# Credits

## Buket Altinoba

**1** Charles Willson Peale (1741–1827), *Reproduction of Explanation [& Illustration] of J. I. Hawkins's Physiognotrace*, 1803, watercolor on paper, 20.3 × 25.4 cm, Courtesy of Jefferson Papers, Library of Congress, Collection of the University of Pittsburgh Art Gallery, Pittsburgh, PA, https://uag.pitt.edu/index.php/Gallery/81/theme_item/1/set_item_id/11806; **2** Charles Willson Peale, *Smoke-Eater*, in Sidney Hart, "'To Encrease the Comforts of Life': Charles Wilson Peale and the Mechanical Arts," *The Pennsylvania Magazine of History and Biography* 110, no. 3 (1986): 323–57, here 340; **3** Christoph Scheiner, Frontispiece (book illustration), *Pantographice seu Ars Delineandi Res Quaslibet per Parallelogrammum Lineare seu Cauum, Mechanicum, Mobile*, published in Rome in 1630. Public domain: Wikipedia Commons, https://commons.wikimedia.org/wiki/File:Scheiner,_Christoph_—_Pantographice_sev_ars_Delineandi_res_Quasilbet_per_Parallelogrammum_Lineare_—_illustration.jpg; **4** Samuel Rayner, *Interior of the Mechanics' Institute (Derby Exhibition)*, 1839, hand-colored lithograph, Derby Museums. Public domain: Wikipedia Commons, https://en.wikipedia.org/wiki/Derby_Exhibition_(1839)#/media/File:Derbys_First_Exhibition_1839.jpg; **5** Benjamin Cheverton, *Machine for Reproducing Sculpture*, 1826, cast iron, oak (wood), plaster, and wrought iron. Science Museum Group Collection. © The Board of Trustees of the Science Museum, London; **6** Plaster bust of Benjamin Cheverton. Science Museum Group Collection. © The Board of Trustees of the Science Museum, London.

## Michael Rottmann

**1** Charles Csuri, with James Shaffer, *Sine Curve Man,* 1967, black ink, paper, Calcomp drum plotter model 565, punch cards, IBM 7094, 104 × 104 cm. Image courtesy of © CsuriVision Ltd; **2** Charles Csuri, *Numeric Milling,* 1968, wood, 3-axis milling machine, IBM 7094, punch cards, 36 × 56 × 22 cm. Image courtesy of © CsuriVision Ltd; **3** Robert Mallary, *Quad II*, 1968, computer-aided sculpture, plywood and laminate, IBM 1130, ca. 195.5 × 25.5 × 30.5 cm (without base). Image courtesy of Josh Powell/Estate of Robert Mallary. © Josh Powell; **4** Charles Csuri, plotter drawing of *Numeric Milling,* 1968, ink, paper, Calcomp Drum Plotter Model 565, punch cards, IBM 7094. Image courtesy of © CsuriVision Ltd; **5** Robert Mallary, plotter drawing, 1968, computer-generated Drawing with *TRAN 2*, ink on plotter paper, IBM 1130, plotter, ca. 30 × 40 cm. Image courtesy Josh Powell/Estate of Robert Mallary. © Josh Powell.

## Ursula Ströbele

**1** Herbert W. Franke, ORCHID, 1984–1992, computer-based animation, screenshot, collection of the ZKM | Karlsruhe © Herbert W. Franke, ZKM | Karlsruhe; **2** Herbert W. Franke, *Spindle*, 1993, loop. Courtesy of the artist; **3** Jeffrey Shaw, Theo Botschuijver, *Virtual Sculpture*, 1981, ZKM | Center for Art and Media Karlsruhe, ZKM-01-0162-02-03081. © Jeffrey Shaw, Theo Botschuijver, photo: © ZKM | Center for Art and Media Karlsruhe; **4** Raqs Media Collective, *Hollowgram*, 2017, holographic projection, dimensions variable. Courtesy of Frith Street Gallery, London; **5** Banz & Bowinkel, *Mercury,* 2016–17, interactive virtual reality installation for HTC Vive, site specific/dimensions variable, components: customized computer, head-mounted display (HMD), 3D-printed porcelain interface button, web cameras, monitor, plexiglass, various cables; set up in a black anodized aluminum frame structure. Courtesy of the artists; **6** Banz & Bowinkel*, Palo Alto,* 2017–18, interactive virtual reality installation for HTC Vive, site specific/dimensions variable, components: customized computer, head-mounted display (HMD), monitor, carpet, various cables; set up in a four-color powder-coated aluminum frame structure. Courtesy of the artists; **7** Moreshin Allahyari, *Material Speculation: ISIS*, *King Uthal*, 2015–16, download link and folder, https://rhizome.org/editorial/2016/feb/16/moreshin-allahyari/; **8** Moreshin Allahyari and Daniel Rourke, sound design by Andre Young, *The 3D Additivist Manifesto*, 2015, 10:11 min., https://additivism.org/manifesto.

