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Circulation as a Visual Practice**

Katharina Steiner* and Lukas Engelmann*

Summary: This special issue looks at some of the ways that images are adopted, co-opted, and adapted in the life sciences and beyond. It brings together papers that investigate the role of visualization in scientific knowledge-production with contributions that focus on the distribution and dissemination of knowledge to a broader audience. A commentary provides a critical perspective. In this editorial we introduce circulation as a practice to better understand scientific images. Along two themes, we highlight connections across the papers. First, the social life of scientific representation follows the contexts, settings, and spaces through which images circulate. Second, authorship, expertise, and trust inform the capacity and the failure of images to circulate. Altogether, this volume raises a set of new questions about circulation as practice in the historiography of images in the life sciences.

Keywords: Image, Visualisation, Circulation, Life Sciences

Visual representations are crucial to the life sciences. They produce and reveal biological and scientific content; they have been borrowed, shared, and copied across and beyond the various subdisciplines of biological research; epistemically and practically, but also for purposes of rhetoric, education, funding, and dissemination, their uses as multidimensional tools have increased and diversified since the 1800s. To take stock of their pervasive influence on the history of the life sciences, this double-issue volume establishes a new dialogue. Papers that investigate the role of visualization in scientific knowledge-

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** This special issue is the outcome of the workshop *The Circulation of Images in the Life Sciences 1800—Present* which was hosted online by the Consortium for the History of Science, Technology, and Medicine on 16, 17, and 23 October 2021. We'd like to thank all participants of the workshop for excellent papers and fruitful discussions. The journal's editor's guidance throughout the process and their engagement with the contributions of this volume greatly improved the contributions. Finally, the extensive reviews offered by reviewers were much appreciated. This research has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie Grant Agreement No. 846552 as well as from the European Research Council (ERC, Grant Agreement No. 947872).

production are paired with contributions that focus on the distribution and dissemination of knowledge to “mixed audiences”¹—that is, how Karl Möbius, German zoologist and enthusiastic popularizer of science,² referred to the scientific and non-scientific audiences attending his talks at the Hamburg Johanneum in the late 1860s. Different to Moebius, who used classic black and white representations of marine invertebrates to illustrate his lecture on the bioluminescence of organisms, the authors assembled in this volume show that scientific images are not just representations of data and phenomena, but also construct political, social, and cultural narratives and meanings as they operate across genres and media. With this approach they contribute to a history of science that combines the investigation of ideas and methods with that of culture and society, offering a balanced picture of scientific knowledge production that integrates the diverse social organization of science.³ All of the contributions in this volume speak to two themes: they emphasize, each in their own way, the *social life of scientific representation* by following the contexts, settings, and spaces through which images circulate. Second, across all contributions issues of *authorship, expertise, and trust* have been raised to inform the capacity and the failure of images to circulate. Taken together, this volume raises then a set of new questions about circulation as practice in the historiography of images in the life sciences. Before we discuss the papers in the framework of the special issue’s themes, we will briefly introduce the core premises from which this contribution departs.

Our focus on the life sciences is based on the close interaction and overlapping of its subdisciplines, as images and image-making-practices play a foundational role to curate and establish these interactions. The inclination that image production and reproduction are based on practices of borrowing and copying, adapting and adopting across disciplines⁴ was the starting point for initiating the workshop that preceded this special issue. It brought papers into conversation to address the issue of circulating images from a broad spectrum of topics and subdisciplines of biology. The workshop’s goal was to trace the ways that such circulations were undertaken and perpetuated. Held in October 2021, the workshop *The Circulation of Images in the Life Sciences, 1800–Present* featured fifteen papers and five commentaries by scholars from biology, the history of biology, history of medicine, history of anthropology, art history, the arts, literature studies, and STS.⁵ Spanning from natural history over medical anthropology to artistic research, the contributors presented a broad spectrum of iconographies, genres, and media—including analog and digital herbaria, health campaign videos, scholarly portraits, scientific images of

¹ In German, Möbius used the phrase “gemischtes Publikum.” Möbius 1861, “Vorwort” on 3.

