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Digitizing Thoreau:

Thoreau Collection Preservation Project

An Interactive Project
Submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by:

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Date: May 5, 2009

Approved:

Professor Wesley Mott, Advisor

Rodney Obien, Co-Advisor

Abstract

The media at the Henley Library of the Thoreau Institute at Walden Woods is deteriorating over time as well as being replaced by newer technologies. Preservation techniques are provided to help improve the longevity of the original media and guides are provided to update this media to a digital format. In doing this, media pertinent to Thoreau and his admirers will not be lost to time and technology.

Executive Summary

The Henley Library of the Thoreau Institute at Walden Woods Library has a collection of audio/visual media that are becoming technologically obsolete and in some cases physically deteriorating. These media include many different discussions, analyses, and narratives relating to Henry David Thoreau and those involved with preserving and using his works, such as the Thoreau Society and Walden Woods Project. Given the vast majority of audio and video cassettes to other media, they will be digitally converted, and the other older media, including vinyl and beta max tapes, will be analyzed for the best available preservation solutions other than the climate controlled vault they are currently in. The vault is helping to postpone the deterioration process, and provides vital time to find a solution, but other measures must be taken. The digital files will help the Henley Library to adapt to newer technologies, and our recommendations will help future projects in the digitization and restoration of the rest of the aging media.

During our project we:

- Gained a firm understanding of Henry David Thoreau and Walden Woods
- Presented the best possible research regarding the technology necessary to digitally restore older media
- Presented the best possible research regarding the equipment and methods necessary to preserve the older media
- Set up a system that allows the curator and his colleagues to do most of the digitization themselves
- Give recommendations for future IQPs

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David Botelho and David Taranto, Academic Technology Center

Division of Work

Although this paper was a collaborative effort, both students used their specialized academic backgrounds to work on different parts. Mr. Collins used his background in computer science to produce the step by step guides for the conversion of the audio and video to a digital format. Mr. Arredondo's background in chemical engineering allowed him to produce most of the information regarding deterioration and preservation of the media. Francis also focused more on the cultural background of the IQP, while Jarrett focused more on the historical aspect. The rest of the paper was a joint effort.

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Introduction

The Thoreau Institute, in collaboration with the Walden Woods Project, has been working for over a decade to try and preserve the legacy of Henry David Thoreau. However, one of the means of carrying on his legacy is in the process of deteriorating. The Thoreau Library currently houses several different forms of media regarding Thoreau, as part of the extensive Thoreau Society Collection. These media on deposit at the Institute since its founding consist of film as old as fifty years and VHS made just a few months ago. The Institute has done all it can to preserve the older formats of media in their current state, from the more common audio cassettes and VHS tapes, to such obscure items as Beta Max and Pneumatic tapes. These formats are becoming more outdated, and in some in cases obsolete. Preservation techniques for this media are technologically limited at this time, and hold off the inevitable for so long, before time will eventually win and the media will deteriorate.

As the years pass, newer forms of media are taking the place of these older forms. This presents two problems to the Institute. First, some of the oldest forms of media are physically deteriorating, almost to the point of no repair. A real possibility is that whatever was stored on this media, and carrying on important aspects of the legacy of Thoreau, would be lost forever. The second problem is that even the formats that are in relatively good shape, and not in danger of being lost to deterioration, are being supplanted by newer technologies. The cassette players and VCRs used to play these older media are quickly being replaced by MP3 players and BluRay. Finally, funding is necessary to try and help remedy these technological issues, and where exactly the money for that will come from.

This Interdisciplinary Qualifying Project (IQP), while working with the Thoreau Institute, aims to solve these technological problems and help the Institute preserve their media from the physical constraints of time as well as advancing technology. This will also help us to gain an understanding as to why the work of Henry David Thoreau should be preserved. This project is not just for preserving media, but for preserving the message and legacy of one of America's most influential authors. To achieve this goal audio and video conversion guides are provided to help the modification of these media to a digital format that is compatible with today's technologies as well as being more resistant to the physical stress of time. Recommendations are provided for preserving and digitizing the other formats that are not technologically capable of being preserved at this point with the resources available. A plan of action is also established for Jeffrey Cramer, curator of the Henley Library, so he can expand on his technological capabilities and have a better idea of how best to digitize and modify the media himself, thus becoming less technologically dependent on outsourcing. This IQP provides a groundwork for solutions to the A/V problems that now face the collections held by the Thoreau Institute.

Background

Cultural

Walden Pond and Walden Woods are not just comprised of a tract of land and an old murky pond that someone wants to keep from being destroyed. It is not just some place where Henry David Thoreau came to live in solitude for a short period of time as an outsider and analyze the world he lived in as well as himself. It is a place that was used by an individual to ground himself in nature, to show just how powerful and enlightening the simplest of things can be. Emerson, Thoreau's mentor, once stated that "the one thing in the world, of value, is the active soul", and Thoreau heeded this. When Thoreau ventured to his solitude in Walden Pond he became a "*Man Thinking*" (Emerson, "The American Scholar", 1837). He isolated himself from the world, not necessarily for hatred of it, (for, in fact, he often referenced competing claims between the natural and social world) but left society to try and examine this "active soul." He wanted to find out who he really was, and he was very firm in finding that out. "Know your own bone, gnaw at it; bury it, unearth it, and gnaw it still," that was his belief (Thoreau, *Familiar Letters*, 1848).

Thoreau was a man of many emotions, and like the seasons his attitude changed often. He could exhibit the fierce tenacity of such essays as "Slavery in Massachusetts" and "Civil Disobedience," yet at some periods in his life he was very depressed and in thought. At points he would be full of life, like the coming of spring on Walden Pond, and at others he would isolate himself from the world, like the many days he would spend in his cabin waiting out the powerful gusts and storms of the winter cold. Walden Woods is not just a monument to the time that Thoreau spent there and the uplifting literature

that he was inspired to write in those woods, but a mark of who Thoreau was. For those who appreciate and respect his works, this land is a lasting symbol of the person, as well as the author.

Thoreau also wanted to inspire people, as Emerson had done for him, to find “a permanent feature of the inner landscape” of their own being (Richardson, *Henry David Thoreau: A Life of the Mind*, pg. 137). Walden Woods was Thoreau’s “inner landscape,” and could perhaps be for others as well. But Thoreau wanted people to find that solitude within themselves where they could reflect on the world around them. To take a step back and really see what was going on; to think on their own, and know that the actions they took in their life were truly theirs. Walden Woods symbolized the refuge that an individual could find in themselves, a place where they could be alone with their thoughts.

It is hard to distinguish Thoreau the intellectual from Thoreau the man, and though Thoreau was able to examine, reflect upon, and inspire in his intellectual endeavors as a writer, he was also very powerful in his physical and political actions; his stay in Walden Woods and his essays on antislavery, respectively, are tangible examples. Thoreau was very much anti-slavery, as shown in such essays as “Slavery in Massachusetts” and “Civil Disobedience.” Thoreau used his isolation in another sense. Thoreau became a fierce opponent of slavery, “a dissenting community of one” (Robinson, “A Life of the Mind”, 1987). He stood for what he believed in, and others would follow in his wake. This was just one of many political topics Thoreau found himself involved in. Thoreau was also very sympathetic toward “the small subsistence farmer.” He worked his own “two and a half acres, cutting down trees and plowing

fields” to show how important this very underappreciated and exploited part of the American economy was. He made this very clear in *Walden*, with his detailed budgets and financial explanations. Thoreau used Walden Woods, not only as a foundation for his intellectual prowess, but as a political stage for his feelings towards the social controversies and problems of the time. This land, through the generosity of people such as Don Henley, is as much a monument to Henry David Thoreau as the Lincoln Memorial is to Abraham Lincoln.

Walden Woods helped Thoreau to further his exploration and fascination with the natural sciences. Thoreau wanted to examine “nature's dynamism” and its connection to our social world (Robinson, “A Life of the Mind”, 1987). He wanted to see the similarities between those aspects of nature that surrounded Walden Pond, and the society that he was now separating himself from. In *Walden*, Thoreau is very precise in his observations and studies of nature, inspired by such authors as Darwin, and used these observations to draw connections for both his intellectual and personal endeavors. He wanted to show others how much there was to learn from just watching the simplicity of nature and its creatures, but also wanted to show himself that there was a way of finding the answers to any questions you seek. If you are persistent, exact, and thorough, there are methods to finding a purpose for anything, and for Thoreau that was finding himself. “The mind's continuing proclivity for order and meaning, proof that it could be done,” is one of many things that Thoreau found in Walden Woods (Richardson, *Henry David Thoreau: A Life of the Mind*, pg. 139, 1986).

