

The Study and Teaching of Buddhist Art and Iconography Using Computer Technology

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No one needs to be told that computers are ubiquitous in the modern academic environment. Virtually every serious academic uses one or more computers, usually one at the office and another at home. Which platform is used is essentially irrelevant, although some platforms are far superior for certain tasks.¹ For most academics, word processing, data basing, and spread sheet analyses are the most common usages, although, for some, especially journal editors, desktop publishing and some graphics may come into play. While I will mention some of these techniques in passing and there is a data basing aspect to any information management project, the following article is about graphic imaging and communicating about Buddhist iconography, and only incidentally about the previously mentioned computer functions. Rather, it is assumed that most persons willing to read an article on computer use in Buddhist iconography will be familiar both with the processes and potentials of those techniques and will be interested in more complex approaches using graphic imaging, rendering and drawing, multimedia, and World Wide Web network applications.

To suggest some of the ways in which the use of computing may be correlated with the study of Buddhist iconography, I will describe some of the current projects in which I, the visual resources staff of the John

C. and Susan L. Huntington Archive of Buddhist and Related Art at the Ohio State University, and my students are working on. Several of these projects overlap so there is some redundancy, but, on the whole, the following are discrete projects, each with their own momentum.

A Preliminary Note on Field Documentation

To understand the following article, the reader must be aware that as an aspect of our scholarly research for the various studies we have done and, more recently, specifically for the *Encyclopedia of Buddhist Iconography*, my wife, Susan L. Huntington, and I have made nearly three hundred thousand photographs and slides of primarily Buddhist art throughout Asia. This collection presently covers the countries of Afghanistan, Pakistan, all of India (including Kashmir and Ladakh), Nepal, Sri Lanka, Bangladesh, Myanmar, Thailand, Indonesia, China, and Japan. It is still on my agenda to carry out photographic documentation in Laos, Kampuchea, Vietnam, Korea, Mongolia, and parts of China that I have not yet visited. In addition, I hope to return to Nepal, Sri Lanka, and Burma to complete work in progress. Although this project began innocently enough as an attempt for us to gather materials for our own teaching and research, it soon grew to have a "life of its own" and the preservation, publication, and cataloging of the material so that it can be used by others has become a major aspect of our ongoing work. One of our goals is to make this material widely available to the scholarly community. The emerging computer technologies, including multimedia, CD ROM publication, and on-line publication, seem ideally suited to this goal of broad dissemination of the material. Much of what will be discussed in the following is to be understood in light of this effort.

Research and Publication

The primary project to which I devote most of my research hours is the forthcoming *Encyclopedia of Buddhist Iconography*, which is to be published on CD ROM under the imprimatur of the American Academy of Religion. The current plan is to publish subsections on a regional basis, e.g., Early India, Gandharan and related regions, Gupta India, Later India, etc. The preliminary research has been to compile a database of deities, based on major primary and secondary iconographic sources, secondary compilations, and major iconographic studies. In its present state, the main file set contains more than six thousand records, and is cross indexed by a number of major subgroups, such as the twenty-eight deity classification, a number of other traditional typologies that

fall outside of these classifications, as well as some of my own classifications that have appeared useful.

Individual deities sometimes have an astonishing variety of forms. For example, there are fifteen historical types and sets of eleven, twenty-one, thirty-three, fifty-three, and one hundred eight described and illustrated forms of the Bodhisattva Avalokiteśvara, in addition to a set of three hundred sixty-five names for Avalokiteśvara that occur in the Chinese canon and in a Nepalese Sanskrit text. In the final form of the Encyclopedia, there will be cross references to each of these types, individual drawings of each and, where possible, photographs of each type.

Where appropriate, the deities are cross referenced to the mandala(s) in which they occur and to their respective position in the mandala(s). The text basis for the teachings regarding the practice surrounding the deity and, where known, iconographic sources are cited. As stated above, the preliminary database is not the end in itself; on the contrary, in its present form it was created only to gain control over the complete list of deities under consideration for inclusion in the Encyclopedia.

The Encyclopedia will use another database "front end" to search for deities, which will lead the user to a set of files of new drawings made by the author (figures 1-4).² It is planned and currently being designed that a user will be able to search for a deity by name, attributes, mandala(s), category of types, and iconological function. It would also be desirable to be able to search for every text reference to any specific deity, but that appears to be impractical to do at more than an occasional level at this time.

We are also working on a "front end" for the complete novice. In this mode, the user will simply answer a few basic interactive questions regarding the morphology of an image, and will be led to a logical conclusion as to the deity's identification in so far as it is possible. However, it must be understood that there are limitations of "in context" versus "out of context." For example, in some "out of context" situations, Śākyamuni in *bhūmiśparśamudrā* cannot be distinguished from Akṣobhya Buddha in *bhūmiśparśamudrā* because the basic form for both is identical and the context of the images are unknown), and, in other situations, there are "dual images" wherein two deities, usually Buddhas, are conflated into a single image. For example, where, read in one way an image is understood to be Akṣobhya, and, read in another manner, it is Śākyamuni. Truly accurate iconographic identification must take such situations into account, and where the context is known, this will be possible to do in the Encyclopedia.

