Digital Humanities in Biblical Studies and Theology Communication

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Presentation of the Center for the Study of New Testament Manuscripts: Bridging the Gap between Ancient Manuscripts and Modern Technology

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Abstract: This article seeks to expound upon the first facet of CSNTM's mission: to capture firsthand digital images of Greek New Testament manuscripts with high resolution digital equipment. By cooperating with likeminded libraries, CSNTM accomplishes the preservation and presentation of cultural heritage artifacts via the utilization of the advances of technology. Details of collaboration, digitization procedures, and preservation and presentation practices are explored, providing a glimpse into this world of artifact digitization. The article then turns to the consideration of ways to improve both digitization and the end user's experience. While CSNTM engages libraries, archivists, researchers, and students, supportive partners serve to facilitate the work. All are essential, enabling CSNTM to preserve and provide access to timeless treasures.

Keywords: CSNTM; manuscripts; New Testament; digitization; digital humanities; multispectral imaging; preservation; collaboration; INTF

1 Introduction

The initial mission of the Center for the Study of New Testament Manuscripts (CSNTM) is to digitally preserve ancient manuscripts for the modern world.¹ In 2002, Daniel B. Wallace founded the Center to utilize emerging technologies to photograph and fully archive Greek New Testament manuscripts. The images produced are freely accessible on the Center's website – a searchable library of Greek New Testament manuscripts. We have collaborated with more than forty-five institutions on four continents to produce images of approximately 700 New Testament manuscripts. These images have been provided to their holding institutions at no cost. In the process, we have “discovered” over seventy-five New Testament manuscripts that had not been catalogued by the *Institut für Neutestamentliche Textforschung* (INTF), more than any

¹ We want to express our sincere gratitude to Daniel B. Wallace, Jacob W. Peterson, and Andrew J. Patton for their beneficial feedback on the draft of this work.

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other organization in the twenty-first century.² The Center is internationally recognized for its expertise in digitization. More than 50,000 users examine the images in our digital library each year. Accordingly, the Center's digitization work facilitates a partnership between manuscript owners, archivists, and researchers around the world. The following profiles the organization's cooperation with libraries to accomplish the preservation and presentation of cultural heritage artifacts via the utilization of the advances in technology.

2 Collaboration

Collaboration with various institutes and individuals in bringing a manuscript from the library's shelf to a researcher's computer screen is a central focus of the Center's mission. The Center collaborates with other organizations and individuals on a daily basis to ensure that images are made available to the greatest number of people possible. This is held in tension with our commitment to honor the contracts and wishes of each holding institute. While many digital libraries contain a single collection, CSNTM is exceptional in that we not only archive and display images of our own manuscript, GA 2882, but also images from scores of other libraries we have partnered with in the last two decades. This allows CSNTM to be a vehicle for scholars to access images they might otherwise not be able to view without visiting the library themselves. In fact, the majority of images on our website are images we digitized at remote libraries or monasteries. By partnering with these institutes, we are able to provide images and access to documents that would likely not be digitized in the near future. Further, this offers libraries the opportunity to have their collections digitally preserved when they may not have the means or expertise to engage in an exhaustive digitization project. The following sections highlight some of these international collaborations.

2.1 Contracts

Obtaining contracts with various libraries is one of the ongoing challenges the organization faces. Considering the broad distribution of libraries – including institutes, private collections, monasteries, and many others – and various political and cultural issues, working with these variables can take years to secure a contract. However, our International Advisory Board and the Center's track record for carefully and completely archiving each document continue to open doors to new opportunities for partnership.³

One aspect of our contract has always been that the library will retain all of the rights to the images.⁴ We simply ask that we be allowed to display them on our website and keep a copy in our archives for preservation.⁵ In this way, libraries know that their images will be properly archived, apart from the copy they receive, and that they will gain international attention by CSNTM giving free access to their images. In order to accomplish these things, CSNTM's viewer has various safety protocols that inhibit researchers from downloading images. Restricting downloads while providing free general access for viewing is not only a common practice in digital humanities but is also a protocol designed to steward the images entrusted to

² A "discovered" manuscript refers to one that was previously unknown to the wider academic community because it is uncatalogued, although sometimes the librarians themselves were cognizant. At other times, CSNTM's researchers have been able to inform the library staff of a new finding that is in their collection. For announcements of these discoveries, see the CSNTM blog.