Walden Woods was also a place where Thoreau was able to create a foundation for some of his most well-respected literary works. It seemed that this solitude and

examination of the “active soul” did truly bear the fruit that Thoreau was so adamant in showing to others. Thoreau “managed to bring to completion only two unified and sustained booklength pieces in his lifetime. Both were essentially shaped during his years at Walden Pond.” (Richardson, *Henry David Thoreau: A Life of the Mind*, pg. 152) These literary works, *A Week on the Concord and Merrimack Rivers* and *Walden*, are now widely admired and inspirational pieces. This is the true proof of self-examination that Thoreau spoke of, and Walden Woods is a lasting testament to, and shining example of, the simplicity and solitude that one needs to find themselves and, in turn, help others find themselves as well.

Walden, arguably the greatest literary work of Henry David Thoreau and one of the greatest books in western culture, is the foundation for all that Walden Woods stands for. It is easy for followers of his work to draw possible connections between the woods and his personality and the way he lived his life, but those are only speculative. Though they are insightful and compelling arguments, they are not the tangible item that *Walden*, the book, is. *Walden* is the evidence necessary to make all the assumptions about him and his connection to nature absolute. There is now something, from the mind of the author himself, which gives those who admire him the security they need to go out and speak the message that he has so eloquently expressed in this book. It is from this work that others will know exactly what he thought and exactly what he felt, and be able to proclaim his message that much clearer and more powerfully.

There are many messages that one can draw from the book, but probably the most powerful is the idea of self-reliance. Inspired by his mentor, Ralph Waldo Emerson, and his essay “Self-Reliance” Thoreau is a glowing example of how one is able to survive on

his own, in solitude and without the help of others. He shows the world of the time that it is from inside that one must find the fortitude to do what is necessary to survive. "Little is to be expected of that day, if it can be called a day, to which we are not awakened by our Genius, but by the mechanical nudging of some servitor, are not awakened by our newly acquired force and aspirations from within ... instead of factory bells." (Thoreau, *Walden*, pg. 71) He despairs at the idea of man being forced along by some other force; he wants man to find his own reasons for living, for wanting to live, and from those do what is necessary to truly live their lives. It is this solitary lifestyle in the wilderness of nature that he shows this desired quality. This does not mean that Thoreau hates man for what he has become and wants to be as far away from them as possible, but shows his passion for what he knows man can become. If anything, *Walden* is more integrated in the analysis of society than the individual. The philosophers and poets who visit him are, in his eyes, the potential for man and man's self-realization, and at some point man's self-reliance.

Thoreau also values simplicity. He feels that man is too caught up in trying to get by doing everything that is necessary to pay the bills and buy nice things that they miss out on how valuable the simplicity of life really is. "We live meanly, like ants; though the fable tells us that we were long ago changed into men ... it is error upon error and clout upon clout, and our best virtue has for its occasion a superfluous and evitable wretchedness. Our life is frittered away by detail." (Thoreau, *Walden*, pg. 73) Instead of rushing around trying to do all that can be done to get all that he can, Thoreau wishes that man would just drop this unnecessary need and live a simplified life. Only then will man be able to analyze the self. Only once man has stripped himself of all unnecessary desire

will he be able to truly appreciate how much more nature and the natural, true self have to offer than the most extravagant of possessions.

To extend on this point, Thoreau wants us to stop unnecessary exertion. “It is not worth the while to go round the world to count the cats in Zanzibar.” (Thoreau, *Walden*, pg. 248) He wants man to remove the mask that gives him this illusion of progress; he doesn’t want man to continue to do what he is doing believing he is accomplishing something, when in fact he is moving further and further from himself. Thoreau wants to remove the mask and allow man to see his reflection in the mirror, to see man as man and nothing more. Take a good hard look at the self and worry about this essential being, not all these unnecessary luxuries that clutter our mental vision.

As one can see, all of these different messages that Thoreau is trying to convey are all coming to this one main ideal, self-reliance and self-analysis. He just wants man to see his true self. That is why Thoreau is so drawn to this simple spot in nature. Walden Pond symbolizes the reflective, pure quality that he has, and that he hopes others will have.

The animals amaze him because they have the simple, sensible mental vision that he wishes man to have. They are simple and only worry about what is absolutely necessary in life. They find those things and perfect them. They do not look for more and more to clog the mind with; they become masters of themselves and what they must do to survive. Walden is unlike any other natural location in that it can possess natural features in such close proximity to each other that so perfectly represent the ideas that Thoreau is so passionate in expressing to everyone else. It is from this book and in these woods that this message of self reliance is so evident. It is from this book that he uplifts and inspires

the wondering individual; the person lost. Those searching for a meaning are drawn to this book. This is why it is so important to keep all that he was and all that people have made him out to be preserved for the years to come.

Walden Woods, both the place and the idea, is a monument to Henry David Thoreau, and Henry David Thoreau is a foundation for so many important intellectual, scientific, and political ideals. Many individuals and organizations are trying to keep his legacy alive, and the best means of doing so is to keep his monument alive in the truest sense of the word. His words, his works, his actions, his legend are in jeopardy of being overrun by time and society. Those who truly cherish and appreciate his powerful inspiration should do all they can to keep his message alive through the trying years to come.

Historical

For nearly seventy years, the Thoreau Society has been the foremost group of admirers keeping Thoreau's works alive. Founded in 1941, it is the oldest and largest organization in America dedicated to an author. Dedicated to all the admirers of Henry David Thoreau and the messages he tried to convey, the society holds annual meetings and conferences as well as publishes an annual journal entitled the *Concord Saunterer*, a newsletter appropriately named the *Thoreau Society Bulletin*, and various books to allow members to share and gain knowledge about Thoreau. The mission statement is:

- To stimulate interest in and foster education about Thoreau's life, works, and philosophy and his place in his world and ours,
- To encourage research on Thoreau's life and writings,
- To act as a repository for Thoreauviana and material relevant to Thoreau,
- And to advocate for the preservation of Thoreau Country.

The Walden Woods Project (WWP) is a nonprofit organization founded by Don Henley and Kathi Anderson in April 1990 to preserve Walden Woods and the surrounding area, including Walden Pond, as they were when Henry David Thoreau spent his time there. Henley had often referred to himself as being similar to Thoreau and his interest in the man stemmed back to his childhood: "Growing up, I became best friends with nature, the woods, the lakes, the streams." (Maynard, *Walden Pond: A History*, pg. 301) Henley's involvement angered other Thoreau enthusiasts by raising large sums of money, because others felt that this was not what Thoreau would have wanted and questioned Henley's true motives. Regardless, the WWP raised nearly six hundred times as much money as the thoreauvian group that preceded it at Walden Pond. During April

of 1990, Walden Woods was set to be the site of an expansive office building and condominium complex. The development was set to be so large that Walden Woods was twice listed by the National Trust for Historic Preservation as one of America's *Eleven Most Endangered Historic Places*. After seeing the story on CNN, Henley became involved and started the organization. A national campaign was launched by the organization to raise awareness and funds necessary to protect the endangered areas. The WWP was able to buy the tract of land set aside for the condominium complex in January of 1991, and the other tract of land was also preserved a few years later when it was acquired at Brister's Hill. Since the formation of the Walden Woods Project, 150 acres in or around the area of Walden Woods have been preserved, and the effort continues as the organization continues to raise money to preserve more land. Through all this hard work, and Henley's vision and dedication, the Walden Woods Project is now a respected organization that helps to preserve Thoreau's legacy and the land he used to create it.

The Thoreau Institute was founded in 1998 as a joint effort between the Thoreau Society and the Walden Woods Project. The institute has long since been a center for research and education based on Thoreau and his achievements in the field of literature and philosophy. The Henley Library at the Institute houses a vast amount of media as well as research papers, books, and publications about Thoreau and his world. Perhaps the most valued pieces in the collection are the collections of Walter Harding and Raymond Adams, two of the foremost authorities on Thoreau as well as founders of the Thoreau Society.

