can also be attached to the *hauberker*.

Begin with a single open ring and a number of closed rings. The number of closed rings will vary depending on the size of the rings and the desired size of the finished piece. Slide all of the closed rings onto the open ring and close it. Start to form a row of the European 4-in-1 pattern, working in a circle around the central ring. Add an extra floating link in between every other ring. Continue to add links in this manner until the piece is big enough to cover the top of the head.

Make a strip of *maille* the width of a five-set and long enough to fit loosely and comfortably around the widest part of the head, just above the eyebrows. Connect the ends, creating a circlet. Ideally, the number of links in the circlet would be the same as the number of links in the outer row of the top piece. If the links don’t match perfectly, don’t worry. Just fudge the join by adding some floating links to even out the numbers. See Chapter VI for more information about floating links. Continue to build down from the circlet leaving the face area open. Once you have reached, in length, to the bottom of the face, you can extend the *maille* back around to the front, if you desire. Once the *maille* has reached the top of the neck, begin to add idle rings periodically to flare out the bottom to cover the shoulders. Be relatively consistent with how many and how often you add the rings to keep the form of the coif regular.
Extend the collar to cover as much of the shoulder as desired. It can cover anywhere from just to the end of the neck all the way to the middle of the chest.

*Camail or Aventail*

The *camail*, also called an *aventail*, is a piece of *maille* which hangs from the bottom of a helm to protect the neck and shoulders. It can be simply a rectangular tube, but a flared shape, basically a truncated cone, long enough to cover down to the shoulders may be used for greater protection and better fit.

Make a rectangular or a trapezoidal piece or *maille* where the top horizontal row, when the *maille* is relaxed, is the same length as the circumference of the bottom of the helm. There is no standard length for a *camail*. It will vary from piece to piece and is determined by two factors 1) the distance between the shoulder and the bottom of the helm, and 2) the amount of shoulder protection desired. The last four or so inches of the *camail* should rest on the wearer’s shoulders, but it could extend as far as part way down the arm. You may add a dagged edge to the bottom by working a series of triangles along the bottom edge. See Chapter VI for triangle instructions. The border of either style may be edged with one or two rows of brass rings for decoration. With a sturdy leather thong, parachute cord, or a shoelace, lace the top row of the *camail* to a series of holes drilled along the bottom of the helm.

*Mitten Gauntlets*

Mitten gauntlets are an early form of hand protection. They can be a separate pair of gauntlets or attached to the end of the sleeves of a *hauberk*. 
Figure 7.4. Camail. Camail courtesy of Larry Bell.
Maille covers the back of the hand only, forming a fingerless, bag-like mitten (see figure 2.2 in previous chapter). The palm is covered with leather to provide flexibility and a secure grip for holding weapons. If the gauntlets are attached to the hauberk, there should be an opening at the inside of the wrist so that the hand may be removed from the gauntlet to use the fingers.

Trace a mitten-shaped outline of your hand, fingers in a relaxed position, on a piece of paper. Leave 1/4" for a seam allowance on all sides. If you wish to make stand-alone gauntlets, trace several inches up the wrist, flaring out to create a cuff for both protection and decoration. Make sure the narrowest point of the wrist is still wide enough for your hand to fit through the opening. Measure the circumference of the widest part of your hand while yours fingers and thumb are pressed together. Make sure this distance is equal or smaller than the span across the wrist, minus all seam allowances and multiplied by two. For a tighter fitting wrist, simply keep the wrist the size measured. A small slit at the center of the inside of the wrist can be added later for ease.

Choose a flexible but durable leather or suede in whatever color you like. Cut four pieces of leather from your pattern, two for each hand. A thicker piece of leather may be chosen for the back of the hand for extra protection, if desired. Next, create a piece of maille the shape of the mitten, only slightly smaller than the pattern before seam allowances are added. A smaller gauge of wire and smaller inner diameter may be better suited than the normal sizes used for most armour. Position the piece of maille on top of one piece leather, placing
a piece of wood underneath the entire stack. Using a leather punch or an awl, punch a series of holes just inside the edge of the maille. Using a piece of leather or suede thong, lace the maille to the leather mitten. If you are going to make a tighter fitting wrist, take the palm piece of leather and make a straight cut, two or three inches long, perpendicular to the narrowest measurement across the wrist. Punch a series of holes along either side of the slit. This can be laced with another leather thong to tighten it. Place the two pieces of leather together, maille on top, and punch a series of holes around the perimeter of the mitten, approximately 1/4 - 1/2” in length apart from each other. Using another piece of leather thong, lace the front to the back (see figure 7.5). Repeat for the second gauntlet.