For example, based on a visual key set for each major descriptor, a user will be able to enter specific elements (unfortunately without diacritics) such as:

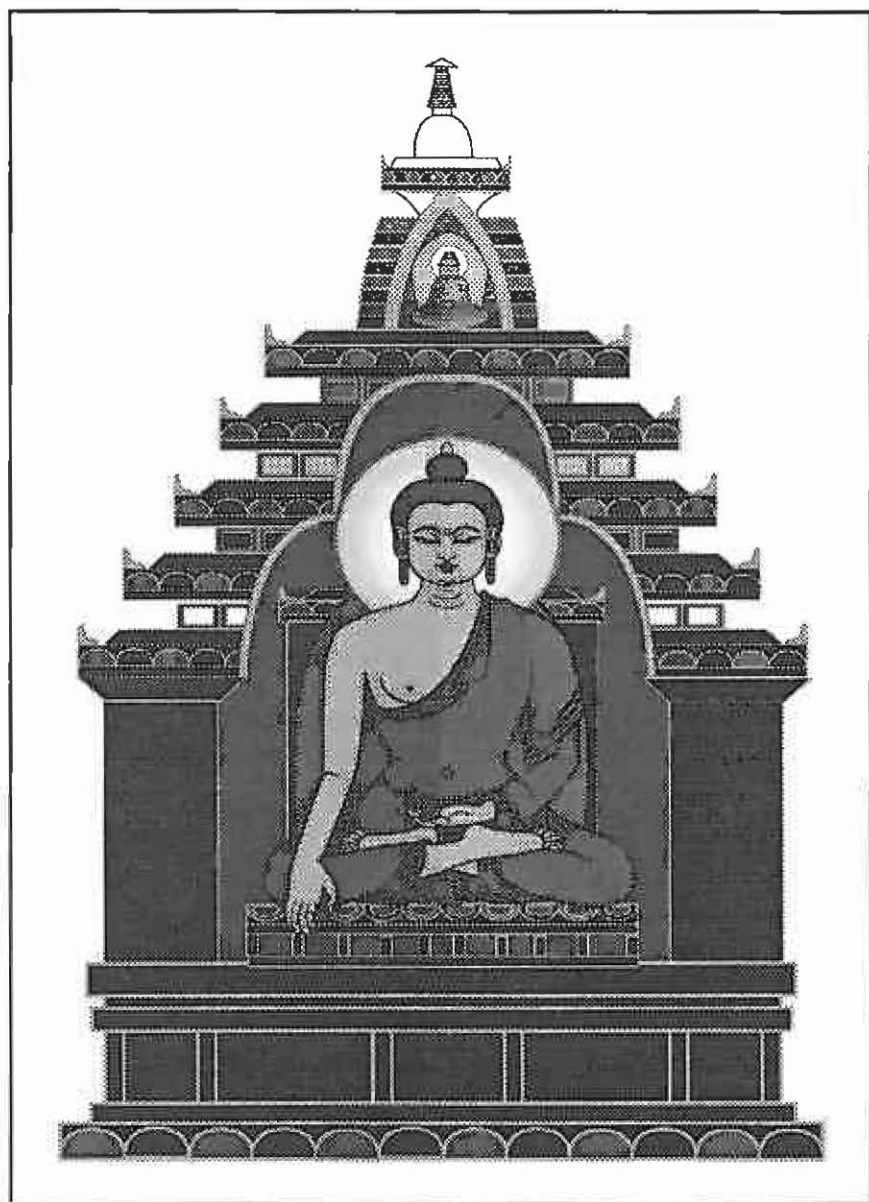


Figure1. The Enlightenment of Śakyamuni Buddha at the Bodhi maṇḍa. From a set of the Aṣṭamahaprātihārya (Eight Great Conjurer's Illusions)