² On Moebius, see Nyhart 1998; Nyhart 2009.

³ Shapin 2010.

⁴ This does not only apply to biology but to the sciences in general, including economics, statistics, and sociology. See Galison 1999; Secord 2004.

⁵ As the production of the special issue underwent various steps of decision making and choices on the authors’ and the editors’ part, the number of contributions shrank. This resulted inevitably in excluding some of the themes which we would have liked to further develop in this volume.

the self, microscopic images, “squished bug” field guides, and virus models. The images represented organisms and objects of research, but also the producers’ resources, methods, practices, ideas, and agencies as well as their communities, schools, and worldviews. Discussions unfolded around the “vision of experts” in relationship to their competencies, responsibilities, and statuses; tacit knowledge and scientific labor were addressed in the context of changing visualization techniques and genres challenging traditional forms of labor, markets, and media; hobbyist, entrepreneurs, architects, health campaigners, and their visual strategies were introduced expanding on Steve Shapin’s “invisible technicians”⁶; authorship and ownership of knowledge and who understands how to reclaim control over public reception. Over the course of the two succeeding weekends of the workshop, a shift in perspective emerged. We foregrounded the three-fold question *why* (purpose), *how* (practices, resources, actors) and *for whom* (audiences, venue, and occasion) an image was produced and circulated, while moving questions pertaining to professional relationships (division and/or complementation of labor and competencies) among image producers, including scientists, artists, scientific illustrators, craftsmen and women, artisans, technicians to the background.⁷

This shift in perspective is key to the collection of essays in this special issue. The authors trace how purposes, practices, resources, and intended or assumed audiences, their needs and expectations, continue to impact the production and circulation of scientific visual knowledge. While the production of scientific images in terms of techniques, genres, iconographies, and actors has been extensively researched over the past forty years—and of course there is still much work to do—understanding the mechanisms and processes by which images circulate has been a nebulous research enterprise, in which many of the terms remain unclear. Circulating a scientific image may mean sharing “original” visual materials⁸ via correspondence or on a database within a community of research interest;⁹ at the same time, circulation points at the image’s dissemination and distribution through scientific articles and monographs, textbooks, graphic training aids, the press, film, or exhibitions,¹⁰ and finally, the circulation of images is shaped, obstructed and/or accelerated by external factors and interests.¹¹ During such travels across time and space, an image is assigned with different meanings, purposes, and functions by its producers and audiences; the image itself might be altered, differently cropped or combined with other images. On its voyage, an image may also transmigrate various domains of standardizations, norms, copyrights, and scientific as well as

⁶ Shapin 1989.

⁷ See here especially in early modern history, e. g., Kusakawa 2012; Nickelsen 2006; Oglivie 2006; Smith 2004.

⁸ “Original” refers here to visual and pictorial representations which are produced during research with the object of investigation. For example, in nineteenth century zoological systematics, this could be sketches, drawings, photographs, microtomic slides, dissections or preservations.

⁹ Latour 1990.

¹⁰ Engelmann 2018.

¹¹ Krige 2019.

ethical regulations according to the (sub)discipline.¹² Circulation, the contributions to this special issue shows, allows us to develop a new lens to trace and understand the social, cultural, and political functions scientific images can serve.

In its literal sense, the term “circulation” is straightforward, emphasizing movement in a circle, but its adaptation as a productive concept for the history of science has remained ambiguous. Different uses and forms of circulation were identified, primarily introduced through global histories and histories of colonial science. These approaches focus on the circulation of goods and people (including animals and plants), techniques and practices, ideas and knowledge addressed in the framework of trade and exchange, exploitation and repression.¹³ The concept of circulation needs to be correspondingly changed to fit our reorientation. Historians of the life sciences have regularly integrated biological foundations of life in their conceptualization of historiographical approaches,¹⁴ and circulation is no exception.¹⁵

We use *circulation* as a practical category, looking at the life cycle of an image by taking visual representations as material objects into account and to examine the images’ life support system.¹⁶ Helpfully, the *Cambridge Dictionary* offers here the following definition for the circulation of non-living things: it subsumes “the series of changes that a product [...] goes through during its existence” and “the length of time something lasts or can be used.”¹⁷

