BOOK REVIEWS

Images from the Past

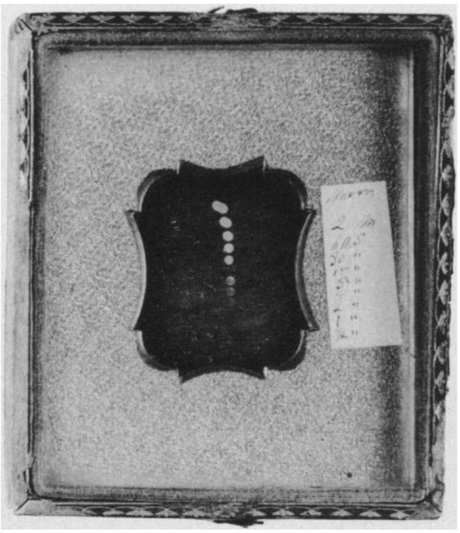
The Daguerreotype. Nineteenth-Century Technology and Modern Science. M. SUSAN BARGER and WILLIAM B. WHITE. Smithsonian Institution Press, Washington, DC, 1991. xviii, 252 pp., illus. $60.

For how many of us has our view of the 19th century been indelibly influenced by those delicate images produced by the daguerreotype—images that are real and yet not real, that disappear with a flick of the hand, that can only be seen when catching the light at just the right angle?

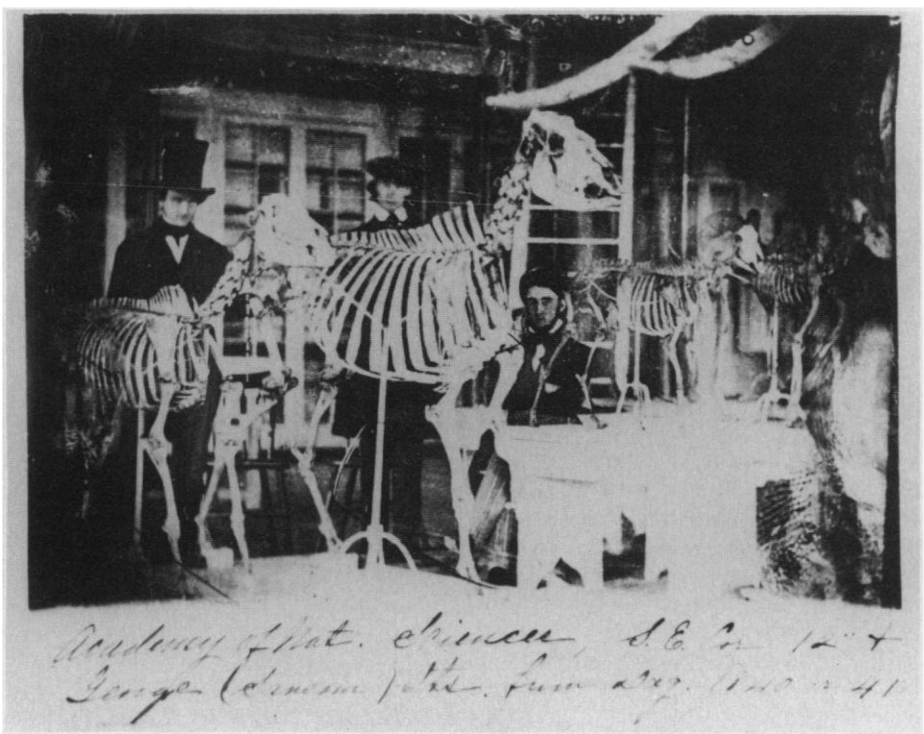
A subject of enduring fascination, the daguerreotype, named after the theatrical-scenery painter and showman Louis Jacques Mandé Daguerre, was the first practical method of producing photographs. The story of the invention has often been told. The interest in realism in art in the Renaissance resulted in the formulation of rules of perspective, which in turn led to the development of mechanical drawing machines. The demand for artists capable of recording images directly as seen grew with the development of the new observational and experimental sciences and with the expansion of industry. The camera obscura inaugurated the idea of letting light do the drawing without human agency. The era of modern photography started in 1727 when Johann Heinrich Schulze discovered the sensitivity to light of silver nitrate, but the problem that dogged the early pioneers during the next hundred years was how to fix the elusive light image in order to preserve it.