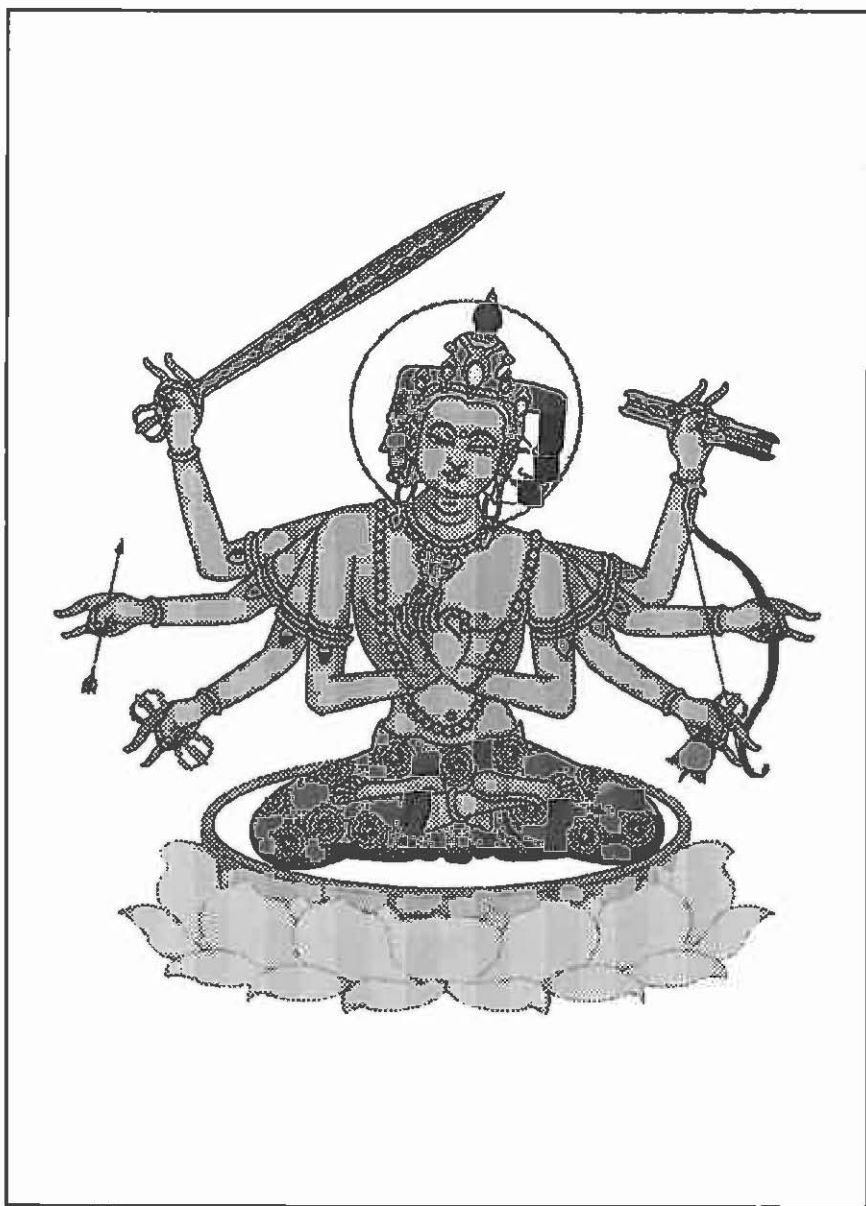


Figure 2. Dharmadhātu Vajrāsvara Mañjuśrī



Figure 3. Vajrañkuśa, a Gate Guardian of the First Enclosure in the Dharmadhātu Maṇḍala



Figure 4. East, Indra deva, from the eight (or ten) Dikpāla

Body type: seated Buddha
Garments: sangati
Usnisa ornaments: atma/ nada
Head ornaments: none
Ear ornaments: none
Neck ornaments: none
Arm wrist, ankle and other limb ornaments: none
Position: vajraparyankasana
Companion: none
Companion's position: does not apply
Support: lotus
Secondary support: lion throne
Body color: blue
Right hand position: extended at right leg with palm up
Right hand holds: fruit
Left hand position: in lap
Left hand holds: patra

To this inquiry (which need not be nearly so complete), the user is referred to Bhaiṣajyaguru Buddha, two sutras, one tantra, two mandalas and four different forms of Bhaiṣajyaguru, is told briefly about Vaiduryavati, the paradise of Bhaiṣajyaguru, and given a list of major references in Western languages on the subject.⁵ By clicking on the appropriate resources desired, the user is then either shown a picture of Bhaiṣajyaguru, pointed to a meditation sequence, or otherwise informed as to the nature of Bhaiṣajyaguru. I hope to add examples of images of each deity from our photographic archive so that one might also request to be shown examples of Bhaiṣajyaguru, in any of the major regions of Asia where his images and practices are known.

Inevitably, there will be considerable unevenness in what is available for each deity. Some deities are known from volumes of both traditional primary texts and numerous secondary sources of information all of which must be condensed, while others are mentioned in passing only a few times or may appear without known explanation in only a single mandala. However, once this information is in place, I hope the Encyclopedia will raise the level of iconographic awareness and greatly increase the ease of accurate and meaningful identifications and iconological interpretation.



A second major project in which computing techniques are central is the Nepalese Buddhist art, architecture, and ritual documentation

project, which I conceived some years ago and which was funded as an aspect of the Encyclopedia project in 1993. Travel to Nepal by the documentation team⁴ took place in summer of 1994 and the data basing of the photographs continues with Ms. Dina Bangdel and myself to the present day. As the data are entered in the database, we are also planning to prepare CD ROMs of each of the major sites in the Kathmandu Valley and collections of small sites by geographic location. For example, the Swayambhu Mahacaitya set currently has nearly seven hundred fifty photographs of the site in it, along with some one hundred photographs of rituals taking place at the site, and about one hundred fifty associated photographs. However, we are only approximately one third of the way through the labeling and data entry process and I expect there to be approximately fifteen hundred photographs of the site and of the associated rituals by the time our disks on the site are published.⁵ The format of these disks will be truly simple with the photographs being the main element. It will be possible to use the disk in several ways depending on the needs of the user. Ultimately, we hope to cover the whole of the traditional art of the Kathmandu Valley at the same level of detail and to publish the whole as a series of CD ROMs.



A by-product of the Encyclopedia project is a series of small books on Buddhist meditation that is being published by Weatherhill Inc. Initially, when I was still thinking "book" as opposed to publishing the Encyclopedia electronically, I had approached Weatherhill as a potential publisher for the entire Encyclopedia. Jeff Hunter, the president of Weatherhill, and Ray Furse, the senior editor of Weatherhill, felt that while the entire project was too big for them to handle, one aspect of the material could be published in a useful format. These were the sketches of the meditation methodologies that I had developed. Accordingly, one booklet, *The Little Monk Meditates...*,⁶ has already been published and others are in progress.⁷ The *Little Monk* drawing is the logo of the *Encyclopedia of Buddhist Iconography* project and was used to illustrate the basic principle of an identity transfer meditation and visualization in the small book.

This project and the response to it by a number of scholars and practitioners alike, has made me realize that here is a major lacuna in how we teach about and discuss meditation while talking about Buddhism. In the traditional environments of Buddhist Asia, teachers discuss the ideas of meditation to a preconditioned receptive audience of persons who are both acquainted with the basic idea and are surrounded by the visual metaphors that a meditator must use. Further, the images are not at all strange to them because they have been surrounded

by the image types for all of their lives. Even when individuals in a traditional culture had no knowledge of the meaning of a particular symbol, architectural feature, or iconographic form, they had still seen it, often from childhood, or, in the case of secret images, been prepared, sometimes for decades, for the rituals that accompany the practices and the visualization. However, Western students and many of the practitioners in non-traditional Buddhist areas must overcome the cultural differences (which often amount to "strangeness" for many) as well as master the mental practices. These little meditation exercises will do much to overcome that deficit.