In the circulation of an image, we ask a range of related questions: How and why are images adapted to their environment? When does an images’ purpose end? What limits or promotes their adaptation and lifespan? Many images are hidden and forgotten in archives, private collections, books, and journals until someone again considers them worth it to work with them. We might assume that an image’s circulation ends when no longer usable, when an image is no longer cited or when its depiction has been disqualified as false—see for example *Haeckel’s Embryos*¹⁸ or a more recent case¹⁹ discussed in this issue. However, such shifts in the scientific function of an image rarely implies that their circulation has ended, but rather that the image’s references expanded

¹² Steiner (under review).

¹³ On circulation, see Gänger 2017, on 12; Hopwood 2015; Secord 2004; Bod et al. 2019; Engelmänn and Lynteris 2020; Greene 2020; Krige 2019; Endersby 2008; Raj 2013; Lee 2015; Fan 2012; Heinrich 2008.

¹⁴ Haraway 1976.

¹⁵ We draw here on Hopwood et al. 2021.

¹⁶ In this way we depart from the perspective advanced by William J. T. Mitchell, Horst Bredekamp, and others, in which the ontology of the visual, the agency of images, advances into the main matter of concern. Without neglecting the significance of these approaches, we argue for a subtle shift in perspective here by focusing on the conditions of possibility that might bring pictures into positions of impact and agency. See Mitchell 2005 and Bredekamp 2021.

¹⁷ *Cambridge Dictionary*, online: <https://dictionary.cambridge.org/dictionary/english/life-cycle> (accessed 8 July 2023).

¹⁸ Hopwood 2015.

¹⁹ See the contribution of Callaerts et al. in this volume.

beyond certain scientific communities and—at times—that the images advanced into objects of historical analysis.

To identify “change over time,” the impact, relevance, dominance, accuracy, and timeliness of ideas, knowledge, practices, and the organization of science are the key tasks of historical inquiries. Charged with “historicizing just such questions about the how, what, and wherefore of knowledge,” the status of scientific images has long captivated historians of science, medicine, and technology.²⁰ From the seminal question Daston and Galison have asked about images as indicators of a shifting sense of objectivity, to Cray’s historical reconstruction of the observer, and to Cartwright’s important call for a history of medicine’s visual culture: images of and in the sciences have shaped important historiographical questions in the last decades.²¹ To think historically about scientific images, one must avoid to naively consider the image as mere window into the past, but—as Ludmilla Jordanova argued—one also must remain attentive to the historical pattering of visual experience and the shifting cultures of perception over time.²²

Although this special issue’s scope spans two hundred years, it is not invested in tracing the continuities and discontinuities of broad visual and pictorial styles of representation that circulated in the world of the life sciences and beyond over time; this is not a historical mapping of styles of visual representation by means of circulation. Nevertheless, the papers in this special issue follow a chronological order to emphasize the historical pattering of different kinds and practices of circulations. Whereas image-production is a clearly defined entity in the literature—to put it short: people with tools, instruments, and techniques, on the one hand, and ideas, knowledge, and expertise on the other hand craft, design, and inform images—, there has been ambivalence about the use of distribution, dissemination, and circulation, about when and how it is appropriate to draw on which notion or concept. Historians of the 1990s and 2000s would have used “dissemination” for what we today often refer to as “circulation”; and “distribution,” a term closely tied to the early days of research on the different media of press, is primarily used when talking about editions, print runs—but not exclusively.

To create an entry point into the complex world of circulating images, meanings, and perceptions we suggest using a complex life cycle model instead of the conventional single loop cycle. On a single loop cycle, following a logic of linear maturation, one would be tempted to think of the early, juvenile stages as periods of production and the mature stages as points for the image’s dissemination and distribution. This model, however, would hide the diversity of ways with which images are produced through circulation. It implies a linear development along the life cycle and invokes imaginations of ageing that circulating images repeatedly undermine.

²⁰ Daston 2017, on 131.

²¹ See, e.g., Daston and Galison 2007; Cray 1992, Hüppauf and Weingart 2008; Tucker 2005; Heinrich 2008; Lynteris 2022.

