

Fumbling for the New and Unknown. On the Emergence of Epistemic Things in G. Ch. Lichtenberg's *Sudelbücher***

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In the writings of the polymath and experimental scientist Georg Christoph Lichtenberg (1742–1799) one sometimes comes across startlingly modern observations on the phenomenology of scientific activity, for example on the relationship between experiment and hypothesis, on the role of contingency in scientific discoveries, or on the dialectic between the invention of the new and the arrangement of accumulated knowledge. In a record of his private notebooks, known as *Sudelbücher* (“Waste Books”), he casually notes what constitutes a pure demonstration experiment:

Now that we know nature, even a child understands that an experiment is nothing more than a compliment paid to it. It is a mere ceremony. We know its answers beforehand. We ask nature for its consensus as the great lords ask the estates.¹

Demonstration experiments were common around the eighteenth century, not only for didactic purposes, but also in the many forms of spectacularization of science, which concerned in particular a then new and mysterious field of knowledge: electricity. The aforementioned definition, however, also brings with it an implicit distinction between a demonstration experiment and a proper experiment: in the former, phenomena we already know are just confirmed and displayed; in the second, something new, which we haven't discovered yet, comes forth. It was precisely this dialectic of expectability and surprise, typical of scientific activity, that engrossed Ludwik Fleck in the twentieth century. According to Fleck, valuable experiments are always

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¹ Lichtenberg 1967–1992, vol. 1, on 448, notebook E, number 332 (i.e. E 332): „Nachdem wir nun die Natur durchaus kennen, so sieht ein Kind ein, daß ein Versuch weiter nichts ist, als ein Kompliment das man ihr noch macht. Er ist eine bloße Zeremonie. Wir wissen ihre Antworten schon vorher. Wir fragen die Natur wie die großen Herrn die Landstände um ihren Konsens.” Quotations from the *Sudelbücher* are hereinafter referred to only with the letter that identifies the notebook (A to L) and the text number directly after the passage. All translations by the author.

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“unclear, unfinished, unique”;² as soon as they become clear and arbitrarily reproducible, they are at best suited for demonstration purposes, but no longer useful for research purposes, for “the richer the unknown, the newer the field of research, the less clear the experiments are.”³ Hans-Jörg Rheinberger later took this tension further and reformulated it as a relationship between “epistemic things” and “technical objects.”

In his epochal book *Toward a History of Epistemic Things* (1997), Rheinberger defines experimental systems as “the smallest integral working units of research,” which “give unknown answers to questions that the experimenters themselves are not yet able clearly to ask.”⁴ Quoting François Jacob, he also calls them “machines for making the future.”⁵ Experimental systems consist of two components: epistemic things and technical objects. The research object is defined as an epistemic thing, which means “material entities or processes—physical structures, chemical reactions, biological functions—that constitute the objects of inquiry.” These objects “present themselves in a characteristic, irreducible vagueness,” which is indispensable, because “paradoxically, epistemic things embody what one does not yet know.”⁶ Rheinberger explicitly follows Bruno Latour’s idea of the indefinability of the new research object. Technical objects, on the other hand, are to be understood as the material, technical arrangement, that makes the production of epistemic things possible in the first place: “instruments, inscription devices, model organisms, and the floating theorems or boundary concepts attached to them.”⁷ Thus, epistemic things build a bridge into the future, while technical objects remain anchored in the present: “A technical product [...] is an answering machine,” whereas “an epistemic object is first and foremost a question-generating machine”.⁸ Epistemic things, however, can in turn transform into technical objects, which then again (in a productive dialectic between stable-known devices and new-unknown objects of inquiry), help to bring forth new epistemic things.

In the research systems, epistemic things have three important properties. One should first of all distinguish epistemic things from epistemic objects: in Bruno Latour’s concept of non-human actors the latter are pure and objective facts (“matter of facts”), whereas epistemic things also fulfil an inner, emotional concern, thus “matters of concern.”⁹ The second aspect is the constitutive theoretical, medial, and technical hybridity of epistemic things, and thus also the constitutive provisionality of their definitions. Eventually, the emergence of

² Fleck 1980, on 112.

