Passionately interested in the entanglements between the philosophy of science, the experimental arts and questions of representation, in his research Hans-Jörg Rheinberger has focused on the history and the epistemology of experimentation, thus inspiring numerous artists. He is a Scientific Member of the Max Planck Society and Director Emeritus at the Max Planck Institute for the History of Science in Berlin, a member of the Berlin-Brandenburg Academy of Sciences and Humanities and of the German National Academy of Sciences Leopoldina. He has published books such as Toward a History of Epistemic Things: Synthesizing proteins in the test tube (1997), An Epistemology of the Concrete (2010) and On Historizing Epistemology: An essay (2010), and has co-authored (with Staffan Müller-Wille) A Cultural History of Heredity (2012) and The Gene: From genetics to postgenomics (2017). He has also published work on art–science collaborations, such as that between the philosopher of science Gaston Bachelard and the copper engraver Albert Flocon, The Hand of the Engraver: Albert Flocon meets Gaston Bachelard (2018), as well as on the contemporary biomedia artwork by Paul Vanouse. Against the grain of the ‘two cultures’ thesis assumption that in the course of the twentieth century the natural sciences and the humanities have grown apart into fields of knowledge that do no longer understand each other from the point of view of a historian of science Hans-Jörg Rheinberger aims to promote a new culture of mutual ‘call-out-and-in’ in order to deal with an epistemic universe that is henceforth no longer comprehensible in a dual but only in an irreducibly plural mode. As such, he actively – and physically – contributed to the performative symposium ‘Applied Microperformativity: Live arts for a radical socio-economic turn’ held at the Angewandte Innovation Lab (AIL) in collaboration with Brut, was curated by Lucie Strecker, Klaus Spiess and Jens Hauser in Vienna in 2018.

Jens Hauser: Your lecture ‘Microperformativity and experimentation’ at the ‘Applied Microperformativity’ symposium in Vienna was both framed and thematically taken up, but also repeatedly interrupted and finally absorbed proverbially and biologically by the art performance Microbial Keywording. On the one hand, your discourse became part of a symbolic–scenic performance; on the other hand, the phonemes you articulated flowed into a microbiological process on a truly material level: the pH value dependent on the phonemes in the oral flora was measured and, depending on this, pheromones were released to micro-organisms, with the effect on these micro-organisms on a level other than the linguistic ultimately producing ‘sense’. Speaking about biological processes acted as a stimulus in real microperformative, biological processes. How did you feel about this experimental performance situation?

Hans-Jörg Rheinberger: On the one hand, it fascinated me; on the other, it disturbed me. I was talking about the laboratory as the context in which such microperformative processes are used to generate knowledge about the living beings involved and, in a sense, make themselves speak – by creating plaques with different fringes and colours in a Petri dish, thereby sending meaningful signals to the experimenter, who in turn translates them back into the research process. In the experimental process, something like an endless loop is created through the interaction between the human performer and the viruses, which attack bacteria according to their own specificities, get them to burst and thus generate forms of visualization. This kind of feedback on the microperformative level is what I described in my lecture. And in the context of the festival it seemed to me as if the whole thing was being reproduced on a metaphorical level – with the same elements I described from the laboratory context: microbes that only grow under certain conditions, depend on the pH value and need their very specific environments. So, I felt somehow torn between alienation effects and moments of recognition.

1 The performative symposium ‘Applied Microperformativity: Live arts for a radical socio-economic turn’ at the Angewandte Innovation Lab (AIL) in collaboration with Brut, was curated by Lucie Strecker, Klaus Spiess and Jens Hauser in Vienna in 2018.

2 The art project Microbial Keywording is described in this issue on pages 56–62.
Lucie Strecker: If we use terms such as ‘sense’ or ‘metaphorical’, the claim of Microbial Keywording is nevertheless that the processes actually take place at the biological level in real laboratory apparatus; that Petri dishes are actually inoculated with the speakers’ saliva, that the microbes’ behaviour and their protein structure changes, beyond the metaphorical.

HJR: Terms like ‘metaphorical’ always depend on the perspective. From the perspective of the scientific laboratory and the way microbes and Petri dishes are handled there, such an experimental art setting initially seems metaphorical. But then, when I enter this alternative setting, the metaphoricity disappears and I find myself in another context of action. It is, however, of a different kind than a laboratory setting, where there is always a follow-up question that leads to the next experiment; otherwise it would be a merely demonstrative context and not one of knowledge production.