²² Jordanova 2012.

An understanding of circulation as having multiple loops might help us to show that dissemination is part of production and reproduction, that the circulation of images through reproduction is the condition for producing new images. In other words: Circulation is constitutional for producing scientific images. From its earliest emergence and in the first loop of image production, images are reviewed, cited, copied, and adapted to compile new pictorial and visual representations. New scientific images are produced in correspondence to already circulating, published, and unpublished scientific images (and texts), embracing or disrupting their intellectual, visual, and pictorial traditions.²³ A scientific image is embedded in circulations from the start, for example as a trace in any experimental setting thus pointing to both the experiment as a process as well as the object they are attributed to.²⁴ The second loop captures images that circulate in the course of either their dissemination and/or their distribution. Images are packaged to accrue specific meanings, used to exemplify and to popularize knowledge. At the same time, those intentions, purposes, and aims are corrupted, shifted, adapted, and aligned through different practices and resources of circulation. Finally, the audiences, in which and for whom such images are made to circulate, define how the depiction and the object it represents is perceived, made meaningful and thus re-framed back towards the image itself.

So, if we are to think of an image having a life cycle, it must be a more complex one. We propose the life cycle of the slime mold *Dictyostelium* as better model (Figure 1). This strange organism lives most often as a solitary amoeba but also sometimes as a cell aggregate and sometimes as a multicellular fruit body. It can reproduce both asexually and sexually. In cell biology, the species *Dictyostelium discoideum* serves as a model organism.²⁵

For our purposes, the slime mold's triple-loop life cycle helps us to visualize the different reproductive options open to images depending on their environments. Roughly explained, as we see in the "vegetative cycle," solitary amoeba reproduce asexually when environmental conditions are favorable. They multiply by copying and dividing themselves and each go on about their solitary lives. This captures what we would conceive as persistent trust in the image, where its circulation does not require any changes, adaptation or manipulation often because of continuity or similarity of audience. As we see in the "sexual cycle," the amoeba reproduce sexually when environmental conditions are unfavorable. Here they exchange genetic material and produce novel amoeba that then disperse. This captures what we describe as shifts in authorship and expertise, which in turn leads to the image's adaptation and to authors adapting existing material to fit new purposes and new audiences. Finally, the social cycle opens a perspective towards considering the range of images and overlapping influences which are supported or undermined by authors, experts, producers, and designers in the processes of circulation, each in their own way contributing to the image's complex social biography.

²³ See, e. g., Latour 1990; Weibel 2002.

²⁴ On the scientific image as trace in and of experimental systems, see Rheinberger 1997.

²⁵ Haver and Scaglione 2021.

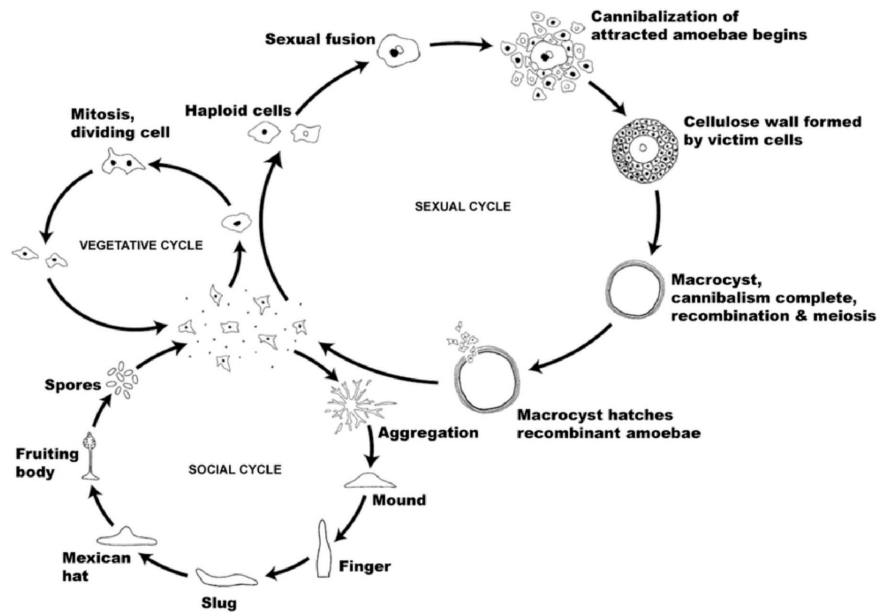


Figure 1. Cellular slime mold *Dictyostelium discoideum* from Flowers et al. 2010. Image reproduced under Creative Commons Attribution 4.0 International license.

