Review: *Image Objects: An Archaeology of Computer Graphics*, by Jacob Gaboury. 2021. The MIT Press. 295 pp.

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For his first book, Jacob Gaboury has chosen a labyrinthine topic—a (pre)history of computer graphics. As an associate professor of film and media studies at the University of California at Berkeley, Gaboury specialises in the history of visual technologies and contemporary visual culture. *Image Objects: An Archaeology of Computer Graphics* (2021) falls under this purview, charting the material history of computer graphics through five case studies. As an accessible introduction to the history of computer graphics that is aimed towards a more general academic audience, inevitably there are limits to the scope of the book: geographically, it is mainly tied to the United States, and temporarily, it focuses on the 1940s to the 1980s. *Image Objects* is engaging and well written, which is laudable given the complex genealogy of computer science that the author stitches together. Suitably for a book about computer graphics, it is well illustrated with relevant figures and photographs, including twenty full-colour plates in the hardback edition.

In the introduction, Gaboury clearly defines his work as media archaeology, stating that this is more concerned with the function of an object than its interpreted meaning. This distinction is important because it positions Gaboury's work as distinct from other related fields. For example, archaeogaming is the archaeological study of video games, which would focus more on the interpretation of games and related technologies rather than the functional approach that Gaboury describes. The introduction also sets up two major threads of the book, the first being the University of Utah as a nexus of computer graphics research from 1965 to 1980. Gaboury posits that the history and the influence of this site have been left out of broader histories of computing in favour of more renowned institutions on the East and West Coasts of the United States. However, even if the University of Utah has generally been marginalised in histories of computing, *Image Objects* could still

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benefit from critical reflection on the potential pitfalls of constructing what could cynically be perceived as a hagiography around this institution. In the second part of this chapter, the author explores the development of computer graphics has not just changed how we conceive of digital objects, but how we design and manipulate contemporary material reality as well. Gaboury reiterates these points throughout the book.

Chapter 1 focuses on the development of hidden surface algorithms, a key concern in the field of computer graphics from 1963 to 1978. In one of the strongest sections of the book, Gaboury explains how in simulating a 3D object, one must describe not just what the viewer should see, but what they should not see as well. To paraphrase Gaboury, the computer is not a visual medium: It must be programmed to display graphics in a way that is comprehensible to human, rather than machine, perception (p. 36). As contemporary conversations around computer graphics often focus on realism and computing power, this discussion is refreshing in that it presents the topic as a philosophy of vision, showing that the way computers visualise objects requires its own ontology.

Then, Chapter 2 takes the history of the computer screen as its focus. As in the first chapter, Gaboury makes observations on how short-term the memory of computer science often seems to be. For example, "prior to the 1970s, there were no computer screens as we know them now" (p. 56). Ironically, the major obstacle in getting a raster scan television to accept computational data was computational memory, the answer to which was the development of the frame buffer (a region of memory for the image displayed on a computer screen). Again, this framing of early computer graphics development as a material history is very welcome in that it moves the conversation beyond benchmarks of technological progress.

Chapter 3 discusses the famous Utah teapot as an iconic digital object. Against the backdrop of computer graphics becoming steadily more standardised throughout the 1960s and 1970s, a PhD researcher called Martin Newell sought an accessible object that could be used to demonstrate object curvature when digitised. His wife Sandra suggested a teapot that she had bought in Salt Lake City. Like many histories, this one belies the original domestic context of the teapot. The hidden labour of women at the University of Utah is acknowledged towards the end of this chapter, but it is unfortunate that Gaboury does not dedicate more space to this topic.

Chapter 4 is concerned with object-oriented programming (OOP) and is especially relevant to researchers interested in game engines programmed in an OOP framework, such as Unity. OOP organises data around objects, rather than functions or logic. Towards the end of the chapter, Gaboury discusses how a project in the mid-1970s involving

the creation of a fully interactive model of New York Harbour for the Maritime Academy's Computer Aided Operations Research Facility would not have been possible without OOP. Thus, this chapter presents a detailed case study on how a military project did not just influence computer graphics, but also how they are now conceived of as a network of objects.

The final case study in the book is the Graphics Processing Unit (GPU), examined in chapter 5. In this part, Gaboury describes how the creation of graphical hardware led to the development of more specialised GPUs, which in turn enabled the digital design of more complex, miniaturised hardware components. The chapter ends with the discussion of contemporary GPUs which have now been co-opted for the mining of cryptocurrency. Gaboury does include a reference to the environmental impact of this technology, though more background on this topic would have been a welcome and timely addition.

Lastly, the concluding chapter harkens back to the introduction by discussing the Volkswagen Beetle—an object digitally modelled by Evan Sutherland and his students at the University of Utah in 1973. Gaboury then reflects on the contemporary ubiquity of digitisation, extending to mundane computer-generated furniture in IKEA catalogues. In this way, he ties up the core narrative of *Image Objects*: computer graphics remaking the world.

For readers of *Press Start* who are likely to be specifically interested in the history of video games, *Image Objects* offers valuable insights into the development of technologies that contemporary games rely on. The book also includes several references to games, not least a fantastic aside on the specialised graphics created for arcade machines in Chapter 5. It also contains detailed endnotes, one of which perfectly encapsulates the main suggestion I would have to improve this book. An endnote for the introduction mentions a critique of media archaeology by Laine Nooney (2013), summarised by Gaboury himself as "a focus on objects rather than the culture of the people that produced them" (p. 204). Though *Image Objects* does catalogue various individuals involved in research at the University of Utah, it could go further in examining how that institutional culture did not just engineer software, but also the careers of the men involved in it. However, Gaboury has written pieces which focus more on political context, such as "A Queer History of Computing" (2013), and given the timescale that *Image Objects* covers, it is understandable that some contextual discussion was cut to the endnotes.

The concluding chapter contains a passage that likens the digitisation of furniture in an IKEA catalogue to Ivan Sutherland's 1965 essay *The Ultimate Display*, which imagines a computer controlling the existence of all matter in a room. Gaboury includes this quote from the piece: "A chair displayed in such a room would be good enough to sit in" (p. 194).

However, in the original essay, Sutherland continues: "Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal" (1965, p. 508). This truncation of Sutherland's original passage and its wider disturbing implications demonstrate in microcosm the general trend of *Image Objects* touching on broader political themes that it perhaps does not have the space to fully interrogate. This is indicative of the case study approach the book takes, which attempts to look at both the macro and micro scales of computer graphics history, but has some difficulty in calibrating its lens to both. Still, *Image Objects* is a great primer on the media archaeology of computer graphics, no doubt leading to future excavations.

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