³ For example, our ongoing relationship with the National Library of Greece has allowed us to work with various monasteries in central Greece, thereby opening doors to historic collections.

⁴ For almost identical policies with regard to image rights and downloading, see the Hill Museum and Manuscript Library, <http://hmmml.org/about/> (accessed 25 October 2019). Unfortunately, there is no one Creative Commons license that encompasses the various types of contracts required by libraries in our digital archive. As such, we do not impose a single rights scheme for our website but view each collection individually, and we request researchers to gain access based on the library's requirements and permissions. If a library requests that their collection be held under a specific creative commons license, we are more than willing to accommodate those stipulations. The general principle is that we allow each library to make that determination.

⁵ In certain instances, the Center has only been allowed to have an archival copy for research purposes and is not allowed to display the images.

us. If CSNTM were to require that a holding institute's images be downloadable, such a stipulation would bring an end to many negotiations, particularly with non-western libraries and monasteries.

If any scholar wants additional access to images for personal copy, publication, presentation, or display, they may contact the library and us in order to request the complete archive.⁶ CSNTM is happy to provide them without any cost to the researcher as long as the proper permissions are obtained from the holding institute which owns the rights. In this way, the Center acts as an intermediary between researchers and libraries by both providing access freely to all and honoring the wishes of the library.

Many researchers presume that all cultural heritage documents should be available with open access. However, libraries around the world are entrusted with caring, preserving, and archiving their collections to the best of their ability. This process is both costly and time-intensive, and researchers often lack sensitivity to such dynamics – especially with smaller libraries. International copyright laws are often unclear on many of these dynamics, and scholars ought to exercise ethical standards that supersede such laws. If a library requests that their images remain private or require various steps for access, scholars ought to enthusiastically support such measures since without these libraries protecting these cultural heritage documents, the world would lose valuable resources. The mere fact that a library has allowed their collection to be digitized demonstrates their commitment to preservation.

2.2 Scholars and institutes

The Center also collaborates with numerous scholars and institutes in various fields of study. This area is primarily focused on providing images for researchers: art historians, text critics, paleographers, papyrologists, codicologists, archivists, and other digitization experts on various projects. At any given time, the Center may be working on or contributing to various research projects. Of course, all of these projects fall within the confines of our library contracts, but these very restrictions make the content of our digitization efforts more widely accessible.

2.3 *Institut für neutestamentliche Textforschung*

One of the main groups the Center has collaborated with over the years has been the *Institut für neutestamentliche Textforschung*. The INTF was not only the first place where the Center digitized manuscripts but has also been a trusted partner in helping the organization gain access to libraries. Because of their aid, the Center was able to digitize the amazing collection at the *Biblioteca Medicea Laurenziana*. We have also provided countless updates to INTF's online and print versions of the *Kurzgefasste Liste*, as we travel to each location revising the information available regarding the library and their collections. As was previously discussed, our contracts only allow CSNTM to host images. Unfortunately, due to the difficulty of even obtaining our own contracts for digitization, the Center is unable to secure additional permissions for third-party organizations. However, we have worked with INTF to help them gain permission to host images on their website after a digitization project is complete.

The INTF began their New Testament Virtual Manuscript Room (NTVMR) a few years after the founding of CSNTM, and in doing so, they have become a fantastic resource for those researching the text of the New Testament. While the NTVMR has grown to provide multiple resources for *researching* manuscripts, the Center has remained a place for *viewing* manuscripts. In no way does the Center want to compete or provide redundant services with the NTVMR. Rather, CSNTM intends to provide the best viewing experience for the manuscripts we have digitized and others we have obtained. For example, our viewer was built on a responsive design, allowing all features to be available on either a desktop or a mobile device. Further, the viewer is intended to be the primary object on the screen – not competing with space for transcriptions and other features.