For future publications in this "meditation" series, I am working on the details of a combination of CD ROM and paper-format publications. Thus, while it will be possible to read a book in the usual manner, it will also be possible to view an enhanced, full color version on either the MacOS or MS DOS/Windows platforms. The benefit of this is the viewer's control over how the material is accessed and the manner in which the meditation is viewed. In its present version, the forthcoming Vajrasattva meditation may be seen with text descriptions, without text descriptions but with the time controlled by the viewer, and in a timed version in which the images and mantras appear at programmed intervals as appropriate to the meditation. Through these techniques, it is hoped that the viewer can undergo the fullest experience of the meditation possible.



In December of 1994, my wife and I were approached by Lewis R. Lancaster and Curtis Hardyck, both of the University of California at Berkeley, but in this context representing the Pacific Neighborhood Consortium (PNC).⁸ The PNC was interested in publishing large parts of the Huntington Archives nearly three hundred thousand photographs of Buddhist and related arts as an on-line database for scholarly research around the Pacific Rim. The on-line version of the Huntington Archive will consist of selected regions, scanned and supplied to regional servers on CDs so that they can be made available from New Zealand, around the Pacific to Chile.⁹ To date we have produced a "proof of concept" CD, been placed as the first priority project for the PNC, and are currently experimenting with formats and transmission rates to determine what is possible and what is the most feasible process for implementing the project. Brought to the project's logical conclusion, a scholar or researcher anywhere in the Pacific Rim will be able to "visit" most major Buddhist sites in Asia and examine them in great detail with leaving his or her computer.



Another project involves publication of CD ROMs of high resolution photographs documenting major Buddhist sites. These would contain much more detail than the PNC internet version listed above and could supply high resolution photographs that would be publishable. This project parallels the Nepalese archive project but is not limited to Nepal. Indeed, the first disk is planned to be a visit to the eight major pilgrimages sites in India. If that is well received, we will continue with the complete photographs of Borobudur, Longmen, Alchi, Phra Pathom Chedi, and the like, through about one hundred fifty to two hundred sites. These are conceived as "stand alone" sets that would only contain the material from one specific site or subset of sites, such as the Buddhist temples of Java. These will be published under the rubric of The John C. and Susan L. Huntington Archive Collection, and are intended to provide an in-depth coverage of the sites for educational and scholarly purposes.



A Battelle Memorial Institute grant to the Advanced Computing Center for Art and Design (ACCAD) at The Ohio State University, led to my being asked to write a script for and create the preliminary designs for a historical visualization video. The goal of the grant project was to use computer visualizations to illustrate things that could not be seen or that did not otherwise exist. For my project, I chose the Lomaś Rīṣi cave in eastern India. This third century B.C.E. excavated cave habitation/shrine was created for the now extinct Ajivika sect, but the techniques could easily apply to Buddhist sites as well. My purpose was to use computer visualization that would allow the viewer to see in detail the wooden architecture on which the rock-cut monument had been based. Following my script and sketches, Peter Hriso and "Moon," Wen-hua Seun, created Alias images using SGI UNIX machines that were then converted into animation in which the viewer could "move" through the structure. This project covered a basic history of the excavation and the evidence regarding its unfinished state using my photographs of the site and following the *Archives of Asian Art* article I wrote on the subject¹⁰ and then, using computer graphics we ventured on to "remove" the facade of the cave and turn it into a wooden structure (figure 5). By extrapolation, the body of the main structure was suggested (figure 6) and then the viewer was taken on a three dimensional "walk-through" of the structure (figure 7). The final form of the project is a ten minute video that should be available in the near future. Elements of the video and still frames from the computer graphics were



Figure 5. The Lomaš Riši facade as a free standing wooden structure.
Three dimensional rendering by Peter Hriso and
"Moon," Wen-hua Seun.

shown in the "Processing Perception" exhibition held at the Center of Science and Industry in Columbus, Ohio, and the Martin Luther King Center, also in Columbus, Ohio, and at the Wexner Center of the Ohio State University.

It should be noted that this project is structured in the far more common manner of most multimedia projects. The "producer" for the project was Wayne Carlson, Director of ACCAD; I was the author, director, and technical consultant; and Pete Hriso and Wen-hua Seun were the artists and production staff. In reality, none of us could have done much without the others. The whole "Processing of Perception" project was funded by the Battelle Memorial Institute in an effort to demonstrate how technology meshes into our research lives.

Graduate Student Education and Research

By using resources like those discussed above, the complexion of graduate instruction and research may be changed dramatically. The



Figure 6. A conceptual reconstruction of the framework of the structure represented by the Lomaś Rīṣi cave. Three dimensional rendering by Peter Hriso and "Moon," Wen-hua Seun.

study of Buddhist art and of Asian art in general is greatly complicated by the need to have access to, what are for the student, and often even for the faculty, physically remote and unfamiliar monuments. No matter how good the photographs are and how careful the descriptions of the locale are, one simply cannot convey the impression of a monument that compares with being there. Whether it is the subtlety of a Zen garden, the monumentality of Borobudur, the majesty of cave 19 at Longmen, or the mystery of Doi Sothep, the full effect and a grasp of the complete details of the site cannot be communicated in a few slides and by a professor's commentary no matter how enthusiastic.

