



## Feyerabend's 'The concept of intelligibility in modern physics' (1948)

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## ABSTRACT

This essay introduces the transcription and translation of Paul Feyerabend's *Der Begriff der Verständlichkeit in der modernen Physik* [The concept of intelligibility in modern physics] (1948), which is an early essay written by Paul Feyerabend in 1948 on the topic of intelligibility (*Verständlichkeit*) and visualizability (*Anschaulichkeit*) of physical theories. The existence of such essay was likely. It is listed in his bibliography as his first publication. Yet the content of the essay was unknown, as no original or copy is extant in Feyerabend's Nachlass and no known published version was available to the community—until now. The essay has both historical and philosophical interest: it is, as far as our current knowledge goes, Feyerabend's earliest extant publication. It documents Feyerabend's philosophical interest as a physicist-to-be, in what he himself called his “positivist” phase; and it gives a rare if fragmentary insight into the early discussions of the ‘Third Vienna Circle’ and, more generally, the philosophical culture of discussion in Vienna.

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## 1. Introduction

*Der Begriff der Verständlichkeit in der modernen Physik* [The concept of intelligibility in modern physics] can be reliably dated to 1948, when Feyerabend was 24 years of age.<sup>2</sup> This sets the essay in the early phase of Feyerabend's formative years in post-war Vienna (1946–1955), a time period for which Feyerabend's own published recollections were the only readily available sources. According to Feyerabend, he had been a “raving positivist”,<sup>3</sup> who maintained that “science is the basis of knowledge; science is empirical; non-

empirical enterprises are either logic or nonsense” (Feyerabend, 1995, p. 68). This testimony has been interpreted in the secondary literature as a reference to Feyerabend's early liaison with Logical Empiricism. Preston (1997, p. 2) argues that the philosophical position expressed in Feyerabend's testimony is “the view associated with Logical Positivists [...] which flourished in Austria from the early 1920s.” Similarly, Oberheim (2006, p. 204) claims that “in Vienna in the late 1940s, [Feyerabend] started as a positivist who rejected scientific realist accounts as unjustifiable metaphysics” and that his philosophy “developed from the logical positivist climate of his university studies in Vienna in the late 1940s” (Oberheim, 2006, p. vii). This interpretation is chiefly supported by the fact that Feyerabend's early mentor and later dissertation supervisor had been Viktor Kraft, a former member of the Vienna Circle and a proponent of an original empiricist position (see Radler, 2006). Kraft offered philosophy tutorials (*Philosophische Übungen*) that Feyerabend attended each term from the very beginning of his studies and from which the Kraft Circle would eventually develop.

The essay from 1948 seems to fit well with this interpretation: it was developed in the context of the Kraft Circle, it contains an exposition of a position labeled “positivism” and I interpret the

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<sup>2</sup> Source documents from the European Forum Alpbach archive are referenced with the abbreviation EFA (I am grateful to Philippe Narval for permission to cite from these sources). Source documents from the Paul Feyerabend's Nachlass are referenced with the abbreviation PF followed by the archive's signature number (I am grateful to Brigitte Parakenings for permission to cite from these sources). Archival documents are not listed in the References section.

<sup>3</sup> Feyerabend (1978a, p. 112, 1993, p. 275), Augustin (2010, p. 153); see also Feyerabend (1978b, p. 26).

essay not only to describe this position, but to defend it by illustrating its positive role in the historical development of physics.

Furthermore, Feyerabend's essay can help expand the interpretation of Feyerabend's self-professed positivism and build a tentative timeline of Feyerabend's formative years. As is well-known, Feyerabend enrolled at the University of Vienna in the winter term of 1946, but after an attempt at general history and history of art, he enrolled physics and astronomy courses in the following term.<sup>4</sup> By July 1948, he had studied three semesters of physics and related subjects (maths and astronomy). Judging by his course record book, it is likely that by 1948 Feyerabend still aimed to become a scientist and self-identified as a training physicist. It might be useful, therefore, to understand Feyerabend's positivism as denoting an approach to epistemic aims developed mainly within physics. Building on the notion of a distinctive "philosophy of physicists" (Scheibe, 2006), Feyerabend's essay can be read as the expression of philosophical views of a young physicist-to-be, drawing from his readings of physicists and their philosophical views to develop his own. In particular, there are distinct Machian motives in it, from arguments down to terminology. This is a starting point to interpret Feyerabend's elusive testimony, stated as early as 1951, that at the beginning of his academic studies he had endorsed an "unclear and thus very dogmatic theory of elements (freely adapted from Mach)".<sup>5</sup> Following this lead, Feyerabend's early philosophical background would have been motivated by the philosopher–scientist tradition still surviving in physics, less in philosophy.