³ Ibid., on 114.

⁴ Rheinberger 1997, on 28.

⁵ François Jacob, quoted in *ibid.*

⁶ Ibid. See also Rheinberger 2021, on 150. Fleck 1980, on 117, has defined “first observations” as “a chaos.”

⁷ Rheinberger 1997, on 29. On research technologies as fixed and inaccessible “black boxes,” see Latour 1987.

⁸ Ibid., on 32.

⁹ See Latour 2005, on 87–120.

epistemic things is not a matter of pure theory and speculation, but is always linked to epistemic practices such as experimental arrangements, measurements, representation procedures, and so on.

In this paper, I will attempt to describe Lichtenberg's *Sudelbücher* as the site of the serendipitous encounter of two practices, both central to the natural scientist *and* to the writer: writing down collected data (observations, experimental protocols, calculations, etc.) and experimenting in order to be able to produce the new and coveted but as yet undefined object of research (the epistemic thing) from a given and more or less fixed setting (the technical thing). Thus, these texts set in motion a peculiar feedback between repetition and renewal. On the one hand, they operate with traditional procedures of classification and representation of already known information assets (in terms of the history of knowledge: with taxonomies; in rhetorical terms: with *inventio* and *ars topica*). On the other hand, they attempt to generate new ideas and rhetorical thought experiments from the archived written material and from the witty associations that spring from it. Rhetorical *inventio* becomes scientific invention.¹⁰

As a scientist, Lichtenberg was primarily concerned with the epistemic thing of the eighteenth century par excellence—electricity. In the history of science, his name is linked to the discovery of the electric figures named after him, which consist of branching electric discharges that sometimes appears on the surface or in the interior of insulating materials. His Essay *Von einer neuen Art, die Natur und Bewegung der elektrischen Materie zu erforschen* (1778), with which he informed the scientific community about his discovery, is also interesting for historical epistemology as well as for the rhetoric of science for several reasons. First, because Lichtenberg is fully aware of the role of chance in the discovery process and reflects on it several times in this text. Second, because the invisible epistemic thing called electricity produces effects (the figures, precisely, that look like snowflakes or flowers) that also have aesthetic appeal. Their particular beauty, which Lichtenberg describes with delight, even seems to be the necessary equivalent of their definitional vagueness. Thirdly, because this text employs several narrative procedures that reveal it to be a perfect example of the auctorial science narration still typical in the eighteenth century.¹¹

But what do Lichtenberg's *Sudelbücher* have to do with epistemic things? First of all, it is important to say that they are not diaries, because they are mostly not dated. Lichtenberg entrusted all sorts of thoughts to the *Sudelbücher*, in which he made notes very regularly: experimental protocols, cursory observations, calculations, funny ideas and linguistic jokes, quotations from other books with his own commentary, drafts of short essays to be published in

¹⁰ On the relationship between rhetorical *inventio* and scientific invention, also with reference to Lichtenberg, see Mengaldo 2022. On Lichtenberg and rhetoric, see Goldmann 1994; Mayer 1999; Hetzel 2007.

¹¹ On narratives in science, see, among others, Harré 1990 and Brandt 2009. About this text by Lichtenberg, see Gamper 2009, on 85–92.

journals, and more. The thematic spectrum is very heterogeneous and by no means limited to questions of experimental science or laboratory technology; it extends to anthropological-psychological, literary-critical, and political topics. Although Lichtenberg, from the *Sudelbuch* H onwards, noted down his scientific and humanistic notes separately,¹² the interaction of the “two cultures”¹³ is constitutive for these notebooks, which served him also as research notebooks in the broadest sense of the word.

The term *Zettelwirtschaft* (“economy of the scribble”) coined by Rheinberger in *An Epistemology of the Concrete* can be applied well to these notebooks, because it turns out to be the expression par excellence of a science in the making. The term encapsulates the “rough notes, scrips and scribbles, and revised write-ups that offer insight into concrete processes of knowledge formation” and are therefore “still of the order of the experimental engagement and entanglement.”¹⁴ Among the numerous tools of knowledge that accompany modern research practices (laboratory tools, experimental arrangements, libraries, archives, etc.) there is thus the desk as well, which has the status of a research laboratory in the broadest sense. As an expression of a science in the making, however, and precisely because of their provisionality, small and unfinished text formats such as notes, scribbles, slips of paper, etc., turn out to be the media par excellence for the production of new epistemic things, one of whose central characteristics is provisional vagueness.