All together this complex cycle better captures that images are being constantly copied as well as adapted into a context of representation, as images are modified for their specific uses and function within changing context. In this process they are charged with new and different meanings. Here is an example of an image with a complex life cycle. In 1892, German zoologist Wilhelm Giesbrecht published a chromolithography of a copepod—a tiny marine crustacean—which was based on drawings from his research. The chromolithograph was used to classify a species. He produced the image based on the standards and examples of his discipline and his observations of specimens. This image was created by a “sexual cycle” of creative image production which then circulated among marine zoologists. Ernst Haeckel nearly perfectly copied several of Giesbrecht’s copepod images and arranged them in his *Kunstformen der Natur* (English title: *Art Forms in Nature*) series. Although the major features (color and style) were copied, Haeckel’s image was not a simple copy with a reference to Giesbrecht. Instead, he changed some details of the image to also fulfill disciplinary standards; and he changed its audience resulting in a newly adapted image for a mixed readership. This modified image served Haeckel’s own taxonomic purposes and were also created in sexual cycles. Drawn from the *Kunstformen*, today Haeckel’s adaptation of Giesbrecht’s image has been reprinted on posters, stickers, T-shirts, covid masks, miniskirts, and coffee mugs.²⁶ These result from less

²⁶ Steiner (under review).

creative, asexual cycles. Each round of the cycle produces a new image disseminated to a new audience.

All models have their disanalogies and one such artifact of borrowing this complex life cycle is that it gives the impression that, because asexual vs. sexual reproduction is a dichotomy, exact copying vs. adaptation is also a dichotomy when it is clearly a multidimensional continuum. We hope the potential adopters of this model can further adapt it to suit their purposes, imagining more loops or new forms of reproduction for example. Remember though that the basic strength of the life cycle model is that it captures how production and distribution and dissemination cannot be separated. Importantly, circulation as a practice is foundational to both the realm of production and that of distribution and dissemination; it usually cuts across these two. For example, when identifying, describing, and depicting a new species, a zoologist draws on all kinds of visual material at hand, thus combining the visual record, which had assembled over centuries in published and unpublished sources, into a new representation. During this process, the published image loops back into the production process. In this way, circulation is by itself a boundary practice, as it involves more than one perspective and operates within and across many realms and disciplines.

While the papers in this issue have in common that their analyses unfold in what historians often refer to as boundary zones, they address different dimensions of circulation. In what follows we discuss the practices of circulation each paper addresses in reference to two themes. Thereby our attention focuses on the question, how does the dialog between the role of visualization in production, distribution, and dissemination help widen the category of “scientific image”? The perspective of *circulation as a practice* shifts our thinking about visual representation beyond the scope of *objectivity*²⁷, thus the collection seeks to explore new ways of thinking and imagining the visual in and across the histories of the life sciences. With this collection we explore and begin a discussion on how *circulation as a practice* serves as productive lens to gain diverse and deeper insights into the visual worlds of the life sciences. We ask: how can circulation as an analytical category help tracing the social, cultural, and political functions scientific images serve?

1. The Social Lives of Scientific Representations

Scientific images are often composite images. Not only are they composed from many sources, but they are also produced by many actors and transformed by many users. The theme of *social lives of images* focuses on the many actors involved in scientific image production. The papers in this volume address this issue on two entangled levels: on the level of individuals, they introduce actors with various expertise, each contributing their ideas, hands-on-experiences with organisms, scientific practices, and visualization techniques, the authors’ stories draw on a workforce spanning from “invisible” to

²⁷ Daston and Galison 2007.

renown actors; on an organizational level, they unravel the societal, cultural, and political contexts within and between which images emerged and unfolded.