The second strand in this story is the discovery of lithography in the beginning of the 19th century to satisfy the growing demand for cheap and efficient ways of reproducing pictures. In 1813 the brothers Nicéphore and Claude Niépce set about improving the lithographic process. While Claude was in England promoting his *pyréolophore*, a boat with an internal combustion engine, Nicéphore was trying to produce light-sensitive images on stone, metal plates, and glass, which could then be printed directly onto paper. In 1826 or 1827, he made the first successful photograph that has survived, in which the image made by a camera obscura was formed in light-sensitive asphaltum spread onto a pewter plate. Shortly afterward Nicéphore and Daguerre joined forces, but Nicéphore died before the famous announcement of the daguerreotype process made by the physicist Dominique François Jean Arago in Paris at a joint meeting of the Académie des Sciences and the Académie des Arts on 19 August 1839. Using Nicéphore's experiments of fuming silver plates with iodine vapour as his basis, Daguerre converted the latent images into real ones by exposing the plates to mercury vapor. The plates were then fixed in hot, saturated salt water. Immediately, "daguerreotypomania" spread throughout the industrialized world. From 1839 to 1860, as many as 30 million daguerreotypes were made in the United States alone.

This account of the history, science, and technology of the daguerreotype is in three parts that can be read more or less independently. The first seven chapters deal mainly with the technical history of the daguerreotype. They constitute a good résumé that describes, in passing, some of the other fledgling photographic techniques that were being developed, such as the photogenic drawings of William Henry Fox Talbot (to become the calotype process), but the strength of this section of the book is the comprehensive description of the tech-



"Multiple-exposure daguerreotype of the full moon taken by Samuel D. Humphrey at Canandaigua, New York, on September 1, 1849. The notations on the side of the image indicate the length of exposure for each image. Note that the moon's shape is distorted for the longer exposures because the telescope used to make the daguerreotype had no tracking mechanism." [From *The Daguerreotype*; Harvard College Observatory]



Gelatin copy photograph, made before 1900, of a daguerreotype taken about 1840 at the Academy of Natural Sciences in Philadelphia. "It has been conjectured that the central figure is Joseph Leidy, who became a leading American paleontologist. The seated figure on the right may be Edgar Allan Poe, who worked in Philadelphia assisting Thomas Wyatt . . . in writing books on natural history." [From *The Daguerreotype*; Library, Academy of Natural Sciences, Philadelphia] niques developed by the daguerreotypists to improve the images. Of particular interest is the detailed discussion of attempts to produce daguerreotypes recreating natural colors (probably the least known aspect of its history), based on the Becquerel effect. One chapter deals with the use of the daguerreotype as a scientific tool, particularly in astronomy but also in conjunction with geological and archeological expeditions and in anthropology and medicine.

The second section, chapters 8 and 9, deals with the scientific explanation for the daguerreotype and summarizes the extraordinary analytic work undertaken by the authors at the Materials Research Laboratory of Pennsylvania State University. Of special interest is their detailed analysis of the image formation, which is not a photographic development in the strictest sense of the term. We can now appreciate the good fortune and doggedness the pioneer daguerreotypists needed to create their remarkable images.

This laboratory work on the part of the authors was indispensable for tackling the problems of conservation and preservation of daguerreotypes, the subject of the third section. The limitations of early conservation techniques are described and modern ones reported on, in particular reactive sputtering and electrocleaning. One of the first American daguerreotype portraits from life, made by John William Draper, would not have been lost through zealous cleaning if these new techniques had been known in the 1930s. The final chapter of the book is a homily on the value of interdisciplinary studies as applied to problems in the history of science and technology. This book attests to the success of this approach. What makes it especially interesting is seeing the problems through the eyes of material scientists.