The *Sudelbücher* are a vast repository in which the act of writing things down first serves to stabilize knowledge; but at the same time, they prove to be a sort of research site for questioning numerous objects of knowledge and for provisionally answering the questions that Lichtenberg keeps asking himself the whole time. Thus, the scene of writing becomes here “the arena of knowledge and of its emergence.”¹⁵ The three over-mentioned factors that play a role in the emergence of epistemic things can be observed in them. Firstly, the private character of these notebooks automatically makes the topics they deal with matters of concern: not or not only supposedly objective facts are dealt with here, but things that concern the author, that is, things to which an affective and emotional investment is attached. Secondly, they are necessarily bound to an epistemic practice—in this case, to the act of writing down—in which the relevance of the things, and thus their emergence at all, first appears. Thirdly,

¹² The notebooks were annotated at the same time, whereby Lichtenberg used to start from the front with the notes on general topics or above literature or even with private notes (with Arabic pagination), while he started from the back with the natural science entries (with Roman pagination). Thus the two sections—the “two cultures”—met roughly in the middle.

¹³ See Snow 1959.

¹⁴ Rheinberger 2010, on 244 and 245. On the relevance of research notebooks in the history of science, see Holmes et al. 2003.

¹⁵ Campe 2011, on 25: “Schauplatz des Wissens und seines Entstehens.” On procedures of observation and note-taking in the *Sudelbücher* and on Lichtenberg’s drawing on economic techniques (waste books), scholarly practices of excerpting (commonplace books) and scientific note-taking (Francis Bacon’s *Novum Organum*; small genre of the *observations* in Renaissance Science Academies), see Campe 2011; Campe 2012; Wankhammer 2021; Mengaldo 2021, on 53–67.

Lichtenberg's epistemic things are hybrid objects of knowledge that are investigated through his scribble economy, and the *Sudelbuch* is the technical medium in which the questioning of these things unfolds.¹⁶ The hybridity of this small, provisional prose, as well as its text-genetic status as a work in progress, makes it an excellent epistemic and poetological engine, capable of maintaining the difficult balance between a firmly consolidated, stored knowledge and the open thought experiments that generate new knowledge.

In the following, I will take a closer look at one notebook—notebook J. This notebook (or rather: its scientific half) occupies a special place in the *Sudelbücher*, because its entries can also be read firstly as notes on a planned compendium of physics, and secondly as private comments on what was probably the most important handbook of physics at the time, the *Anfangsgründe der Naturlehre* (1772) by Johann Polycarp Erxleben, Lichtenberg's predecessor in the chair of experimental physics in Göttingen. Lichtenberg used this compendium as the basis for his lectures, and after Erxleben's death (1777) he published four further editions of it. His handwritten marginalia in the handbook were not only used for the lecture, but many of them were included in the next editions in the form of additions and improvements. The records from notebook J were written between the beginning of 1789 and April 1793, the period in which almost all the marginalia in Lichtenberg's hand copy of the 4th edition of the *Anfangsgründe der Naturlehre* were written as well.¹⁷ It is worth comparing some passages, also with regard to the emergence of epistemic things.

First of all, it is remarkable that the half of notebook J that deals with scientific topics is titled “1789. Miscellaneous notes (actually just a finger pointing) about physics and mathematics.”¹⁸ The gesture of finger-pointing refers to future knowledge that can only be hinted at, and the notes are rather directional approximations whose intuitive moment, however, makes them all the more valuable despite or precisely because of their fleetingness.¹⁹ This heading is followed by methodical instructions on how to produce the new, however improbable and absurd it may seem in the present: “Since everyone immediately thinks of the ordinary, go at once deliberately to the unusual and uncommon. Sexus plantarum, Sexus astrorum, acidorum et alcalinorum pp.” (J 1254) Scattered throughout the notebook are thoughts that highlight the difficulty and, at the same time, the inevitability of re-thinking, which can be fostered by the attitude of doubting and questioning in the first place, such as in the following entries:

¹⁶ Campe 2012, on 165 has spoken of “Kritzeln als Medium” (“scribbling as a medium”) and “das Sudelbuch als Form” (“Sudelbuch as a form”).