⁶ This is explained in more detail on the Center's website, under the "Terms of Use," Section 3b, which each user must agree to in order to view the digital library.

2.4 Additional partnerships

The Center works with various granting agencies, foundations, and individual donors who care about the work of digitization and preservation (e.g., Hillcrest Foundation, Bank of America, N.A., Co-Trustee). These groups understand the importance of digital preservation and grasp that the Center's services allow numerous collections to be freely available worldwide. Such collections would otherwise remain limited to microfilm or would be virtually inaccessible to researchers. Further, many individuals not only contribute financially, but they also contribute their time to aid CSNTM with website development, indexing, and other tasks that make future research easier. This also lowers the operating costs of the Center, permitting us to focus our efforts on accessing and presenting more manuscripts through our digital library. Thus, the Center collaborates with everyone from librarians and researchers to monasteries and museums in order to bridge the gap between state-of-the-art scholarship and ancient collections.

3 Digitization

The first facet of CSNTM's mission is to capture firsthand digital images of Greek New Testament manuscripts with high resolution digital equipment. The Center has dedicated itself to achieving this goal without charge to the owner of the manuscript. CSNTM has never accepted any form of compensation for the privilege of digitizing manuscripts. To clarify, the mission is to obtain *firsthand* images. "Firsthand" refers to the direct digitization of New Testament artifacts, as opposed to scanning a previously made photostat, for example. Although high-resolution photography has been the vehicle used to capture the manuscripts, such a descriptor is a sliding target. As technology advances, so does the Center's insistence on the highest available digital resolution. We started with a 4-megapixel point-and-shoot camera in 2002, at the time a medium- to high-end digital camera. That camera and its technology are now relics. Currently, the cameras that the Center uses are 50-megapixel professional cameras, and in the not-too-distant future these specifications will be superseded by yet another technological advancement with even greater capabilities. With refined protocols and superb equipment, a preservation outcome is achieved that is accessible and capable of duplication without deterioration. In the last decade, our standards now meet international guidelines set by the Library of Congress, the British Library, and the *Deutsche Forschungsgemeinschaft*. It is to this end that CSNTM pursues its purpose. There are two aspects to digitization: the manuscript examination and the manuscript capture. The capture can be subdivided into standard imaging and multispectral imaging. Digitization leads naturally into the preservation and presentation of the images.

3.1 Manuscript examination

The examination of a manuscript occurs as a prerequisite to its digitization. Internally, this is referred to as an autopsy, although such a term could be misleading. The manuscript is not deconstructed in any way, but its evaluation is relatively thorough nonetheless. Several types of routine data are collected: contents, date, material, physical dimensions, library's shelf number(s), columns, and lines per page. In addition to these specifications, CSNTM also records specialized data that is not often found in other catalogs, including details such as quire count, leaves in each quire, and depth measurements. The leaf count is particularly useful information because the digitizing team must have an accurate count and notes about when the numbering may have variations.⁷ Following the examination, the manuscript is ready for the team to begin the process of digitally recording its contents.

⁷ It is fairly routine for the leaf and/or page numbering to have anomalies. For example, the numbering may skip or duplicate (3, 4, 6, 7, 8 or 3, 4, 4, 5, 6). The digitizers must be keenly aware of such inconsistencies so as to not make an error in their preservation efforts.

The autopsy is a vital part of the digitization process for a couple of reasons. First, because digitization records the artifact in a virtual state, precise details are essential for a researcher to comprehend the manuscript and utilize it properly. This researcher will likely not have the luxury of examining the manuscript herself – due to the expenses associated with travel or the difficulty of gaining in-person access to a library’s treasure. In addition, these data points feed metadata collection processes. Accurate metadata is necessary to produce useful searches in a database and for a library’s own records. CSNTM’s website is searchable. This metadata is the lifeblood of such a presentation of these valuable records of the New Testament.