If you are attaching the gauntlet to your hauberk, create the maille piece, but instead of flaring at the wrist, attach it to the end of the hauberk sleeve. Line the gauntlet with leather to protect the hand and to improve the grip.

**Chauses**

*Chauses* are form-fitting leg coverings made of maille (see figure 2.2 in previous chapter). Each leg is separate, shaped like a lady’s stocking, and typically attached to a belt at the waist to support them. They may enclose the leg entirely or cover only the front, leaving the back open to be laced shut. *Chauses* are one of the most challenging maille items to make due to the
Figure 7.5. Mitten gauntlets. Illustration by Gwendolyn Sweezey Lindsey and Don Lindsey.

intricacies of the fitting. They require a great deal of proficiency in increasing and
decreasing links.

**Fantasy**

*Maille* has become a popular fashion accessory in recent years. In addition to its uses in high fashion, people wear *maille* fantasy fashion items at Medieval reenactment events and Renaissance festivals. Fantasy items such as *maille* bra tops and smaller jewelry items such as necklaces and handflowers, one or more rings connected across the back of the hand to a bracelet, are also popular.

**Headpiece**

Headpieces can be made in a variety of styles (see figure 7.6). From a simple circlet to an elaborate netted veil, let your imagination run wild. If possible, get a Styrofoam head form (from a beauty supply store) or borrow somebody’s head and work three dimensionally. Otherwise, use your own head and try on the headpiece frequently. Be especially careful to make clean cuts in your links and to close them fully, so that the headpiece does not catch in the hair.

**Necklace**

Necklaces can be made from any of the chain patterns and in any length desired from a choker to a long chain (see figure 7.7). Longer chains can fasten to themselves, and be put on over the head, but a shorter one will need a clasp. You can purchase clasps from a jewelry supply shop, hardware store, or
Figure 7.6. Headpieces. Top headpiece courtesy of Alice Buzzard.
Figure 7.7. Necklaces. Necklaces courtesy of Mike Fuchs.
make your own. Toggle clasps are a simple and elegant option. Two-part, separating key chains are another option. You can make a hook by bending a piece of wire as well. Necklaces may also be made using any other maille patterns. Let your creativity run wild.

**Bracelet or anklet**

Bracelets and anklets are often made using a chain pattern (see figure 7.8). Make the chain long enough to just wrap around the wrist or ankle. Adding a clasp will usually provide enough ease for comfort. You can purchase a clasp from a jewelry supply shop, hardware store, or make your own. Toggle clasps are a simple and elegant option. Two-part, separating key chains are another option. You can also make a hook by bending a piece of wire as well.

**Handflower**

The handflower is a bracelet that comes to a v-shaped point over the back of the hand, secured by a finger ring or a loop around the middle finger (see figure 7.9). This is a popular style for dancers. Begin with a bracelet and add a triangle slightly smaller than the size of the back of the hand. See Chapter VI for triangle instructions. Make the triangle from the European 4-in-1, Japanese 6, a network of chains, or whatever you fancy. The ring may be a purchased ring, a thin chain, a decorative cord, or a bit of elastic. For comfort, make sure that there is enough ease in the back of the handflower to allow the hand to close completely into a fist while wearing it.
Figure 7.8. Bracelets. Bracelets courtesy of Mike Fuchs.
Figure 7.9. Handflowers. Handflowers courtesy of Mike Fuchs.
Bikini top

This is a very popular piece with the Renaissance Fair crowd and dancers. See the top in figure 5.2. Create two triangular pieces of maille large enough to cover each of the breast areas. The European 4-in-1 pattern and the Japanese 6 pattern both work well for this. Create the straps from whatever pattern you choose: spiral, European 4-in-1, simple chain, or other. You can line it with fur -- fake or real, leather, or fabric for comfort and modesty.