The papers in this volume, as already mentioned above, foreground the latter. In light of **Aleksandra Kaye's** and **Samantha Muka's** contributions to this volume we use the pictorial genre of portraits as a window into this theme. We do so in two ways. First, this includes its “classic” appearance as a personal depiction of an individual—traditionally a human to be depicted with symbolic attributes that reflect on their social status and stages their role in society.²⁸ “Classic” portraits are underrepresented in the literature on scientific images. Because they do not represent viruses, algae, genes, data or research hypothesis, “classic” portraits, it seems, do often not to have more than an illustrative function within knowledge circulation. At first glance, one would identify the personal portraits released in print media which Kaye and Muka discuss as classic portraiture. While also serving an illustrative role in their stories, both authors do not use these images to negotiate the scientific lives and biographies of the individuals they represent.

Instead, their analyses focuses on biography of the portraits themselves, exploring their independent existence by tracing from how these images were set up to starting their own lives through circulating in print media.²⁹ Kaye's paper traces the circulation of portraits of Polish naturalists in the Polish illustrated press from the 1840ies to the 1880ies. The second half of the nineteenth and the first decades of the twentieth century was the heyday of the illustrated press, tasked to entertain, inform, and educate vast audiences;³⁰ and it was also when Poland was portioned among Russia, Prussia, and Austria-Hungary pushing emigration and Polish people into diaspora and creating a national identity was on top of the political agenda in the rage for independence. Kaye offers an intriguing analysis of the mediums' audiences which reached beyond the general educated public, a social component that shaped the medium's program. Naturalists, editors, and science writers hoped that circulating portraits of scientists along with their original findings, Kaye argues, would loop back, and reinforce both the reputation of natural history and a Polish identity in a scattered Polish state. In this “didactic function”³¹ the images, yet embedded in Polish language text were, on the one hand, meant to shape the public reception of science in general and elevate natural history as a desirable profession. On the other hand, it was the goal to elevate a Polish identity. In this way “men of science” were transformed into “agents of independence”³²; and vice versa science was used, as we know from other histories, as an indicator of the power and strength of a nation. Within this

²⁸ As Ludmilla Jordanova pointed out, there is no exact definition of a portrait. Jordanova 2000, on 14–20. On portraits in science, see also Gigante 2018, on 32–50.

²⁹ On the concept of the biography of artefacts in science studies, see, e.g., Pollock and Williams 2008.

³⁰ Fyfe and Lightman 2007.

³¹ Kaye in this volume.

³² Ibid.

framework, the author shows how these portraits were presented as icons of the status of a discipline and an envisioned nation. The journals' editors and science writers were "creating," as Kaye puts it, "a community of interpretation."³³

Comparable but different is the circulation of two portraits of Indonesia-based Lee Chin Eng, a key figure in the international aquarium hobbyist community. Muka uses his portrait photography as an entry point to unravel the representational and social dynamics within the "reefers" community. With the aid of that visual tool this community was built, in parallel standards and conventions outside academia were established. Eng's portraits and his landscape photographs of aquariums—the second genre Muka draws her argument upon—were "produced for an explicit audience" who had the knowledge, experience, and apprehension to read and interpret the images.³⁴ Hobbyists' journals were read also by academically trained conservationists. Tracing the portraits reproduction and adaptation, Muka shows that Eng's portraits were not only used to stabilize the authority of a successful coral conservationist, but his portraits elevated him—and his particular mode of representation—onto a role model. The image of Eng posing in front of the tank he built became iconic and its iconography was adopted by other members in the reefer's community to showcase their tanks and proof their expertise.

Second, suggesting a figurative interpretation of portraiture, graphs, histograms, and diagrams can portray programs, schools, and institutions³⁵ and also deliver powerful icons of adversaries to the public's health³⁶. Yet, they serve as a window into a social epistemology of images. With detailed context analyses of the circulations that produced these images, the authors reconstruct the genesis of a set of scientific images and thus unravel the interactions between individual perspectives, research programs, schools, and institutions within which they were generated.