Methodology

General Methodology

We have a firm grounding in the historical contexts of both Walden Woods and Henry David Thoreau's connection with those woods. We have researched and appreciated the cultural aspect of the environment in which we will be working. With this knowledge and understanding, we plan to preserve and modernize the media that are preserving Thoreau's legacy and those that appreciate him. Mr. Cramer's most pressing concerns involved the preservation of the media, the quality of the media once it was digitized, and the quantity of the media that was digitized. We have detailed explanations on the best means of preserving each form of media. We researched different inexpensive and efficient equipment and software for digitization that Mr. Cramer and his colleagues could obtain to use on site at the Library. We have step-by-step guides for the digitization of audio and video cassettes, as well as recommendations for the other media.

We acted as consultants and gave recommendations were provided on media deterioration as well as preservation. Guides were provided to the Thoreau Institute for the conversion of audio cassettes and VHS tapes to a digital media; however, guides were not provided for the oldest forms of media at the Thoreau Institute. These older forms of media include: vinyl records, films, microfilm strips, and beta max cassettes, all of which are stored in a climate controlled vault at the library. Although this media is not in the same abundance as the audio cassettes and VHS tapes, they still contain recordings valuable to the Thoreau Society. Each form of media faces a different type of deterioration over time as well as the risk of destruction of the physical media (i.e., physical damage that could be caused by handling). The oldest forms of media are in the

most danger of physical deterioration, but because the conversion process is a bit more complex and more can be done with the newer media faster, the project focuses on ways to preserve the oldest media so that it is still in good quality when it is eventually converted to digital. The deterioration of audio cassettes and VHS tapes is also a concern, but since they will be converted to a digital format soon, physical deterioration is not a serious problem. Detailed guides to physical media deterioration and guides for potential preservation can be found in the following Appendices:

- Appendix C (VHS Tapes, Beta Max, and Audio Cassettes)
- Appendix D (Vinyl Discs)
- Appendix E (Film and Microfilm)

We have also presented possible paths that future IQPs could follow, such as copyright issues of the digital media. We worked with the WPI Academic Technology Center (ATC) to provide the highest quality digitization possible to the Henley Library given the current state of the collection while still adhering to the rules of media preservation. The main goal of this project has been to provide a system that will allow for smoother cooperation and interaction between the Henley Library and WPI in future projects, and make the Thoreau Library self-sufficient in the digitization process.

Technical Methodology

Though the Thoreau Society Collection includes several different forms of media, our emphasis is on the analog-to-digital conversion of audio cassette tapes and Video Home System (VHS) tapes. This report focuses on the digitization of these media because the Thoreau Collection includes these in large quantities and because they are accessible and relatively inexpensive to convert to a digital format. We created detailed step-by-step guides for how to complete this process for both cassettes and VHS (see Appendix A for audio cassettes and Appendix B for VHS). These guides were simple and user friendly and specifically designed to enable Mr. Cramer and his colleagues to complete the digitization of the cassettes and VHSs at the Henley Library. This allowed for less dependence on WPI. The other media, such as albums and beta max tapes, are a concern because of the deterioration process they are going through. Methods of preservation and digitization have been recommended (Appendices C-E), but were not a major priority given the lack of technology or funds readily available to digitize these formats.

You will find in the appendices:

- Different methods of preserving the media we were not able to provide guides for
 - Chemical reactions that they undergo that could lead to deterioration
 - Possible solutions for remedying these reactions
- Best procedures and methods that are available for analog-to-digital transfer of the different media
- Digitization that would be best given the condition of the media
- Digitization that would be best given the situation that the media will be used in

Media from the Henley Library were tested at WPI on the equipment and software that will be needed for the conservation. We first tested cassettes then VHS. We collaborated with the Academic Technology Center about the physical conversion of the cassette and VHS media, as well as their recommendations for how it should be done. The ATC assisted with the technologies necessary, as well as the procedures involved in the digitization. The technologies involved with cassette conversion were a computer, a tape deck, the most efficient and effective freeware available, and the cables to connect these devices. The amount of VHS tapes is the same except for the tape deck is swapped for a VCR, and a converter box and Firewire card are also necessary. More detailed explanations of these technical requirements are in the appendix. The ATC did not assist with the man power needed for the actual conversion testing, but tests were run on the different media in our own work space to find the best freeware and freeware settings available.

Recommendations

Organization of Digital Media

The organization of the digital media is a key archival task. Media is currently scattered throughout the vault of the Henley Library. Creating a well-organized system for finding media is very important and ultimately time saving. Once you convert the analog media into a digital file, immediately label it with a name relevant to the file and the date the original tape was created. This labeling will allow for quick searches through countless numbers of files stored either on the computer or other portable memory. With regards to physical storage of the files, there will really only be two options. The curator will have to decide as to whether he wants these digital files stored on either a CD/DVD or an external hard drive. The drawbacks to consider when choosing what digital format and organization to use can be found in Appendices F and G.

In comparison to the analog media, CD/DVDs would greatly cut down on the amount of physical space taken up by the collection as well as the number of pieces of media it is stored on. However, it is recommended that files be backed up on an external hard drive instead. The memory of this device is nearly 300-600 times that of a CD and about 30-60 times that of a DVD--not to mention the fact that external hard drives are at a lower risk of being damaged through handling as well as wear and tear. Also, once converted, the entire collection at the Thoreau Library could probably be fit on either one or two external hard drives. The only drawback of the external hard drive is that with the amount of memory required it could cost upwards of \$100. It is still the view of this project that the external hard drive would be the best option for storage of the collection,

and another hard drive, which is not in use, should be kept away from the public and used primarily for back-up purposes.

Older Media

The primary focus of this IQP was the conversion of audio and video cassettes to a digital format. The conversion of these media was the most pressing, since there were over 200 of both the audio and VHS, and the analog to digital transition of these media was simpler and more efficient than that of older media. This is because audio and VHS were the most recently developed of the older media that needs to be converted. The other media were more difficult to find the information and technologies necessary to convert to a digital format. However, general recommendations for how these older media (vinyl records, film/microfilm, beta max) can be converted are as follows:

Vinyl Records

Two options can be used when trying to convert vinyl to a digital format. First, the more popular but more exclusive method is to purchase a turntable specifically designed for analog to digital conversion. This means that the turntable has a direct USB output that can be connected to the computer. The other method, which is similar, but also a little more expensive, is to buy a general purpose converter box. An average converter box runs for around \$200. The converter box first receives the stereo audio input from the turntable, so make sure the turntable has stereo audio output. The converter box then will take the signal and send it to the computer via a Firewire or S-Video input. How to deal with the signal once it has reached the computer is up to the software and the way it interprets the signal. The more expensive the software, the more features and higher quality audio will come out of it.

Film/Microfilm

The analog-to-digital conversion of film also offers different methods just as vinyl did. The first and more amateur method of conversion is to buy a digital film scanner, which takes the negatives and converts them to images on the computer and strings those images together to create a streaming video. Software provided with the scanner should allow for the creation of video files; however, separate software would have to be purchased for video editing options. The analog-to-digital conversion can also be professionally done, ensuring a higher quality of resulting video. The next method, which is a little more simplistic but at the same time offers no editing options and lower quality, is to videotape the film while it is playing on a screen. Once again, this can be professionally done, with high resolution cameras that would increase quality relative to recording ability but not rival the quality of the digital scanning of individual frames into the computer. Software concerns are similar to that of the other media. Given the current situation at the Thoreau Institute, neither option is more advantageous than the other.

Beta Max

The old-time rival of VHS, beta max, has a very similar analog-to-digital conversion method. Beta Max players will have similar video/stereo audio outputs as VHS players and therefore are able to be connected to a converter box in the same fashion. The procedure for converting beta max to digital is nearly identical to that of VHS with few varying details. Please refer to page 32 for the VHS step-by-step guide, when contemplating possible methods of converting beta max.

Converter Box

The converter box is recommended because this project deals with several different older media. If just one media were being converted it would make sense to buy conversion technology more specific to what you want to convert, since it would be a slightly simpler process and less expensive (ex: USB turntable). However, when dealing with these quantities of media, having a converter box that can be used as a medium between the computer and several of the older media is much more convenient and less expensive. Remember, converter boxes are capable of dealing with vinyl, VHS, beta max, and audio. Purchasing one will save a lot of money, and with a limited budget, as the Thoreau Institute has, this is a good option and should be given serious consideration when planning the conversion of the media.

