Scientific Illustration in Anthropology

Katie Guenther
University of Manitoba

The discipline of anthropology uses scientific illustrators to effectively communicate different types of information in visual form using many different types of media. Visual representation can capture shape, details and anatomy where language falls short (Hodges 1989). Advances in technology have transformed the art of scientific illustration, with all of the choices available for illustration, the question I have set out to answer is, can drawing and painting remain relevant in the wake of modern photography and computer graphics? Different types of scientific illustrations, including hand drawn ones, have been incorporated into the work of anthropologists and specific conventions are followed when illustrations are intended for anthropological use. The introduction of scientific illustrations into anthropology has been fairly in comparison to a longer history that dating back to the 16th century. There is a need to examine the illustrations being used in anthropology because of the power images have to influence people, and the problems that this can create.

What is Scientific Illustration?
According to the Encyclopedia Britannica scientific illustrations are visual records utilized in the both natural and social sciences to explain and describe "as objectively as possible the characteristic and typical features of a given phenomenon" (2009:1). When words cannot convey an idea or subject clearly, an illustration can display that subject more succinctly. Informative and pleasing to the eye, illustrations are both useful and interesting at the same time (Hodges 1989). The people who create these illustrations are artists who use their distinctive aptitude in the service of science. Working in seemingly polar opposite fields, they meld precise details with creativity and design to convey scientific messages. Scientific illustrations take one step further than normal illustrations. Images must be well measured and exact in their dimensions and details. Skilled illustrators can achieve both creative and impressive results with their pencils and paints as clarification of multiple focal depths can be achieved, and differentiation between many overlapping layers is also possible (Hodges 1989).

Variety of Illustrations
To create a scientific illustration there are many possible tools and techniques usable. The process and tools used to render a subject on a page vary with an artist's desired final outcome. Final illustrations can belong to one of three basic categories as outlined by Elizabeth Morales (1989). They can be created using pen and ink drawing techniques, colored paints or on an computer. As artistic rendering techniques become increasingly diverse, illustrations are made with creative mixed media combinations that do not always fit into the aforementioned categories. For instance, "The Painful Shoulder" by William Westwood was created using...
airbrushing techniques, watercolor paints and colored pencils (Lynch 1989).

Published illustrations are most commonly created with pen and ink on polyester drafting film (Morales et al 1989). This medium is used to create line drawings. A line drawing uses the contrast of black against white alone to illustrate a subject (Briscoe 1996). Shading is achieved by using various concentrations of black dots, an effect called stippling (Briscoe 1996). Contour lines, hatching or cross-hatching can also be used to this end (Briscoe 1996). Cross-hatching must be utilized with care, because it may appear like unintended texture on the surface of an object (Hodge and Hodges 2003). One type of ink that is especially popular is India ink, because it is a strong black shade and useful for drawing not only lines, but also for filling large areas with solid blackness (Smith 2003).

Pencils are very commonly used to make preliminary drawings of a subject, and can also be used for final drawings (Hodges and Rawlins 2003). Artists can use three different types of pencil, including waxy, charcoal and grease. Graphite pencils are excellent tools because of the spectrum of leads that are available. Leads in the hardness range of 2H to 4H are among the most popular because they have an excellent balance of softness and hardness (Hodges and Rawlins 2003). This range will create solid dark markings but do not need to be sharpened as often as softer leads (Hodges and Rawlins 2003). Shadows can also be depicted using continuous tone, this is a technique that uses shades of grey, black and white in illustrations (Briscoe 1996). Depending on the media used for an illustration, tonal variations of different colors can also be achieved. Illustrations can be completed using carbon pencils, watercolor washes or airbrushing, and creates a finished product that appears very realistic (Briscoe 1996). One advantage of using paints instead of inks or pencils is the ability to depict color with pigments. Watercolor, acrylic, and oil are the three most well known types of paints today. Watercolors and acrylics are used more often than oil paints for scientific illustrations because oil paintings take a much longer time to dry (Hodges Rawlins 2003).

Watercolors are very versatile, and depending on the amount of water used in a painting, illustrators can achieve a variety of effects. Realistic looking illustrations are created when watercolors are applied with a dry brush (Sheehan and Hurd 2003). Application of watercolors on a wet surface with a wet brush will create a transparent appearance. This type of painting will have a softer look (Sheehan and Hurd 2003). Dry and wet brush techniques are both used to create scientific illustrations. In comparison to watercolor paints, acrylic paint can convey very vivid colors in illustrations. (Hodge 2003). There are also archival benefits of acrylic paint. They tend to fade less and resist discoloration, because acrylics are more adaptable to changes in air quality over time (Smith 2003). Acrylic paints also retain
flexibility after drying, allowing for increased portability of the finished product (Hodge 2003).