Vest

A vest is a sleeveless shirt which is completely open down the front. Make a waist-length haubergeon with no sleeves. See earlier in this chapter for haubergeon instructions. Leave the front open. You can angle the front from the shoulder to the waist or leave it straight, lacing the opening to keep it in place. Decorative fasteners may be used to fasten the center front (see figure 7.10).

Belt

A belt is one of the easiest pieces to make - a great first piece (see figure 7.11). For a basic belt, you will need a 2 1/2" diameter stainless steel ring, in addition to your rings. These rings may be purchased at most hardware stores. Starting from the ring end, attach 5 links to the large ring and close them. Consider this your first horizontal row in the European 4 in 1 pattern. Start building down, alternating rows of 4 links and 5 links. Stop when you have a length equal to your hip measurement plus 12 - 24 inches, depending in how
Figure 7.10. Vest. Illustration by Eric Kuehn.
Figure 7.11. Simple belt. Collection of the author.
Figure 7.12. Coin belt. Courtesy of Alice Buzzard.
long you want the tail to hang. The tail will loop through the ring to secure the belt. If you choose, you can begin with more links at the ring and taper the number of rings back to the desired width. The tail end may be terminated with a triangle or straight across. Feel free to adjust the length and width to suit your purposes, experiment with running the grain of the maille the opposite direction, or change the size of the large ring.

Belts can also be very decorative. They can be made using any of the various chain patterns and embellished as desired (note coin belt in figure 7.12).

Skirt

The skirt can be any length you choose from ankle length to mini skirt. It can be made from any pattern, but it is often done in an open network of chains to save time. A skirt of European 4-in-1 is time consuming but beautiful. Skirts are often worn over another skirt of fabric, but may be lined with fur - fake or real, leather, or fabric. Slide a sturdy drawstring through the top row to secure the skirt while it is being worn. Elastic is generally not strong enough to support the weight of a steel skirt, but it may work for a light weight aluminum piece. Dark elastic or cord will be less noticeable than light elastic or cord when it is woven through the links.

Dress

One way to make a basic dress is to combine a skirt bottom with a bra, vest, or shirt top. A sleeveless style will be easier for fitting, as a sleeved dress tends to produce fitting complications, especially when the arms are lifted. A
netted style will cover a greater area with less effort than an all-over maille pattern (see figure 5.2). Be creative with your designs and let your imagination guide you. Experiment with open work and cut-outs in your design to add visual interest and to save time and weight.

**Decorative Items**

Maille is also used for many decorative purposes. Accessory items, such as a purse or bag, are often made out of maille. Other common household items, such as glass bottles and stuffed animals, can also be found decorated with maille.

**Stuffed animals**

Any stuffed animal can be given its own suit of maille. Teddy bears are an especially popular choice. A simple shirt is usually enough, but you may wish to make a coif instead or in addition (see figure 7.13). Suits for stuffed animals can be quick to make due to their small size. You may also stretch the maille more tightly over a stuffed animal because the maille does not have to give as much to get it on and off or for ease of movement. Simply follow the patterns listed above in a smaller scale.

**Bottles**

Any sort of bottle will do for this. Look for something pretty in shape or color. Create a network of chains or a solid piece of maille to wrap around the bottle. It can be made to be removable or permanently attached. You can add a carrying strap of maille or leather for convenience if you wish. Try to chose a
Figure 7.13. Stuffed animals. Top courtesy of Alice Buzzard. Bottom photo courtesy of Bill Love.
rust resistant metal for decorated bottles, as it is designed to be used with liquids.

**Pouch**

This small bag can be used as a purse or to hold dice or other small objects. The European 4-in-1 pattern is probably the most popular pattern for this style (see figure 7.14). A pouch may be constructed in any one of several different fashions: round, cylinder, or flat. The top closure may also be constructed in a great variety of styles. Covered here are Single Drawstring, Double Drawstring, or Flap. These styles only represent a few of the different possibilities for creating a pouch. Feel free to mix and match or adapt the techniques, or design your own style completely. It is advisable to line the pouch with cloth or a soft suede to protect the contents from the steel links and to keep the contents from slipping out from between the links. A shoulder strap of maille chain, a durable cord, or leather - try braiding it for strength and decoration - can be added if desired.