MP3 Players

One recommendation for the Thoreau Institute is that the Library invest in mp3 players. There are two main reasons this investment is suggested. First, the sound technology of an mp3 player is less advanced and sensitive than that of a computer, so when listening to an audio track on an mp3 player the quality seems better because it doesn't pick up as much background noise and hissing. Second, mp3 players are also portable storage devices so library patrons could simply relax at the Library and not be stuck in front of a computer screen while trying to listen to an audio track related to Thoreau. And unlike CD-RWs, it does not take a long time to rewrite data onto the memory of these devices, allowing for different tracks to be played on them without their memory ever reaching capacity. A few (1-3) 1 GB mp3 players should cost the institute only \$60. These are highly recommended for sound quality alone.

Acquisition of Funds

Simply put, the time, effort, and equipment that go into the conversion process are not cheap. All the equipment necessary to complete the goals of this IQP will roughly end up costing the Henley Library upwards of \$400, and this estimate does not include the countless man hours Interns will spend converting tapes and ensuring for quality when they are digital files. The Walden Woods Project is a non-profit organization so it does not have money to just throw around. In order to acquire the money they need, the Library could put some of its rare, less well known, or most popular digital tracks up on its website and make them available for download at a small fee. After a short time, the Library would probably have the money it needs if enough Thoreau enthusiasts download the audio tracks. Another idea would be to have a fundraiser. For example, the group's founder and *Eagles'* band member, Don Henley, in the past has signed guitars which the Society has sold for upwards of \$2000.

Future IQPs

Although this IQP has made significant strides in helping the Henley Library on its way to digitizing its collection, much remains to be done. A few major things were not done because of time constraints of this project and could result in future IQPs. The first and more pressing task left undone was the digitization of the oldest forms of media in the collection. Earlier in this section, brief guides were provided as to how to convert these older media to a digital format, but these are mere skeletons. More research needs to be done by future IQP groups in order to give the Thoreau Library a comprehensive step-by-step guide they can use to convert their vinyl records, beta max tapes, and film into a digital format. A second major task relative to this project is the copyright issue

involved with converting analog material and copying preserved items for archival purposes. The curator of the Library is aware of these issues and knows to proceed cautiously during the conversion process. Hopefully, the Thoreau Institute will seek future endeavors in collaboration with WPI in order to finish the digitization of their collection as well as make sure they are well aware of the legal copyright issues surrounding it.

Conclusion

The main goals of our IQP have been to preserve the media of the Thoreau Library, convert this media to a digital format, and give the members of the Walden Woods Project guidance in how to accomplish these goals on their own. We also wanted to help succeeding IQP students get an idea of what they could potentially do to follow up this project. We have only taken the first steps in the much larger goal of the Walden Woods Project: the complete conversion of the media to a digital format. We feel that this IQP is a stepping stone for the completion of that endeavor as well as a guide for many more projects and cooperative efforts between WPI and the Walden Woods Project in the years to come.

Appendices

Appendix A: Audio-to-Digital Conversion

The first thing to consider when attempting to convert an audio cassette to a digital format is the technologies that will be involved. Below is a list of the technologies necessary for this conversion.

- Computer with a microphone input (Figure 1.1)



Figure 1.1

- 1/8 inch male-male audio jack (Figure 1.2)



Figure 1.2

- Standard audio cassette player (Figure 1.3)



Figure 1.3

Any computer built in the last ten years has a microphone input, so there should be no problem finding a capable computer. The cost of the male-male audio jack and cassette player depends on the quality of the audio that you wish to receive at the end of the process. The higher quality jack will transmit a more distinct electronic signal from the cassette player to the computer, and the higher quality cassette player will pull more electronic signals from the audio on the tape, allowing for a more detailed piece of audio to be received by the computer. The quality you can expect in the digital audio file is relative to the quality of the technology that you use to transfer the audio from the tape to the computer. All of the items described above are easily found at any electronics store. Exactly which version and brand of each technology to buy is up to you, though a relatively inexpensive version of each should be fully capable of the conversion we plan to do.

After having these technologies properly set up, and with a tape in the cassette player, you can now turn your attention from the hardware to the software. The first software that must be installed is the Audacity audio editing software. This freeware can be found at the following website:

<http://audacity.sourceforge.net/>

- Click the third tab labeled “Download” (Figure 1.4)



Figure 1.4

- In the box labeled “Stable: 1.2 – for all users” click Windows 1.2.6

(Figure 1.5)



Figure 1.5

- In the “Recommended Download” section click the Audacity 1.2.6 installer link

(Figure 1.6)

Recommended Download

[System Requirements](#)

Click the appropriate link below, which takes you to the SourceForge download page - don't "save link as.." or "save target as..". The SourceForge download should start automatically. If it does not, click the links in the black panel marked "direct link" or "mirror". **Only these links and the automatic download are authorized versions of Audacity.** Disable any automatic download managers if the download is incorrect.

- Windows 98/ME/2000/XP/Vista: [Audacity 1.2.6 installer](#) (.exe file, 2.1 MB) - The latest version of the free Audacity audio editor. See [further information about Vista](#).



Figure 1.6

The next screen will give you one of two scenarios depending on the security of your computer’s internet access. Either an advertisement will pop up with a “click here to download Audacity manually” link, or your computer will block the pop-up and a yellow bar will run across the top of the webpage explaining that it blocked your computer from downloading the Audacity installer (Figure 1.7).

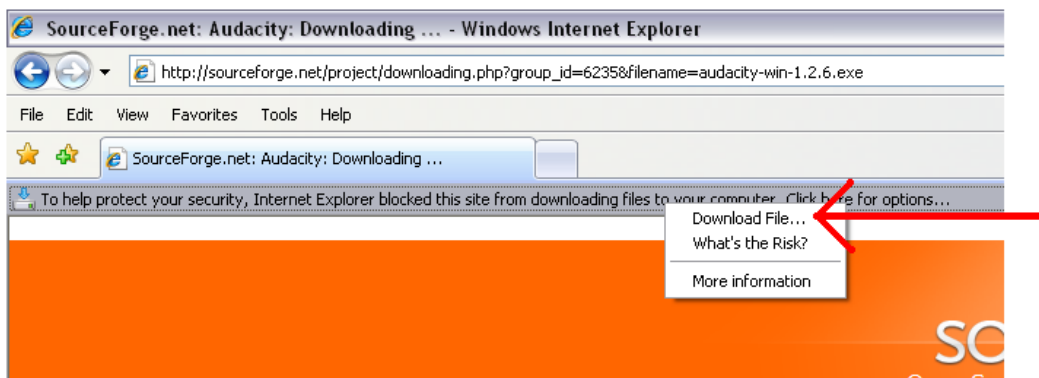


Figure 1.7

In both cases just click the link or yellow bar and choose to download Audacity. Save the file to your computer and then run it. The installer will bring you through the installation process. Once that is complete, open the program. Once the program is open go to:

- The edit menu and select the preferences (Figure 1.8)

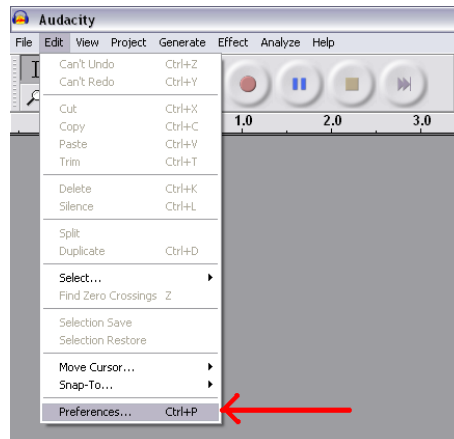


Figure 1.8

- In the “Recording” section select the appropriate input where you inserted the audio input jack (usually labeled “microphone” or “Microsoft Sound Mapper – Input”)
- Also in the “Recording” section select two channels, the standard stereo input
- Click “OK” (Figure 1.9 covers last three bullets)