¹⁷ See Mengaldo 2021, on 24–52.

¹⁸ Lichtenberg 1967–1992, vol. 2, on 229: “1789. Vermischte Anmerkungen (eigentlich bloß Fingerzeige) für Physik und Mathematik.”

¹⁹ The projective gesture, however, also points, specifically, to the planned and never realized compendium of his own, of which some of the notes in notebook J are possibly intended to represent a kind of draft or sketch.

Questioning things that are now believed without further investigation—that is the main thing everywhere. (J 1276)

On the reason why it is so difficult to invent something new and useful. (J 1279)

Why do I believe this? Is it really made up like this [...] (J 1326)²⁰

The fact that they are provisional and rather heuristic thoughts is also proved by their elliptical structure, for they are often unfinished sentences (e.g., infinitive clauses). According to my thesis, the whole notebook J therefore reads as a self-discipline guide, in order to learn thinking differently and producing bizarre connections of thought, which can promote the emergence of new epistemic things.

Sometimes a shift from technical objects to epistemic things becomes visible in the notebooks. From the 3rd edition of the *Anfangsgründe* (1784) onwards, Lichtenberg precedes the beginning of Erleben's paragraphs with a "Description of Smeaton's Air Pump" (which had been fabricated by the British engineer John Smeaton in 1771). At the end he describes his personal variant of the air pump (provided with an illustration, see Figure 1): here, a tube is attached that is connected at the other end to a bell through which the air is sucked up.

Then Lichtenberg adds:

In passing I note that the connection of the tube to the bell is most conveniently made by means of a small resin vial, for in this way the bell can still be turned and adjusted without damaging the tube, which is fixed tightly to the pump.²¹

The "small resin vial" is here only a small technical device that facilitates the functioning of the air pump. A few years later (1790), however, a peculiar development takes place in notebook J. Along a few notes, Lichtenberg ponders various phenomena during extreme temperature changes. J 1261 is a sort of methodical instruction that follows the short report (J 1260) on a real experiment of his own with heat and cold: "Something quite paradoxical about this, which no man can yet have easily thought of" (J 1261).²² Paradoxical ideas are thus not only possible, but they prove to be very useful because they can trigger further, inventive thoughts. What now follows is a truly bizarre thought experiment about the freezing of cities:

It is not at all difficult to produce heat in the greatest cold, but it requires much skill to produce cold in great heat. It is possible to burn down a house and towns in the greatest cold, but as yet we know of no means of making the people in one village freeze to death while the others

²⁰ "Dinge zu bezweifeln, die ganz ohne weitere Untersuchung jetzt geglaubt werden, das ist die Hauptsache überall."; "Über die Ursache, warum es so schwer ist etwas Neues und Nützliches zu erfinden."; "Warum glaube ich dieses? Ist es auch wirklich so ausgemacht".

²¹ Erleben and Lichtenberg 1787, on 28: "Im Vorbeygehen merke ich an, daß die Verbindung der Röhre mit der Glocke am bequemsten vermittelt eines Federharzfläschchens geschiehet, denn auf diese Weise läßt sich die Glocke noch drehen und stellen, ohne der Röhre die an der Pumpe steif ansitzt, Gewalt anzuthun."

²² "Etwas recht Paradoxes hierüber, woran noch gar kein Mensch leicht gedacht haben kann."