As in the directions for the coif, begin with a single open ring and a number of closed rings to make the round and the cylinder styles. See earlier in this chapter for coif directions. Continue to build a circle until you have reached the desired size. The entire piece may be circular to make the round style or formed with a circular base and a tube for the body to make the cylinder. To make the flat style, construct two flat panels of the same size and shape. Place them in top of each other and join the two pieces by working a row of rings into
the pattern of the *maille*.

To make a single drawstring, lace a durable cord or leather thong through the top row of rings to pull it shut. A double drawstring, consisting of two cords, each emerging from opposite sides of the top row, can also be used. Alternately, a flap can be formed of *maille* to fold over the top of the bag. Add a decorative clasp to keep it closed and a shoulder strap to create a purse style bag.
Figure 7.14. Pouches. Photo courtesy of Bill Love.
CHAPTER VIII

CONCLUSION

Congratulations! You have made it through *Chain Mail: A Guide Book for Making Maille*. I hope you have enjoyed the journey, explored your creative side, and fashioned some wonderful and unique maille items. Here are some examples of maille to help further inspire your creativity.

Figure 8.1. *Maille* boot. Courtesy of Mike Edelman.
Figure 8.2. Bench with *maille* webbing. Courtesy of Mike Edelman.

Figure 8.3. *Maille* tea kettle. Courtesy of Mike Edelman.
Figure 8.4. *Maille* chair. Courtesy of Mike Edelman.

Figure 8.5. *Maille* key chain. Courtesy of Bill Love.
Figure 8.6. *Maille* pouch with drawstring. Courtesy of Bill Love.

Figure 8.7. *Camail*. Courtesy of Amanda Morris.
Figure 8.8. Modern *maille* butcher’s glove. Courtesy T. J. Harmon.

Figure 8.9. *Camail*. Courtesy of Rick Buzzard.
Figure 8.10. *Maille* bracelet. Collection of the author.

Figure 8.11. *Maille* bracelet. Collection of the author.
Figure 8.12 *Maille* key chain. Courtesy of Mike Fuchs.

Figure 8.13 *Maille* key chain. Courtesy of Mike Fuchs.
Figure 8.14. *Maille* shirt. Courtesy of Mike Fuchs.

Figure 8.15. *Maille* shirt. Courtesy of Mike Fuchs. Model: Nissa Armstrong.
RESOURCES

This is just a short list of some of the commercial resources available to the maille maker. This is by no means a complete list, but it should provide a starting point. Be sure to check your local phone book for resources in your area by looking under Hobby Shops, Farm Supplies, Hardware Stores, Scrap Metals, or Blacksmiths. Space has been left for you to write notes or information for your favorite sources.

Centaur Forge
Blacksmithing equipment
117 North Spring Street
Burlington, WI 53105
(800) 666-9175
www.centaurforge.com

E.B. Fitler & Co.
jewelry making tools and supplies
18526 Cool Spring Road
Milton, DE 19968
(800)346-2497
www.fitler.com
eJewelrySupplies.com

*jewelry making tools, supplies, silver wire*

EJS P.O. Box 7103
Libertyville, IL 60048
(800) 634-0525
www.ejewelrysupplies.com

Neptunic

*shark suits*
San Diego, CA
(619) 236-0711
www.neptunic.com
Info@neptunic.com

Rio Grande

*Jewelry making tools, and supplies*

6901 Washington Ave. NE
Albuquerque, NM 87109
(800) 545-6566
www.riogrande.com
Whiting & Davis
*makers of metal mesh fabric, butchers’ gloves, and aprons*
(800) 876-MESH (6374)
200 John Dietsch Blvd
Attleboro Falls, MA 02763
www.whitinganddavis.com

Worth Manufacturing Company
*makers of stainless steel split rings and jumprings*
(715) 344-6081
P.O. Box 88
Stevens Point, WI 54481
www.worthco.com
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Books


Articles


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