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LASER BONES: COPYRIGHT ISSUES RAISED BY THE USE OF INFORMATION TECHNOLOGY IN ARCHAEOLOGY

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TABLE OF CONTENTS

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I. INTRODUCTION

In the past two decades, information technology has made radical changes in the process of scientific inquiry. Because it has traditionally relied on observation and manual labor, archaeology has been slower to incorporate this new technology than have other disciplines.[1] In recent years, however, archaeologists, anthropologists, and paleontologists have begun to make use of the full panoply of information technology.[2] Unlike its use in other sciences, however, the use of this technology in archaeology, anthropology, and paleontology frequently involves third parties who control either the raw data itself or the means of acquiring the raw data. As a result, property and intellectual property issues have been raised by the use and manipulation of this data. The scope of intellectual property protection in raw and manipulated data is still unclear.[3]

This Article will explain why raw data should not be protected by copyright and why raw data embedded in protectable expression should be made accessible. This Article will also argue that the scope of the fair use doctrine should be expanded for factual works used non-commercially.

Part II of this Article describes the various ways that information technology has been applied to archaeological inquiry. Part III presents two cases that illustrate the conflict between governments and archaeologists over copyright issues. Part IV discusses the copyright issues raised by the use of information technology in archaeology; and Part V proposes a standard which should be applied to that use.

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1. "Archaeologists and anthropologists always get to the technology about twenty years after everyone else." Corey S. Powell, *Relinquishing Relics*, SCI. AM., Dec. 1994, at 46.

2. Interestingly, some techniques now used by archaeologists are finding their way back to other disciplines. *See* Anjana Ahuja, *From Mummies to Motherhood*, THE TIMES (London), Feb. 12, 1996, at 16 (discussing the medical application of a computer program developed for archaeologists which converts two-dimensional ultrasound slices into a three-dimensional image).

3. *See* Jerome H. Reichman, *Electronic Information Tools — The Outer Edge of World Intellectual Property Law*, 17 DAYTON L. REV. 797, 837 (1992) ("[E]lectronic information tools pose a challenge to world intellectual property law that will not go away. . . . [L]aws applicable to patents, copyrights, trade secrets, unfair competition, trademarks and industrial design are increasingly destabilized by the need to deal with aspects of new technologies for which they are inherently unsuited.").

II. The Use of Information Technology in Archaeology

Traditionally, archaeologists have chosen their dig sites based on documentary evidence, local legends or history, geological or topographical indications, serendipitous finds, and the occasional good guess. Before beginning a full-scale dig, sample pits might be dug to test the site for suitability and to establish its boundaries. Once a traditional dig is underway, every find is catalogued by hand and the exact location of every find is recorded. The work is painstaking and glacially slow. Since no one knows what might be under the next trowelful of dirt, removal must proceed with great care. Every effort is made to obtain a sense of each find's context by assigning to it a location in three-dimensional space which can be plotted against every other find. However, because the plot graphs are two-dimensional, some of this context may not be conveyed. Many of the finds are fragmentary, leaving their finders to guess at their true form or function. Some of the finds are damaged by the digging process, others are too fragile to exist outside of their hidden environment for long.[4] The site itself has been destroyed, and any secrets it may have held which science is not yet advanced enough to decipher are lost forever. The use of information technology has radically altered these traditional techniques and their results.

A. Site Finding

Various geophysical techniques are now routinely used to locate likely sites.[5] In addition, technology from other disciplines is being adapted to the requirements of site finding. Each technique produces a data set[6] which, when interpreted, may show major ground features, disturbances, structures, and, in some cases, artifacts.[7] The most commonly used geophysical techniques for determining the suitability of

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4. For example, the writing on tablets made of wooden leaves found at a British Roman site was so ephemeral that it became unreadable after fifteen minutes of exposure to the air. *See* BRIAN FAGAN, TIME DETECTIVES 238 (1995).

5. *See* CHRIS GAFFNEY ET AL., INSTITUTE OF FIELD ARCHAELOGISTS, TECHNICAL PAPER NO. 9, THE USE OF GEOPHYSICAL TECHNIQUES IN ARCHAEOLOGICAL EVALUATIONS (1991).

6. Most geophysical survey devices can output their data in digital format.

7. *See Researchers Develop Map-Making Device for Buried Objects*, Report from Japan, May 31, 1993, *available in* LEXIS, Asia and Pacific Rim Library, Asia/Pacific News File.

a particular site include electrical resistivity,[8] thermoremanence,[9] magnetometry,[10] seismic refraction,[11] and ground-penetrating radar.[12] On a larger scale, satellite imagery[13] and space shuttle-based earth imaging radar[14] can give clues to potential sites and locate otherwise totally hidden sites.[15] Geographic information system software can be used to overlay data from various geophysical techniques onto topographical maps and aerial photographs to create a complete picture of the potential site.[16]

B. Mapping and Cataloguing

Sites can now be measured using global positioning satellite information and can be mapped digitally by using computer-based geographic information systems that permit three-dimensional mapping of a site's topography using data from government geographical services.[17] On a smaller scale, sites can be measured and mapped using hand-held electronic distance measuring devices, laser levels, and laser rangefinders.[18] Finds can be recorded using archaeological excavation

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8. This method is based on the relative inability of certain materials to conduct an electrical current. A small electrical current is injected through the earth of a site and the sub-surface variation in the resistance over a given area is measured. *See* GAFFNEY ET AL., *supra* note 5, at 2.

9. This method measures the permanent change in magnetic orientation of an object which has been subjected to high temperatures, such as pottery, metalwork, ovens, hearths, etc. *See id.*

10. This method measures changes in the magnetic field associated with archaeological features. The degree of resolution varies with the type of magnetometer used. *See id.* at 3.

11. This method artificially generates seismic waves and measures their return, by reflection and refraction off of archaeological features, to the soil surface. *See id.* at 5.

12. This method provides a three-dimensional view of a site by measuring radar echoes. It provides a high-resolution image capable of locating smaller artifacts. *See id.* at 5-6.

13. *See, e.g.*, ROBERT MCCORMICK ADAMS, HEARTLAND OF CITIES 33 (1981).

14. *See* Jamie James, *Shuttle Radar Maps Ancient Angkor*, SCI., Feb. 17, 1995, at 965. Spaceborne Imaging Radar, as the Shuttle system is known, can resolve features as small as a few meters, distinguish textural variations, and penetrate as deeply as five meters underground. *See id.*

15. These systems can find overgrown or buried roadways, paths, fields, and structures. *See, e.g.*, ARCHAEOLOGY & INFO. AGE 4 (Paul Reilly & Sebastian Rahtz eds., 1992) (describing the use of digital satellite images to find lost sections of the Great Wall of China).

16. *See* Simon Denison, *Prehistoric Britain, As Seen By Computer*, THE INDEP., Nov. 21, 1994, at 26.

17. For example, *U.S. Geological Survey* or *British Ordnance Survey*.

18. *See* John W. Rick, *The Use of Laser Tools in Archaeology*, SOC'Y FOR AM. ARCHAEOLOGY BULL., Mar.-Apr. 1996, at 8.

record software[19] and plotted using archaeological computer-aided design ("CAD") systems,[20] giving a three-dimensional view of the relationship of finds to each other and to the site.[21] The laborious registering and cataloguing of finds can now be vastly expedited by using digitizing cameras to record and code each find, and by using bar-coded containers for storage.[22] Significantly, much of this can now be done in the field with laptop, and, in some cases, hand-held, computers.[23]

C. The Virtual Dig

Even the most careful excavation does irreparable damage to the site and, sometimes, to the finds.[24] In developing countries,[25] or in situations where archaeology must be done quickly,[26] further damage is done. An increasing number of archaeologists have come to believe that some sites should remain undisturbed.[27] Where the site may contain particularly fragile artifacts, or where there is insufficient time for a careful excava-

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19. *See* Faline Schneiderman-Fox & A. Michael Pappalardo, *A Paperless Approach Toward Field Data Collection: An Example from the Bronx*, SOC'Y FOR AM. ARCHAEOLOGY BULL., Jan.-Feb. 1996, at 1 (discussing "The Missing Link" hand-held computer system, which can store and organize field notes, including locations, stratigraphy, and observations, as well as generate simple charts and graphs, such as artifact frequencies and distribution tables, all of which can be downloaded to a personal computer).

20. *See* GEOPHYSICAL SURV. SYS., INC., ADVERTISING BROCHURE (on file with the *Harvard Journal of Law & Technology*) (discussing how one subsurface interface impulse radar system automatically plots all features on a profiling recorder as the site is being surveyed).

21. Three-dimensional imaging does more than provide an aesthetically pleasing picture of the site. Frequently, topographic features are not discernable unless displayed in three dimensions. In addition, the use of simulated lighting and real-time graphics systems to allow the researcher to browse over the "site" increases the likelihood that otherwise unnoticed details will be found. *See* Paul Reilly & Alan R. Halbert, Using Computer Graphics to Analyse Archaeological Survey Data from the Isle of Man (Apr. 22, 1987) (unpublished manuscript on file with the *Harvard Journal of Law & Technology*).

22. *See* ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 6.

23. *See generally* Elisabeth Geake & Helen Geake, *Implications of Grid Systems' GridPad Computer for the World of Archaeology*, ELECTRONICS WKLY., Jan. 30, 1991.

24. In addition, excavation exposes the site to looting and vandals.

25. For example, many of the contents of the tomb of the Marquis Yi of Zeng, a fifth-century B.C. Chinese nobleman, were irretrievably damaged when the open excavation was flooded. Local archaeologists had failed to secure the site against seasonal rains. *See* Thomas Maier, *High Technology Creates New Ethic Among Archaeologists*, OTTAWA CITIZEN, Apr. 1, 1995, at H10.

26. As when development of the area is imminent, or where war or political instability threaten a site. In Japan, for example, 99% of all archaeology projects are carried out prior to the destruction of sites by development. *See* Akifumi Oikawa, *Japanese Archaeological Site Databases and Data Visualization, in* ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 57.

27. *See* Maier, *supra* note 25, at H10.

tion,[28] these archaeologists map the site carefully and leave it to future generations and improved technology to excavate.[29]

Even where exigent circumstances do not exist, information technology provides an alternative to digging. Ground-penetrating radar, remote control miniature cameras, infrared photography, thermal mapping, electro-magnetic mapping, and other remote-sensing devices can give enough information about a site to answer many of the questions raised.[30]

D. Interpretation of Finds

Fossils, bones, and hard artifacts are often found in fragments, with many pieces missing.[31] Artistic artifacts such as paintings, drawings, petroglyphs, and writings may be too faded to interpret. Buildings may consist of no more than an incomplete foundation outline. Animal, human, or plant material may be too fragile to be examined. Traditionally, archaeologists examined what they had and made educated guesses about what they could not examine. Information technology, however, allows archaeologists to go beyond guesswork.