Daguerreotype of Robert Cornelius "demonstrating the proper way to use a syringe-bottle to wash a precipitate out of a beaker onto a filter." Engravings based on daguerreotypes produced by Cornelius were used by James C. Booth to illustrate his book *The Encyclopedia of Chemistry* (1850), "the first chemistry textbook published in the United States." [From *The Daguerreotype*; International Museum of Photography at George Eastman House]

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Processes in Development

Developmental Patterning of the Vertebrate Limb. J. RICHARD HINCHLIFFE, JUAN M. HURLE, and DENNIS SUMMERBELL, Eds. Plenum, New York, 1991. xii, 452 pp., illus. $115. NATO Advanced Science Institute Series A, vol. 205. From a workshop, Santander, Spain, Sept. 1990.

The development of the vertebrate limb was first investigated in depth by Ross Harrison in urodele embryos. This volume reflects the growing trend toward molecular studies of limb development and is one of a few volumes to cover the role of development in limb evolution. It will serve as a reference point from which to gauge how fast the field of limb development is advancing when compared to research presented at the Fourth International Conference on Limb Development and Regeneration, which took place recently at Asilomar, California.

The book appropriately begins with an overview chapter by Wolpert that enumerates the major questions about mechanisms of limb development that everyone wants answered. These are (i) how the relative positions of skeletal and soft tissues are specified in the limb; (ii) how the basic blueprint of the segmentation and branching pattern of the limb skeleton is generated; (iii) how specific axial identity arises in each of the skeletal and soft tissue elements; (iv) how the differentiation of skeletal cells and the migration and differentiation of myogenic cells are initiated and maintained; (v) how the form of each limb element is attained; and (vi) what changes in developmental mechanisms are responsible for the evolutionary transformation of appendages.

These questions are addressed in the book's three main sections (on the molecular basis of patterning, on the extracellular matrix in limb development, and on the developmental basis of limb evolution), which in all contain nearly 50 chapters. Many of the chapters are simply abstracts of posters, but there are enough long chapters to give an extended and thoughtful view of the various problems in research on limb development. Overview and summary chapters at the beginning and end of each section summarize the broader themes emerging, and they can be read as a group to get a good sense of where the field stands at the moment.

As might be expected, retinoic acid (RA) is a major topic in the first section. The most interesting results, presented by Summerbell and Waterson and by Bryant *et al.*, call into question the idea that RA is the morphogen that specifies the anteroposterior axis of the chick limb bud. They instead affirm that exogenous RA simply posteriorizes the positional identity of anterior cells and turns them into zone-of-polarizing-activity cells. Maden *et al.* provide the interesting observation that RA is present in the regeneration blastema, suggesting that it plays some important role in limb regeneration.

A major new direction in the molecular analysis of limb patterning is the study of homeobox (*Hox*) gene expression. In addition to information about the asymmetric spatial and temporal patterns of *Hox* gene expression in different limb tissues, or within the same tissue, two interesting studies by Lyons *et al.* and Blundell *et al.* demonstrate, using the mutants *limbless* and *limb deformity*, how interactions between the apical ectodermal Mal ridge (AER) and mesenchyme define patterns of gene expression in these tissues. These studies emphasize the analytical power of combining the experimental manipulation of normal and mutant tissues with the use of molecular probes to study the relationship between tissue interactions and the expression of specific genes. On the molecular level, Tabin *et al.* describe an interesting set of retroviral gene transfer and tissue culture techniques to directly analyze the developmental functions of cloned genes in limb growth and development.

The section on extracellular matrix contains several notable chapters describing interactions between extracellular matrix (ECM) molecules, cell surface molecules, and growth factors that are involved in initiating prechondrogenic condensation and the role of ECM in the migration of myoblasts from the somites into the limb buds. It is now clear that condensation of precartilage cells is mediated by interactions between several matrix molecules, including heparan sulfate proteoglycans, mesenchymal chondroitin sulfate proteoglycan, fibronectin, and tenascin, as well as syndecan, an integral membrane proteoglycan that links the cytoskeleton to ECM