LS: But for me as a choreographer and artist, who, together with Klaus Spiess and an interdisciplinary team, is staging a scientific–artistic symposium, you in turn have become part of our experiment, in order to make the material itself – the theorist’s utterances – speak, and to illustrate it in a metabolic process. We have tried to bridge the gap between the abstract linguistic and the somatic levels. How did you experience the second part of the performance in a separate room, where a tube was put into your mouth and you then repeated the phonemes of your ‘keyword’ in an experiment?

HJR: In this laboratory-like set-up, which made use of a microbiological cosmos, one was no longer just an active spectator, but was involved as a component of the staging, but basically in a performance without an audience, which triggered different associations and disquiet in all the participants. For me, the discomfort was also an important experience.

LS: In view of the possibilities of biotechnology, the whole symposium attempted a change of perspective to explore how, within the performative arts and in choreography, the typical questions of staging work are changing from ‘How do people act? How do they move? How do they speak?’ to ‘How can anthropocentric approaches be expanded?’ If one then thinks of findings such as that the interaction between microbes and the brain is a key factor in cognitive or mental processes, one now asks about the power of biology and so forth to act – which can be both friend and foe to humans.

HJR: Yes, in all the activities of the Vienna symposium one was always somehow struck by the fact that so much microbiology is constantly present in everything we do and are. Through our own microbiome, which has partly been made visible here, we are practically always and everywhere in a microbial, that is, in a microperformativity, context, which we do not notice in our everyday experience.

JH: In this sense, ‘microperformativity’ also implies a sensitization not only to other levels of spatiality but also of temporality than those accessible to the mesoscopic phenomenology of the human animal, which so far correspond to the very broad concept of performativity in art and theatre studies, linguistics and anthropology. In your symposium contribution about ‘microperformativity in in vitro life science experimentation’ you emphasize the importance of ‘compression’ and ‘dilatation’: ‘What is too small for being directly investigated must be enlarged... What is too big must be downsized’ and ‘What is too quick to be observed must be slowed down; and what is too slow to be observed must be accelerated’. But why does the concept of performativity in general, and microperformativity in particular, make sense with regard to experimental practices in the natural sciences? What does it add to the acquisition of knowledge and understanding of experiments and epistemic objects?

HJR: The term ‘performativity’ was originally associated with actions or activities, but human ones. The concept of performativity was investigated in interdisciplinary collaborations over decades, and was employed by Erika Fischer-Lichte (2008), among others, to describe action-theoretical contexts. I myself, on the other hand, have always been interested in the actions you can induce in the objects you are experimenting with – what are they themselves doing? In experimentation, the concept of microperformativity can be made just as fruitful: what counts is not the experimenters, who are somehow performing...
in the laboratory and pushing the Petri dishes back and forth and pouring something in here and sucking something out there, but that they are getting substances and organisms to interact with each other, or creating an environment and initiating a process in which these interactions can take place – and from which they themselves can withdraw. Experimenters want to know how the microbes behave and not what they have done to them. This is the conflict for any experimenter, that they naturally see themselves as people who arrange all this but, precisely by arranging it, take themselves out of the game, because they are not interested in their own actions. In the laboratory, two performance contexts collide – that’s what’s really exciting and interesting for me. Micro-processes, which as a rule are not accessible to our senses, are amplified so that we can perceive them.

**LS:** You always emphasize the importance of the milieu as an artificially created environment and ask to what extent natural processes are still shown or ‘mirrored’ here, or whether the artificial environment alienates the objects of observation so that they react differently.