Museum exhibits display many different scientific illustrations including murals and dioramas. Murals are painted on a much larger scale than normal scientific illustrations. Museums also use dioramas that can be created on many scales; the largest of these allows viewers to walk through the display. Even smaller scale dioramas use certain construction and design techniques to increase the viewer's perception of realism. Dioramas usually have a painted background for the display, which blends with focal objects in the foreground through lighting, a sloped floor and curved background wall (Chase 2003).

Traditionally paintings are created with a brush, but since the invention of modern computer graphics, illustrators have an entirely new way of painting.

Computer images are a modern technological innovation within the discipline of scientific illustration. There are three different types of graphic images including painting, drawing and layout programs. Illustrators can use computer graphics in combination with traditional art medium, or illustrations can be created by graphics alone. Traditional methods of illustration seem very different from computer graphics, but both require the same understanding of design principles used within illustrations (Lavendel 2003). This kind of work takes artistic sensibilities like creativity and an eye for composition (Hodges 1989).

Computer graphics are also useful in the field of mapmaking. In the past, maps were hand drawn in ink, but technological advances allow for computer mapping of geography. Geographical information systems are a type of computer information program that converts scanned geographical data into maps. Cartographers use this technology to visually display and layer the complex information of a landscape. Cartographers design maps with layers of information, this serves to clarify and emphasize important parts. Mapmakers interpret a subject, and illustrate it with eye-catching aesthetics (Cole 2003).

The use of photographs as a form of scientific illustration is the result of another relatively new technological development. Photographs are advantageous in some respects, and also convey a slightly different type of information than other forms of illustration. Drawings and paintings are viewed as subjective sources of information, and photos are seen as a primarily objective source of information. Photographs produce a very accurate copy of a subject, but measurements cannot be inferred from photos. This problem can be overcome by placing a scale within the pictures frame (South 1968). Another advantage of digital cameras is the easy transfer of pictures onto computers by simply inserting a memory card. Cameras are fast and accurate in capturing images, and can be used by a wide range of people. While photography is seen as a very valuable, even indispensable, tool in anthropology there are still very important reasons to continue using
traditional, hand drawn illustrations (Morales et al 1989).

**Why Is Drawing Important?**
Scientific illustration can elucidate the often unseen world (Hodges 1989). With the invention of the microscope illustrations of the fascinating viral world could be made. Internal plant anatomy can be shown, geological cross sections of the earth displayed and extinct animals reconstructed for all to see (Hodges 1989). Using the observational, aesthetic and technical talents of artists to scientific ends creates an accurate representation of a subject (Hodges 1989). Elizabeth Morales (1989) has stated that the benefit of a photograph is its relative objectivity, and that the advantage of drawing is precisely the opposite, its interpretive uses. Artists can separate or show hidden or usually inaccessible objects.

Drawn illustrations can also portray what Kemp called “archetypical images” (Topper 1996:226). Rather than portraying only one variation of a subject, an archetypical depiction allows for the communication of the most average looking subject possible. David Topper (1996) argues that this is why scientific illustration has survived, even in the face of the invention of photography. Photographs are constrained by the limitations of what can be seen in the present physical world, whereas the illustrations of artists are limited only by their own imaginations.

**Scientific Illustration in Anthropology**
One of the primary concerns of anthropology is the collection of accurate information. Once it is gathered, the subsequent translation of data into the published form without losing accuracy is important. Each of anthropology’s sub-fields provide unique challenges and opportunity for illustrators, requiring artists who work in anthropology to be as flexible and knowledgeable about visual representation in a variety of contexts using a variety of techniques (Morales et al 1989). Could anthropologists accomplish the task of illustration with photographs just as well as with drawings and painting? Photography is an essential tool within the discipline, but there are still some advantages to hand drawn images today. Illustrators can take an object and line draw it, highlighting important details in order to accentuate them (Hodges 1989). When working from a photograph, an illustrator can eliminate confusing shadows, dirt and cracks from the artifact, redirecting focus to the subject’s most significant aspects (Morales et al 1989). A broken specimen can be reconstructed in a drawing, giving people an idea of what it may have looked like in the past (Hodges 1989). Small specimens can be enlarged when drawn, without losing detail or blurring the image in the process (Morales et al 1989). Drawing is also an important tool to use in situations where recording images of artifacts must be done in a culturally sensitive manner. When working with a group of people who are not comfortable with the use of cameras to document human skeletal remains, drawing continues to be extremely important. An anthropologist needs to be able to share visual information without
giving offense or disregarding a group's cultural and religious beliefs. For instance, some Native American people do not allow photographs of human remains or associated material artifacts (McKinley, verbal communication, October 2009). In order to record valuable visual information about this significant subject matter, other methods must be used.