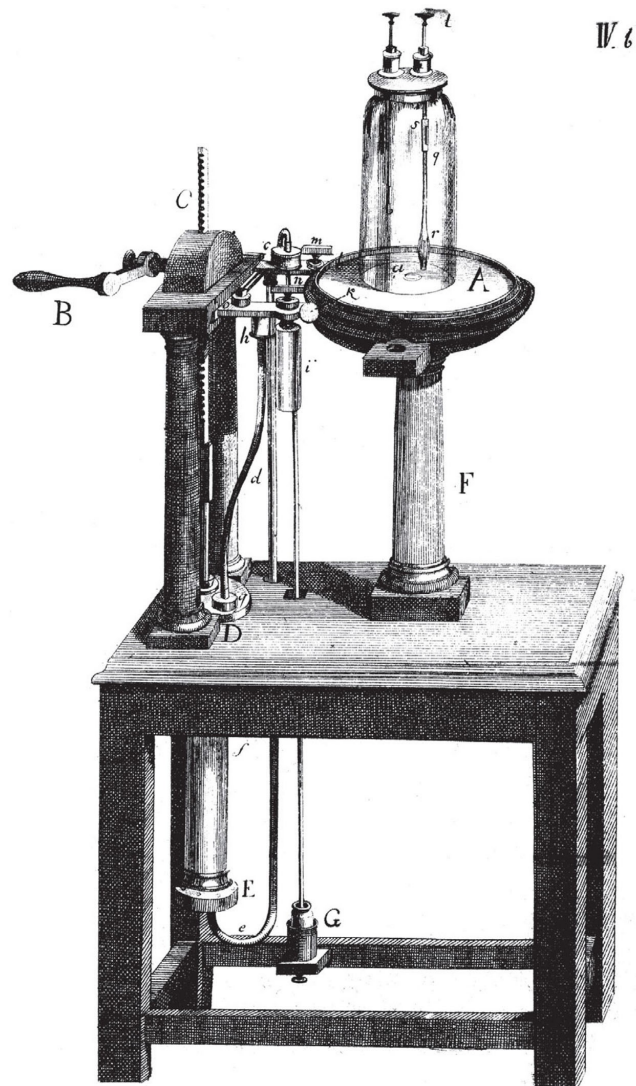


Figure 1. Lichtenberg's illustration of his alternative model of Smeaton's air pump. In: *Erleben and Lichtenberg 1787*, on 1099. *Forschungsbibliothek Gotha der Universität Erfurt*, N 8° 328.

nearby have the most pleasant summer. In itself, the one is as little impossible as the other. (J 1262)²³

²³ "Es ist gar nicht schwer in der größten Kälte Hitze hervorzubringen, allein es erfordert viele Kunst, in großer Hitze Kälte hervorzubringen. Man kann bei der größten Kälte ein Haus und Städte abbrennen, allein bis jetzt kennen wir noch kein Mittel zu machen, daß die Leute in einem Dorf verfrören während die andren in der Nähe den angenehmsten Sommer haben. In sich unmöglich ist das eine so wenig als das andere."

A few pages further down, Lichtenberg notes a thought experiment by Erasmus Darwin, which he had formulated in an essay on freezing experiments published in 1788 in the *Philosophical Transactions*:

Mr. Darwin believes in his beautiful frigorific Experiments on the mechanical Expansion of air (Philos. Trans[actions] Vol. 1788) that one will perhaps seriously learn once more to make the wind, as I do of the freezing of cities. Monstrous thoughts also have their uses. (J 1380)²⁴

Here, the idea of “monstrous thoughts” refers back to Lichtenberg’s own idea of the “freezing of the cities.” This then triggers the next note, which also belongs to his own methodological guideline: “Can a monstrous thought be attached here, as those in the preceding §. are” (J 1381).²⁵ Two entries further down, we finally encounter the very resin vial that figured as a small technical device in the description of Smeaton’s air pump: “To fill a resin vial with powder like a cannon cracker and to ignite it” (J 1383).²⁶ This strange, witty link of thought obviously plays on the idea of a quite concrete monstrosity—the danger of destruction by this novel weapon. There follows another entry with its own little thought experiment (which, as is often the case, is formulated as a conditional clause²⁷) about the substitution of cupping glasses with resin vials:

In the bath I found that the resin vials suck in excellently, if one could give them even more elasticity, or if one could have them even stiffer than my flaky one, then they could be used quite well instead of the cupping glasses. (J 1384)²⁸