Digital imaging systems[32] can scan photographs or other images[33] of an artifact or remains (or, in some cases, the item itself) and create a digital image which can be manipulated by computer. Manipulation may

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28. Archaeology is frequently a race against the clock. For example, in July 1995, the Egyptian government gave archaeologists four months to search the seabed near Alexandria for the Pharos Lighthouse, one of the Seven Wonders of the ancient world. The Egyptian government intended to cover the undersea ruins with concrete barriers to protect a 15th century fort on the coast. *See Divers Speed Hunt for Ruins of Pharos Lighthouse*, THE TIMES (London), July 21, 1995, at 10.

29. For example, many archaeological sites in London have been discovered during construction. Where the construction will do no harm to the site, archaeologists have been willing to allow the site to be covered by the construction as long as it has been mapped. Special construction precautions must be taken, like the use of pilings rather than a foundation, and the owner must bear the cost. Some archaeologists argue, however, that excavation should always take place as there is no way of knowing whether the site will be damaged by even cautious construction. Pilings, for example, might damage artifacts in their path, stress nearby artifacts, alter the water table, or channel rainwater to lower strata. Interview with Dr. Clive Orton, London Institute of Archaeology (Oct. 16, 1995).

30. *See, e.g.*, David Keys, *Leaving Every Stone Unturned*, THE INDEP., Nov. 29, 1992, at 66.

31. Alan Kalvin, one of the developers of the IBM computer visualization system, noted, "[v]ertebrate fossils are rarely found complete and undamaged. They have usually been broken into pieces by geological processes, weathering or carnivores." Diana Phillips Mahoney, *Visualization Technology Helps Anthropologists Re-Create the Past*, COMPUTER GRAPHICS WORLD, Jan. 1995, at 18.

32. Software such as the IBM Visualization Data Explorer digitizes, extrapolates from, and manipulates data. *See id.*

33. For example, X-rays, magnetic resonance images, and computed tomography.

include extrapolation to supply missing information, scaling to fit unrelated but complementary pieces together, positional changes, or animation.[34]

This data may also be used to create a solid model of the find.[35] Using laser scanners and computed tomography ("CT"), the interior and exterior structure of an artifact, remains, or fossil can be digitized and stored.[36] This data can then be used in computer-controlled modelling devices[37] to create a perfect[38] nylon model of the object.[39]

Even tiny fragments of animal, human, or plant remains can be subjected to DNA testing for the purposes of identification and evaluation.[40] Scanning electron microscopy can be used to identify past disease or injury.

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34. By inputting data on the fragmentary skeletal remains of "Lucy," an *Australopithecus afareninsis* found in Ethiopia in 1974, into a program designed to produce animated simulations, anthropologists and paleontologists were able to determine that Lucy probably walked upright. *See* Nick Nuttall, *Special-Effect Key to Age-Old Riddle*, THE TIMES (London), July 12, 1995, at 3.

35. A computer was first used to create a three-dimensional image from a series of CT scans at the World Heritage Museum at the University of Illinois, Urbana. Models were made by hand from the images. *See* Karen Wright, *Tales From the Crypt*, DISCOVER, July 1991, at 54.

36. CT provides enough detail to show worn enamel on a tooth or healed injuries on a bone. Three-dimensional laser scanners capture details less than a millimeter across. *See* Powell, *supra* note 1, at 46.

37. Rapid prototyping, or sintering, is used in manufacturing to create a nylon or polycarbonate model of an object from the object's digital measurements. Sintering systems download scanned measurements and then use the information to control a laser. The laser fuses nylon or polycarbonate powder into a thin (less than .005 inches) layer, building up precisely measured layers into a three-dimensional model. *See, e.g.*, Peter Tyson, *Replicating Relics*, TECH. REV., Aug. 1994, at 20.

38. The creation of a solid model based on extrapolation or hypotheses quickly demonstrates the deficiencies or errors in the data. *See* ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 7.

39. These models are so detailed that in the case of bones, for example, the models reveal evidence of disease, life span, and behavior. *See* Tyson, *supra* note 37, at 20.

40. An interesting use of DNA analysis is occurring in Israel on the Dead Sea Scrolls. In an effort to match the thousands of remaining fragments of the animal skin scrolls, researchers are attempting to use DNA analysis to divide the fragments by animal species and, in some cases, by individual animal. *See* John Musey, *DNA and Jigsaws*, CURRENT ARCHAEOLOGY, Nov. 1995, at 31.

Faded artistic artifacts can be made clearer by the use of infra-red photography, x-rays,[41] and ultra high-intensity strobe photography.[42] These techniques may reveal art which has been totally obscured by time or by the artist.[43]

Building sites can be recreated by using techniques such as resistivity, magnetometry, thermal mapping,[44] or ground-penetrating radar to discover the site dimensions and composition.[45] Using CAD systems and knowledge of local building materials and styles, archaeologists can create an "artist's interpretation" of how the site originally might have appeared.[46] Using geographic information systems, archaeologists can even determine the visibility of ancient structures in the landscape.[47]

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41. *See* Shelley M. Bennett, *New Insights into British Paintings*, CALENDAR (The Huntington Library), July-Aug. 1995, at 1 ("The lead content in white paint appears opaque when x-rayed, thus revealing hidden layers of pigment."). X-ray images can also be used to clarify brushstrokes, as a tool to detect forgeries. *See* Henry Adams, *Rembrandt or not Rembrandt*, SMITHSONIAN, Dec. 1995, at 82.

42. Using a 2,400 watt-second strobe and polarizing filter to eliminate surface reflections, a photographer can recover faded and obscured petroglyphs. The photographs can then be digitally enhanced to improve resolution, contrast, and color. *See* Paula Bock, *A Kinder, Gentler Archaeology — Obscured Over Time, the Painted Rocks of Horsethief Lake Show Their True Colors on Film*, SEATTLE TIMES, May 28, 1995, at 12.

43. *See, e.g.*, Suzanne Muchnic, *Exorcising the Ghosts of Art*, L.A. TIMES, June 25, 1995, at 58 (describing how the Huntington Library's use of x-ray photography found that Thomas Gainsborough had originally painted, and then obliterated, a small dog next to his "Blue Boy").

44. Thermal mapping can convey an outline of the structures on a site, and give some indication of building materials, by measuring the rate at which solar energy dissipates over an area. For example, a buried stone wall will retain the day's heat for considerably longer than would the surrounding soil. *See* Keys, *supra* note 30, at 66.

45. *See, e.g.*, Norman Hammond, *Earth Throws Up Secrets of the 'British Pompeii,'* THE TIMES (London), July 25, 1995, at 5. One commentator argues that information technology allowed the "British Pompeii" archaeologists to discover in six months what would have taken 100 years to excavate. *See Virtual Spadework*, THE TIMES (London), July 25, 1995, at 15.

46. *See* Mike Fletcher & Dick Spicer, *The Display and Analysis of Ridge-and-Furrow from Topographically Surveyed Data*, *in* ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 97-122.

47. This process is referred to as "viewshed analysis" and is based on the premise that the importance of a building can be inferred from its position. Archaeologists use topographical data with geographic information system software to understand how a building or monument once fit into the landscape. To understand how it appeared to observers, the structure's dimensions and the height of a hypothetical observer are added to the mix. View maps can then be produced of every point from which the structure could have been seen. Comparisons can also be made with the visibility of other local structures. *See* Denison, *supra* note 16, at 26.

E. The Virtual Museum

The data from digital imaging programs can be used to create holographic[48] or three-dimensional[49] images of artifacts for examination in a virtual museum.[50] Entire collections of artifacts can be made available on CD-ROM.[51] Archaeological sites can be recreated using three-dimensional mapping and CAD programs.[52] Because of the flexibility of these programs, the museum "visitor" is able to "walk through" the site or to "dig" through the relevant strata, receiving information about the site at the touch of a button.[53]

Researchers can use the virtual museum or models to examine artifacts that are too remote or too fragile for conventional research.[54] In addition, many researchers can examine an artifact simultaneously, preventing hoarding and similar problems.[55] Finally, the virtual museum

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48. Unfortunately, holography (other than the so-called "white light" holography used on credit cards and novelties) is expensive and requires significant computing power. Sampling techniques (removing redundant or irrelevant data) may make holograms more common in the future. *See* NICHOLAS NEGROPONTE, BEING DIGITAL 122-25 (1995).

49. *See, e.g.*, Glenn Rifkin, *Rebuilding the Sphinx with PCs*, N.Y. TIMES, Sept. 25, 1991, at D9. By digitizing measurements and photogrammetric (stereoscopic-type) pictures, researchers have been able to create a three-dimensional digital model of the Sphinx as it is today. Modifications can then be made to reproduce the likely appearance of the Sphinx when it was created.

50. *See, e.g.*, Theodore Wolff, *Computers and Artifacts Reveal Glory of Pompeii*, THE CHRISTIAN SCI. MONITOR, Sept. 11, 1990, at 10 (discussing the use of computer simulations as an adjunct to a traditional museum exhibition).

51. EmbARK is a program that allows museums to create CD-ROMs of their collections, form exhibits, and catalogue and categorize their collections. *See* Nicholas von Hoffman, *Ad Electronica — Digitizing the Fine Arts*, ARCHITECTURAL DIG., July 1995, at 46.

52. *See* Alan Chalmers & Simon Stoddart, Insite Project: An Interactive Photo-Realistic Visualisation System for Archaeological Sites (1995) (unpublished manuscript, on file with the *Harvard Journal of Law & Technology*). This system allows archaeologists to manipulate parameters to create any reasonable interpretation of the appearance of the programmed site. The resulting hypothetical is then shown as a photo-realistic image.

53. The University of Newcastle Museum of Antiquities was the first museum in Britain to put a "traveling" exhibition onto the World Wide Web. The museum's experience was uniformly positive. Museum "visitors" helped to modify and improve the exhibit, it was significantly cheaper than a conventional exhibit, and fragile artifacts were spared the wear and tear of a lengthy exhibition. *See* Letter from Lindsay Allason-Jones, Archaeological Museums Officer, University of Newcastle, England, to the author (Aug. 21, 1995) (on file with the *Harvard Journal of Law & Technology*).

54. This technology can also be used to identify and return artifacts to the culture to which they belong. For example, an electronic catalogue of digital images of Native American artifacts is being used to ensure that tribal artifacts are properly repatriated. *See Come Home, Little Arrowhead*, BUS. WK., Jan. 22, 1996, at 94D.

55. *See generally* Cindy Alberts Carson, *Raiders of the Lost Scrolls: The Right of Scholarly Access to the Content of Historic Documents*, 16 MICH. J. INT'L L. 299 (1995) (discussing the problems of scholarly hoarding).

preserves the context and content of the site for study even if the actual site has been later reburied, looted, or destroyed.[56]

III. ILLUSTRATIVE CASES

In the late 1980s several human skull fragments from the Middle Pleistocene (approximately 780,000 to 28,000 B.C.E.) were unearthed in Morocco. The fragments consisted of a braincase from a small female, unearthed at Salé, and two facial fragments from a male or large female, unearthed at Thomas Quarry.[57] At the time, since no complete human skull of similar antiquity had been found in northwest Africa, paleoanthropologists were very interested in creating a composite skull from the fragments.