3.2 Manuscript capture

3.2.1 Standard imaging

Standard digital imaging has traditionally involved digital single-lens reflex (DSLR) cameras.⁸ Professional level equipment utilized by an experienced staff person yields a virtually impeccable end product. CSNTM’s standard for image quality is “perfection.” The target of perfection is an amalgam of principles that work together to constitute a good image: image focus, 3:2 vertical ratio (see below), horizontal alignment, square page, top and inside margin alignment priority, stylus pressure, and hole awareness. Many times, the manuscript itself will physically present obstacles to this standard. For example, a tight binding may cause pages to create a natural waterfall effect,⁹ which in turn affects the squareness of the page in the image and results in a trapezoidal appearance. A trapezoidal page also violates the principle that seeks a straight top margin. In order to hold the page straighter, a stylus can be used, but too much pressure can cause the outer margin to dip undesirably. Balancing these standards is a tedious and sometimes time-consuming process. Over time, the articulation of that standard has been adjusted to “practical perfection.”¹⁰ Nevertheless, each image and the processes to produce it are scrutinized to deliver the best possible representation of the manuscript.

The typical equipment setup currently utilized includes a 50-megapixel camera, a custom-made mobile copy stand, and a laptop computer. The computer runs the image-capture software; thus, the digitization is controlled directly from the computer rather than from the camera. With a skilled manuscript holder and computer operator, image capture with standard imaging can occur quite rapidly. The skills involved, however, are not easily mastered, and many digitizing teams have been frustrated in attempting to achieve the Center’s exacting standard. We have found that the teams do not reach a high level of proficiency until they have captured about 10,000 images.

Since its inception in 2002, CSNTM has transitioned through several versions of standards protocols. These protocols are the guidelines that govern the methods used to create page-by-page digital images of ancient texts. While it is unnecessary to reminisce about each of these, a description of some of the aspects of CSNTM’s current practices may be instructive.

Digitization captures the entirety of the manuscript, page-by-page, and all six sides of a codex. In that way, the entire artifact is preserved – even if New Testament material comprises only a small portion of the contents of the manuscript. Capturing the entire artifact is a best practice that CSNTM fully supports. In terms of framing the page, the vertical spaces above and below the page are set at a 3:2 ratio. That is, the background of the page itself is at a 3:2 ratio – 3 parts on top of the page and 2 parts below. The rationale

⁸ New technology is emerging that uses a mirrorless camera. Time will tell whether this evolution will replace DSLR photography for manuscript digitization.

⁹ The “waterfall” effect is a situation that occurs when the pages fall over from the binding to the outer edge with the effect that the top or bottom is not straight. The goal is to capture the page as flat as possible without doing any damage to the binding.

¹⁰ This means that we strive for perfect images according to our standards, but it also allows for slightly increased margin or variation in positioning in order to ensure such standards do not slow down image capture to an impractical speed or damage the manuscript.

is simple. Medieval manuscripts were usually written with a top to bottom margin ratio of 1:2 or 1:3.¹¹ By inverting that space for digitization, more black space (when a black cloth is used as a background) is above the page. And the byproduct is that the text is approximately centered vertically in the image. It also results in an aesthetically pleasing appearance. CSNTM has always used one person to hold the manuscript during digitization and another to control its capture via a laptop. Such a setup provides a dedicated person, trained in artifact-handling, to attend to the manuscript at all times, ensuring its safety. This individual is responsible for positioning the manuscript in the field of capture along with preventing stress to the binding and pages during the project.