Ryan Hearty traces the pictorial continuities and discontinuities of the oxygen sag curve by following its circulations through the dynamics of disciplinary milieus that examine water pollution in US rivers conducted by scientists for governmental institutions. With ten examples, the author shows how the oxygen sag curve—an icon to represent water pollution from an engineer's perspective—was first conceptualized, then simplified, and further adjusted to reveal individual biologists' approaches to examining and visualizing water pollution, thus carving out the close relationship of methodology and representation. Following these different paths of adaptations, Hearty's paper demonstrates the various life cycles an image can be embedded in. The issue of how new technologies impact the self-understanding and public image of a scientific field is raised by **Nepthali Callaerts**, **Alexandre Hocquet**, and **Frédéric Wieber**. The shift from analog to digital recording devices walks

³³ Ibid.

³⁴ Muka in this volume.

³⁵ See the contributions of Hearty and Callaerts et al. in this volume.

³⁶ See the contribution of Bock v. Wülflingen in this volume.

hand in hand with a shift from a kind of tinkering, as the authors put it, to being able to represent data visually accurate and thus raise the social status of the team from tinkerers to experts.

Bettina Bock v. Wülfingen's argument loops us back to broader audiences, tracing the adaptation of visual representations of the corona virus from early images and descriptions in the 1940ies to the current Covid 19 pandemic. With a focus on both the scientific context as well as the many popular places, in which iconographic representations of virus images are produced, designed, and circulated, Bock v. Wülfingen sharpens attention to the different ways in which images assume meanings as either experimental placeholders for biological specimen or as scientific images at the heart of a global pandemic crisis. The contexts of circulation determine if the picture of the virus is merely an indicator of scientific truth or if it becomes entrusted with a public health purpose, symbolizing a risk to justify policies of social distancing.

2. Authorship, Expertise, and Trust

Users (and consumers) of a scientific image generally expect a high degree of trust in its author's expertise, integrity, and responsibility presenting the material accurately and honestly, relying on scientific, visual, legal, and ethical standards, conventions, and norms. The theme *authorship, expertise, and trust* concerns how the meaning and understanding of scientific authorship is affected through the lens of *circulation*. Our starting point is that images are made by many sources and hands—this is not just horizontal across social, cultural, and political spaces but also vertically across time. Users, which might become potential authors of adapted and new images, seek to trust the images they are building upon and expect a degree of control over the meanings and implications they are inheriting and disregarding within the image they working with. To do so, they need to know the record to which an image is related to. In their publications, taxonomists, for example, offer a detailed evaluation of a species' visual representations which have been published and informally shared among colleagues since its first nomenclatural defining. Because the definition of a species builds, among other things, on their visual representation, an extensive review of the (visual) literature is crucial to the taxonomic project. While images may be designated to their author(s), their making commonly includes a history of fragmented authorships.³⁷

The visual representations Muka, Hearty, and Callaert et al. introduce, circulated within expert communities tied together by their respective interest in scientific and practical problems. Considering the value of images in this circles leads to negotiations over the standards for claiming expertise and parameters of trust. Callaerts et al. show how quickly an image can overrun from the circulation among knowing experts to PubPeer reviewers, where the underlying social structures remain even more opaque than in images

³⁷ On fragment authorship, see Baglioli and Galison 2013.

becoming mass media products.³⁸ Standards and categories of trust and expertise are negotiated from a new angle in different communities of expertise—a research that is worth to do in the future. Callaerts et al. thus raises questions about the locus of presentation: What do people choose as their media, genre, or technique of trust and how is this choice tied to ideas about authorship? What are the expected places of tension scientific images and their authors are confronted with at design and productions stage? What is the purpose of authorship for images in scientific publishing and beyond? How are images used to claim authority and expertise? How do the authors of scientific images gain trust differently from authors of scientific prose and data? Do image producers address that images can be simplifications of the data and arguments behind it? What do they want the readers to place their trust in (the data, image, or the argument)?