The fragments belong to the government of Morocco, but are held for study at the Musée de l'Homme in Paris, France. With the agreement of the museum and the Moroccan government, the skull fragments were subjected to laser scanning, magnetic resonance imaging, and CT. These data sets were provided to a group of researchers interested in creating a composite skull image, with the understanding that the original data sets would not be released.[58] Both the Moroccan government and the museum claimed a copyright interest in the data sets.

Using computer visualization technology, these researchers were able to modify and amend the data sets sufficiently to create an image of a virtually complete skull. This image was ultimately published by the researchers, although the original data sets were not.

Subsequently, researchers have expressed an interest in using sintering[59] to create a three-dimensional model of the composite skull.[60] While it would be possible to use the composite image as the basis for the model, a better result would be reached if the original data sets were used.

In another recent instance, known as the Sacred Way Project, archaeologists, with a European Community grant to apply new technology to the protection of cultural heritage, planned to produce an interactive compact disc ("CDI") of a Greek site.[61] The Greek Ministry

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56. *See, e.g.*, Brian Fagan, *Enlightened Stewardship*, ARCHAEOLOGY, May-June 1995 (discussing the vulnerability of sites located on private land).

57. *See* Alan D. Kalvin et al., Visualization in Anthropology: Reconstruction of Human Fossils from Multiple Pieces (Apr. 1992) (unpublished manuscript, on file with the *Harvard Journal of Law & Technology*).

58. *See id.* at 8.

59. *See generally* Tyson, *supra* note 37.

60. *See* Kalvin et al., *supra* note 57, at 7.

61. *See* Paul Reilly, *Three-Dimensional Modelling and Primary Archaeological Data*, *in* ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 158.

of Culture refused to allow them to digitize government photos or imaging data of the site, claiming a copyright interest. When the archaeologists attempted to compile their own data, they were barred from the site.[62]

IV. COPYRIGHT ISSUES RAISED BY THE USE OF INFORMATION TECHNOLOGY IN ARCHAEOLOGY

When an archaeologist works on a dig, the site measurements are likely to be his own, and any images of the site that he may create are based on those measurements. Similarly, photographs which he may take of the site or of artifacts are his own. Nonetheless, as with the Sacred Way Project, governments or individual landowners may attempt to prevent archaeologists from photographing sites or artifacts, or from publishing the resulting images.

While privacy and property issues may explain why permission would be denied for excavation and examination, it is less clear why a government or individual would try to prevent the publication of images of a site or an artifact that has already been excavated. The greatest concerns may be loss of control over how the images will be used and any profits the use may create.[63] Governments or individuals may try to prevent the use of the archaeologist's own images by restricting access to the site, by making non-publication a condition of access, or by declaring that all images become the property of the landowner.

A government or individual may attempt to take this issue of control one step farther, as with the Moroccan skull fragments, by preventing the publication of raw data that have been produced by the government or an individual, or by preventing the publication of images that have been created from that raw data.

Who owns the right to reproduce raw data? Who owns the right to publish a manipulated version of that data? And who owns the right to produce second-generation items, such as models, from that data?

62. *See* Telephone Interview with Dr. Gary Lock, Oxford University, England (Dec. 8, 1995).

63. *See id.* ("It was all about power and control — the Greek Ministry of Culture felt that they were losing control of their material.").

A. Copyright in Raw Data

"Raw data" may be defined as information directly recording the physical state of a subject, that has not been the subject of editorial or idiosyncratic input from the data gatherer.[64] The process of collecting the raw data may have been laborious and time consuming, and its use by another may pre-empt the gatherer's ability to capitalize on the data. Nonetheless, it is well-established in the United States[65] that copyright protection will not be given to a work where the author's sole contribution is time and labor.[66] Other protections may apply, such as unfair competition or trade secret, but the mere collection of raw data, without more, fails to meet the creativity requirement of modern U.S. copyright law.

1. Copyright Protection Generally

To receive copyright protection an item must be an original work of authorship fixed in a tangible medium of expression.[67] Every information technology tool discussed in this Article produces data that are fixed in tangible media of expression.[68] Even those tools which communicate directly with analytic or manipulation computer programs produce data which are stored in random access memory ("RAM").[69]

As all of these tools are direct measurement devices, which rely on the artifact or site for input, the data they produce are original, i.e., not plagiarized.[70]

Determining whether the data produced by these tools are works of authorship is more problematic. The statutory categories under the

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64. *See* Richard H. Jones, *Is There a Property Interest in Scientific Research Data?*, 1 HIGH TECH. L.J. 447 (1986) ("'[R]aw' scientific research data [is] defined here to include any unedited recording of information concerning measurable properties of physical objects resulting from experimentation or controlled observation.").

65. Most other countries take a similar view. The notable exception is British copyright law, which is based not only on originality and creativity, but also on "skill, judgment and labour." W. R. CORNISH, INTELLECTUAL PROPERTY: PATENTS, COPYRIGHT, TRADE MARKS AND ALLIED RIGHTS 268-69 (1989).

66. *See, e.g.*, Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340 (1991).

67. *See* 17 U.S.C. § 102(a) (1994).

68. In 1976, when the Copyright Act was adopted, most of these tools, and their means of expression, were virtually unknown. Nonetheless, they are included in the subject matter definition by the phrase, "any tangible medium of expression, now known or later developed, from which [the works] can be perceived, reproduced or otherwise communicated, either directly or with the aid of a machine or device." *Id.*

69. *See* 1 WILLIAM F. PATRY, COPYRIGHT LAW AND PRACTICE 171 n.208 (1994).

70. Novelty is not required. All that is necessary is that the work be original to the author in question. *See, e.g.*, *Feist*, 499 U.S. at 345.

definition of "works of authorship" would only include these data by analogy as "literary,"[71] "graphic,"[72] or "audiovisual"[73] works.[74] The wording of the statute indicates that the list is not exclusive, however.[75] For example, courts have interpreted the statute to include computer programs.[76]

What distinguishes these direct measurement data from the listed categories (and subsequent additions by interpretation of the listed categories[77]) is a lack of input from the purported author. The process which creates the data produced by magnetic resonance imaging ("MRI") or laser scan, for example, is a mechanical one in which choices are non-existent or minimal, and from which the author's personality is absent.[78]

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71. *See* 17 U.S.C. § 101 (1994) ("'Literary works' are works, other than audiovisual works, expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects, such as . . . film, tapes, [and] disks . . . in which they are embodied.").

72. *See id.* ("'[G]raphic . . . works' include two-dimensional and three-dimensional works of fine, graphic, and applied art, photographs, . . . charts, [and] diagrams. . . . Such works shall include works of artistic craftsmanship insofar as their form but not their mechanical or utilitarian aspects are concerned . . . .").

73. *See id.* ("'Audiovisual works' are works that consist of a series of related images which are intrinsically intended to be shown by the use of machines, or devices such as . . . electronic equipment . . . .").

74. *See* 17 U.S.C. § 102(a) (1994) ("Works of authorship include the following categories: (1) literary works; (2) musical works . . . ; (3) dramatic works . . . ; (4) pantomimes and choreographic works; (5) pictorial, graphic, and sculptural works; (6) motion picture and other audiovisual works; (7) sound recordings; and (8) architectural works.").

75. *See* 17 U.S.C. § 101 (1994) ("The terms 'including' and 'such as' are illustrative and not limitative.").

76. A computer program is defined as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." *See id.* For examples of such interpretations, see Digidyne Corp. v. Data General Corp., 734 F.2d 1336 (9th Cir. 1984); Hubco Data Prods. Corp. v. Management Assistance, Inc., 219 U.S.P.Q. (BNA) 450 (D. Idaho 1983).

77. *See* H.R. REP. NO. 94-1476, at 51 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5664 ("[S]cientific discoveries and technological developments have made possible new forms of creative expression that never existed before. In some of these cases the new expressive forms — electronic music, filmstrips, and computer programs, for example — could be regarded as an extension of copyrightable subject matter Congress had already intended to protect, and were thus considered copyrightable from the outset without the need of new legislation.").

78. The author of the computer program which drives the MRI or laser scan is probably entitled to protection for the program itself.

a. Facts Are Unprotectable

Bare facts standing alone, such as the state or appearance of an artifact, are clearly unprotectable under the Copyright Act[79] and case law.[80] Each datum that directly represents a point or condition of an artifact is a fact.[81] These data represent discovery and recordation, but do not represent protectable creation.[82] For example, a laser scan of the Moroccan skull fragments is intended to measure and record, millimeter by millimeter, the dimensions and contours of each fragment. These measurements are verifiable and reproducible; repeated laser scans will produce identical results.

One of the purposes of copyright is to encourage the dissemination of information.[83] Theoretically, when copyright protects an author's expression, he will make that expression public; when he makes it public, its underlying factual content becomes available for use.[84] The monopoly granted by copyright law is a limited one — the protection extends only to the author's creative expression.[85] The underlying facts may be used by a subsequent author as part of his own expression, or for

79. *See* 17 U.S.C. §102(b) (1994) ("In no case does copyright protection for an original work of authorship extend to any idea, . . . concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated or embodied . . . .").

80. *See, e.g.*, Harper & Row Publishers, Inc. v. Nation Enters., 471 U.S. 539, 547 (1985).

81. *See* Triangle Publications, Inc. v. Sports Eye, Inc., 415 F. Supp. 682, 685 (E.D. Pa. 1976) ("For the purposes of copyright infringement, data and ideas are treated as equivalents.").

82. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 347 (1991) ("[F]acts do not owe their origin to an act of authorship. The distinction is one between creation and discovery: the first person to find and report a particular fact has not created the fact; he or she has merely discovered its existence.").

83. *See* Gary L. Francione, *Facing the Nation: Standards for Copyright, Infringement, and Fair Use of Factual Works*, 134 U. PA. L. REV. 519, 538 (1986) ("Copyright protection is 'granted for the very reason that it may persuade authors to make their ideas freely accessible to the public so that they may be used for the intellectual advancement of mankind.'") (quoting 3 MELVILLE B. NIMMER & DAVID NIMMER, NIMMER ON COPYRIGHT § 13.03(A)(1) (1985)).

84. *See* HOUSE COMMITTEE ON THE JUDICIARY, COPYRIGHT LAW REVISION, H.R. REP. NO. 94-1476, at 57 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5670 ("Copyright does not preclude others from using the ideas or information revealed by the author's work. It pertains to the literary [work] . . . in which the author expressed intellectual concepts.").