The postproduction of images that make up the manuscript digitization begins while on-site. Quality control processes are run in order to ensure that the caliber of every image meets “practical perfection.” These checks include things such as reviews of focus, naming conventions, alignment relative to the inside margin (tight but without missing any portion while attempting to exclude text from the preceding page), all four sides being completely in the image without any portion clipped, avoidance of waterfall effects or trapezoidal appearance, relative consistency (size, color, etc.) from one page to the next, verification that all pages were captured without skipping or duplicating any, and file conversions. Following quality control, an initial backup of the project is made. After the digitizing teams return to the office, the images are moved onto the local server, and additional backup processes are conducted. The images of the manuscript are prepared for display on CSNTM’s website (<http://csntm.org>), which includes tagging of important features and indexing.

The standard imaging digitization process is quite laborious but exceedingly profitable. The product yields fruit that is necessary for the work of many. Although the initially-envisioned users of CSNTM’s online manuscript library were primarily students of the New Testament and textual scholars, history has demonstrated a wider audience. Byzantine art historians might utilize the vibrant images to research the icons in medieval manuscripts; paleographers might analyze handwriting; and Greek teachers might illustrate the shift from the written to the printed text. It is to this end – the digitizing of handwritten texts for the benefit of the humanities – that the Center makes its work freely available.

3.2.2 Multispectral imaging

Multispectral imaging (MSI) is a revolutionary, highly technical combination of equipment and software that facilitates the collection of data about a cultural heritage object to reveal details about that artifact.¹² MSI uses a method completely distinct from standard imaging to capture the artifact, yet its benefits are invaluable. Depending upon how the data is processed, MSI can produce results that were heretofore unimaginable. For example, MSI, when utilized properly, can reveal text that is either difficult or impossible to read with the unaided eye. Text could be illegible due to exposure to water, being a palimpsest, or some other condition. A skilled technician can then, through post-processing, reveal the hidden or obscured text and thus provide researchers with valuable testimony to a lost text. The results of MSI can also be analyzed to identify specific color compounds used to create icons.¹³ With that information, the materials can be traced so as to potentially provide a place of origin for the artifact. An archivist can use data from periodic MSI sessions to track the rate of deterioration of a manuscript in its storage environment. Doing so can give the archivist tangible evidence that the storage conditions are adequate or that they might be improved. The applications of MSI are seemingly endless.

MSI digitization, which is more properly called data collection, begins with the equipment. CSNTM currently uses a system developed by MegaVision that is portable and designed specifically for cultural

¹¹ The top margin of skillfully made medieval manuscripts was typically one-ninth the page’s height; the bottom margin was two-ninths of the page’s height; the inner margin was one-ninth of the page’s width; and the outer margin was two-ninths of the page’s width (Tschichold, *The Form of the Book*, 43–44; see also Johnston, *Manuscript & Inscription Letters*). Of course, variation exists between manuscripts, but the thrust of CSNTM’s principle is that the top margin is larger than the bottom’s to counter the manuscript’s layout. CSNTM’s practice moves the text toward the center of the page.

¹² MSI actually has a much broader range of applications, but we are speaking here in terms of relevance to our work.

¹³ This can be accomplished by comparing color values of various portions of the image and what those values demonstrate as far as the component makeup of the ink.

heritage digital imaging. Twenty-five images, some of which also utilize filters, are captured across the ultraviolet, visible, and infrared light spectra with a monochrome sensor. Each of these images reveals different amounts and types of data. Depending upon the desired outcome, some of these may be more valuable than others in the post-processing stage. Additionally, a composite color image can be created by combining the individual images from the visible spectra. The resulting image does not *look* dramatically different from a color image taken with standard imaging equipment. However, the composite image vastly improves color accuracy by overcoming the obstacles inherent in the interpretation of color by the sensors in DSLR cameras. The outcome is a “highly accurate color reproduction of a very wide range of difficult subjects.”¹⁴ But the real magic occurs during the post-processing stage.¹⁵ It is at this stage that the desirable outcomes can be achieved.

The intersection of New Testament textual studies and digital humanities has become a welcome union with great potential. The spectral attributes of the data that is collected from MSI along with the potential results from post-processing lend themselves to being used by the skilled researcher to reveal tremendous insights. When compared to standard imaging, MSI is exponentially more time-consuming because its process is far more exacting. This technology assists CSNTM to achieve its goal of “practical perfection” in image production.