1948, then, marks a decisive step in Feyerabend's eventual engagement with scientific philosophy and Logical Empiricism, as he joined the Austrian College Society in January, which only a few months later led to the establishment of the Kraft Circle, or 'Third Vienna Circle', as it has been recently dubbed by Stadler (2010; see also Kuby, 2010). The discussions about Logical Empiricism in the Kraft Circle must have been substantial, as only a few years later Feyerabend would offer a sophisticated discussion of the logical-empiricist protocol sentence debate in his dissertation (1951), putting forward his own proposal, a causal theory of basic sentences.<sup>6</sup> In the same year, he also gave a talk dubbed "The dogmas of Logical Empiricism", offering a qualified critique of Logical Empiricism while defending the method of doing philosophy championed by the Vienna Circle (Feyerabend, 2010; see also Kuby, Limbeck-Lilienau, & Schorner, 2010).

Feyerabend's essay may be seen as the earliest and timely document of a transitional phase leading to his involvement with scientific philosophy, having been written only a few months into the discussions of the Kraft Circle and still echoing Feyerabend's early philosophical activity rooted in physics.

## 2. The Austrian College and the Third Vienna Circle

Contrary to his own testimony, Feyerabend did study philosophy from his first term.<sup>7</sup> But his philosophy studies, with the possible exception of Viktor Kraft's and Karl Roretz' courses, covered mostly traditional topics in the history of philosophy and

didn't touch upon scientific philosophy and Logical Empiricism. This can be explained by ample historical evidence that by the mid-1930s the philosophical landscape in Europe had been purged from most scientifically-oriented philosophy.<sup>8</sup> This has led Stadler (2010) to investigate how Feyerabend's formative years developed on the background of scientific philosophy despite a strong anti-positivist climate in the post-war period in Vienna.

The Kraft Circle is a case in point. The University's involvement in its establishment seems to be only tangential. While the continuity of the anti-positivist climate at the philosophy department and in governmental education politics went on uninterrupted, a lively scientific and cultural climate developed outside Viennese academe in the immediate years following the war. In order to assess the more dynamic activities occurring in Vienna at the time, we need to focus on the existence of several para-academic institutions, i.e. societies seeking to emulate an academic setting but not directly affiliated with the University of Vienna. The Austrian College Society (*Österreichisches College*) was the most important one as Feyerabend's involvement is concerned, but we know of several para-academic societies in which Feyerabend was active, like the Institute for Science and Art (*Institut für Wissenschaft und Kunst*) and, starting in the early 1950s, the Institute for European Social Studies (*Institut für Europäische Gegenwartskunde*, a spin-off of the Austrian College).

How did these organizations gain such a momentum in the immediate post-war situation? My working hypothesis, which will be developed elsewhere, is the early onset of a competitive climate in the nascent Cold War, which would turn Vienna into a battleground between political fronts, carried out through ongoing attempts to reach a cultural hegemony. This competition translated into several interventions: a sustained knowledge transfer from the USA to Austria–Vienna in particular—both in terms of personnel and material supplies (books, newspapers, magazines, journals) and funds pouring into scientific as well as artistic projects. On the other side, the evanescent alliance between social-democratic and communist forces (the latter backed up by the East).