CDs, on-line resources, and interactive media will never be able to totally replace the experience of a physical visit to a site. However, these media can provide a vastly greater resource, literally thousands of photographs, rather than tens or at best a few hundred, of a monument. Through such visual richness, the student and researcher will be able to capture some of the sense of exploration and wonder as they pick their own way through the data. I am probably too old and set in my

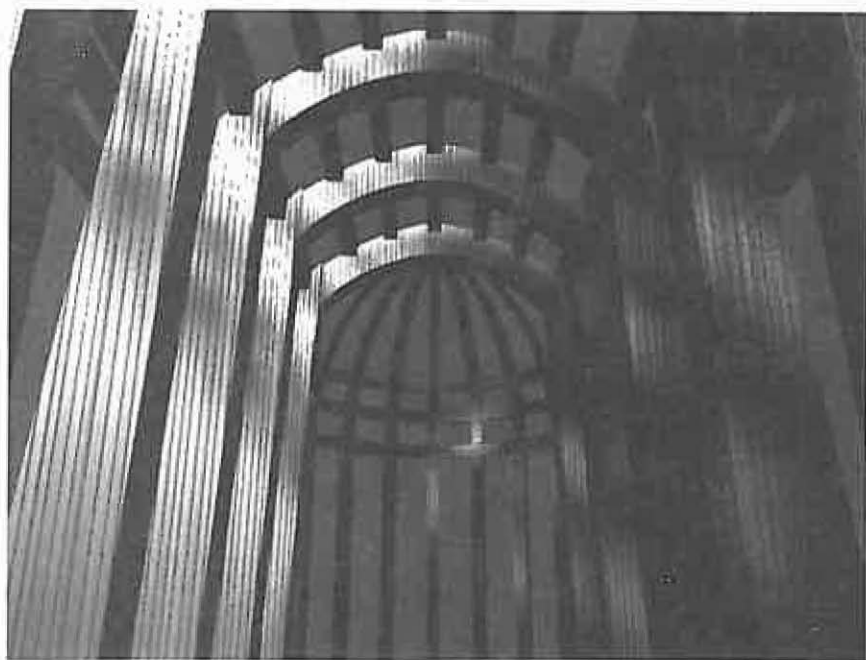


Figure 7. A "fly-through" of the conceptual reconstruction of the framework of the structure represented by the Lomaś Rishi cave. Three dimensional rendering by Peter Hriso and "Moon," Wen-hua Seun.

ways to discover much that I have not already seen, but our students can combine material and data in new ways that we have not yet imagined. I look forward to this winter and spring terms in which students in my seminar on sacred space will be each provided a CD ROM containing extensive photography of the site they are supposed to study and through that medium explore how the Newars of the Kathmandu Valley have defined their own sacred space(s).

How far can this go? I have no idea. Both Janice Glowski and Dina Bangel, two of the Nepal team noted above, are already exploring ideas that go beyond anything mentioned here.

Undergraduate Education

Even at its simplest usage, both the CD ROM technology and the WWW on-line technology promise vast changes in how we teach our undergraduates. No matter what the course, a student can be required to review and come prepared to discuss monuments on an entirely dif-

ferent order of magnitude than before. Previously, preparation for lecture/discussions was limited to articles, published photographs, and the few diagrams of practice or an occasional video of a single ritual. Now, it is possible for students to literally see the entire ritual of any of a number of mandalas, examine in detail the entire environment of a religious institution and to experience in detail the sense of "exploring" without ever leaving their desks. While these are new techniques and are untested over any prolonged experience, I will be very surprised if there is not a radical improvement in comprehension of the phenomena involved by the students exposed to these materials.

I hope that in the future, one of the *Gubajus* (Vajrācārya priests) who has offered to "teach more rituals to the camera" so that a viewer may actually experience the details of the process of learning how to perform a ritual, will also allow us to attach a camera to either himself or the *Jagman* (offerer) and thereby allow the viewer of the video to actually see through the eyes of the participant(s). With an added detailed explanation we could come as close as possible to letting the undergraduate actually experience participation the rituals.

By contrast, what is currently possible is to show the students slides, or have them work in a photographic archive. In either case the numbers of images it is possible for them to examine is extremely limited. With CD ROM the number is virtually unlimited. Just the logistics of handling photographs and the problem of staff time in a photographic archive effectively limits the number of photographs a student can examine. Imagine, for example, a class of twenty-five students with each student being assigned a single monastery to examine. The sets of photographs for each monastery may run between several hundred to several thousand. At a thousand per monastery, that is twenty-five thousand photographs that need to be dealt with! In the CD ROM environment it is only twenty-five CDs. The logistics alone make the production of the CDs worth the effort. Moreover, when every photograph is in the hands of the student one can require a more thorough examination of the material than was possible from the standard photographs. Frankly, these are just the obvious benefits of the system. To me, one of the most important factors is the sense of discovery and exploring that one really can develop from the images on a fully developed CD. This benefit cannot be measured in either time such as can logistics or in staff requirements as can the numbers of photographs that must be handled. It is an experience of the mind that creates the dynamic of learning and of affiliation with one's own discoveries. This is unquantifiable, but beyond question the most important factor in developing young scholars and students.

Technical Training in Computer Use

Although most undergraduates and virtually all graduate students are computer literate in the sense that they have learned to do word processing and played a few games on various systems, generally they have not developed much beyond that stage. User training in a suite of scholarly programs is highly desirable for advanced undergraduates and all graduate students. In the following I shall describe the programs that I have taught and will be teaching in the next year or two as an adjunct faculty member at ACCAD in our Emerging Technologies Studio (ETS).