Mario Biagioli and Peter Galison pointed at the tension between standards of scientific authorship and the broader market,³⁹ a tension that becomes visible in Kaye's, Muka's, and Bock v. Wülfingen's papers. In stark contrast to the genre of scientific journals at the time, the editors and science writers of the Polish mass media used portraits and Polish language to publish original research. In this way, the illustrated press claimed authority to replace the scientific journal as the dominant venue for publishing original findings⁴⁰ and thus pushed its potential as an authority over scientific discourses. Muka's and Bock v. Wülfingen's visual examples as well operate on the boundary of academic and non-academic authorships and readerships, and thus with strategies to serve both the authors' and the audiences' needs and expectations. Whereas with Muka tensions in visual standards between academia and a hobbyist community can be captured through the portrait, Bock v. Wülfingen draws our attention to color as a meaningful and emotive visual tool bound up in the struggle of presenting accurate data that is, at the same time, attractive to the public.

If we bring the purpose of authorship into question, the papers provide diverging stories. For Muka's and Hearty's protagonists, authorship is constitutional for gaining acceptance, authority, and trust. Muka's hobbyists relied on photographs to communicate their craft and to demonstrate what they have each achieved. Muka distinguishes between two variants of portraits: "Active portraits" representing Eng collecting species in the field; and two "passive portraits" where Eng is staged in front of his tank with living organisms in it. These images demonstrate that practice, while not explicitly a science, still requires personified expertise. Altogether, the portraits of Eng collecting in the field, him posing in front of the tank and the close up of species in the tank, the original article offers the storyboard for a narrative that suggests: "This is how they do it in Indonesia"—the caption underlining Eng's authorship, thus proving the actual achievement and expertise of building and breeding, maintaining and conserving. In this case, authorship demonstrates the skills

³⁸ See the contributions of Kaye and Bock v. Wülfingen in this volume.

³⁹ Biagioli and Galison 2013, on 3.

⁴⁰ Kaye in this volume.

required; at the same time, it is used as a truth claim drawing on photography as an advocate: “Pics or it didn’t happen” is the slogan to further establish trust and elevate the image into a teaching tool.⁴¹ The scientific status of these images risks here to be mixed up with portraiture.

In Hearty’s paper authorship crystallizes as a legitimization for the biological approach to examine and evaluate water pollution. Visual approaches to the analysis and representation of water and its pollutants different from field to field and from discipline to discipline. Not only are these underlying methodological differences, but Hearty also shows how visual cues, styles, and formatting practices provide a disciplinary index to visualizations, which in turn gather trust (in biology). In a comparable fashion, this argument then extends also the contribution of Callaerts et al., which challenges the ways social status comes to matter for the trust placed in the authorship of images; an issue that has received increasing attention in the tensions between review practices in scientific journals and on open review platforms such as PubPeer. A further erosion of standards of trust provided by authorship can then also be observed in the shift towards digital technologies in the production of scientific images, which in turn has raised questions about how to trust technological tools and instrument in image production.

Hearty’s and Callaert et al.’s arguments both unfold in tension between standards on the one and methodology and technology on the other hand. One of the questions that brings both papers together is this, how the emergence of new scientific methods has triggered and manifested new standards of visual and pictorial representation? Much in the same way does Bock v. Wülfingen’s contribution on the iconography of the virus raise issues about the implicit absence of images, when circulating as mere indicators of a scientific authority in times of crisis. This, as Bock v. Wülfingen’s paper clearly shows, stands in strong contrast to the intentional and laborious design that went into the crafting of the image depicting SARS-Cov-2, for example. However, this image, like many comparable ones, seem to gain trust precisely by the lack of authorship that it could be associated with. It seems as if the virus image just visualizes itself.

Trust is, as the images discussed in this collection show, not always (and perhaps rarely) an effect of clearly identifiable expertise and authorship. Rather, most of the images suggest that a fragmented authorship across time and spaces, a collection of contributions, a sense of provenance and associations with styles, norms, and standards is what gather trust in images in the life sciences. In other words, circulation and the practices of circulating an image, are neither effect nor a thread to trust but provide the conditions under which images become legible as representations of scientific objects, ideas, and concepts.

⁴¹ This explicit claim raises a basic issue of photography and trust, in terms of manipulation and “true to nature.”

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