Para-academic societies like the Institute for Science and Art (established 1946) and the Austrian College (established 1945) played but a small part in this competitive race, yet are of particular importance for explaining Feyerabend's engagement with scientific philosophy in post-war Vienna. Crucially, these societies offered a platform for scientific philosophy at a time when no other was available—though from very different perspectives. The Institute was a leftist organization, backed up by the KPÖ (Austrian Communist Party), where discussions in the tradition of the Vienna Circle could find a place under Walter Hollitscher, a former student of Moritz Schlick and Robert Reininger and by the time an engaged communist and member of the KPÖ. The Austrian College, on the other hand, was politically center-right, with ties to the conservative ÖVP (Austrian People's Party) and close connections to the USA. It was a politically anti-communist platform, yet championed a liberal "marketplace of ideas" ideal in which no philosophical traditions were precluded and also communist ideas could find their expression, at least intellectually, in debates. In this open-minded climate, scientific philosophy could find several venues of expression (Kuby, 2010; Schorner, 2010).

All of these societies exploited the shortcomings of traditional academic institutions to offer a place for students and academics to self-organize their studies and discussions, establish connections to international networks and form communities of interest. Among their task was the recruitment of bright minds among students—a

<sup>4</sup> Cf. Feyerabend (1995, pp. 63–64) and his course record book (PF 5-5-1).

<sup>5</sup> "[E]ine unklare und daher auch sehr dogmatische Elemententheorie (frei nach Mach)" ("Lebenslauf", in Feyerabend, 1951, my translation).

<sup>6</sup> See Oberheim (2006, 46–70) for an excellent exposition of Feyerabend's later pragmatic theory of observation, a development of his early behavioristic theory of basic sentences.

<sup>7</sup> "I had studied theater, history, mathematics, physics, and astronomy. I had never studied philosophy" (Feyerabend, 1993, p. 261). Philosophy is the only subject that he took every single term over the course of his studies. See Feyerabend's course record book (PF 5-5-1).

<sup>8</sup> See exemplary studies in Dahms, 1985; Fischer & Wimmer, 1993; Heidelberger & Stadler, 2003; and Stadler & Heidelberger, 1987.

talent scouting of sorts to which Feyerabend may well owe his later career. The competitive practice gave rise to a virtuous circle from which young students like Feyerabend could profit in terms of support and research venues.

The available evidence tells us that Feyerabend joined the Austrian College Society in January 1948.<sup>9</sup> The College organized a yearly two weeks forum for lectures and discussion in Alpbach, a small mountain village in Tyrol, Austria. Here Feyerabend participated in the summer of 1948 and here he met Karl Popper for the first time. Beside the summer event, the Austrian College was active all year long, being structured in ongoing local College communities (*Collegegemeinschaften*) in Vienna, Innsbruck and Graz (later Salzburg as well). Each local community organized three types of activities among which were so called working groups (*Arbeitskreise*) which were deemed the most important ones: “The linchpin [*Grundzelle*] of each College community is the ‘working group’. The working group ought to bring together a selection of student according to certain demands (intellectuality, liveness, tolerance, universality) to work fruitfully in small groups [...] under the guidance of a specialist”.<sup>10</sup> These working groups were explicitly pitched as alternatives to traditional academic courses: “The ‘working groups’ are fundamentally different from seminars at current universities, in that they set their own discussion topic and that their members get together through personal contacts or individual selection”.<sup>11</sup>

What is known today as the Kraft Circle was actually the working group devoted to ‘natural philosophy’ (*naturphilosophischer Arbeitskreis*), one of several working groups of the Viennese College community. We have evidence that by early 1948 working groups had been established in the following fields: German language and literature, psychology, history, theology, anglistics, maths, law, sociology, art studies, historically oriented philosophy, systematically oriented philosophy—and ‘natural philosophy’. (A physics working group would have been established in the fall of 1948.)

The Kraft Circle was established sometime between February and March 1948. The earliest mention of it can be found in an overview series of the Viennese working groups (May 1948):

We want to begin our overview of the Viennese working groups by paying a visit to the natural philosophy working group. While this working group has begun its activities only recently during the semester break, its program and problem statement already deserve our full attention. The natural philosophy working group has set itself the task to discuss the anorganic sciences by studying the foundations of measurement procedures [*Meßgrundlagen*] and their application in the special case of relativity theory. Further, the working group wants to draw comparisons between these methods and those actions [*Handlungen*] and primitive theories that allow us to orient ourselves in everyday life. A second comparison is planned with the methods in the humanities [*geisteswissenschaftliche Methoden*], in particular by example of the concepts of space and time. So far the basic notions of physical measurement and of special relativity have been reviewed, setting the foundations of all further work. We look forward to the next deliverables of this most recent, yet already hard-working and interesting working group.