To begin, let me make two notes. First, the ETS lab is a MacOS lab and therefore all of the following programs are referred to in their Mac iterations. However, either these same programs, or something very like them, exist for the MS DOS/Windows environment and some of them even exist for UNIX systems. Therefore, whatever is said here applies to all platforms. Second, in the following, I will assume that word processing is a given and will only state that all papers, reports, theses, dissertations, etc., done under my supervision must be turned in word processed using a single font that I have designed that includes all the necessary diacritics for the study of Buddhism in Asia. In this manner I can be certain that students have used the computer and have learned (or not learned) the proper use of diacritics. I am also exploring the notion of letting students turn in papers in CD ROM format but, because of the present technical difficulties in doing so, I have not actually attempted this on a mandatory level yet. However, there are several advanced users in the program who will be encouraged to do so this year just to see what happens.

Data basing: Although data basing is by far the most important technique of information management, data basing is very difficult to teach except as general theory. In the history of Asian art and the iconographic studies we are doing at Ohio State, the data basing techniques are, of necessity, specific to the problems and materials at hand. Therefore, the databases in use have been designed either by myself or by Susan L. Huntington in conjunction with various members of the Huntington Archive staff. Accordingly, there has been no formal training in the classroom environment by either myself or other faculty in the department. What limited training we have offered has been under the purview of Janice M. Glowski, the Associate Curator in the Visual Resources Library and the Huntington Archive archivist, and has been limited to the management of visual resources in the collection. All Graduate Research Associates in the program are expected to have at

least a one year appointment in the archive during which they learn the techniques of collections management and the process by which they can begin to learn to control large amounts of data. We look on this process as an internship and expect that a person who has held one of the Graduate Research Associates in the Archive would have learned to manage a collection if the occasion arose.

Drawing: There are many techniques and types of drawing possible on the computer. They range from loose, freely formed "painterly" images, ground plans and architectural elevations, two dimensional renderings, and nearly photographic three-dimensional renderings that can be incorporated into animation and the like. For the projects enumerated above, we have not found a use for the painterly types of drawings such as are possible in Paintshop, although I am sure that it is a technique that could be valuable. Ground plans and elevation drawings of Buddhist sites are done in MacDraw/Claridraw. A seminar on Newari Bahal iconography that I taught in 1993-94 resulted in eight students becoming proficient in such drawing techniques. Several of them actually became very proficient and have essentially added the Claris/Draw skills to their vocabulary of skills.

Precise linear drawings in Adobe Illustrator (or Aldus Freehand) hold a great deal of promise for the type of work that I am doing. All of the Encyclopedia drawings start out in Illustrator. A few students have done some minimal work in this program but it is somewhat time-consuming to learn and truly master. I have not yet made this program type the focus of a special course offering.

Three dimensional drawings are truly time-consuming and are best done in either WaveFront or Alias (or specialized in house software) on high end UNIX machines. ACCAD is one of the premier facilities in the country in terms of teaching artists to do this type of drawing. To date, only two of our students have availed themselves of this opportunity and, while I am certain they learned a great deal, I have yet to see their skills applied to an art history or iconographic project. An illustration by Eric R. Huntington, showing the arrangement of the Meru base, the lotus pedestal and the vajra above the Dharmadhatu Mandala as found in Nepal was rendered in Three-D Studio on a DOS/Windows platform and demonstrates some of the potential of the medium (figure 8). In its final form this project was an animated illustration where the viewer was able to "walk" around the mandala.

While it takes time to develop the necessary drawing skills (on or off the computer), computer drawing is a very useful mode of communication about Buddhological and iconographic ideas. The better one gets at creating such drawings the more ideas that appear as something that can be best communicated with a drawing.



Figure 8. The structural Dharmadhatu maṇḍala as found at many Bahals in the Kathmandu Valley. Three dimensional rendering by Eric R. Huntington.

Photo manipulation and retouching: It is improbable that one could say too much about this technique and it is impossible to overestimate the value of it. As a documentation photographer in the field, I find that it is far too expensive to do calibrated bracketing of exposures, reshoot several frames of an object that is difficult to focus on, or employ many of the other "insurance" techniques of the professional photographer. Further, on occasion, I am forced to shoot into the sun or into a bright sky in such a manner that I will get very disturbing flare in the final photograph (sometimes shooting at another time of day would have helped, sometimes not and, in any case it is not always possible to time one's photography to mesh optimally with light conditions). Adobe Photoshop (available on all three platforms) provides the photographer or retoucher the tools with which to correct all but the most disastrous errors. For producing CDs and on-screen images, one can work from low resolution images on virtually any computer as long as there is a good monitor (.28–.23 mm pixel dot or smaller), good color depth (24 bit or better) and sufficient disk and memory to store and work with the image files. For publication, when one must work with 18 to 64 mega-byte files the process is exactly the same but the machines must be

equipped with sufficient memory capacity (RAM) and storage (disk space) to handle the image files necessary. If you have never seen this process, but use photographs taken of works or sites in situ you really need to learn what can be done with this program and how to do it.

Use of Photoshop is a mandatory part of my "Photography for Art Historians" course and students are expected to demonstrate a reasonable mastery of the retouching aspect of it¹¹ after the completion of the term.

Graphics for CDs and disk development programs: Frankly, this is a rapidly changing field with new programs and techniques being distributed in the market virtually weekly. While Adobe's Illustrator, Photoshop and Premier all do an exceptional job of preparing the necessary graphics and videos, the CD development delivery programs, such as Macromedia Director, Apple Media Tool, and the like, are in their infancy. All such programs that I have tried either have defects (some disastrous), require C++ or similar programming, or other advanced techniques that are far beyond the scope of this article to either explain or warn about. You are free to contact me if you wish to consult on this matter and I am currently beta testing a product that may solve the issue, but, at this time, my only recommendation is caution and/or professional help. ACCAD asks its students to learn to use Director and they have produced some remarkably fine, professional disks with it. As our experience grows and as the field matures perhaps it will become easier or services will be offered where a specialized organization will take your data and put it into CD format.