85. *See Harper & Row*, 471 U.S. at 556 ("[C]opyright's idea/expression dichotomy '[strikes] a definitional balance between the First Amendment and the Copyright Act by permitting free communication of facts while still protecting the author's expression.'") (quoting Harper & Row Publishers, Inc. v. Nation Enters., 723 F.2d 195, 203 (2d Cir. 1983)).

any other purpose.[86] In this way, the product of the original author's intellect is protected while the public store of information is increased.[87]

If raw data were considered protectable expression, the author's monopoly on the expression would extend to the underlying facts as well.[88] Not only would this enlarge the statutory scope of copyright, but it could serve to undermine one of its purposes — the dissemination of information.[89]

b. Effort Is Unprotectable

Using high-technology imaging devices, such as three-dimensional CT and spaceborne imaging radar, can be time consuming and costly. After a significant investment of time or labor, an 'author' may feel that he has a protectable interest in the resulting data. Prior to *Feist Publications, Inc. v. Rural Telephone Service, Co.*, some courts and scholars agreed with that position.[90]

The *Feist* Court, however, made it clear that the 1976 Copyright Act requires that an author show at least some minimal amount of intellectual creativity before protection will lie,[91] and even then the protection subsists only in the creativity and not in the underlying facts. Physical or economic effort alone will not suffice to transform unprotectable facts into protectable expression.[92]

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86. *See* U.S. REGISTER OF COPYRIGHTS, 87TH CONG., REPORT OF THE REGISTER OF COPYRIGHTS 3 (1961) ("Copyright does not preclude others from using the ideas or information revealed by the author's work, . . . anyone is free to create his own expression of the same concepts, or to make practical use of them, as long as he does not copy the author's form of expression.").

87. *See, e.g.*, H.R. REP. NO. 94-1476, at 56 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5664.

88. *See* Atari, Inc. v. Amusement World, Inc., 547 F. Supp. 222, 228 (D. Md. 1981) ("[W]hen an idea is such that any use of that idea necessarily involves certain forms of expression, one may not copyright those forms of expression, because to do so would be in effect to copyright the underlying idea.").

89. *See* Herbert Rosenthal Jewelry Corp. v. Kalpakian, 446 F.2d 738, 742 (9th Cir. 1971) ("When the 'idea' and its expression are . . . inseparable, copying the 'expression' will not be barred, since protecting the 'expression' in such circumstances would confer a monopoly of the 'idea' upon the copyright owner free of the conditions and limitations imposed by the patent law.").

90. *See, e.g.*, Robert C. Denicola, *Copyright in Collections of Facts*, 81 COLUM. L. REV. 516 (1981).

91. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 345-446 (1991).

92. *See* Financial Info., Inc. v. Moody's Investors Serv., Inc., 808 F.2d 204, 207 (2d Cir. 1986) ("To grant copyright protection based merely on the 'sweat of the author's brow' would risk putting large areas of factual research material off limits and threaten the public's unrestrained access to information.").

c. Creativity Is Required

The Moroccan government and the Musée de l'Homme maintained that they had a copyright interest in the laser scans, magnetic resonance images, and CT scans of the skull fragments.[93] They were willing to allow researchers to use the data sets for the purpose of creating a composite digital image, but only with the understanding that the original data sets, and presumably their digital equivalent, would not be made public. While courts would enforce such an agreement under contract law, there should be no copyright interest in the original data sets because they lack sufficient creativity for protection.

MRI images, CT scans, and the like are analogous to photography, in that they produce an image which records some aspect of the subject. Protectability of the resulting data should depend, however, not on the technology's similarity to a generally protectable medium, like photography, but rather on whether the threshold requirements for protectability have been met.[94] Unlike most photographs, these imaging technologies will usually lack the spark of creativity that differentiates authorship from mechanics.[95]

It is generally understood that, for copyright protection to apply, the "creator" must, at the very least, have had the power to make subjective choices that affect the resulting image.[96] Without this discretion, and the concomitant possibility of alternative outcomes, there can be no creativity. In photography, choices are made with regard to subject,

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93. *See* Kalvin et al., *supra* note 57, at 8.

94. *See* PATRY, *supra* note 69, at 251-52 ("[Q]uestions have arisen regarding photographs taken by satellites and medical technology. . . . There is no *per se* bar to copyright in photographs taken by any of these technologies. The question in individual cases should be resolved not so much by reference to the particular technology, since Sec. 102(a) permits 'fixation in any tangible medium of expression,' but rather by the presence or absence of authorship.").

95. Even a photograph may be too mechanistic to be protected. In Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53 (1884), an early photography case, the Supreme Court said that unprotectable photography might be of the type which "is merely mechanical, with no place for novelty, invention or originality. It is simply the manual operation, by the use of these instruments and preparations, of transferring to the plate the visible representation of some existing object, the accuracy of this representation being its highest merit." *Id.* at 59.

96. *See* Jane C. Ginsburg, *Creation and Commercial Value: Copyright Protection of Works of Information*, 90 COLUM. L. REV. 1865, 1867 (1990) ("The prevalent contemporary understanding identifies authorial subjectivity as the hallmark of original works of authorship: original works reflect the personalities of the authors or, at the very least, embody their creators' subjective choices in the selection or arrangement of material.").

pose, background, exposure, lighting, composition, and equipment.[97] In medical imaging, such as an MRI, the operator only decides whether or not to scan, which view to scan, and makes very limited adjustments of the intensity at which to scan. The image is an expression of a fact — the condition of the subject. Creativity in the expression of this fact would run counter to the scan's purpose of accurately representing the subject.[98] Similarly, a technician may decide whether to take a blood pressure reading and how to place the sphygmomanometer, but the digital readout is an inevitable result of the measurement process.

In using some mechanistic information technology tools, such as spaceborne imaging radar, seismic refraction, or laser measuring devices, the operator has little input in the result — even though some operator choice may exist in selecting the mode of presenting the result. However, while the data may be presented in alternative modalities (as, for example, when an operator chooses a bar graph over a point graph), it does not necessarily follow that the creativity requirement has been met, particularly if the alternative modalities are standard to the equipment.

Imaging data, such as from a laser scan, MRI, CT, etc., represent the condition of the artifact imaged by converting the artifact information into digital, and hence, machine-readable form. This transformation has the potential to include sufficient creativity to warrant copyright protection. The operator could position the artifact in such a way so as to create an artistic image, or change the intensity of the scan to create an unrepresentational but aesthetically pleasing combination of light and shadows. Interest in accuracy dictates that this creative potential is not realized in most cases. While it is certainly possible to envision a medical ultrasound operator boosting the gain on an image to create an aesthetically pleasing result, it is impossible to imagine that same operator considering aesthetics when the goal is diagnosis. Similarly, an operator may use his skill and knowledge to determine the optimum placement of the artifact for an accurate view, but because, by definition, there is only one optimum position, the operator's choice is not creative.

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97. *See* Compendium II of Copyright Office Practices § 508.01 (1984) ("Generally, original photographic or holographic authorship depends on the variety and number of elements involved in the composition .... Original photographic composition capable of supporting registration may include such elements as time and light exposure, camera angle or perspective achieved, deployment of light and shadow from natural or artificial sources, and arrangement or disposition of persons, scenery or other subjects depicted in the photograph.").

98. *See* PATRY, *supra* note 69, at 252 ("A CAT scan photograph of a patient might not be protectible if there is no discretion in the placement of the patient, while a CAT scan photograph of a grapefruit might be protectible.").

To find otherwise would be to give a patient or a doctor rights in an electrocardiogram ("EKG") print-out, or an automobile owner or mechanic rights in the results of an auto-pollutant emissions test. Copyright protection should not apply when the source and the form of the data are not within the "author's" artistic or creative control, nor should copyright protection obtain when creativity is not exercised.

d. Human Authorship Is Required

If there is no authorial creativity, the process is a purely mechanical one and its results are unprotectable. U.S. courts have not yet recognized a protectable interest in a work in which a non-human is the author. In fact, United States Copyright Office procedures prohibit the registration of works created entirely by machine.[99]

The 1988 British Copyright Act[100] gives limited copyright protection to works that are "computer-generated by computer in circumstances such that there is no human author of the work."[101] While this section has not been fully interpreted by the British courts, the British Photographers' Liaison Committee believes that it applies to scientific, technical, and remote surveillance photography.[102] By extension, it may also apply to any mechanical imaging device. This must be considered, however, in light of the fact that British copyright law has traditionally focused more closely on effort and labor than on creativity.[103] The U.S. focus on creativity is antithetical to the concept of non-human authorship.

Many medical imaging devices, remote-sensing devices, and measuring devices operate with minimal or no human input after the initial programming. For example, the CT equipment used on the Moroccan skull fragments operated automatically after the positions of the fragments were selected and adjustments were made for their size. The software which produced a three-dimensional CT scan from the

99. *See* Compendium II of Copyright Office Practices § 503.03(a) (1984) ("In order to be entitled to copyright registration, a work must be the product of human authorship. Works produced by mechanical processes or random selection without any contribution by a human author are not registrable.").

100. *See* Copyright, Designs, and Patents Act, 1988, ch. 48 (Eng.).

101. Jane Austin, *Altered States*, DESIGN WK., Mar. 3, 1995, at 16.

102. *See id.*

103. *See generally* CORNISH, *supra* note 65.

initial CT information operated totally automatically.[104] In neither case was protectable authorial creativity exercised.

Computer programs and databases are protectable,[105] as are the results of the human use of many computer programs, since they meet the definition of literary, pictorial, graphic, or audiovisual work and contain the requisite level of creativity to be considered a work of authorship.[106] While some computer programs may be designed to produce random results, most are not, and instead respond in an ordered and logical way to the instructions given by the programmer. Is the author of the resulting work the programmer, the user, or both?

On one end of the spectrum is a word processing program used in writing a protectable literary work. The word processing program itself is incidental to the protectable literary content of the work; therefore, the programmer has no protectable interest in the work.

At the other end of the spectrum is a program designed to operate a measuring or analytical device with minimal input from the user, for example, a program that operates CT equipment. In that case, neither the programmer nor the user should be entitled to protect the results. The user has no protectable interest because he has had no creative input in the result. While the programmer is entitled to protect the program, she is not entitled to protect the results of the program since — because it measures or analyzes the state-of-being of the subject — it is purely factual, and, therefore, non-creative.

Between these poles lie works where only the programmer should be entitled to protect the results,[107] and where the programmer and user should be entitled to protect the results jointly.[108] The identity of the "author" for copyright purposes, and the question of protectability, will

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104. Computed tomography produces an x-ray image of an object in slices approximately 2 mm thick. The two-dimensional images produced by a series of slices are easiest to understand if they can be synthesized into a three-dimensional image. Various three-dimensional reconstruction programs automatically create a three-dimensional synthesis of the slices by extrapolating surface contours, projecting from one scan to the next, and shading. Similar types of three-dimensional reconstruction from serial slices are used in MRI, ultrasound imaging, and electron microscopy. *See* Michael W. Vannier & Glenn C. Conroy, *Three-Dimensional Surface Reconstruction Software System for IBM Personal Computers*, 53 FOLIA PRIMATOLOGICA 22 (1989).

105. *See* H.R. REP. NO. 94-1476, at 54 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5667 ("Computer data bases [are protectable] to the extent that they incorporate . . . expression of original ideas, as distinguished from the ideas themselves.").