**HJR:** To be able to represent, in the test tube, a biological reaction supposed to take place in the cell, one has to destroy the cell. To learn about life in an *in vitro* or test-tube experiment I smash it to pieces and have to separate *one* reaction from all other reactions that normally occur simultaneously in the cell. I assume that what I see there is a ‘mirroring’ of the intracellular process – which in this context of experimental performance it is not; rather, it is the performative context that creates the situation, or the illusion. This is the contradiction – or rather the tension – from which the whole experiment lives. Following the biochemist and historian of science Herbert Friedmann, what has been really new about test-tube cultures is the claim and demonstration that tissue extracts could provide and represent not just what have been called natural products, that is, *compounds* synthesized in tissues and organs, but natural *processes* as well; Friedmann claims, ‘From now on, extract repeats or *mirrors* process’ (1997: 108). What is thus at stake in the transition from a living system to a test-tube system is not just the transition from biology to chemistry or from physiological processes to organic substances. What is at stake is rather something akin to a *reduplication* of life; a life – so to speak – under other conditions. The milieu of the cell or the ‘milieu intérieur’ of the organism, in the words of the French nineteenth-century physiologist Claude Bernard, is being replaced by a milieu composed in the test tube. In this process of repeating or of mirroring life, however, what is implied is a permanent threat of aberration, which confronts its practitioners with the equally permanent question of how far, in the mirror, we are still able to see ‘nature’.

In the late nineteenth century, microbiology became only possible by such artificially created environments. And it is still the case today that only some of the microorganisms surrender to the brutalities of being cultivated in a technically created environment beyond their actual living conditions. For others this does not work at all, so they are simply ignored – which does not mean, however, that they are not perhaps the more important ones and that we may perhaps only investigate a few completely unimportant ones, just a few small pathogens that thrive on our – and your – ‘stage’ of the artificial milieu. A vast unexplored continent is here waiting for the sciences.

**LS:** How do processes change when they are repeated in artificial milieus – perhaps there is a comparable tension in performance practice between the body of work and the process? For example, is it the dramatic text or choreographic notation that is essential, or the performance itself? How do these elements interact? Even if primarily related to human actions, the theatre scholar Erika Fischer-Lichte emphasizes the fundamental transformative power inherent in the encounter between performers and perceivers.⁴ The text is then no longer the work of art, but the performativity of the text. Parallel to this, one could argue that in anthropology it is not the written down and handed on *myth* that is most important, but the *rite* performed – that is, the action itself, the performative. All of this now focuses on the mediality of the performance, rather than on the text being performed, and thus, thanks to this ’in-between’, it thereby involves the spectator concretely as an essential element. This ’in-between’ also seems to play a central role in your *epistemology of the concrete*.

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⁴ In their Editors’ preface, Minou Arjomand and Ramona Mosse underline the procedural and relational aspects in the subjective experience of performance by also elaborating on linguistic differences between German and English: ‘In contrast to the word *perform* the German *aufführen* is a more narrowly focused term that refers specifically to a live theatrical context and is distinct from *ausführen*, which describes the doing of a particular task; to *perform* subsumes the two and allows them to be aspects of a single concept.’
(Rheinberger 2010 [2006]), where the focus is not on the action character of the human, but on the agency of non-human dimensions.

**HJR:** Of course that is the fundamental situation that runs through everything: what comes first? Is it first the practical context and then the symbolic horizon – or is it that the symbolic horizon is always already there, and somehow leaves its mark on the concrete actions? This is known as a specific situation in the theatre, and also from the anthropological contexts you mentioned, differently on each occasion; but one also finds similar constellations in experimentation, as the ideal of ‘mirroring’ shows. In this way, one always creates a tension in the scientific experiment. Because the ‘art’ – in quotation marks – consists on the one hand in creating such ‘unnatural’ milieus in order to provoke those visibility effects, but on the other hand the milieu should be of such a nature that the actors in it do what they would otherwise do outside this artificial milieu.

For example, the activities of viruses that infect bacteria can only be made visible by creating environments in which bacteria form ‘huge’ plaques that cover a large area compared to their own size. The effect would not be noticeable on an individual bacterium. Bacteriophages, which exploit the genetic apparatus of microbes to reproduce themselves, instrumentalize bacteria that farm themselves to death – a terrible process, which also takes place ‘naturally’ and invisibly in nature in every infection process, but that cannot be captured ontically as a singular event, but always only iteratively, in the differential.

**JH:** Here your often-cited figure of ‘iteration’ (Rheinberger 2005) comes into play: the concept, transposed from philosophy and literature into the life sciences, of writing oneself in via processes or graphemes, the circling and searching for the unpredictable in the process of scientific research. For molecular biology in particular, you have suggested that this is a cultural understanding that goes hand in hand with the execution of a code to be understood as analogous to writing – ‘because the contemporary biologist also speaks of writing and pro-gram in relation to the most elementary processes of information within the living cell. And, finally, whether it has essential limits or not, the entire field covered by the cybernetic program will be the field of writing.’