Techniques and Tools

I cannot even begin to describe the hundreds of computer techniques and tools that are possible. The majority of mine consist of organizing data and of creating visual resources (other than photographs). The most interesting (and by far the most rewarding) are those that allow one to communicate ideas that could not otherwise be done. For example, the problem of a Kushan coin inscription that I dealt with in a recent article¹² was better facilitated by making a font of "Kushan Greek" letters to show just how the readings worked. In addition, I was able to make tracings of the coins in question based on several photographs, rather than relying on a single image of the coin.

The techniques are quite simple. By scanning the coins, and then placing them as a template in Adobe Illustrator (available for both the MacOS and PCs) I was able to draw the coins to approximately .01 mm. Then, by combining drawings from different photographs made with different angles of raking light, every visible detail of the coin was ren-

dered in one drawing. As for the font, I applied the same technique, using examples of every letter form the gold coins of Kaniska (where the workmanship is distinctly superior to the copper coins). These were scanned from photographs, traced to a uniform size and copied into a program called Macromedia Fontographer (available for both MacOS and Windows), which was used to create the unique font. (One note of caution: If you create a new font it will only appear on the machines on which it has been installed. Therefore you must supply copies of the font to anyone who wishes to use it and to publishers who will need it to allow it to appear in your articles.)

In making the drawings for the Encyclopedia, I have used two techniques. The first was to teach myself to draw the deities using the drawing instruction books of Gega Lama and Jamyang.¹³ Once this was accomplished, it was possible for me to draw a complete set of the sixteen bodhisattvas as described in a particular mandala in only a couple of days by using computer copy and paste techniques rather than redrawing every repeating element. Thus, my difficulties in making the drawings for the Encyclopedia are not in the number of drawings that must be made but in the complexity of some forms, such as Mahāsāmvara, Viśvarūpa Avalokiteśvara and the like.

The drawing method that I have found to be the most expedient is to make a libraries of body parts, attributes, jewelry, garments, *mudra* and the like. Then, with very little effort, these can be resized and assembled into new drawings. Once one gets into doing some of the more obscure deities in secondary and tertiary levels of the mandalas, the attributes are often unknown in most publications and primary sources for them are increasingly difficult to find. Two Newari manuscripts, illustrating more than two hundred mudras and attributes for the deities of the *Sarvadurgatiparśodana tantra* have proved most useful in verifying the descriptions from such texts as the *Niṣpannayoga-vali* and others. However, even these source materials must be used with caution. For example when Maitreya's *nāgakesara* flower is mentioned, drawings range from quasi-lotuses to polymorphic fantasies. In such cases I have attempted to maintain a modicum of botanical accuracy.

Getting Started

Some readers who have gotten this far, will be, I hope, inspired to try something for themselves. To this end I have several advisory comments. As is obvious to any advanced computer user, what we are doing in computer techniques in the study of Buddhist iconography is neither new nor different than similar types of work than is being done in many

fields. Rather, it is the application of established techniques and programs to specific problems. While those techniques and programs have to be adapted to the problem at hand, we are neither writing new code, nor creating new hardware to accomplish what we are doing. Everything that has been accomplished or that is in progress is using "off-the-shelf" systems and programs that have been developed for the general market. It is true that the graphics processing stations are "high-end," which is necessary to ensure the best color for the reproductions but the equipment is still "off-the-shelf" in both the literal and figurative sense. It is therefore within reason for literally *anyone* who has a basic familiarity with computers, who can conceptualize the problem, and who is willing to read the instruction manual that comes with a program, to undertake similar kinds of activities.

One word of caution, however; having been (overly?) enthusiastic during my first years of attempting this kind of work, I learned very much the hard way that being the first on the block with a new piece of equipment or a new type of software is almost certainly a prescription for major frustration, and possibly failure. I have lost months of time and endured many hours of frustration when pieces of equipment simply didn't work and using software with "undocumented limitations." Even though it may sound wonderful, let the new computer, software, or technique mature in the market for a few months before trying it yourself. Unless you are a very sophisticated user or a closet software engineer you should carefully read the reviews in computer magazines, talk to other users, and, if at all possible, buy equipment and software with a money back guarantee.

That note of caution having been said, however, there is another dimension to the issue. There is an undeniable excitement to the development of a technique that will facilitate scholarship or education in your respective discipline. There is the excitement of students when they see the full version of a program that you have developed and there is a real satisfaction when you have presented a kind of living vision of what you are trying to explain rather than a few still slides interspersed with your best effort to explain them. An hour tape of a Vajracarya priest performing the Saṭpuja at Swayambhu Mahācaitya, in Nepal probably taught one of my classes more about the reality of Buddhist lay practice than all of the lectures that I could give in an entire term.