106. An obvious example is the result of using a word processing program.

107. For example, a program designed to write in the style of Hemingway. The resulting work, although a product of the program, will probably demonstrate enough creativity by the programmer to warrant protection.

108. For example, the same program, except the user lists subjects or words to be included in the final work.

vary with the degree of input of the parties who claim authorship and the creativity of the resulting work.

An elephant at the Phoenix Zoo in Arizona paints canvases with a striking combination of colors and forms.[109] The zoo has been selling the paintings for several years,[110] and purchasers hang the paintings in their homes as they would any human-generated art.[111] An animal has no copyright interest in its work, however, even if it represents the result of choices which would be described as creative if the "author" were human.[112] This either indicates that we do not believe a non-human is capable of making choices, or that we have made a policy decision that only human-generated work is protectable. In either case, a work generated automatically by an imaging device should clearly be unprotectable when a work generated by an intelligent, but not human, being cannot be protected.

2. Compilations and Derivative Works

While facts alone are unprotectable, protection may extend to a compilation[113] of otherwise unprotectable facts if the compiler shows sufficient creativity in the creation of the work.[114] The level of creativity required is not high;[115] the *Feist* Court only required that "the selection and arrangement of facts cannot be so mechanical or routine as to require

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109. *See* Vicki Croake, *Zoos Cash in on Pachyderm Picassos*, BOSTON GLOBE, Aug. 20, 1994, at 25. The elephant uses artist's brushes and selects colors from a palette; when she no longer wishes to add anything to a given painting, she drops the brush until a new canvas is in position. Her "artistic" impulses are not unique to her; elephants in the wild and in zoos are known to scratch patterns in the dirt or on walls with stones and sticks. *See id.*

110. The zoo claims a copyright interest in prints made of her work, as well as in the originals. They recognize that their claim in the originals may be insupportable. *See* Telephone Interview with Richard George, Marketing Director, Phoenix Zoo (Mar. 8, 1996).

111. When the identity of an elephant "artist" was revealed to abstract expressionist painter Willem de Kooning, who had just favorably reviewed one of its paintings, de Kooning commented: "Damned talented elephant." *See* Dan Oldenburg, *Creatures: A Trunkful of Talent*, WASH. POST, Dec. 12, 1985, at F5.

112. *See* Compendium II of Copyright Office Practices § 202.02(b) (1984) ("Human author. The term 'authorship' implies that, for a work to be copyrightable, it must owe its origin to a human being. Materials produced solely by nature, by plants or by animals are not copyrightable.").

113. *See* 17 U.S.C. § 101 (1994) ("A 'compilation' is a work formed by the collection and assembling of preexisting . . . data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of authorship.").

114. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 347 (1991).

115. *See id.* at 345 ("[T]he requisite level of creativity is extremely low; even a slight amount will suffice. The vast majority of works make the grade quite easily, as they possess some creative spark, 'no matter how crude, humble or obvious' it might be.").

no creativity whatsoever."[116] In *Feist*, an alphabetical arrangement in a telephone book was, according to the Court, not only unoriginal, but practically inevitable.[117] Similarly, the arrangement of data in a scan or reading will inevitably (barring error) be an accurate representation of the subject or its condition. There can be no "selection" of facts if all of the facts are used, as occurs in a medical scan. Nor can there be an "arrangement" of facts when they are only coherent in one particular order.[118]

A creator may contend, however, that the images produced by a scan or reading constitute a derivative work,[119] much like a translation.[120]

For example, an MRI could be viewed as a new fixation of the fact of the condition of the Moroccan skull fragments. Arguably, the unprotectable skull fragments will have been translated into a magnetic resonance image, just as a public domain literary work may be translated into another language. The underlying work remains unprotectable, but the new fixation may be protected against direct mechanical copying. A protectable translation requires some creativity; the translator must make choices as to which words best express the meaning of the original while presenting the best overall literary effect. For this reason, a computer-generated translation is not likely to be considered protectable.[121] Automatic word-for-word substitution of one language for another is not only likely to be partly nonsensical,[122] but is also likely to lack the required "spark of creativity."[123]

For copyright protection to subsist, the process of translation from one form to another requires that some authorial subjectivity be demonstrated, however slight. When Bill Gates' Corbis Corporation purchased the Bettman Archive, Corbis claimed copyright protection for the digital reproductions of public domain photos which were to be made

116. *Id.* at 362.

117. *See id.* at 363.

118. *See* Miller v. Universal City Studios, 650 F.2d 1365, 1368 (5th Cir. 1981) ("[I]f the expression, arrangement and selection of the facts must necessarily, by the nature of the facts, be formulated in given ways, then they are not copyrightable.").

119. *See* 17 U.S.C. § 103(a) (1994) ("[T]he subject matter of copyright as specified by section 102 includes . . . derivative works.").

120. *See* 17 U.S.C. § 101 (1994) ("[Derivative works include] . . . translation . . . abridgment, condensation, or any other form in which a work may be recast, transformed, or adapted.").

121. The program itself, however, would be protectable.

122. For example, see the user's manual for any piece of electronic equipment.

123. *See, e.g.*, Signo Trading Int'l Ltd. v. Gordon, 535 F. Supp. 362, 364 (N.D. Cal. 1981) (finding that a translation of short phrases from English to Arabic was incapable of "nuance and subtleties" and therefore lacked creativity).

available on CD-ROM.[124] Corbis based this claim on the idea that the scanning process by which the digital reproductions were made required selection, judgment, and aesthetic choices.[125] If this is true, copyright protection should apply, although only very limited protection should be given.[126]

With regard to the MRI and laser scan images of the Moroccan skull fragments, even the minimal degree of creativity that Corbis may have demonstrated is lacking, since no aesthetic choice was exercised.

B. Copyright in Manipulated Data

A digital image may constitute a compilation.[127] Different data sets may be combined to produce the final image.[128] The measure of copyright protection afforded a compilation is limited, however.[129] The arrangement, format, or structure may be protected if the *Feist* creativity requirement is met,[130] but the underlying data would not gain protection thereby. If the compilation demonstrates sufficient creativity, it is subject to independent copyright by the compiler; if the underlying data are facts, they would remain unprotectable.

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124. *See generally The Next Copyright Debate — Does He or Doesn't He*, INFO. L. ALERT, Nov. 3, 1995.

125. *See id.* at 1 ("The process of scanning a work may not be as mechanical as it first seems, involving decisions regarding pattern, grains, dots per inch, brightness, and contrast.").

126. *See id.* ("I personally see no social policy problem in protecting the electronic representations of a public domain literary work, provided the scope of the copyright is understood to be so thin that only direct, electronic methods of copying infringe. . . .") (quoting Professor Dennis Karjala, Arizona State University). This protection may be viewed by some as insufficient. For example, some museums have resisted digitizing their collections because they fear that they will lose intellectual property control over them. *See* von Hoffman, *supra* note 51, at 46, 48.

127. *See* 17 U.S.C. § 101 (1994) ("[A compilation is] a work formed by the collection and assembling of preexisting materials or of data that are selected, coordinated, or arranged in such a way that the resulting work as a whole constitutes an original work of authorship.").

128. *See* John Gastineau, *Bent Fish: Issues of Ownership and Infringement in Digitally Processed Images*, 67 IND. L.J. 95, 109 (1991) ("The Act's inclusive language also suggests that a digital image could be considered a compilation, if for no other reason than it is an assembly of data about previously existing [images]. . . . That conclusion is bolstered by the result in Geshwind v. Garrick, 734 F. Supp. 644, 650 (S.D.N.Y. 1990) (creators of an animated film were the authors of the film, as well as of the database from which the film was created).

129. *See* 17 U.S.C. § 103(b) (1994) ("[Copyright in a compilation] extends only to the material contributed by the author of such work, as distinguished from the preexisting material employed in the work, and does not imply any exclusive right in the preexisting material.").

130. *See* Feist Publications, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 354 (1991).

If the original data are manipulated with sufficient creativity, the resulting work would be more than a mere compilation. The creative changes would gain copyright protection in their own right as a derivative work.[131]

The author of the manipulated image is entitled to a copyright in the derivative work, but only so long as his use of the original data did not infringe.[132] An author of a digitized derivative image will have copied the original data, and therefore infringed its copyright,[133] if any, at least twice: once when the data were scanned or otherwise input into the digitizing computer, and once again when the derivative work was created.

Digitizing[134] a photograph, x-ray, or other image creates, first of all, a copy. This "copy", however, may not be exact. In digitizing, data often undergoes instantaneous automatic error correction or enhancement, and it is not unusual for data compression to occur.[135] There would, nonetheless, most likely be a similarity between the original and the copy sufficient for a finding of infringement. At some point, however, the adjustments prior to input may be so great and the similarity to the original data so small that while copying in a technical sense occurred, infringement has not. If the original data were machine-readable, however, the first input of the data would be an infringing copy, even if the subsequent manipulation produced a derivative image totally unlike that of the original.

A good example of the type of manipulation courts should consider independently protectable is that which takes place when scientists use computer visualization programs to reconstruct sites or artifacts. Data

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131. *See* Gastineau, *supra* note 128, at 109 ("[A composite] digital image would qualify as a derivative work. The image would have been created from photographs, which are copyrightable subject matter; it would have been created by transforming, adapting or modifying those photographs either into digital form or into new visual arrangements; and it would be considered an original work of authorship.").

132. *See* 17 U.S.C. § 103 (1994).

133. Unless his use was authorized.

134. Digitizing occurs when the information from some object is transformed into bits. For example, a black-and-white photograph can be digitized by assigning numbers to all the shades of gray on the continuum between the colors black and white. If the photograph is divided into small sections and each section is assigned a number corresponding to its shade, a computer can reproduce the photograph. The resolution of the photograph, and hence the quality of the copy, improves the smaller the sections are and the more numerous the shade choices. Unlike mechanical copying, however, digital copying actually permits a copy which is superior to the original; errors can be corrected and resolution can be enhanced. *See* NEGROPONTE, *supra* note 48, at 14-16, 58-61.