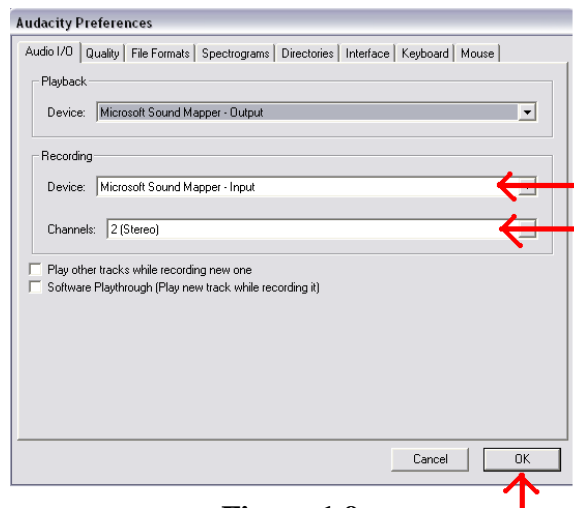


Figure 1.9

Next:

- Click the “Pull down input level meter menu” (Figure 1.10)

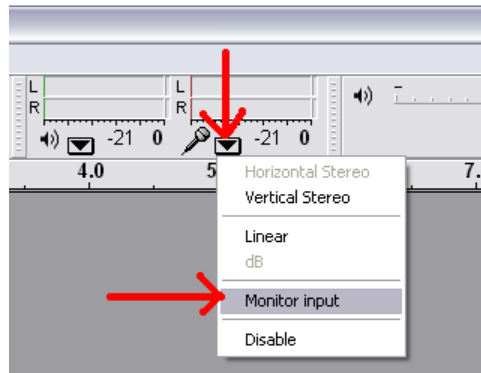


Figure 1.10

- Click “Monitor input”

You are now at the stage where you can record your audio from the cassette into Audacity. To do that, first press the red record button in Audacity and give about a five-second buffer, then press “Play” on your cassette player and record the audio into Audacity. Once you are finished with the tape, or have stopped the cassette player, give another five-second buffer and then press stop in Audacity. Before editing, if you wish to get rid of any part of the recording, simply click and drag across the portion of the audio clip you wish to remove to highlight it, and then press the delete button on your keyboard.

Once you are left with the audio clip you wish to edit, go to the edit menu and click select→all (Figure 1.11).

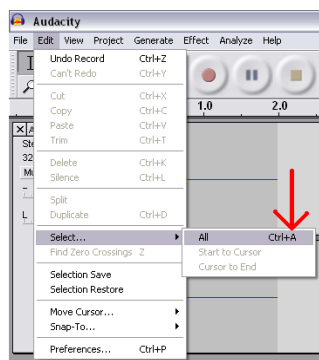


Figure 1.11

Then go to the effects menu and select normalize (Figure 1.12).

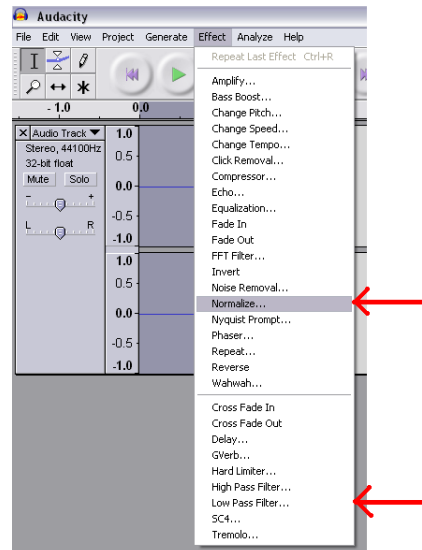


Figure 1.12

In the “Normalize” box make sure both check boxes are checked and click OK. Go back to the effects menu and select the low pass filter (Figure 1.12). In the “Low Pass Filter” you must use your discretion when selecting a frequency at which to cut off the sound. This effect will cut off all sounds below a certain frequency that you select on the scroll bar. The boundary between the fuzz of the audio and the actual audio is where you must draw the line. Eliminate as much interference as possible without affecting the audio you want to capture. If you select a cut-off and are unhappy with it, go to the edit menu and undo it (the first option). This process is just trial and error, and you must keep trying until you reach the audio file quality you desire. However, do remember there is only so much the software can do. If the audio clip cannot reach the quality you desire the poorer quality may have been caused by any number of factors:

- Bad placement of audio equipment when recording
- Poor-quality audio recording equipment

These factors cannot be fixed anymore, and you will just have to deal with those quality issues. After using the low pass filter, normalize the audio clip one more time.

You now have an edited Audacity file, but Audacity files are not compatible with any other audio player than itself, so the file must be converted before it can be used for general purposes. The most compatible of all audio files is the MP3 file. In order to convert the Audacity file to an MP3 file you must download a converter. The link to the necessary converter can be found at the following website:

<http://lame.buanzo.com.ar/>

Look for “Audacity on Windows” and click to download [libmp3lame-win3.98.2.zip](#) (Figure 1.13).

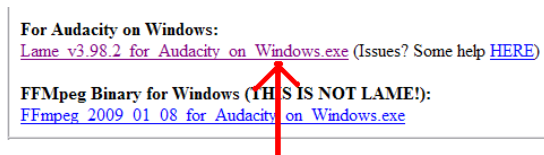


Figure 1.13

Save the file and then open it. Drag the file named “lame_enc.dll” to your Audacity folder. The Audacity folder can usually be found in My Computer/C:/Program Files/Audacity. In Audacity now go to the file menu and select to export your file as an MP3 (Figure 1.14).

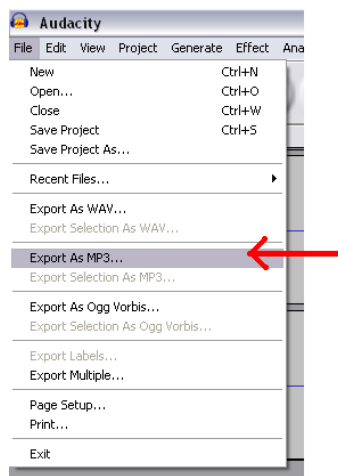


Figure 1.14

A box will appear that will allow you to further describe, organize, and help identify your audio clip. You then have to save your file as you would any other file on your computer. You are now finished with your audio-to-digital conversion, and can now listen to and transfer the MP3 file as you would any other audio file.

A closing remark for this process: Though there are other software out there that can do more than Audacity, the quality you get from this freeware is unsurpassed when it comes to free audio editing software. Because of the budget constraints of this conversion process at the Henley Library, this process is highly recommended.

Appendix B: Video-to-Digital Conversion

As with the audio, the first items you will need for the digital conversion of video files are the necessary technologies. They are the following:

- Video Cassette Recorder (VCR)
- DC Hardware Codec Converter Box (Figure 2.1)



Figure 2.1

- Computer
- Two-sided male video/stereo audio wire (Figure 2.2)



Figure 2.2

- Firewire cable (Figure 2.3)



Figure 2.3

- Firewire card (Figure 2.4)

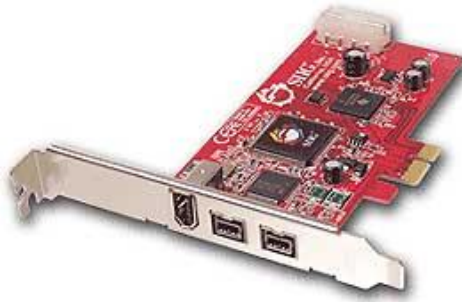


Figure 2.4

One end of the two-sided male video/stereo audio wire must go into the video/stereo audio output on the back of the VCR. The other end goes into the video/stereo audio input in the back of the converter box. Now depending on how many pins the Firewire input/output on the back of the converter box contains, the wire that is plugged in must also contain that many pins. The same is true for the end that goes into the computer; whether 4 or 6 pins, the wire must contain the same amount of pins. There are wires with four and six pins on both sides of the wire, as well as wires with one end having six and the other having four pins. So there should be no problem finding an appropriate wire. The other end of the wire goes into the back of the computer into the Firewire input card that was just newly installed. This card is a vital purchase in this process. You must then place a tape in the VCR, and using the controls on the VCR find the appropriate point in the tape at which you want to start converting.