In the last examples given above, it is obvious that the small resin vial in the *Sudelbücher* is not merely a technical device within a larger apparatus (as Lichtenberg’s description of the air pump in the compendium), but it is repurposed to reveal another epistemic thing, even if only as a little thought-experimental fantasy or in a monstrous idea like the record about the cannon cracker. And indeed, further down in notebook J, Lichtenberg wonders whether his own instruments can be converted and repurposed:

Must once go through my entire cabinet with the question: what else can this instrument be used for apart from its actual purpose. I believe that I will be able to save a lot by doing

²⁴ “Herr Darwin glaubt in seinen schönen Versuchen frigorific Experiments on the mechanical Expansion of air Philos. Trans[actions] Vol. 1788. daß man vielleicht im Ernst noch einmal den Wind werde machen lernen, so wie ich vom Verfrieren der Städte. Die monströsen Gedanken haben auch ihren Nutzen.”

²⁵ “Kann hierbei wohl ein monströser Gedanke angebracht werden, so wie die im vorhergehenden §. sind.”

²⁶ “Eine Federharzflasche mit Pulver zu füllen wie einen Kanonen-Schlag und anzuzünden.”

²⁷ On conditional clauses (the *Konjunktiv II* in German) as the experimental mode par excellence in Lichtenberg, see still relevant Schöne 1983.

²⁸ “Im Bad habe ich gefunden daß sich die Federharzflaschen vortrefflich ansaugen, könnte man ihnen noch mehr Elastizität geben, oder könnte man sie noch steifer haben, als meine eine schuppigte [sic!], so ließen sie sich recht gut statt der Schröpfköpfe gebrauchen.”

this. For example, the lamps of the pyrometer could be used quite well for Kempelen's machine. Pockholz's balls in electrical experiments. [...] (J 2138)²⁹

Thus, the familiar technical object serves to generate new epistemic things when placed in a different context—in a different experimental system.³⁰ Because it often produces bizarre ideas and “monstrous thoughts,” the investigation of new epistemic things tends to be commended to the private *Sudelbücher* and not to the glosses on Erxleben's compendium; to the conversation with himself and not to the (often agonally colored) dialogue with his predecessor. No coincidence, then, that they are sometimes born at night time. The aforementioned entry J 2138 ends with this very personal note: “This can become a good occupation during sleepless nights.”³¹ In his considerations on the economy of the scribble, Rheinberger takes on François Jacob's concept of “night science” (in contrast to the well-ordered “day science”), of which the research notes form a “residuum”:

By contrast, night science wanders blind. It hesitates, stumbles, recoils, sweats, wakes with a start. Doubting everything, it is forever trying to find itself, question itself, pull itself back together. Night science is a sort of workshop of the possible where what will become the building material of science is worked out. Where hypotheses remain in the form of vague presentiments and woolly impressions. Where phenomena are still no more than solitary events with no link between them. Where the design of experiments has barely taken shape. Where thought makes its way along meandering paths and twisting lanes, most often leading nowhere.³²

The *Sudelbücher* prove to be not only a scientific but also an epistemological question-generating machine. They are the ideal place for thought experiments, for witty associations, thus for the extension to other fields of knowledge—to other experimental systems. The new epistemic things emerging here appear as “vague presentiments”; the fact that they are entrusted to these private notebooks automatically makes them not cold objects of research, but highly personal and warm matters of concern.

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²⁹ “Einmal mein ganzes Cabinet mit der Frage durchzugehen: wozu kann dieses Instrument außer seiner eigentlichen Bestimmung sonst noch gebraucht werden. Ich glaube daß ich dadurch manches sparen können werde. Z.B. zu Kempelens Maschine könnten die Lampen des Pyrometers recht gut genützt werden. Die Kugeln von Pockholz bei elektrischen Versuchen. [...]”

³⁰ On the re-functioning of technical objects to create new epistemic things, see Rheinberger 1997, on 28–31 and, more recently, Rheinberger 2021, on 154.

³¹ “Dieses kann eine gute Beschäftigung bei schlaflosen Nächten werden.”

³² Rheinberger 2010, on 246.

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