135. Data compression, or sampling, removes the redundancies and irrelevancies in the original data set. The remaining portions, or samples, can still give the impression of the complete original data set if the samples are spaced closely enough in time or space. *See id.*

from many sources can be brought together to complete a reconstruction or hypothetical image, such as occurred with the Moroccan skull fragments.[136]

The morphology of an early species is usually determined by bringing together information from many fragmentary finds.[137] The fragments may or may not come from the same individual. To properly understand the characteristics of the species, archaeologists, anthropologists, or paleontologists usually physically construct a composite individual by gluing together fragments or casts of fragments, and by inserting spacers of various sorts to replace missing fragments.[138] The process is complicated by the fact that many fossils are found in a stony matrix from which they may not be easily removed, and which, in any case, obscures their internal anatomy.[139]

By using laser scanners or electromagnetic stylus devices, researchers can digitize the external surfaces of a fossil. They can then use CT and magnetic resonance imaging to digitize the obscured internal anatomy. Digitization allows researchers to quantify any modifications in size or position, and to compare these statistics to the work done on other individuals.[140]

A case in point is the digital "construction" of the Moroccan composite skull from data obtained from skull fragments belonging to two individuals found at different sites.[141] The Musée de l'Homme wished to keep the fragments in France, and so released MRI, CT, and laser scans of the fragments to researchers. In any case, physically conjoining the fragments would have been difficult and misleading, as the two individuals were of markedly different size. A computer visualization program,[142] however, allowed scaling of the digitized images of the fragments. The advantages of using computer visualization are many and varied: 1) missing pieces can be created by mirror imaging, 2) pieces from different-sized individuals can be scaled, 3) pieces do not need to be trimmed or otherwise damaged to make them fit, 4) the resulting model can be modified as new pieces or theories become available, and 5) very precise measurement data is generated.[143]

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136. *See generally* Kalvin et al., *supra* note 57.

137. *See id.* at 1.

138. *See id.* at 2.

139. *See id.*

140. *See id.*

141. *See id.* at 3.

142. For example, IBM Visualization Data Explorer. *See IBM Visualization Data Explorer*, <http://www.almaden.ibm.com/dx>

143. *See generally Advanced Computer Techniques Help Anthropologists Search for Clues to Mankind's Origins*, BUS. WIRE, July 12, 1994, *available in* LEXIS, News Library, ARCNWS File.

Visualization programs tend to be open-ended. Users are not presented with a closed design program, but are instead allowed to modify the design program to tailor it to their needs.[144] Once the data have been visualized, manipulation takes place. The user can create or modify manipulation tools, including the ability to rotate, scale, translate, or mirror the images on any axis using a mouse, three-dimensional cursor, and graphic sliders, buttons, and probes with varying degrees of control.[145] A degree of animation or motion is also available to allow the user to see temporal processes directly.[146] The user can manipulate quantitatively (by typing in the numerical values of changes) or qualitatively (by "eye-balling").[147] Qualitative changes made by eye-balling can be quantified so that the next item can be modified quantitatively using the constant obtained.

Visualization programs do not merely input data sets and output images. Along the way, the user makes dozens of creative choices.[148] First, the user must decide which data set to use or, where a composite image will be created, which data sets to combine. Second, the user must decide how much of the data set to use. Third, the user must decide whether to present the data as a two-dimensional image, a three-dimensional image, a graph, a contour map, or an equation. If the data set will be used to produce an image, the user must decide how the image will look by selecting the degree of opacity of the image, as well as color hue, saturation, and distribution. The user must choose between a surface contour rendering or a volumetric rendering of the object. The image parameters for "front," "back," "inside," "outside," "up," and "down" must be established. The image may need shading, which will require the user to determine the amount and direction of diffuse light falling on the "object," as well as the degree of ambient light. In addition, adjustments can be made for the texture of the surface of the object, and the resulting specular highlights. The final image can be animated, rotated, scaled, translated, transformed, or combined with other images or data. All of the functions which change the size, appearance, location, or orientation of the image operate on graduated systems with an almost infinite number of gradations. Finally, the user may wish to annotate the image by importing text.

Researchers scaled the Moroccan skull fragments to achieve the effect of having pieces from the same individual's skull. A surface

144. *See* Kalvin et al., *supra* note 57, at 5.

145. *See id.* at 6.

146. *See generally Data Explorer in Action*, <http://www.almaden.ibm.com/dx/samples/Samples.html>.

147. *See* Kalvin et al., *supra* note 57, at 6.

148. *See generally Data Explorer in Action*, *supra* note 146.

construction algorithm was used to digitally erase the stone fossil matrix, as well as the metal braces which had been used to support the fragments during the CT scan. The researchers were able to join broken fragments digitally to give the effect of a seamless whole, and undistort pieces that had been warped by fossilization. They created mirror images of pieces to achieve bilateral symmetry, and made slight modifications in the mirror images to reflect the fact that symmetry is never perfect in living beings. They were able to fill in gaps with digital pieces created from a bank of morphometric[149] data. Finally, they added lighting, color, and texture to create a realistic rendering of the composite skull.[150]

All of these processes required making selections from an almost infinite range of variables to create an image which has no "real life" counterpart. The skull image created by the researchers, and the individual it would represent, never actually existed; the fragments of which it is composed belonged to individuals separated by gender, distance, and time. For these reasons, there is no question but that the composite skull image demonstrates sufficient creativity for copyright protection.[151]

C. Copyright in Second-Generation Data

Sintering programs can be used to make three-dimensional models from many types of imaging data. A CD-ROM database now being compiled at the University of Texas will make images of fossils and artifacts available throughout the university. Eventually, the university will put the material onto the Internet.[152] This will enable anyone with access to a sintering device to make perfect replicas. Similarly, photographs taken by a museum-goer[153] could be used as the basis for the creation of a model of the museum's public domain art.[154]

While sintering is usually used for research purposes, it is certainly possible to envision a commercial use. Currently, several U.S. companies specialize in the sale of "museum quality reproductions" of fossils

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149. Morphometrics combines biology, geometry and statistics to create a bank of probable body structure information. *See generally* Dennis E. Slice, et al., *A Glossary for Geometric Mophometrics*, <http://129.49.19.42/morph/glossary/gloss1.html>.

150. *See generally* Kalvin et al., *supra* note 57.

151. However there is no copyright protection in the underlying data. *See supra* part IV.A.

152. *See* Powell, *supra* note 1, at 47.

153. Assuming the museum permits photography.

154. PhotoWin 35 is a computer program that can create a three-dimensional metric reconstruction of an object from two or more photographs of the object taken from different angles. This reconstruction data could then be used to drive a sintering program. *See Advertisement for PhotoWin 35*, SOC'Y FOR AM. ARCHAEOLOGY BULL., Jan.-Feb. 1996, at 5.

and artifacts.[155] According to the largest producer of these reproductions, Skullduggery, models are currently cast by hand directly from the original object, but when sintering equipment becomes less costly, it expects to use the new technology.[156] Even though Skullduggery recognizes that no intellectual property interest exists in the fossils and artifacts themselves, it nonetheless enters into a contract with the fossil or artifact owner similar to a copyright licensing agreement.[157]

The source of the data will determine whether researchers are liable for copyright infringement when sintering is finally used to create a model of the Moroccan composite skull. The original data sets lack sufficient creativity for copyright protection. Therefore, any model made from them would not be infringing. If the model is made from the composite skull data, however, it will infringe the copyright of the composite unless the model's creator obtains a license. If independently protectable, this model would constitute a derivative work.

It is unlikely, though, that the model would be independently protectable. A sintering device creates the model automatically from the data provided. The result, by definition, is a perfect replica. Unless the modeler exercises some creativity, perhaps with regard to color or texture, protection should not extend to the model.[158]

Sintering is currently being used to reproduce the sound made by a species of dinosaur.[159] The skull of the parasaurolophus contained tubular air passages running from the nostrils to the end of a six-foot, rear-facing projection from the crown.[160] By using laser-scanned data from a fossil belonging to the Museum of Pennsylvania, researchers at the Sandia National Laboratory in New Mexico will attempt to create a polyvinyl-chloride model of the skull, complete with synthetic mucous membranes, through which air will be pumped to reproduce the dinosaur's call.[161]

The dinosaur skull belongs to the Museum of Pennsylvania, but was used with permission by the Sandia National Laboratory so that an accurate model could be made.[162] Use of the actual skull itself is not absolutely necessary, however. Certainly, the sintering could be done by

155. *See, e.g., Advertisement for Skullduggery*, NAT. HIST., Apr. 1996, at 72.

156. See Telephone Interview with Skullduggery representative (May 3, 1996).

157. *See id.*

158. *See, e.g.*, L. Batlin & Son, Inc. v. Snyder, 536 F.2d 486 (2d Cir. 1975); Gallery House, Inc. v. Yi, 582 F. Supp. 1294 (N.D. Ill. 1984).

159. *See* Quentin Letts, *Dinosaurs Were the First Trombonists*, THE TIMES (London), Mar. 13, 1996, at 1.

160. *See id.*

161. *See id.*

162. *See id.* (In fact, the Sandia National Laboratory did the work at the request of the curator of the Museum of Pennsylvania, who was also the discoverer of the fossil.)

using pre-existing measurement and composition data, including photographs.

Is the sound created by pumping air through the skull model protectable? The sound created by the model would be a derivative work if the model were protectable.[163] While the basic model is probably not protectable, the addition of synthetic mucous membranes, musculature, etc. is sufficiently speculative for the requisite level of creativity to have been met. The sound created is not musical in the usual sense, however, and its production may not be subject to human discretion, or may be composed of so few notes, as not to create an independently protectable musical work.[164] The format of an audiotape of the sound may nonetheless be protectable, if creative.[165]

D. Fair Use

The purpose of American copyright law is to "promote the Progress of Science and useful Arts."[166] This is effected in two ways. First, a monopoly is given to authors to encourage authorship and publication by allowing them to benefit commercially from their creative labor,[167] and second, the monopoly is strictly limited by time and by the doctrine of fair use to encourage others to use the author's results as a stepping stone for their own pursuits or to exploit the fruit of the author's labor when he has abandoned it.

Ultimately, the goal of copyright law is to encourage societal, intellectual, and technical development, and, although necessary, the protection of the author is secondary to that goal.[168] This status is particularly appropriate where the author's monopoly restricts access not just to his creative effort, but to the public domain data on which his effort is based. The fair use doctrine represents an attempt to balance the

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163. *See* 17 U.S.C. § 101 (1994).

164. *See* Compendium II of Copyright Office Practices § 404.02 (1984) ("[P]hrases consisting of only a few musical notes, such as chimes . . . cannot be registered."); *see also* Smith v. George E. Muehlebach Brewing Co., 140 F. Supp. 729 (W.D. Mo. 1956); Shapiro, Bernstein & Co. v. Miracle Record Co., 91 F. Supp. 473, 474 (N.D. Ill. 1950).

165. *See* H.R. REP. NO. 94-1476, at 56 (1976), *reprinted in* 1976 U.S.C.C.A.N. 5659, 5669 ("[T]here may be cases (for example, recordings of birdcalls, sounds of racing cars, et cetera) where only the record producer's contribution is copyrightable.").

166. U.S. CONST. art. I, § 8, cl. 8.

167. *See* Mazer v. Stein, 347 U.S. 201, 219 (1954) ("The economic philosophy behind the clause empowering Congress to grant patents and copyrights is the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors in 'Science and the Useful Arts.'").