4 Preservation and presentation

CSNTM serves as stewards of the images that it captures, both in terms of preservation and presentation. CSNTM provides a complete archival copy of images to the library. This copy includes whatever format of images a library requests including RAW, TIFF, and JPEG. The Center will provide any or all formats that a library requests. As was previously mentioned, these images will also be the sole property of the library, so they may use them however they wish without restriction. We simply ask for attribution for digitizing the collection.

The images are also backed up in a RAID (Redundant Array of Independent Disks) configuration on CSNTM’s local server, which is both housed in a secure location and inaccessible without proper permissions. Our archives are stored in a climate-controlled server room with fire controls and multiple redundancies in order to ensure that the images last for generations to come. One such redundancy is that our images are also backed up at two separate international locations, further ensuring the future of the manuscript data. This backup is in standard archival formats and is done in accordance with best practices in order to guard against the obsolescence of the data.

While other sites host images of New Testament manuscripts and make them available freely, CSNTM is unique in that the majority of the manuscripts on our website are images we have digitized ourselves. In order to present the most accurate rendering of the artifact, the images are displayed in the viewer unaltered by digital editing software. These manuscripts have been personally examined by our staff, and information about that examination is also freely available alongside the manuscript viewer. Further, the viewer was designed to function with a searchable database, so that the images of the manuscript can be displayed based on the keyword searches. For example, if someone wants to view icons in a certain manuscript, they can easily search for the type of icon they want by clicking on the list to the left of the image viewer. This type of search is accomplished because of tagging. Anyone can contribute to image tagging by contacting the organization and getting private login credentials. Furthermore, as more and more verses are tagged on the website, the search becomes more robust. A researcher may type in a verse reference and every manuscript page that is tagged with that reference will quickly appear. This is all done through our manuscript viewer, which as discussed earlier prevents downloading of images. The library and the manuscript’s characteristics are also displayed prominently, so it is clear where it is located and

¹⁴ “MegaVision Archival and Cultural Heritage Imaging.”

¹⁵ The term “post-processing” is being utilized in a more expansive way than in the standard imaging section above. Post-processing of MSI includes those things in standard imaging but extends to the processing of the raw data to reveal additional information (e.g., faded text).

what features it has. This is done in order to create the best viewing experience possible, so searching and viewing are done easily and without multiple steps. All of these features and archival procedures are done to ensure that we remain faithful stewards of the digital collection that was entrusted to us.

5 What lies ahead?

CSNTM staff are constantly seeking for ways to improve both our digitization and the end user's experience. Three areas of expansion seem particularly beneficial: (1) comprehensive image metadata, (2) continual website improvements, and (3) optical character recognition.

5.1 Metadata

Metadata, which is "data about data,"¹⁶ serves as the glue that binds together the raw materials of digital humanities. Without precise and relevant metadata, the images that the Center collects are not easily navigated, and the information they contain could be cumbersome to utilize. Metadata Encoding and Transmission Standard (METS) of the Library of Congress captures the importance of metadata well.

Maintaining a library of digital objects of necessity requires maintaining metadata about those objects. The metadata necessary for successful management and use of digital objects is both more extensive than and different from the metadata used for managing collections of printed works and other physical materials. While a library may record descriptive metadata regarding a book in its collection, the book will not dissolve into a series of unconnected pages if the library fails to record structural metadata regarding the book's organization, nor will scholars be unable to evaluate the book's worth if the library fails to note that the book was produced using a Ryobi offset press. The same cannot be said for a digital version of the same book. Without structural metadata, the page image or text files comprising the digital work are of little use, and without technical metadata regarding the digitization process, scholars may be unsure of how accurate a reflection of the original the digital version provides. For internal management purposes, a library must have access to appropriate technical metadata in order to periodically refresh and migrate the data, ensuring the durability of valuable resources.¹⁷

Metadata collection has always been a part of the methodology used by the Center. However, there are ways that the collection and storage of this information might be improved so that it can meet additional standards and improve accessibility. A fruitful place to look for direction in this regard is the METS.¹⁸ CSNTM is exploring ways to automate metadata collection, effective ways of storing information, and efficient sharing to constituents to boost collaboration.