Techniques/Conventions
Conventions for the execution of anthropological illustrations generally follow the same standards as scientific illustrations, but there are a few rules that are specific within anthropology. Conventions are widely agreed upon practices and standards used to ensure continuity and accuracy in scientific illustrations. Two basic practices followed in scientific illustrations are lighting subjects from the left, and including a metric scale in the drawing. There are also conventions specific to anthropological illustrations. One of these is the orientation of stone projectiles with points facing up. Anthropological illustrations also position side views of an object on the corresponding side of the page. For example, left views are drawn on the left side. There are rules regarding the choice of drawing technique in relation to the material being illustrated. For instance, stippling would be used when working with porous stone or bone artifacts. Hard and shiny stone tools are often sketched using parallel lines. The choice of pen or pencil as the media for drawing is also guided by conventions associated with certain types of subjects (Morales et al 1989).

Grave marker rubbings are one subject area that should be illustrated in pencil or graphite. Pencil rubbings of these sometimes highly decorated stones can be traced in pen on paper afterwards. Also unique to illustration within anthropology is the technique of the rollout. Rollouts are when strips of plastic are taped around the sides of a pot and the iconography is traced, then this can be transferred into a more refined drawing on paper. This technique is increasingly difficult when vessels are larger at one end. By drawing the pattern slightly larger at the top or bottom, the proportions can be adjusted (Morales et al 1989).

In ink and pencil drawings color cannot be seen in the illustration, but color-coding offers a solution. In order to represent color in a black and white illustration several patterns can be drawn, or the illustrator uses dot screens. Different percentages of dots in a screen represent types of color, from light to dark. When using this technique a key matching the actual colors to the shades in the drawing must be included, otherwise no one will know what color the shade or pattern represents (Morales et al 1989).

History of Scientific Illustration
Scientific illustration has been practiced almost throughout human history. The formation of the discipline as it appears today began in the 16th century with the use of illustrations in scientific books. Modern scientific illustration stems from a long tradition of recording plants and animals in pictorial form. The history of visual communication of knowledge can be traced back to
our Cro-Magnon ancestors. Ford (1993) argues that cave paintings discovered in France were aids for teaching methods of attack, hunting strategies and even show animal anatomy. The Greek and Roman tradition of drawing plant life on papyrus paper also predates modern scientific illustration. To preserve knowledge of medically important plants, their structures were illustrated in detail, and this was used to help others identify them. In some cases text also appeared with these herbal illustrations, describing the plants and their accompanying medical uses (Ford 1993).

One of the most important developments for the spread of scientific illustrations was the invention of the printing press in the 15th century. Printing with woodcuts allowed for the wider public dissemination of scientific texts with accompanying illustrations. By the 16th century books with text and pictures were printed and distributed, this is the point where scientific illustration as we conceive of it today, begins. At this time illustrations were usually drawn from first hand observations as accurately as possible, to accompany scientific writing in printed books or journals. Just as the discipline was reaching its prime, new trends began to emerge which resulted in less accurate scientific illustrations (Topper 1996).

A new trend began to emerge, where illustrations were widely being created using other illustrations as their primary subject. This copying of images by scientific illustrators in the 16th century may have been because of the spreading use of drawing guidebooks for novice artists. David Topper (1996) argues that these books taught artists not only how to draw, but also perpetuated stylistic techniques as well. Instead of depicting a specific specimen, a 'typical' looking subject was created, and the artistic conventions of the time were also strongly transmitted within scientific illustrations.

The Power and Problems of Images
Images are powerful because of they easily transmit complicated ideas. Complex symbolic information can be communicated with just one glance. Samuel Edgerton states that pictures are an important method of communication. They are a "unique form of pictorial language" that uses "symbols and conventions" to send information both intentionally and unintentionally (Topper 1996:168). The symbols in illustrations, especially in the tradition of scientific illustrations of human evolution require interpretation and thought on the viewers part to understand them (Topper 1996).