168. *See, e.g.*, Sony Corp. of Am. v. Universal City Studios, 464 U.S. 417, 429 (1984) ("The monopoly privileges that Congress may authorize are neither unlimited nor primarily designed to provide a special private benefit.").

author's exclusive rights with the public's interest in the free dissemination of information.[169] Originally a creation of the courts, fair use was codified in 1976.[170]

Section 107 of the Copyright Act lists the factors for consideration when determining whether a given use is fair:

> [T]he fair use of a copyrighted work . . . for purposes such as criticism, comment, news reporting, teaching, . . . scholarship, or research, is not an infringement of copyright. In determining whether the use made of a work in any particular case is a fair use the factors to be considered shall include:
> 1) The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
> 2) the nature of the copyrighted work;
> 3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
> 4) the effect of the use upon the potential market for or value of the copyrighted work."[171]

The most important factor in the fair use analysis is the effect on the market or value of the work.[172] Professor Goldstein has made the distinction between "copying" and "improper appropriation," with the view that infringement only applies in the latter cases. In Professor Goldstein's view, copying only becomes improper appropriation and hence actionable when the "second comer capture[s] the audience and thus the economic rewards that would otherwise belong exclusively to

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169. *See id.* (citing H.R. REP. NO. 60-2222, at 7 (1909) ("First, how much will the legislation stimulate the producer and so benefit the public; and, second, how much will the monopoly granted be detrimental to the public? The granting of such exclusive rights, under the proper terms and conditions, confers a benefit upon the public that outweighs the evils of the temporary monopoly.")).

170. *See* 17 U.S.C. § 107 (1994).

171. *Id.*

172. *See* 3 MELVILLE NIMMER & DAVID NIMMER, NIMMER ON COPYRIGHT § 13.05 (A)(4) (1990) ("If one looks to the fair use cases, if not always to their stated rationale, this emerges as the most important, and indeed, central fair use factor."); *see also* Harper & Row Publishers, Inc. v. Nation Enters., 471 U.S. 539, 566 (1985).

the plaintiff."[173] Where the market has not been damaged, the use is appropriate.

"Effect on the market" includes the copyright owner's future ability to license the work for derivative use,[174] but only where a potential market actually exists.[175] Where the owner of the data does not normally charge licensing fees for the scholarly use of artifacts, for example, no real licensing market exists. Even if an actual market exists, however, one scholarly use of the underlying data by researchers does not necessarily preclude use by others; even those engaged in identical paths of inquiry will be interested in reproducing the results obtained to test their validity. In some cases, the value of the work will actually be increased by use, in that the data will be brought to the attention of others who were unaware of it.

In addition to these factors, the courts have found fair use where other compelling factors exist.[176] "The four factors are intended merely to serve as general guidelines and should be considered in light of the purpose of the fair use doctrine: to prevent strict enforcement of the copyright law when its enforcement 'would inhibit the very Progress of Science and useful Arts' that copyright law is intended to promote."[177] The ameliorating effect of the fair use doctrine limits the author's power to control and exploit his work in situations where an infringement would increase the store of public knowledge.

Fair use has been viewed as a substitute for voluntary contractual agreement where transaction costs are too high.[178] It is certainly the case that where transaction costs are too high for an agreement to take place, fair use may be the only defense available to a claim of infringement.[179] But there is no indication that the statute or the doctrine as applied by the courts requires that transaction costs be prohibitive before the protection of fair use will apply. It is significant that the statute itself characterizes fair use as a limitation on the exclusive rights granted by copyright law,

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173. J.H. Reichman, *Goldstein on Copyright Law: A Realist's Approach to a Technological Age*, 43 STAN. L. REV. 943, 958 (1991) (citing 2 GOLDSTEIN, COPYRIGHT: PRINCIPLES, LAW AND PRACTICE § 7.1.2.).

174. *See Harper & Row*, 471 U.S. at 568.

175. *See* PATRY, *supra* note 69, at 774.

176. Essentially, the fair use doctrine is "an equitable rule of reason." *Harper & Row*, 471 U.S. at 560 (quoting H.R. REP. NO. 94-1476, at 65 (1976), *reprinted in* 1976 U.S.S.C.A.N. 5659, 5679).

177. Penelope v. Brown, 792 F. Supp. 132, 136 (D. Mass. 1992) (quoting Sony Corp. of Am. v. Universal City Studios, 464 U.S. 417, 477 (1984)).

178. *See, e.g.*, American Geophysical Union v. Texaco, Inc., 37 F.3d 881, 898 (2d Cir. 1994).

179. *See generally* Wendy J. Gordon, *Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and Its Predecessors*, 32 COLUM. L. REV. 1600 (1982).

rather than as a defense to infringement.[180] For example, there is no requirement that a license agreement be attempted before the fair use doctrine applies, nor is there any limitation on the applicability of the fair use doctrine in instances where a request for a license has been refused. The need for factual material is at the heart of all research, and a monopoly on factual material is antithetical to the goals of copyright law. For this reason, any transaction cost, no matter how small, should be viewed as too high for voluntary agreements to occur between scholarly researchers and data gatherers.

1. Fair Use of Data Embedded in Protectable Expression

In some cases, unprotectable data will be embedded in protectable expression, such that the data cannot be reached without copying and therefore infringing the protectable expression. For example, if the original data sets of the Moroccan skull fragments had been part of a World Wide Web site, the arrangement of which was protectable, researchers would have to download from the site to use the unprotectable data. In so doing, they will have made an infringing copy of the protectable material.[181]

In such a case, the only way to reach the purely factual material is through copying protectable material.[182] When an author sets up a wall of protectable material, intentionally or not, between public domain material and potential users, he should not be surprised to find that the wall has been breached. As long as the copying of the protectable material is only incidental to reaching the data, and the data cannot be reached in any other practical way, fair use should be found.[183] A finding of fair use prevents authors from exerting a monopoly over facts by embedding them in protectable expression.[184]

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180. *See* 17 U.S.C. § 107 (heading) (1994).

181. *See* Jessica Litman, *The Exclusive Right to Read*, 13 CARDOZO ARTS & ENT. L.J. 29, 54 n.58 (1994) ("In the absence of a proof of fair use or other relevant defense, there is an infringement of the reproduction right . . . [w]henever a digitized file is 'downloaded' from a BBS or other server, [because] a copy is made.") (citation omitted); *see also* Barbara Cohen, Note, *A Proposed Regime for Copyright Protection on the Internet*, 22 BROOK. J. INT'L L. 401, 412, 412 n.58 (1996).

182. *See* Sega Enters. v. Accolade, Inc., 977 F.2d 1510 (9th Cir. 1992).

183. *See id.* at 1527 ("Although the question is fairly debatable, we conclude based on the policies underlying the Copyright Act that disassembly of a copyrighted object code is, as a matter of law, a fair use . . . if [it] provides the only means of access to those elements of the code that are not protected by the copyright and the copier has a legitimate reason for seeking such access.").

184. *See id.* ("[T]hat computer programs are distributed for public use in object code form often precludes public access to the ideas and functional concepts contained in those programs, and thus confers on the copyright owner a *de facto* monopoly over those ideas

2. Fair Use of Marginally Protectable Data

Works that are primarily factual, but contain the bare minimum of creativity necessary for protection, should be subject to a broader application of the fair use doctrine in non-commercial settings than more creative works.

Some information technology tools, such as satellite imagery and geographic information systems, require a degree of judgment or selectivity on the part of the operator. In other cases, marginal creativity may be demonstrated in the arrangement of the results of the use of information technology tools. Despite this, the resulting work is factual and represents an accurate depiction of the state-of-being of the site or artifact. The judgment or selectivity exercised by the operator or compiler may be enough to warrant copyright protection, but just as with the embedding of data in protectable expression, this minimal degree of creativity may permit the author to exercise control over access to facts. If the facts can be acquired in no other practical way, the author has been given a monopoly over those facts.[185]

If the purpose of copyright law is not to be subverted, this factual information should be available for use. Researchers should be permitted to use the underlying facts even though doing so requires making a copy of the marginally protectable material, as long as the researchers' use does not damage the author's market for the protectable expression.

A data gatherer may feel that he has a moral right to his data, even in cases where it is not sufficiently creative for copyright protection. Under this theory, the data gatherer should be entitled to some protection to encourage his socially useful work, as well as to prevent "free riders" from benefitting from it by passing it off as their own. The Berne Convention[186] concept of *droit moral* focuses on the integrity of the author's work, attribution of nonoriginal material, and the unjust enrichment of the infringer. The original Moroccan data sets, for

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and functional concepts. That result defeats the fundamental purpose of the Copyright Act — to encourage the production of original works by protecting the expressive elements of those works while leaving the ideas, facts and functional concepts in the public domain for others to build on.").

185. *See* Myers v. Mail & Express Co., 36 Copy. Dec. at 478-79 (S.D.N.Y. 1919) (Hand, J.) ("[O]ne may use quite freely the works of previous scholars . . . regardless of whether one takes one's knowledge of the facts they record from their copyrighted works or repeats their . . . researches. To hold to the contrary, while not formally giving the first author a monopoly over narrating the facts, would in effect do so.").

186. *See* The Berne Convention for the Protection of Literary and Artistic Works, Sept. 9, 1886, 828 U.N.T.S. 221; *see also* The Berne Convention Implementation Act of 1988, Pub. L. No. 100-568, 102 Stat. 2853 (1989).

example, were used in their totality and as they were intended to be used; therefore, the integrity of the work was not harmed. Attribution was given in the researchers' publication,[187] thus the reputation of the author was not diminished. The researchers may be unjustly enriched if they profit from the use of the data; however, there is little direct profit motive in most scholarly research.

In general, American law has not recognized a natural or moral right in any works other than those in the visual arts.[188] Nonetheless, a version of *droit moral* seems to underlie the rarely-applied concept of "wholesale usurpation" of factual works. Under this theory some courts have found infringement of copyright in factual works where the copier appropriates "the total entity with its unique and protected mosaic, comprising the overall arrangement and selection of facts."[189] Wholesale usurpation assumes that the copier should not be able to enjoy the fruits of the author's labor by "bodily appropriating" his research.[190] While some courts have been willing to find wholesale usurpation where the copier's unjust enrichment is clear,[191] doing so confers protectability on material which would otherwise be unprotectable.[192]

Alternatively, the need for a fair use analysis could be circumvented by adopting the view that primarily factual works are subject to a compulsory license.[193] But licensing presumes a right in the factual aspect of the work that is not justified by the underlying principles of the Copyright Act. The fair use exception is preferable in that it recognizes that the right is only in the creative aspect of the work, and that this right is secondary to the public's right to have access to the factual component of the work. If the author's creative contribution is very small, so should be his protection.

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187. *See, e.g.*, Kalvin et al., *supra* note 57, at 8.

188. *See* Sony Corp. of Am. v. Universal City Studios, 464 U.S. 417, 429 (1984).

189. *See* Francione, *supra* note 83, at 522 (quoting Harper & Row Publishers, Inc. v. Nation Enters, 723 F.2d 195 (2d Cir. 1983)).

190. *See id.* at 582.

191. *See generally Harper & Row*, 723 F.2d at 203, *rev'd*, 471 U.S 539 (1985).