**HJR:** That is a quotation from Jacques Derrida (1974: 9) from the first chapter of his Of Grammatology, which I quote in Iterationen.

**JH:** Exactly. So how important is the constant inscribing and overwriting, this performative iteration instead of a preferably final interpretation of an ontologically established fact – scientific activity as a play of writing and laying tracks, playing of differences?

**HJR:** This brings us back to the concept of process, which here overlaps with that of microperformance: knowledge cannot be stopped; research cannot be brought to final rest. There is no omega point – that is what makes scientific knowledge so fundamentally different from theological knowledge. Scientific knowledge is not oriented towards an end state, but is always only defined by dissatisfaction with its present state. This movement is unfinishable in its essence. That is for me the decisive factor of performativity in general, at least of the iterative type.
is basically an attempt to replace ontology with
epistemology. But if it all ends there, it leads to
that sort of arbitrariness that we know well from
constructivism. There needs to be a feedback to
the ontic realm that keeps gaining on us. The
quote from Laboratory Life can be interpreted in
such a way that the traces left by the experimental
process do not simply end in a conclusion. In order
for these traces to remain virulent, they must
themselves assume a performative character by
tempting us to take the next material step in the
experimental context. Seen in this light, it is clear
that, on the one hand, script is again becoming
action, in whatever form it may take, and that,
on the other hand, action can always assume
something like a written form, so that it can be
subjected to our interpretation. So, everything
turns around this to and fro between scripturality
and materiality.

HJR: One could say that the concept of the
performative as a reflexive concept has the
potential to counteract this kind of media
blindness. Preparations, as the name tells us, are
things worked on, configured and reconfigured.
But to appear authentic, the procedures must,
paradoxically, be rendered invisible, so that
a preparation looks authentic if the media used
to create it are effaced in the final product.

JH: An important aspect of the performative,
which you have described using the history of
specimens and experimental systems, is that it
can be used to reveal widespread media blindness.
You emphasized the paradox of the scientific
preparation, which appears authentic to the
viewer above all when the previous technical
manipulation the object has been subjected to has
been made to disappear, that is, the performative
action is usually negated by the resulting object.

Before there can be Wahr-Nehmung (perception),\(^5\)
however, there needs to be means of Wahr-Gebung
(giving of truth),\(^6\) as the philosopher
Walter Seitter (2002) formulates it, but this giving
of truth is often suppressed.

HJR: Yes, that is one of the characteristics of
science and technology studies in the tradition of
historical epistemology. One attempts to get away
from the question, 'What is there?' and rather
to understand, 'What is being done there?' So, it
is basically an attempt to replace ontology with

HAUSER & STRECKER: ‘AGENCY IS EVERYWHERE’ 69

\(^{5}\) In German, perception literally translates as 'true-taking'.
\(^{6}\) In German, literally 'true-giving'
the job. I have always found it strange that it is almost a necessity of life for scientists to hide the apparatus they use to make their objects visible. If you listen to scientists, they never actually talk about the instruments they use to tackle nature, but about the wonderful effects – which they have created – as the things themselves.

JH: On the occasion of the exhibition and publication *Fingerprints* about the biotechnological live installations by the artist Paul Vanouse (Rheinberger 2011) you addressed the fact that such microperformative art reveals and demonstrates what is often hidden in a scientific article under the heading 'Materials and methods'.

HJR: 'Materials and methods' are always listed at the beginning of an article – so it’s easier to forget them. Now, Paul Vanouse’s genome-critical performative art goes against the grain of this general tendency on the part of scientists to hide the epistemic dimension of their work: the ever-changing means and media, the whole plethora of research technologies. Vanouse looks at them, while scientists tend to look through them and treat them as transparent and translucent, to view them as allowing unadulterated and immediate access to the ‘findings’ themselves. Transposed into an artistic environment, Vanouse’s biotechnological installations reveal something of the reflexive power of alienation (*Verfremdung*). This is an ingenious – scientifically and artistically effective – way of keeping the media of knowledge production in the game, in all their opacity, an antidote against the tendency of the sciences to make them disappear.