Scientific head: Prof. Viktor Kraft

Student leader: Paul Feyerabend

Meeting place: Institute of Philosophy, University of Vienna.<sup>12</sup>

The essay was published only two months later and thus puts us at the very beginning of Feyerabend’s engagement in the Kraft Circle.

### 3. Feyerabend’s essay

Feyerabend’s essay was written as an antithesis after a joint discussion between the philosophy working group and the science working groups of the College community in Vienna on the paper by Erwin Schrödinger in German, *Die Besonderheit des Weltbilds der Naturwissenschaft* [The distinctiveness of the scientific world view], published in the newly founded journal *Acta Physica Austriaca* (Schrödinger, 1948)<sup>13</sup> and discussed in a widened session of the Kraft Circle in July 1948. The introductory remark is consistent with an announcement in a previous newsletter by the Austrian College:

The *natural philosophy working group*, which counts as one of the most active ones, also continued its work and plans to discuss a paper by Prof. Schrödinger in the near future together with the working groups devoted to philosophy.<sup>14</sup>

We can infer that the discussion had been organized in preparation of the upcoming International College Weeks in Alpbach, where Schrödinger was supposed to give a talk being announced as “subsequent to” the published paper and bearing the same title.<sup>15</sup> However, a reading of Feyerabend’s essay on the background of Schrödinger’s paper highlights how little the former is specifically targeted at the latter. No part of Schrödinger’s paper is specifically addressed; Schrödinger’s name is not mentioned once.<sup>16</sup> As the introductory remark tells us that Feyerabend’s essay was written “as an antithesis”, the reader is left wondering: against what and whom? It addresses, for one, philosophers’ concerns about positivism by describing the role of positivism in (the history of) physics; and, secondly, it replies to Schrödinger’s conception of intelligibility rooted in Boltzmann’s *Bilder* conception.<sup>17</sup>

The way in which the introductory part of the essay frames the topic—physicists versus philosophers—mirrors the setting of the session, a joint discussion between scientifically and philosophically oriented working groups. The further remark that not “much edifying will come out of” a discussion where physics and philosophy are each allowed to “have their say” may well be a hint at the

<sup>12</sup> “5. Mitteilungsblatt der College-Gemeinschaft Wien”, [May 1948], EFA, p. 5, my translation.

<sup>13</sup> A translation can be found as a chapter in (Schrödinger, 1956, pp. 178–228) bearing the title “On the Peculiarity of the Scientific World-View”.

<sup>14</sup> “Der naturphilosophische Arbeitskreis, der als einer der regsten zu gelten hat, setzte ebenfalls seine Arbeit fort und plant in nächster Zeit gemeinsam mit den philosophischen Arbeitskreisen einen Aufsatz von Prof. Schrödinger (Dublin) zu besprechen” (“Österreichisches College: Juni 1948”, 1948, EFA, p. 4, my translation).

<sup>15</sup> “Vierte Internationale Hochschulwochen Alpbach des Österreichischen College, Alpbach-Tirol, 21. August bis 9. September 1948”, 1948, EFA, p. 10. The program further tells us that the talk was canceled; Schrödinger was replaced by physicist Arthur March giving a talk on “the concept of law in physics” (Schrödinger, 1956, p. 12).

<sup>16</sup> Though the essay can be said to contain an allusion: Schrödinger is probably among those “certain physicists” that Feyerabend takes to “still invoke [a theory’s] *Unanschaulichkeit* as an argument] against the modern development of the sciences” (Feyerabend’s essay in this volume).

<sup>17</sup> On the relation between Schrödinger’s and Boltzmann’s conceptions cf. De Regt (1999).