5.2 Website renovations

Because the website is the face of the organization, staff members routinely improve the site, both in content and presentation. CSNTM has to be strategic in its implementation of improvements because of practical limitations. Two areas of future development provide significant promise for increased functionality of the site.

First, improved indexing and tagging of the images of manuscripts on the site would be tremendously beneficial. Indexing is the labeling of specific verses associated with a particular image of a page. For example, the first verse and the last verse on a particular page can be tagged. In that way, a search can

¹⁶ Gilliland, "Setting the Stage," <http://www.getty.edu/publications/intrometadata/setting-the-stage/>. Gilliland continues to articulate the essence of metadata: "metadata is...the sum total of what one can say at a given moment about any *information object* at any level of aggregation."

¹⁷ "METS: An Overview and Tutorial."

¹⁸ "METS: Home." A broader list of other standards can be found at the site "Standards at the Library of Congress."

bring a user directly to the page that contains the desired passage. Currently, indexing occurs manually, so a method to increase the speed of indexing would greatly improve the user's experience. Further, indexing of biblical manuscript images has been accomplished by other organizations, so enabling our website to import such data would eliminate redundancy. In addition to general tagging, the further ability to provide micro-indexing – i.e., the tagging of a specific verse in its actual location in an image – would be invaluable to researchers. Finally, we are exploring ways of moving indexing to a more automated process within the digitization and processing workflow.

Second, researchers often have needs that extend beyond verse indexing. Supplementing the website's database with additional tags increases its usability. Fuller tagging of manuscript pages with headpieces, *ektheses*, icons, canon tables, etc. expands the ways the data captured in digitization can be used by researchers. Even more, if the website were to include a Spectral Curve Analysis with multispectral images, researchers could compare these metrics with subsequent images to verify that their preservation practices are indeed effective. These are ways that could dramatically impact facility with which a researcher utilizes the image data.

5.3 Optical character recognition

Since CSNTM's inception, its goal has been to leverage developing technologies to reduce the manual workload involved in creating a pool of all New Testament textual variants. A couple of technologies in particular were envisioned: MSI and optical character recognition (OCR). The first is now a reality; the second remains on the (distant) horizon.

OCR is essentially the usage of computer software to recognize typed or handwritten characters of a text based on a digital image. The end product would be a transcription of a manuscript in a machine-readable format. Any product of OCR would necessarily require a very high degree of accuracy to be of any practical use. It is true that most models fail to provide a sufficient level of accuracy, but we have seen some promising developments recently from some researchers that point to this vision becoming a reality. If successful, the creation of full transcriptions could be automated, with a review process in place, thereby increasing the speed of transcriptions exponentially. In turn, this would provide a significant increase in the available data for manuscript comparison and possess increased accuracy of such data.

5.4 Summary

Whether the Center moves forward with one of these methods to improve or some others, it will continue to strive to bring together technological advances to facilitate New Testament textual criticism. These proposed ways forward are in essence the outplaying of the broader scope of the Center's vision. They are in no way intended to be techniques that would supplant the first facet of CSNTM's mission: capturing firsthand digital images of Greek New Testament manuscripts with high resolution digital equipment.

6 Conclusion

While serving to bridge the gap between New Testament manuscript testimony and digital humanities, CSNTM engages libraries, archivists, researchers, and students. The intent is that these manuscripts are preserved for posterity, making them easily accessible to the present and the future. Technology is a tool that assists in that endeavor. None of it can be accomplished without partners. Some offer financial backing. Others volunteer technical know-how. Still others bring specialized knowledge of the Greek language and New Testament textual criticism. All are essential.

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