Once the proper technology has been obtained and properly set up, the attention can now be turned to the software installation and usage. The first thing that you must download is the Windows Media Encoder. The Windows Media Encoder allows the transfer of video input to a windows media video file (.wmv). This format is not

compatible with all computers, specifically Macintosh, but software is available that allows you to convert a file from a windows media video format to other video formats, such as more compatible ones like AVI (.avi) or QuickTime video files. There is also some software that runs basically every kind of video file--an example being the free VLC Media Player. (This will just require a little more research that is not necessary in this situation.) The Thoreau Library runs on PCs, and all PCs can run .wmv files. To keep things as simple as possible, this is the easiest format to work with in the current situation. Since the Thoreau Library will just be viewing, transferring, and potentially streaming these videos off of PCs, it is fine to leave the video file format as the default .wmv file.

The Windows Media Encoder can be found free at the following website:

<http://www.microsoft.com/downloads/details.aspx?FamilyID=5691ba02-e496-465a-bba9-b2f1182cdf24&displaylang=en>

In the upper left hand corner of the yellow box in the middle of the screen there is a “Continue” button (Figure 2.5).



Figure 2.5

Once this has been clicked the computer can potentially ask you to install or run the validation software. There is also the possibility that it will run the software

automatically, and when it is finished it will reload almost the same page except that now the box in the middle of the screen is blue and the button in the upper left of the box now says “Download” (Figure 2.6).

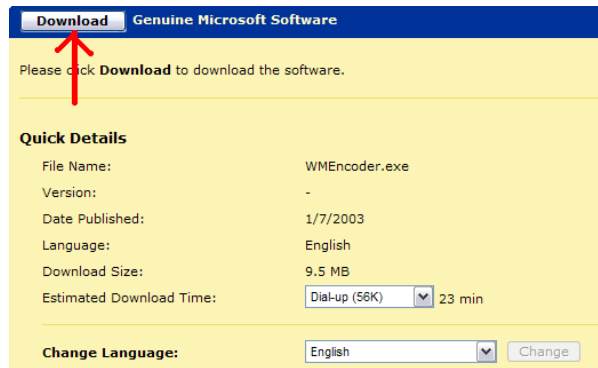


Figure 2.6

Download the software. The installation of the encoder is easy as the installer guides you through the process.

Now that the encoder is ready to go, you need only one other piece of data to download: that is the settings that will later be imported into the encoder to give the video that is digitized the best possible quality for video while still keeping the size of the video file relatively small. These settings maintain a reasonable video size when you has to consider the hard disk space they will be storing all of these video files in and how quickly that can fill up. These settings were sent in an e-mail by Francis Collins and Jarrett Arredondo as they are difficult to explain and it would be much more efficient if they were just sent in a settings file and then imported directly into the encoder (e-mail sent to Jeffrey Cramer) (Figure 2.7).

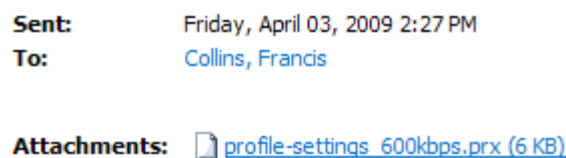


Figure 2.7

These are the best possible settings for the current situation.

The program is running, and the first thing that will be asked in a small pop-up box is what you want to do in the encoder. Choose the option “Capture Audio or Video” (Figure 2.8).

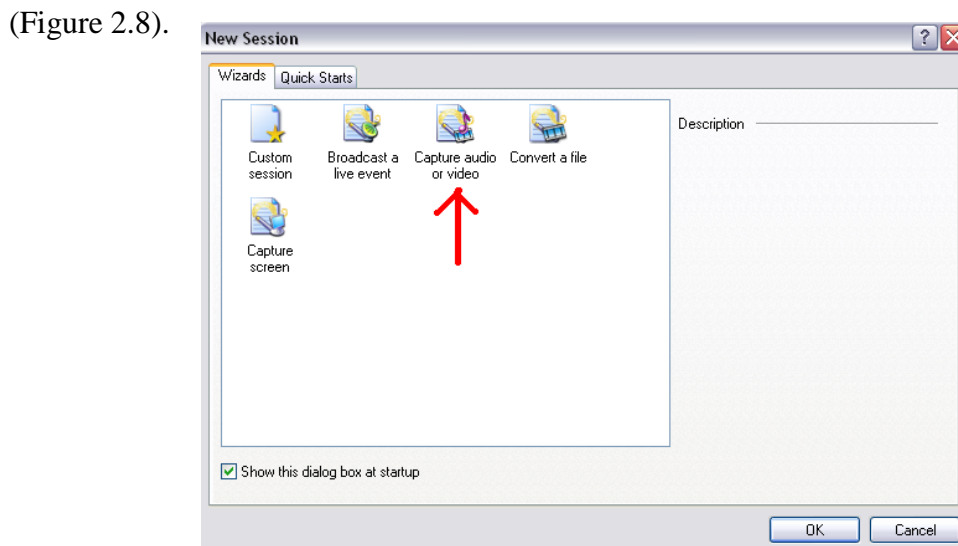


Figure 2.8

The next screen will ask from what devices you want to receive the video and audio, and you will select the device appropriate to the Firewire cable that was inputted into the back of the computer (Figure 2.9).

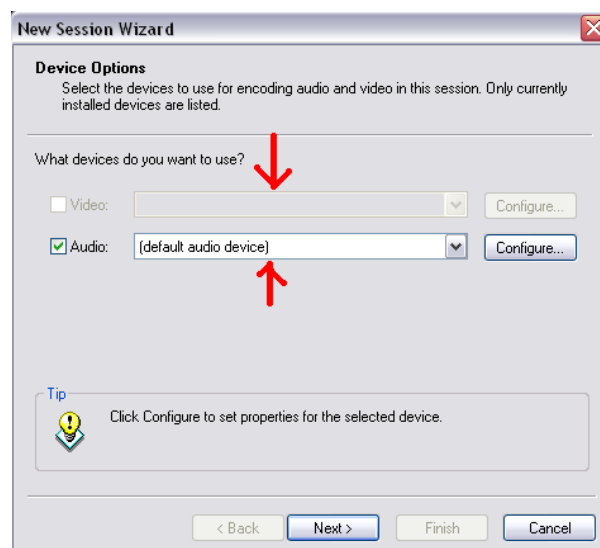


Figure 2.9

Once the devices have been squared away you will then be asked to save the file somewhere on the computer, wherever you choose, and give it a file name. Once that has been done, you will be asked what the file will be used for. Select “File Archive” (Figure 2.10), which is exactly what the digital video file is being created for in the Henley Library.

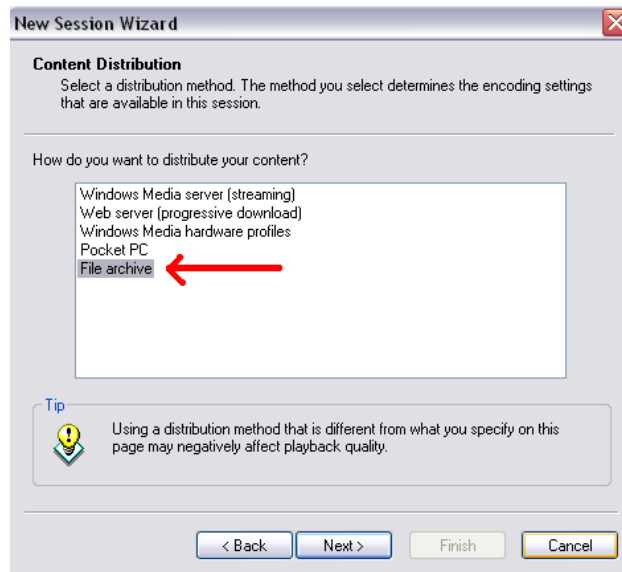


Figure 2.10

However, this file will be fine for streaming online video. The next page asks for your preferences on the quality of the audio and video. You can disregard this, as the quality settings will be imported later from the settings packet that was received in the e-mail. The second-to-last page will ask for further details describing the video file and any fields can be filled in to better organize the video files, at your discretion. Finally, the last page reviews everything that has just been executed and then click “Finish.”

The video should be right before the point at which it going to be recorded into the computer; a five-second buffer on both ends of what needs to be recorded is a good practice. The settings described previous should now be imported into the encoder. To do this go to the “Properties” button on the toolbar, and click it to display a side menu with

tabs (Figure 2.11). Select the “Compression” tab and the “Edit” button on the right side of the side menu (Figure 2.11). The “Import” button is in the upper right hand corner of the box that pops up in the middle of the screen (Figure 2.11). Select this and then browse through the computer to wherever the settings were saved and open them. Click OK on pop-up menu and “Apply” on the side menu (Figure 2.11). There is a “Start Encoding” button on the top toolbar of the Encoder window; press this before you press play on the VCR (Figure 2.11). The portion of the video that needs to be recorded is then recorded, and “Stop” should be pressed on the VCR before the “Stop” button on the toolbar (right next to the “Start Encoding” button) (Figure 2.11). The file is now stored under the name that was given it when setting up the video file.