<sup>9</sup> See Feyerabend’s membership card reproduced in Feyerabend (1997, p. 103).

<sup>10</sup> “Informationsschrift des Oesterreichischen College”, Nummer 2, [1948], p. 2, EFA, my translation.

<sup>11</sup> “Programm des Österreichischen College”, [1947?], p. 2, EFA, my translation.

unfruitfulness of the preceding discussion. Secondly, Feyerabend's remark that positivism "has likewise fallen into disrepute among many philosophers" is possibly a reference to the long standing anti-positivist attitude in the *Gelehrten*-tradition in German speaking countries (Ringer, 1990, pp. 298–9), but is even more pressingly an allusion to the immediate post-war situation in Viennese academic philosophy. By the mid-1930s, the philosophical landscape in Europe had been purged from most scientifically-oriented philosophy (see Dahms, 1985; Fischer & Wimmer, 1993; Heidelberger & Stadler, 2003; and Stadler & Heidelberger, 1987). Positivism would have been used in a very loose manner to denote a range of beliefs, a scientific attitude, a distrust of philosophical speculation, science as a value judgement-free enterprise, and, possibly, more refined references to verificationism. Feyerabend's strategy, then, is to make a case for positivism by narrowing down the meaning of the word to denote a specific method in physics and by discussing its roles in this restricted domain.

Feyerabend's essay responds to Schrödinger's take on the role of the "supposition of the intelligibility" of nature in physics (*Verständlichkeitsannahme*) as constitutive in the birth and development of science. The essay also mirrors the same methodological and historical method of arguing that can be found in Schrödinger's paper.

In his response, Feyerabend introduces a second concept alongside intelligibility—that of *Anschaulichkeit*. While the word itself doesn't occur in Schrödinger's paper, *Anschaulichkeit* plays a major role in his physical theorizing and in his thinking about physics, giving credence to the view that Feyerabend is indeed targeting (what he understands to be) Schrödinger's point of view.

### 3.1. Schrödinger on intelligibility and *Anschaulichkeit*

By introducing the term *Anschaulichkeit*, Feyerabend comments on a—by then—decades old dispute in physics about that very concept, which begun with relativity theory and reached its height with the development of modern quantum mechanics in the mid 1920s, and to which Erwin Schrödinger contributed in a number of ways. The discussion about *Anschaulichkeit* was part of a family of interrelated disputes about the aims of physics and, in particular, the requirements of a satisfactory physical theory. Many such issues concerned the question what features had to be taken as constitutive of the very concept of a successful physical theory and which could or had to be abandoned in light of new developments into the realm of relativistic and quantum physics. The concept of *Anschaulichkeit*, mostly used in its adjectival form *anschaulich*, has been variously translated as 'intuitive', 'visualizable', 'picturable', 'intelligible', 'insightful'. *Anschaulichkeit* has given translators a hard time, because each one of these English words captures only a particular segment of the semantic space of the German word (see Petruccioli, 2006, p. 32, note 12).<sup>18</sup>

Much has been written about *Anschaulichkeit*, its role in the development in quantum mechanics and its relation to the zeitgeist of the 1920s.<sup>19</sup> To understand Schrödinger's role in this discussion though we can, at first, isolate the quasi-technical meaning of the word in the physical context: visualizable processes which take place in a space-time framework. A theory is *anschaulich*, therefore, if the processes described are amenable to space-time

representation. Conversely, the *Unanschaulichkeit* of a theory refers to the circumstance that a given theory doesn't allow for a space-time representation.