This reminds me of a telling situation I encountered when musing about a contribution to the ‘Iconoclash’ exhibition, curated by Bruno Latour and Peter Weibel at the ZKM Center for Art and Media in Karlsruhe in 2002. I had a long and in-depth discussion with Bruno Latour in Paris about the opportunity to contribute a video to the exhibition, in collaboration with my colleague, the art historian Peter Geimer. We approached an otherwise very open-minded scientist to suggest collaborating on the video that would show what has to go into the technology of radioactive tracing in order to make it work. We wanted to document the visualization procedures and make apparent the enormous technical efforts it entails – starting with the cyclotrons and atomic reactors from which the isotopes come before they are nicely packaged in small ampoules and sent to the molecular biology laboratory; we wanted to put the entire epistemology of this process into the picture. To my disappointment, but not to my surprise, we were unable to convince this scientist of the interest of such an endeavour in view of the time and work that would have to go into it. Instead, he suggested producing a spot featuring the models that were the result of his experiments using the technology of radioactive tracing. Again, products – not means and media – would occupy centre stage, and, of course, the people promoting the establishment of these models. We spent a whole day in his lab and left in the evening without having achieved anything. The film was never made.

LS: In various branches of the performing arts, including choreography, we are currently seeing great international interest in questioning the human performer in their anthropocentric position as the main actor. Even top choreographers such as Mette Ingvartsen have sometimes even banned human performers completely. Recently the Muffathalle, Munich celebrated its twenty-fifth anniversary with a preview of the ‘performance of tomorrow’ with the festival *[un]*[split]: *Micro performance & macro matters*.7

JH: It was about the potential of the arts to create awareness for agencies that escape the visible and our mesoscopic bubble by expanding our habitual scales. Just as Kant once underlined the importance of other scales with the concept of both the dynamically and the mathematically sublime and in the encounter with the all-powerful, so today the no longer imaginable and experienceable is perhaps graspable when microperformative processes in art are confronted with their macroscopic effects. This seems all the more enticing to artists, since the development of these scales often requires technoscientific apparatus and media, between particle physics and climate research.

LS: Or between the biotechnological manipulation of micro-organisms and ecological questions.

HJR: Even though our everyday performance takes place in a mesocosmos conditioned by the
range and specificity of our senses, I hesitate to divide the scientific sub-fields themselves into micro, macro and meso – precisely because all the instruments that bring the smallest and the largest into our mesocosmos again and again break down such divisions. For example, instruments that allow us to learn something about the heavens work with micro-processes such as wavelengths far below any visibility. But it makes a lot of sense to take a close look at the agential relationships between the micro-, meso- and macrocosmic dimensions. Such an analysis of the performativity of both non-human actors and the apparatuses is also welcome with regard to the much-cited term ‘Anthropocene’. This not really happily chosen term can rightfully be criticized, since it just does not express what is actually happening here: a reversion of performance. The globe, the planet is striking back – and it is no longer primarily the people who are acting. Michel Serres (1990) described this reversion thirty years ago in his wonderful book The Natural Contract. Our environment has gained an independent ability to strike back, so to speak, exactly because of the way we have treated it, something we had not suspected. Non-human things are making themselves felt to the extent that it was believed that they could be tamed by scientific and technological development. Of course, forces of nature were also there in a past replete with things so overpowering that they were interpreted as punishment of the Gods. Now, this kind of interpretation does not work anymore so well today. But in reverse, theoretical offers such as those made by constructivism, as an extreme fantasy of omnipotence, have also failed. Today, as those made by constructivism, as an extreme – and it is no longer primarily the people who are acting. Michel Serres (1990) described this reversion thirty years ago in his wonderful book The Natural Contract. Our environment has gained an independent ability to strike back, so to speak, exactly because of the way we have treated it, something we had not suspected. Non-human things are making themselves felt to the extent that it was believed that they could be tamed by scientific and technological development. Of course, forces of nature were also there in a past replete with things so overpowering that they were interpreted as punishment of the Gods. Now, this kind of interpretation does not work anymore so well today. But in reverse, theoretical offers such as those made by constructivism, as an extreme fantasy of omnipotence, have also failed. Today, the discussion about the power of action of things has become urgent: ‘agency is everywhere’ – with massive consequences. It would not have needed Corona to demonstrate it.

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