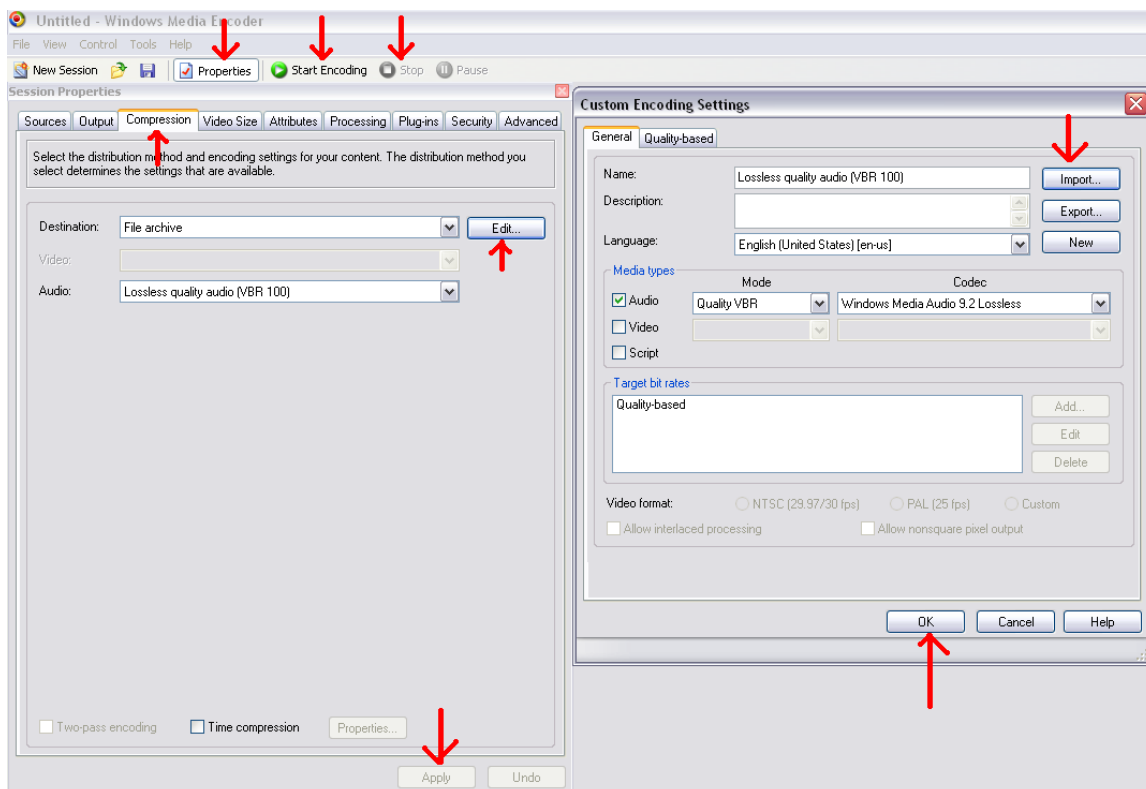


Figure 2.11

The encoder has now served its purpose. The next program to be used is the Windows Media File Editor. This can be found in the folder that contained the encoder, but inside of another folder called “Utilities” (Figure 2.12).



Figure 2.12

Once this is opened, go to “File” and open the file that needs to be edited (Figure 2.13). Once the file is open, use the scroll bar under the screen to position where the video should start and click the “Mark In” button, which is in the bottom right-hand part of the screen (Figure 2.13). Then use the scroll bar the same way and position where the video should end and click the “Mark Out” button (Figure 2.13). The editing is minimal in this example: you can mark what you want and just leave it running. The editor will only record what you want into the new file--a time and hassle saver.

Once you select the portion of video you want, save and index the file (Figure 2.13). The same name will be used as the default, but if you want to save the original, you can just “Save As” and index the edited file under another name (Figure 2.13). It will be saved in the same folder as the original. It is now finished.

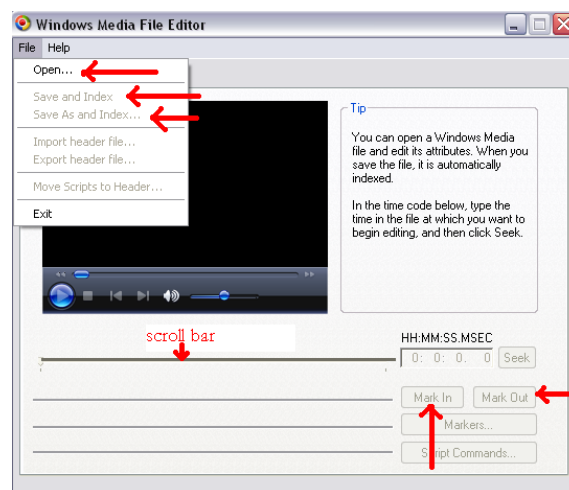


Figure 2.13

Appendix C: VHS Tapes, Beta Max, and Audio Cassettes (all referred to as tapes)

The magnitude of the problem regarding VHS tape and audio cassette deterioration has to do with the magnetic tape within the VHS or cassette. This is a problem that has only come into view in the last few years and can potentially affect tapes that are only 10 years old. The problem is chemical in nature in that the glue or binder holding the magnetic particles to the polyester base of the tape (in a pattern matching the recording) begins to break down and create a tough adhesive on the tape/cassette that makes it extremely difficult to play (sometimes referred to as “Sticky Shed Syndrome”). In the most severe cases, the magnetic material literally falls off the base leaving a pile of dust and a clear base completely erasing the recording.

There are numerous ways to keep your tapes in the best shape possible:

- *Keep tapes clean, cool, and dry*

Dirt, humidity, and heat can cause tapes to become impossible to play back in short periods of time. They are better off being kept in an environment of constant temperature and humidity.

- *Check the tape for a smooth/consistent wind*

Tapes that have edges raised above the pack are exposed to damage over time.

Gaps in the tape indicate uneven pressure. These gaps can get progressively worse over time.

- *Avoid Tape Rewinders*

Tape rewinders put an unnecessary amount of tension on the tape/cassette, because of the speed at which they rewind the tape. Using a VCR or tape deck is recommended when rewinding or fast forwarding your tape. Tapes should not be

stopped in the middle; they should be either fully rewound or fast forwarded when not in use.

- *Protect tapes from physical damage*

In order to protect tapes, simply place them in a shipping case or a plastic sleeve instead of a cardboard sleeve or “library” case, which offer little protection and just like the tapes degrade over time.

- *Make a copy*

If a master tape is lost, there is no way to recover it. A copy is the only insurance. It should be kept out of circulation and played back only when necessary, ideally to make another copy. Copies are inexpensive to make and are the only way to ensure protection against loss of the recording. However, these copies will be of slightly lower quality than the original, which may have deteriorated over time. Copies should be kept in different places and made at different times so that they don't age together.

- *Use working machines to play tapes*

The biggest cause of damage to tapes is the use of machines that are not in good condition as they may damage the tapes upon play. If the condition of the machine is unknown, one can insert a non-valued tape and ascertain the quality of the machine.

- *Label your tapes*

This will ensure that tapes are not accidentally recorded over and allow the user to know what is on the tape without having to play it, thus keeping the tape in good condition.

Appendix D: Vinyl Discs

Vinyl is considered to be the most stable among the many forms of analog recording media. It is a nearly unbreakable light plastic made of PVC (polyvinyl chloride acetate copolymer). Research has shown that the handling and care of vinyl discs plays a key role in determining the longevity of the media. Although newer models of vinyl records, 7" 45s, are made with polystyrene, a more fragile polymer prone to fracture, the same guidelines for handling and care apply. Cleaning of discs is recommended to improve their fidelity. Many foreign substances such as oils from fingerprints, soot, adhesives, and the number one contributor--household dust—can damage the disc. Dust can be permanently embedded in the discs grooves and cause the needle to skip as it plays back the disc, causing inferior play quality as well as scratches on the disc. The disc should be cleaned before and after each play. A common cleaning method is to take a lint-free cloth and using distilled water clean the disc in a circular motion in the direction of the grooves. In the most severe cases, discs that are of poor quality, dirty, and scratched can become unplayable. There is controversy amongst experts as to the best way to preserve these discs, but the majority agree on a basic set of guidelines.