192. *See* Miller v. Universal City Studios, 650 F.2d 1365, 1372 (5th Cir. 1981) ("The valuable distinction in copyright law between facts and the expression of facts cannot be maintained if research is held to be copyrightable. There is no rational basis for distinguishing between facts and the research involved in obtaining facts. To hold that research is copyrightable is no more or less than to hold that the facts discovered as a result of research are entitled to copyright protection.").

193. *See* Jane Ginsburg, *Creation and Commercial Value: Copyright Protection of Works of Information*, 90 COLUM. L. REV. 1865, 1924-26 (1990) (noting that works of "low authorship" should be subject to a compulsory license for derivative use).

3. Fair Use of Protectable Fact-Based Expression

Even where protectability is clear, such as with the use of visualization programs or CAD systems, the societal value of scientific progress should permit a broadening of the concept of fair use. Researchers should be permitted to copy protected fact-based expression for the purpose of private study, as long as no harm is done to the author's market.

Protection of the author's market is important, and where copying serves as a substitute for purchase of the author's creative work it is not fair use.[194] On the other hand, where there is no real market for the author's work, or the copier would not be a participant in that market, copying for private study should be permissible if no harm is done to the author.[195]

In *Sony Corp. of America v. Universal City Studios*,[196] the Supreme Court agreed with the district court that there was no market harm and significant societal benefit in permitting time-shifted copying of television programming for the private use and convenience of consumers.[197] Just as the programming in *Sony* was made available over the public airwaves, much of today's scientific scholarly work is available over the Internet. At the very least, works that have been made widely available in this way should be subject to copying for private study. The societal benefit of such a use among scholars must certainly exceed the societal benefit in time-shifted television recording.

194. *See generally* American Geophysical Union v. Texaco, Inc., 60 F.3d 913 (2d Cir. 1994).

195. *See* Sony Corp. of Am. v. Universal City Studios, 464 U.S. 417, 450-51 (1984) ("Even copying for noncommercial purposes may impair the copyright holder's ability to obtain the rewards that Congress intended him to have. But a use that has no demonstrable effect upon the potential market for, or the value of, the copyrighted work need not be prohibited in order to protect the author's incentive to create. The prohibition of such noncommercial uses would merely inhibit access to ideas without any countervailing benefit.").

196. 464 U.S. 417 (1984).

197. *See id.* at 454-55.

IV. CONCLUSION

The purpose of American copyright law is "to promote the Progress of Science and useful Arts."[198] If an author is permitted to control, or prevent access to, factual information this progress will be retarded.

On the other hand, the monopoly granted by copyright encourages authors to produce and publish. If there is no copyright protection in data, is there sufficient incentive to acquire it?

Some of the most valuable data in the world, scientific formulae, are produced and acquired with no expectation of copyright protection;[199] existing trade secret and unfair competition protections are considered to be sufficient. If the "author" chooses to reveal the formula, it is no longer protectable.[200] Other valuable and interesting information is virtually given away daily on the Internet. The "authors" of this information expect no compensation, and yet willingly expend the effort to acquire and publish it. In practice, the acquisition and dissemination of information is, in many cases, an end in itself.

The purpose of science is to enlighten and to expand the information base. While the hoarding of artifacts and the refusal to grant access to sites obstructs this process, there are many reasons, some of them legitimate, why a nation would wish to keep its cultural property to itself. The artifacts involved may be too physically fragile to be examined, or they may be highly symbolic of the nation's patrimony and therefore be philosophically fragile. They may belong to a nation that has enemies who would try to wrest them away, or they may be artifacts or sites that are subject to ownership disputes. Technological representations of these artifacts or sites, however, are not subject to these concerns. A laser scan, for example, may be copied many times, may be examined in any amount of detail, and may even be destroyed, all without actually, politically, or philosophically harming the original artifact.

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198. U.S. CONST. art. I, § 8, cl. 8.

199. *Cf.* H.R. REP. NO. 103-388, at 23 (1993) ("[A] certificate of registration on a scientific treatise would not extend to the formula therein, although it would extend to an original explanation of the formula.").

200. *See* Int'l News Serv. v. Associated Press, 248 U.S. 215, 250 (1918) (Brandeis, J., dissenting) ("The general rule of law is, that the noblest of human productions — knowledge, truths ascertained, conceptions, and ideas — become, after voluntary communication to others, free as the air to common use.").

A. Raw Data

Archaeologists, like other scientists, have an ethical obligation to publish, and to allow others to critique, their findings. Publishing data sets in machine-readable form is the ultimate expression of this obligation, in that others are free to analyze the basis of an archaeologist's findings and come to their own conclusions. While it is possible for other archaeologists and anthropologists to look at the results of the Moroccan skull composite and learn much, it is not possible for them to analyze the validity of the results by reproducing the original work. Similarly, with regard to site evaluation, making the raw data available allows archaeologists to "re-excavate" a site and search for evidence that escaped attention during the actual excavation.[201]

As with all research, to some extent the answers that archaeological research gives depend on the questions that were asked and the assumptions that were made. This problem is compounded when other researchers must base their work on the result of another's work, rather than the facts on which that result was based. Having access to raw data, uncontaminated by methodological and theoretical biases, permits the conjunction of differing opinions, and is more likely to result in a synthesis that is accurate.

While the Moroccan government and the Musée de l'Homme may have a property interest in the skull fragments themselves, they do not have an intellectual property interest in them; there is no copyright in skull fragments. If they are given a copyright interest in the data representing the fragments, however, they would then be allowed to protect the information that comprises the fragments in a way that they would never be able to do with the fragments themselves.

Present U.S. copyright law does not allow protection of raw data, facts, ideas, or theories; only human creative expression is protectable. Where the equipment being used to produce the data requires little or no creative input from the user, the resulting data lack the creative spark necessary for protection, regardless of the effort expended in collecting it.

B. Raw Data Embedded in Protectable Expression

Unprotectable data should not become protectable simply because a palisade of protectable expression has been erected between the data and the potential user. When data are embedded in a Web site, a compact disc, a computer program, or a manipulated readout, copying

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201. *See* Paul Reilly, *Three Dimensional Modelling and Primary Archaeological Data*, ARCHAEOLOGY & INFO. AGE, *supra* note 15, at 162.

for the purpose of extracting the data, when there is no other practical means of acquiring it, should not be viewed as infringement. Any other result would be to grant the creator of the protectable expression a de facto monopoly over the underlying unprotectable data.

C. Marginally Protectable Data

Data that demonstrate only a small amount of creativity in either its initial collection or arrangement, such as satellite imagery or geographic information system readouts, should be subject to a broader application of the fair use doctrine. Some information technology techniques require a degree of creative input from the user, even though the results are still factual. The character of the results should be a stronger indicator of the level of protectability than the character of the user's input. Where the results are factual, non-commercial copying should be permitted as long as attribution is given and the copy does not supplant the need for the original. The requirements that the use be non-commercial and non-supplanting ensure that the market for the author's work will not be damaged. The attribution requirement ensures that the copier will not be able to "pass off" the author's work as his own.

D. Protectable Fact-Based Expression

When data have been transformed into clearly protectable expression by the addition of sufficient creative "value," such as with the use of visualization or CAD systems, it should still be subject to fair use. Two special considerations should apply to such fact-based works in a fair use analysis:

1. There is a great social interest in finding fair use when copying the protected expression of a fact-based work is the only practical way to reach the underlying factual material, and
2. There is a great social interest in finding fair use when the copying of the protected expression of a fact-based work is for the purpose of private study, as long as no harm is done to the author's market.[202]

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202. *See* Sony Corp. of Am. v. Universal City Studios, 464 U.S. at 451 ("A challenge to a noncommercial use of a copyrighted work requires proof either that the particular use is harmful, or that if it should become widespread, it would adversely affect the potential market for the copyrighted work. Actual present harm need not be shown; such a requirement would leave the copyright holder with no defense against predictable damage.

A transformative use, one which presents the data in a different form, should be more likely to be found fair use since it is less likely to supplant the original work in its market.[203] A requirement of attribution would be additional protection for the author.

A non-commercial use that satisfies the requirements of fair use, and which does not intrude upon or supplant the author's market, should be permitted even if no license agreement is attempted,[204] if for no other reason than that, in a non-commercial setting, any transaction cost will be too high.[205] A commercial user, on the other hand, should bear a greater responsibility for attempting to obtain the right to use the information by contract.[206] This is because the cost of a license is part of the cost of engaging in a commercial enterprise, and because a commercial use is more likely to intrude on the author's market.

Non-commercial, non-supplanting use is the sort of use that increases the public store of knowledge and encourages scientific and technological advance.[207] The Copyright Act acknowledges the social utility of this class of use when it states that a use is more likely to be considered fair if it is for the purposes of criticism, comment, news reporting, teaching, scholarship, or research;[208] enterprises that, by definition, increase the public store of knowledge. Similarly, another limitation on copyright, over and above fair use, has been carved out for research libraries and archives, institutions dedicated to preserving and expanding the information base.[209]

The trend in copyright law is toward an expansion of the parameters of protection. This approach, however, may be counterproductive in an

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Nor is it necessary to show with certainty that future harm will result. What is necessary is a showing by a preponderance of the evidence that some meaningful likelihood of future harm exists.").

203. *See* Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569 (1994) ("Although . . . transformative use is not absolutely necessary for a finding of fair use . . . the goal of copyright, to promote science and the arts, is generally furthered by the creation of transformative works."). *See generally* Pierre N. Leval, *Toward a Fair Use Standard*, 103 HARV. L. REV. 1105 (1990).

204. *See Campbell*, 510 U.S. at 585 n.18.

205. *See* Reichman, *supra* note 173, at 960 (citing 2 GOLDSTEIN, COPYRIGHT: PRINCIPLES, LAW AND PRACTICE § 10.1).

206. *See Sony*, 464 U.S. at 451 (in dicta) ("[E]very commercial use of copyrighted material is presumptively an unfair exploitation fair use analysis of the monopoly privilege that belongs to the owner of the copyright . . . ."). *But see Campbell*, 510 U.S. 569, 583-85 (indicating that there are really no presumptions in the fair use analysis, rather each factor must be weighed); Twin Peaks Prod. v. Publications Int'l, Ltd., 996 F.2d 1366, 1373-74 (2d Cir. 1993).

207. *See, e.g.*, Sony Corp. of Am. v. Universal City Studios, 464 U.S. 417; Pacific & Southern Co. v. Duncan, 744 F.2d 1490 (11th Cir. 1984).

208. *See* 17 U.S.C. § 107 (1994).

209. *See* 17 U.S.C. § 108 (1994).

information-based culture. If societal goals include the rapid dissemination, modification, and expansion of information, the copyright laws should permit non-commercial use for the purpose of increasing the information base.[210] It is only when that use intrudes upon or supplants the author's market that it should be limited.

210. *See* Carey v. Kearsley, 170 Eng. Rep. 679, 681 (K.B. 1803) (Lord Ellenborough) ("While I shall think myself bound to secure every man in the enjoyment of his copy-right, one must not put manacles upon science.") (cited in *Campbell*, 510 U.S. at 575).