In the first half of the 1920s, major physicists in Göttingen and Copenhagen—Bohr, Born, Heisenberg, Jordan and, most forcefully, Pauli—suggested, with different degree of comfortableness, to dispense of visualizable models that relied on a continuous space-time picture in order to find a way out of several problems that afflicted the older quantum mechanics.<sup>20</sup> As Beller (1983) has stressed, the original matrix approach was much more radical in breaking with classical physics than the later development of the Göttingen–Copenhagen program would show. Schrödinger's lasting contribution to quantum mechanics, the development of wave mechanics, was a worried reaction to the radical way put forth by the development of matrix mechanics in 1925. In contrast to the assessment of his colleagues, he felt that the lack of *Anschaulichkeit* was the problem, not the solution (Beller, 1983, p. 488; De Regt, 1997, p. 470). Wave mechanics was Schrödinger's attempt to reinstate *Anschaulichkeit* in the atomic realm. In one way, his attempt can be said to be successful, as wave mechanics was well received among the scientific community and provided solutions to open problems (e.g. stationary states, hydrogen atom). It pressed Heisenberg to change their initial program in substantial ways in order to regain the upper hand in the scientific competition. In another way, though, Schrödinger's intervention was a failure, as the success of wave mechanics didn't equally extend to Schrödinger's physical interpretation and never developed to reinstate full *Anschaulichkeit* that Schrödinger sought. As Beller (1983, p. 491) puts it: "The aging Schrödinger witnessed a remarkable state of affairs: the universal use of his theory coupled with an almost total rejection of his interpretation. Schrödinger's methods proved indispensable. His philosophy did not."

There are two intertwined ways in which Schrödinger's articulated his plea for *Anschaulichkeit* in the realm of physical theory. For one, he argued on the basis of heuristic success—a pragmatic (and familiar) mode of argument in physics. Thus, according to Schrödinger, a theoretical approach retaining *Anschaulichkeit* could be developed more fruitfully in order to solve outstanding physical problems (wave mechanics was a case in point). This side of Schrödinger's plea for *Anschaulichkeit* was well received among physicists, as it resonated with a way of physical theorizing familiar to many (see Bacciagaluppi & Valentini, 2009, p. 193). A second side to Schrödinger's plea is less pragmatic and more principled. He argued not only that *Anschaulichkeit* was more conducive to successful physics, but that it was a *necessary condition* not only for physical theorizing, but for the very aim of physics. Articulations of this idea can be found already in his famous technical papers, such as the second of his papers series in 1926:

It has even been doubted whether what goes on in the atom could ever be described within the scheme of space and time. From the philosophical standpoint, I would consider a conclusive decision in this sense as equivalent to a complete surrender.

<sup>18</sup> For the translation of the word in Feyerabend's essay see the translator's note on this volume.

<sup>19</sup> See Mehra and Rechenberg (2001); Bitbol (1996, esp. pp. 65ff.); Beller (2001, esp. pp. 19–22); Bacciagaluppi and Valentini (2009, chaps. 4.6 and 8.3); Kojevnikov (2011).

<sup>20</sup> See Kojevnikov (2011, p. 330): "Our common visual intuitions, one could argue, relied on human experiences in the macroscopic world with objects roughly the size of our own, but did not have to remain valid within the microscopic domain of the atom. Trying to make sense of atomic phenomena with the help of such inadequate intuitive visual (*anschauliche*) representations could be the chief source of contradictions encountered within the quantum theory of the atom. Different formulations of this idea were provided by Bohr (complete space-time representation of atomic processes is impossible), Born (geometry fails within the atom), Heisenberg (positions and trajectories of the electron in the atom do not exist) and Pauli (abandonment of the mechanical, spatial-temporal representation of the stationary state of the hydrogen atom). To build a new theory from the ground up, it had 'first to throw away visual representations of the atom', the *Anschaulichkeit*."

For we cannot alter our manner of thinking in space and time, and what we cannot comprehend within it, we cannot understand at all.<sup>21</sup>

Scholars of Schrödinger's philosophy have proposed various interpretations as to how this inalterable "manner of thinking" (or *Denkformen*, as he called it) should be understood: Is it a cultural necessity? A metaphysical *conditio sine qua non* of human thought? Conceding that stronger and weaker interpretations are both consistent with Schrödinger's writings, I shall follow de Regt's view in his (1997) that Schrödinger's seemingly principled demand for *Anschaulichkeit* is indeed relative to the background concept of *Verständlichkeit* ('intelligibility' or 'understanding'). Briefly put: Following Ludwig Boltzmann, Schrödinger's background conviction was that science's constitutive aim is to *understand* the phenomena, not just to describe them. His demand for *Anschaulichkeit* was directly dependent upon his notion of intelligibility in that he understood the former to be a necessary condition of the latter. His claim about the inalterability of *Denkformen* is thus a claim about the practice we call physics and the constitutive role that the aim of understanding has in its development.