## Sasha Sobrino

**1** Skawennati, *Dancing With Myself*, 2015. Diptych: machinimagraph and photograph; **2** Activating AbTeC Island, 2018; **3** Skawennati, *Celestial Tree*, 2017. Machinimagraph from *She Falls for Ages*; **4**. The *Celestial Tree* installed in the Sculpture Garden on AbTeC Island; **5** The Celestial Tree logo from *She Falls for Ages*, 2017; **6** Skawennati installing her sculpture *The Celestial Tree* on the Promenade Fleuve-Montagne for the *Path of Resilience* exhibition in 2017; **7** Skawennati, *The Celestial Tree*, 2017. Steel, aluminum, and retro-reflective sheeting; **8** Skawennati, *A Slice of Skyworld*, 2021. Virtual installation. Courtesy of New Art City; **9** xox (left) and I chatting in the bedroom of the Residency of the Guardian of the Celestial Tree, 2022.

## Alexandra Weigand

**1** Iñigo Manglano-Ovalle, *Phantom Truck*, 2007. Installation view at Documenta Halle, Kassel, Documenta XII, 2007. Photo: Eli Ping Weinberg; **2** Slide 21 of the "Remarks to the United Nations Security Council, Secretary Colin L. Powell, New York, February 5, 2003," U.S. Department of State Archive, https://2001-2009.state.gov/secretary/former/powell/photos/2003/17324.htm; **3** Philipp Messner, *La Produzione della Costruzione*, 2007. Installation view at ArGe Kunst, Bolzano, 2007. Photo: Matthaeus Kostner; **4** Erwan and Ronan Bouroullec, *Console with Vase and Bowl*, 2001 for Italian design company Cappellini. Photo: © Cappelllini; **5a** Julian Mayor, 3D-computer rendering of the *General Dynamic* chair, 2003–04. Image: © Julian Mayor. **5b** Julian Mayor, *General Dynamic*, 2004. Photo: Armel Soyer, **6a** Front Design, *Sketch Furniture*, 2005, design process; http://frontdesign.se/sketch-furniture-performance-design-project. **6b** Front Design, *Sketch Furniture*, 2005. http://frontdesign.se/sketch-furniture-performance-design-project; **7** SANAA, *New Museum*, New York, 2007. View of the museum building at 235 Bowery. Photo: Dean Kaufmann.

## Mara-Johanna Kölmel

**1** Moreshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video. Photo: Don Hall, MacKenzie Art Gallery. Courtesy of the artist; **2** Moreshin Allahyari, *She Who Sees the Unknown: Aisha Qandisha*, 2019, installation with 3D-printed resin sculpture, reflecting pool, and HD video. Photo: Don Hall, MacKenzie Art Gallery. Courtesy of the artist; **3** Moreshin Allahyari, *She Who Sees the Unknown: The Laughing Snake*, 2019, installation with 3D-printed plastic sculpture, mirrored room, and interactive hypertextual narrative, at *Refiguring the Future*, Hunter College, New York. Courtesy of the artist; **4** Shirin Fahimi, *Umm al Raml Sand Narratives: First Story*, 2021, screenshots, augmented reality. Open this link on a mobile device to see the effect preview: https://www.instagram.com/umm.al.raml/?hl=de. Courtesy of the artist; **5** Shirin Fahimi, *Avaz-e-Eshgh in the House of Fire & Rose in the House of Water*, from *Umm al Raml's Sand Narratives*, 2022, digital render-

ing of 3D models. Courtesy of the artist; **6** Shirin Fahimi, *Umm al Raml's Sand Narratives*, 2022, exhibition view at articule, Montreal. Photo: Guy L'Heureux. Courtesy of the artist; **7** Morehshin Allahyari, *Material Speculations: ISIS, King Uthal*, 2015–16, download link and folder, https://rhizome.org/editorial/2016/feb/16/moreshin-allahyari/. Courtesy of the artist; **8** John Craig Freeman, *Border Memorial: Frontera de los Muertos*, 2012, augmented reality public art, Lukeville border crossing, Arizona. Photo: John Craig Freeman. Courtesy of the artist; **9** Gabriella Torres-Ferrer, *Monumenta*, 2018–present, participative unique website, http://monumenta.co/#en. Courtesy of the artist.