Handling:

- Do not simply pick up discs barehanded, use clean lint free gloves.
- Handle the disc by the edges and label areas only, avoiding the grooves of the disc.
- Remove the disc from its jacket by bowing the jacket open and gently sliding the disc with its inner sleeve out and repeat the process for the inner sleeve.
- Do not remove the disc from its jacket unnecessarily; unneeded exposure to light and air can cause the disc further damage.

Storage:

- To prevent warping, store discs in an exact vertical fashion and allow for 4 to 6 inch spacing. Keeping weights between them will cause the discs to stay straight up and prevent slumping.
- Do not store discs on wooden shelves, as wood can contract and expand, instead use metal shelves.
- Dents can be formed in discs by allowing them to hang over the edge of shelves.
- Remove shrink wrap from jackets to avoid forced contact between the vinyl disc and jacket and compression of the disc.
- Use polyethylene sleeves as opposed to PVC sleeves that can chemically interact with the vinyl disc. Paper sleeves should be replaced as they deteriorate so they do not leave residue on the disc.
- Discs that are not in use should be stored at a cooler temperature than those in use.

Playback Equipment Concerns:

- The stylus tip or needle should be kept clean at all times. Always clean it from back to front gently with a damp cloth.
- The stylus should be inspected for quality and gradual wear and tear from use. Discs should never be played with a worn stylus.
- Use proper tracking force on the turntable. If incorrect force is used this could result in the stylus bearing down on the groove walls or bounce within the groove.

Appendix E: Film and Microfilm

Film is a more complicated media than those previously described. There are many problems that affect it, and each has its own solution. One of the most basic tips to ensure a film's longevity is to make sure it is tightly wrapped on its reel. This will eliminate air pockets between convolutions. Handling is key in film preservation. Just as with vinyl discs, the most damage, including scratches, tears, and surface pollution, can be done to film because of improper handling. Handlers should always wear gloves, proper equipment should be used and cleaned before and after use, and there should be no smoking around open film. Inspectors should have the following equipment: a microscope, 7X to 10X eye loop, gloves, rewind station, and a light source. This is equipment that the Institute does not have, but it is not a huge problem. A film reader, which is a machine that goes through the film frame by frame, should never be used to view damaged or contaminated film. The following is a list of problems that can affect film, along with signs of detection. *Note:* These problems can be resolved by making a silver duplicate of the film using brown-toned film, unless a specific solution is given.

- Antihalation dyes return to their original pink or blue colors because of acid from cellulose acetate deterioration. This is indicated by blue or pink color on sheet film.
- Cardboard is destroyed by hydrogen chloride gas released by deteriorating vesicular film made in the 1960s, indicated by brittle cardboard film storage boxes. The solution is simple: replace the storage box, as it may not be acid free.

- Additives to film, such as plasticizers which make film non-flammable, ooze to the surface of the film, indicated by crystalline deposits on the film or liquid-filled bubbles on the film.
- The cellulose acetate film base deteriorates due to embrittlement of the film resulting in torn or easily torn film. All tears and splices in the film should be repaired using approved splicing materials per Standard MS23-1998 (Practice for Operational Procedures/Inspection and Quality Control of First-Generation Silver Gelatin Microfilm of Documents).
- The following is a list of problems, indicated by faded edges on the film.
 - Involvement of metallic silvers in chemical reactions.
 - Fading of color dyes in color films.
 - Deterioration of cellulose nitrate film.
 - Fading of dyes in diazo film.
- Oxidation of silver in film creates redox blemishes also known as “measles” or “red spots.” These are easily noticeable gold-colored circular tiny dots are apparent on the film.
- Oxidation of silver in film can also lead to “silvering” or “mirroring” which creates gold or rust-colored blobs and causes wavy lines to appear solid.
- High humidity and temperatures can result in the growth of mold on gelatin emulsion, causing noticeable mold growth on the film.
- If diazo images are completely faded, silver images are destroyed chemically, or vesicular images get destroyed by heat or pressures the images on the film can become obliterated. All of these are images that can be contained on film.

- Shrinkage of film (noticeable) can be caused by cellulose acetate base deterioration, which also causes the film to acquire a vinegar odor (vinegar syndrome). Any film with vinegar syndrome should be removed from the collection immediately so that it does not affect other film.
- Acetate base disintegration can result in soft and sticky film.

Appendix F: DVD and CD Drawbacks

Just as with media of the past, newer forms of media are not invincible when it comes to the wear and tear compiled over time. However, the benefits that these formats have in storing media far surpass those of the past. In terms of media transfer, these discs allow for media to be easily transferred from one computer to the next, and burning a disc is a basic capability that is common amongst computers made in the last 10 years (CD/DVD drives can also be purchased separately and installed in your pc). Other advantages of these discs include size, media quality and memory. These discs are much smaller than other forms of media but hold much more content on them (the amount of content is usually based on the quality of the data stored), allowing much more material to be stored in less space. This also makes transport easier, considering how hard it would be to move 50 discs in comparison to 50 tapes or vinyl records. Also the quality of video on a DVD is much better than that of video on a tape, and the same goes for CDs in comparison to cassettes.

Many of the problems relating to discs come mainly from handling and storage. If CD/DVDs are not stored or handled properly, fingerprints, scratches, dust, and dirt can get on the playable side of the disc making it impossible for a player's laser to read the disc. Another thing to consider is that these discs are rather fragile and if put under stress they can be physically broken. Other drawbacks to these discs are related to the media limitations as well as capabilities. Basic discs can only have data written onto them once. So once it is transferred to the disc it cannot be overwritten. Some discs which can be formatted and have data written to them multiple times. Just as with tapes, these can be labeled so that important information doesn't get deleted, but if the data is deleted off the

disc and not backed up on the computer, it's gone. These discs will degrade over time, but the cost of making copies is low enough that backing up information isn't a problem. Ultimately this media is one of the best ways to store data today. Advancing technologies will create competition over time (such as blu-ray, and portable external hard drives), but DVDs and CDs are currently the most recognized formats or media storage. However, advancing technologies also have backwards compatibility which will keep DVDs and CDs from going out of use for awhile.

Appendix G: Digital Media Drawbacks

The Thoreau Institute needs their media converted into a digital form which can be stored on a computer. Media stored in this form is perhaps the most advantageous, but it is also flawed. One of the major drawbacks to storing media as digital files is in the potential stability of the files. If the file is in any way damaged, even to the lowest bit of memory, it will be unplayable and useless. Other problems arise from issues such as compatibility, memory size, backup, and convenience.

Most media files stored on computers are universally compatible, but there are instances where files are saved for a specific media player and cannot be converted. Memory size creates a problem when the great debate of quality vs. quantity arises. It is a known fact that media of a lower quality takes up less memory than that of media saved in the highest quality possible. Computers do have a limited amount of memory, so a sacrifice in quality or quantity will sometimes have to be made. On another note related to memory, data files can easily be erased off a computer. Initially when deleted they can be restored, but if permanently wiped from the computer's hard drive, files can be lost forever. For convenience, if you want to play your file. You need the computer the file is on or a piece of media that it is recorded onto as well as a computer or whatever device that plays that piece of media.

Each one of these drawbacks can also be looked at from an advantageous standpoint as well. As technology has progressed, so have the digital files used to store media. Most files can be read by almost all media players, and compatibility is a rarely seen problem. Memory is not simply limited to the computer the file is stored on. It can now be purchased and more files can be stored and accessed by the computer. And just as

easily as it can be erased, memory can also be backed up. Through use of an external hard drive, e-mail, DVDs, CDs, flash drives, and zip disks, memory can easily either be stored over the internet or on a physical entity other than the computer and in multiple copies, which are easily made, cost nothing, and are of the same quality of the original. Convenience in terms of these files can also be looked at from a different view. Data files can be played on a computers, DVD players, CD players, and mp3 players. Storing media as digital files is a superior storage solution to analog formats of media and may become the only way that media is stored in the near future.

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