### 3.2. Feyerabend's rejoinder

If Feyerabend's 'antithesis' is indeed directed against Schrödinger's paper, how should his counterargument be understood? Without the intention of providing a full-fledged interpretation of Feyerabend's essay, I shall provide a few notes which may aid future interpretations.

Feyerabend's rejoinder tackles the concept of 'intelligibility *qua* visualizability' as it resonates in the German term *Anschaulichkeit*. Feyerabend introduces the diffuse meaning of the everyday use of the word to distinguish the partial meanings of 'conceptual' and 'visual', thereby introducing a sense in which a theory may be *anschaulich*, i.e. intelligible, without being visualizable, opening the way to a positivist meaning of *Anschaulichkeit*. This argumentative move is similar to Werner Heisenberg's redefinition of *Anschaulichkeit* in his first uncertainty relation paper of 1927.<sup>22</sup> Both Heisenberg and Feyerabend gain a notion of *Anschaulichkeit* that they can put to use against Schrödinger's charge of *Unanschaulichkeit*. But the similarity does not go much further, as Feyerabend's move does not appear to be intended as a replacement of the previous meaning of *Anschaulichkeit*, but to add it alongside the latter. Feyerabend concedes that the notion of 'intelligibility *qua* visualizability' plays an important role in the history of physics. This aspect should be stressed in view of Feyerabend's at times rather straightforward historical account.

Feyerabend proceeds historically providing evidence for the claim that what is deemed *anschaulich* is relative to a specific development of science in time. On the basis of this claim, he argues that the abandonment of *Anschaulichkeit* is crucial, from time to time, for the progress of physics. This historical claim comes up time and again in the writings of physicists defending matrix mechanics. But the view was not exclusive to the Göttingen–Copenhagen school. In a critical discussion of Heisenberg's interpretation of the uncertainty relation, Max von Laue is careful to distance

himself from a general critique of the new quantum theory on grounds of *Unanschaulichkeit*:

Nothing would be more embarrassing than the misunderstanding that these remarks are directed against today's quantum and atom theory. It seems to me that there is a fully objective gauge [*Maß*] for the progress that the latter brings along; it lies in its *Unanschaulichkeit*. What is deemed *anschaulich* is time-conditioned. A theory that forces ourselves to change our conventional conception [*hergebrachten Anschauung*] of the external world seems always *unanschaulich*, and necessarily so, in most cases even to its creators [*Vätern*]. That was already the case with Copernicus, with Faraday–Maxwell.<sup>23</sup>

Here not only the historical claim, but the link between recurring un-visualizability of physical theories and scientific progress is fully spelled out.

The distinguishing mark of Feyerabend's take is the methodological bent of his argument. *Unanschaulichkeit* is not just an effect of major theory change; it is conducive to, may be even necessary for, major theory change. In this respect, Feyerabend's exposition shows a distinctive Machian element: The familiarity of mental pictures stands in the way of the adaptation of thoughts to new facts. These pictures should therefore be historically framed in order for scientists to be fully reminded of their historicity and to let go of them eventually. That is not to say that Mach would have banned *anschauliche* pictures from science altogether. To the contrary, once pictures have been freed from their metaphysical baggage, they can play a positive role:

Once we have accurately determined wherein a picture conceptually coincides with the facts, it combines the advantages of intuitive clarity [*Anschaulichkeit*] with conceptual purity [*begrifflichen Reinheit*]. It now lends itself to taking on without reluctance such further determinations as may be required by new facts, say of electrodynamics or chemistry. (Mach 1976 [1920], p. 182)

One can't help but notice the similarity of Mach's view and the "possibility of metaphysical constructions" prospected by Feyerabend once new phenomena in a domain have been accounted for.