## Elizabeth Anne Johnson
**1** Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Rabbit Ears Antenna Placement on General Lee in New Orleans at Lee Circle for Prospect.3 New Orleans,* 2013, silver gelatin print, 8 × 10 in, © 2013 Mary Ellen Carroll/MEC, studios; **2** Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Proposed Tower Location for Prospect.3 New Orleans,* 2013, ink and colored pencil and marker on vellum, 8 × 10 in, © 2013 Mary Ellen Carroll/MEC, studios; **3** Mary Ellen Carroll, *PUBLIC UTILITY 2.0, Empty Plinth with General Lee Removed at Lee Circle for Prospect.3 New Orleans*, 2017, silver gelatin print, 8 × 10 in, © 2017 Mary Ellen Carroll/MEC, studios.

## Claudia Giannetti
**1** Abraham Palatnik, Desenho para o projeto de peça *Cinecromática 02,* Item 29 (Drawing for the piece project Cinecromatic 02, Item 29), April 1956. 110 × 70 × 20 cm. Photo: Vicente de Mello. © Abraham Palatnik; **2** Abraham Palatnik, *Aparelho Cinecromático* (Cinecromatic Apparatus), 1969/1986, wood, metal, synthetic linen, light bulbs, and motor. 112.5 × 70.5 × 20.5 cm. Photo: Everton Ballardin. Courtesy Nara Roesler, São Paulo. © Abraham Palatnik; **3** Abraham Palatnik, *Objetos Cinéticos* (Kinetic Objects), exhibition view, 2012, curated by Frederico Morais. Photo: Everton Ballardin. Courtesy Nara Roesler, São Paulo. © Abraham Palatnik; **4** Nicolas Schöffer, *CYSP 1*, 1956, aluminum and mixed media (computer, traction motor, direction motor, two microphones, two photoelectric cells, nineteen micromotors), height: 2.6 m. © Nicolas Schöffer, Photo: DR. © Adagp, Paris; Archives de Nicolas Schöffer, Collection Eléonore de Lavandeyra Schöffer/© VG Bild-Kunst, Bonn 2023; **5** José Luis Alexanco, genesis of *Mouvnt*, 1969, eight elements, intervened on photographs on baryta paper, 50 × 100 cm. Courtesy of the artist and Galería Maisterravalbuena, Madrid. © Galería Maisterravalbuena/© VG Bild-Kunst, Bonn 2023; **6** José Luiz Alexanco, *Mouvnt*, 1969, plotter output print on paper, 100 × 70 cm. Courtesy of the artist and Galería Maisterravalbuena, Madrid. © Galería Maisterravalbuena/© VG Bild-Kunst, Bonn 2023; **7** Analívia Cordeiro, *Materialization of Sight II*, 2015, computer-assisted sculpture, blue polyamide, 28.43 × 22.42 × 21.38 cm. Photo: Edouard Fraipont. © Analívia Cordeiro; **8** Analívia Cordeiro, *Tribute to Oskar Schlemmer I*, 2016, computer-assisted sculpture, red polyamide, 23.36 x 16.74 x 10.31 cm. Photo: Edouard Fraipont. © Analívia Cordeiro.

## Jens Schröter
**1** Schema of the virtual camera, in Timothy Binkley, "Refiguring Culture," in *Future Visions: New Technologies of the Screen*, ed. Philip Hayward and Tana Wollen (London: BFI, 1993), pp. 92–122, here p. 104; **2** A. Michael Noll, The Digital Computer as a Creative Medium, 1967; **3** Jeffrey Shaw, *The Golden Calf*, Responsive Installation, Still taken during the exhibition *Interact!* (1997) at Wilhelm Lehmbruck Museum, Duisburg. Courtesy Jeffrey Shaw; **4** Karin Sander, *Karin Sander 1:7,7... Unlimited*, 2001, 3D body scan of the living person, 3D-printing, plaster material, pigment (chromium oxide hydrate green), Scale 1:7.7… Height: 20.6 cm. Exhibition view Galerie Ute Parduhn, Düsseldorf, Oct. 7–Nov. 14, 2005. Photo © Galerie Ute Parduhn, Düsseldorf; **5** Gabriel Orozco, *Untitled*, 2013, 3D-printed ABS plastic, Gabriel Orozco, 23 9/16 × 23 9/16 × 23 9/16 in. (60 × 60 × 60 cm). Printed by Ribuoli Digital, New York. Courtesy of the artist and Marian Goodman Gallery. © Gabriel Orozco; **6, 7** Sander Veenhof and Mark Skwarek, *Augmented Reality Art Invasion MoMA*, New York, 2010. Image: screencapture of announcement website.