Notes

- ¹ It has been my experience as a CPM (anybody remember that?), MacOS, PC DOS and UNIX user, that each of these platforms has their special strengths. CPM is pretty much a dead issue, although it transferred well to early versions of Microsoft DOS. Both CPM and MS DOS are essentially word processing and data basing systems, although some graphics are possible on in MS DOS. Windows, in its numerous iterations, is nothing more than an attempt to copy the MacOS and with its latest version, Windows 95, it is finally approaching the level of some of the early Macs in ease of use. The Windows operating system and the IBM clones are in such ascendancy in many environments that many individuals are forced to use the system just to be compatible with other computing environments in the university setting. This is regrettable in that for multimedia development and graphics, the Mac platform is far superior to the Windows environment. UNIX, especially on SGI machines, is extremely important for high end graphics, animation, and visual realizations. The Mac, long dismissed as not being for serious computing, is by far the best general tool for Desktop publishing and all graphics work. Ignorance and opportunistic use of improper platforms has led to a number of mildly amusing situations. One scholar, while presenting a paper on his interpretation of a Buddhist subject, bragged at length that he had used a \$100,000 SGI work station for several months to achieve the effect that he was showing in his slides. Most in the audience were suitably impressed but a few of us in the audience knew very well that the presentation could have been done on a mid-level Mac in, at the most, an hour.
- ² Of the six thousand images currently in the working database, I have made drawings of about twelve hundred. By the time the project is completed I expect that there will be between six thousand and seven thousand iconographically correct drawings, all in color, of the deities.
- ³ This listing is not meant to be complete but is simply what comes up at the present time.
- ⁴ The team consisted of Susan L. Huntington, who worked on metal casting in Nepal and assisted in the major documentation effort; Janice M. Glowski, the archivist from the John C. and Susan L. Huntington Photographic Archive of Buddhist and Related Materials; and Dina Bangdel, one of our advanced graduate students, who has served as an assistant archivist, and as a research associate to the project. We were also accompanied by Eric R. Huntington who did site surveys of about forty bahals and Larry Hill, and at times by Bibakar Shakya,

Scott Roller and Tom Mak, all of whom were immediately pressed into service in the project. During the first three months, when most of the team was present, we concentrated on major sites and for the second three months when only Dina Bangdel and I remained in Nepal, we concentrated on smaller sites. In total, we took more than twenty-three thousand color photographs of a total of four hundred sixty-five Buddhist monuments. We are presently seeking funding to return to photograph a number of related sites and the Hindu sites in an equally extensive manner.

- ⁵ These disks will probably also be published by the American Academy of Religion as well, but no agreement has been made at this time. However, because of their discrete nature, these disks will undoubtedly be published well prior to any of the Encyclopedia disks.
- ⁶ John C. Huntington, *The Little Monk Meditates...* (New York and Tokyo: Weatherhill, 1995).
- ⁷ The next planned is a detailed version of the Guru Vajrasattva meditation using the one hundred syllable *mantra* and containing a detailed history and iconography of Vajrasattva. At present, I am experimenting with means of producing an acceptably subtle CD ROM which would accompany the publication.
- ⁸ The PNC consists of more than thirty Pacific rim institutions which are coordinating efforts to exchange data through the Internet and WWW facilities. One of its first major efforts will be to act as a publisher of data that will be of interest to various subsets of the academic community around the Pacific. One aspect of this will be the on-line "Museum of the Pacific." Member institutions are being asked to contribute selected images of their research collections (any discipline from agriculture to zoology) to the museum so that others may share in the data. The Huntington Archive at The Ohio State University was very happy to accept the PNC's invitation to join the project since it is one of our long-range goals to put the entire archive on-line in order that the materials be widely available to scholars.
- ⁹ One may wonder why it is necessary to put the material on-line at more than one site. In the Pacific area, connect time to international net sites is very expensive and inherently limits access to foreign files. Moreover, the bandwidth necessary to transmit images of sufficient quality to be useful is not available in all areas, further increasing the cost by increasing the time necessary to transmit images files. American institutions, with their major computing centers and either SONNET or Ethernet connections, have a distinct advantage over some areas of the Pacific rim where phone lines operating at 1200 baud are still the fastest connections. By putting material on local servers, specialized local bandwidth conditions may be addressed

and user access may be through local telephone service. Even so, regrettably, some of the images may have to be of lower resolution such as 8 bit color at 640 x 480 pixels per inch, with no real opportunity for higher resolution. It is our long term plan to put all of the archive on our own server at high resolution where a publishable photograph, at about 18~32 mbs with low JPEG compression, may be downloaded by a user. This, however, is at least a few years away.

- ¹⁰ John C. Huntington, "The Lomas Risi, Another Look," in *Archives of Asian Art* 28(1974-1975): pp. 34-56.
- ¹¹ Photoshop is also a powerful drawing and painting program that is of great use in developing CDs and on-line graphics.
- ¹² John C. Huntington, "A Re-examination of a Kaniṣka Period Tetradrachm Coin Type with an Image of Mētrago/Maitreya on the Reverse (Göbl 793.1) and a Brief Notice on the Importance of the Inscription Relative to Bactro-Gandharan Buddhist Iconography of the Period," *The Journal of the International Association of Buddhist Studies* 16:2 (1993).
- ¹³ Gega Lama, *Principles of Tibetan Art*, 2 vols. (Darjeeling: the author, 1983.) [Amdo pa] Jamyang. *New Self-learning Book on the Art of Tibetan Painting*. (Mussoorie: the author, 1982.) Two other useful ones are Pema Namdol Thaye, *Lha sku-i thig dpe mi pham dgongs rgyan: Concise Tibetan Art Book*. (Kalimpong, the author, 1987); and Sherig Parkhang, *New Self-learning Book on the Art of Tibetan Painting* (Dharamsala: Tibetan Cultural Printing House, [ca. 1981-82]) (This is Amdo Jamyang's book reprinted in a smaller and much less satisfactory edition, but it was still available in Nepal in 1994.) Gega Lama is a master of the elegant Karma Gardri School, while Jamyang is of the elaborate Amdo school. I have tried to combine the best features of both of these masters and, where necessary or useful, modified them with Newari and Indian techniques. One can follow either as one chooses or develop one's own style. However, it is my suggestion that the style should stay confined within acceptable traditional limits and not diverge too far.