Conventions and symbolism in illustrations of human ancestors are powerful, and can influence generations of future illustrators. David Topper believes that these meanings often stem from artistic traditions, giving scientific illustrations "a source of theory-leadeness from art itself" (1996:229). He argues that visuals do not just reiterate what a text is saying, but have their own messages, history and conventions. Judith Berman (1999) gives an example of the influence artistic traditions have on
scientific illustrations; an early painting entitled, 'Cain,' by Fernand Corman. "Cain" was painted in 1880, and viewed as an accurate representation of human ancestors, but many of the details in the artwork stemmed from a tradition of Wildman paintings displayed in French Salons in the nineteenth century. These paintings strongly influenced depictions of cavemen, resulting in a stereotype of early humans in scientific illustrations and modern media with shaggy hair, draped fur as clothing, a hairy body and heavy brow. Berman (1999) states that the amount and positioning of the caveman’s hair places him into the category of human ancestor, but further down the evolutionary scale than modern humans and closer to animals (Berman 1999). In this case, the illustrations had an active role in the discourse about the "humanness" of cave dwellers.

Some of the symbols and conventions in scientific illustration have underlying messages of social hierarchy. For instance, physical anthropologist’s study of the facial bone structures of Homo sapiens sapiens were used to reinforce the conclusion that early human ancestors were most similar to the bone structure of Western European people. Diane Gifford-Gonzales (1993) surveyed 88 scientific illustrations, in these there were over four hundred people depicted. Half of these images were of men, less than one quarter contained females, there were a similar number of children as women, and a very small fraction of people were elderly. The postures and movement of characters in these illustrations also sends messages about who is important and dominant, and who is submissive and less significant. Older people and women were most often still, while men were depicted and animated as they made tools and hunted. In general, Glifford-Gonzalez (1993) found that illustrations of human ancestors were strongly biased towards depicting middle aged white men and activities believed to be typically associated with them.

Illustrations can also make arguments about what constitutes humanity, by offering visual evidence. In the debate over human ancestry, scientific illustrations were used to argue where recovered fossils should be placed in the line of human evolution. Stephanie Moser (1996) exemplifies the use of scientific illustrations in the debate over the evolutionary positions of Australopithecus boisei versus Homo habilis. One representation clearly shows Australopithecus boisei as being non-human as indicated by an increased amount of hair and the use of plain rocks. Homo habilis by comparison is standing uphill, has more ‘human like’ features and is holding tools. He is being communicated as the human ancestor the use of certain symbols, tools indicate that he is inventive and learns through experimentation (Moser 1996).

Images are an excellent tool to employ when making an argument because they are often accepted without critical evaluation. Greg Myers says that we uncritically accept illustrations because of “gratuitous” details (Gifford-Gonzales 1993:29). A
detailed and realistic style can convince people of the illustration's truthfulness. Landscapes, well drawn backgrounds, compelling facial expressions, the postures of characters and tools all help viewers to relate to an illustration, convincing them it is realistic (Gifford-Gonzales 1993). Judith Berman (1999) said that most people never question the shaggy hairdos of human ancestors in scientific illustrations. There is evidence offered by evolutionary biologists and archaeologists that contradicts the popular hairstyle given to our ancestors. Knowledge of ancient hair styles can come from the self representations of Upper Paleolithic people, including the Venus figures. These figures show women and men with styled hair, as opposed to wild, untamed hair. Representations of human ancestors must be critically evaluated in order to uncover the other messages that are being sent alongside the intended information. While a well researched and reconstructed image may help convey important ideas, it is problematic to portray these symbol laden, man-made illustrations as scientific fact (Berman 1999).

Conclusion
In conclusion, illustrations do not just reiterate the statements in a text; they are powerful tools of communication that convey independent messages. What is considered important enough to illustrate reflects not only enthusiasms of a discipline, but can also unintentionally perpetuate narratives of social hierarchy. This is especially apparent when reviewing the influence of artistic traditions within scientific illustrations of human ancestors. Illustrators, anthropologists and public viewers need to be cautious and critical in the interpretation of these images. New tools are being used to illustrate subjects as technology advances, modern photographs and computer graphics continue to increase in popularity, but traditional methods still fill an integral place in the discipline. From cave paintings created thousands of years ago, through history to today, drawing and painting has survived many technological advances and they continue to be used in new ways and in combination with recent technologies.

References


Encyclopaedia Britannica 2009 Scientific Illustration. Electronic document


http://penelope.uchicago.edu/~grout/encyclopaedia_romana/index.html


South, Stanley A. 1968 *Photography in Historical Archaeology.* Historical Archaeology Vol. 2:73-79