## 4. Attribution

The source document of the essay was found among unorganized stacked documents in the European Forum Alpbach archive and is unsigned. The essay is part of a larger document, a self-edited newsletter of the Austrian College dated July 1948. The first part of the newsletter ('Beiträge') contains six essays; the second part contains two further sections ('Rubriken') devoted to news from individual College-communities ('Aus den Collegegemeinschaften') as well as book and article reviews ('Wir haben gelesen...'). According to the table of contents, the newsletter ends with a preview of the upcoming edition of the international summer school (*Internationale Hochschulwochen*), which unfortunately is not

<sup>21</sup> E. Schrödinger, "Quantization as a problem of proper values II" in Schrödinger (1982, pp. 26–27); cited in Bitbol (1996, p. 66).

<sup>22</sup> "We believe we have gained *anschaulich* understanding of a physical theory, if in all simple cases, we can grasp the experimental consequences qualitatively and see that the theory does not lead to any contradictions" (Heisenberg, 1927, p. 127; translated by DiSalle, 2012).

<sup>23</sup> "Nichts wäre mir aber peinlicher als das Mißverständnis, diese Ausführungen wendeten sich gegen die heutige Quanten- und Atomtheorie. Es gibt, so scheint mir, ein ganz objektives Maß für den Fortschritt, den sie mit sich bringt; es liegt in ihrer so stark getadelten Unanschaulichkeit. Was man anschaulich bezeichnet, ist zeitbedingt. Eine Theorie, welche die hergebrachten Anschauungen von der Außenwelt abzuändern zwingt, erscheint den Zeitgenossen ihrer Entstehung immer und notwendigerweise unanschaulich, meist sogar ihren Vätern. So war es schon bei Kopernikus, bei Faraday-Maxwell" (Von Laue, 1934, p. 441; my translation).

preserved in the document at hand. Some of the contributed essays are related to individual working groups and labeled as such; the remaining contributed essays are not explicitly related to working groups. All but the essay at hand are attributed in print to their respective authors.<sup>24</sup>

In Feyerabend's bibliography by Oberheim (1999) the first entry in the section 'Articles, review, interviews, published letters, and a film' reads

(1947) 'Der Begriff der Anschaulichkeit in der modernen Physik', Veröffentlichungen des Österreichischen College, Vienna.

Oberheim compiled the bibliography integrating his original research with bibliographical data written down by Feyerabend himself and available in his Nachlass. The entry's source is a typescript containing a bibliographical listing compiled by Feyerabend around 1977 that opens with the following entry:

(1) [1947], 'Der Begriff der Anschaulichkeit in der modernen Physik', Vereefrentlochunges [sic!] des Oesterreichischen College, Vienna.<sup>25</sup>

Oberheim took over this entry, correcting only the severe misspelling of the journal's name. Digging further, archival research leads to what is possibly one of the earliest bibliographies by Feyerabend, compiled in 1955. Here a similar entry, the first listed under 'Papers and Essays written', reads:

Der Begriff der Anschaulichkeit in der modernen Physik; Journal des österr. College, Wien 1948.<sup>26</sup>

The publishing date (1948) given in the early bibliographic entry fits the date of the source document. This leads to the conjecture that the backdating by one year to 1947 only occurred in later revisions of the bibliography, possibly by error. The newsletter's date is consistent with the announcement of an upcoming joint discussion of "a paper by Prof. Schrödinger" in a previous newsletter dated June 1948. This sets July as *terminus post quem*. July is also consistent with the preview of the upcoming edition of the International College Weeks that started August 20th of the same year. Indeed, the joint discussion of Schrödinger's paper was a preparation to the seminars in Alpbach, where Schrödinger was expected to give the very same paper.

The bibliographic entries attest to a variation of the publication venue's name: "Journal of the Austrian College", or the more generic "Publications of the Austrian College". Materials found in the European Forum Alpbach archive, documenting the Austrian College's public activity, suggest that no fixed identity can be established for what may be best characterized as an amorphous "stream" of self-published newsletters, whose circulation may have been as few as the members of the Austrian College Society.<sup>27</sup> Beside documents of this genre, there is no evidence that the Austrian

College Society published a scholarly journal at the time. Indeed, it seems safe to exclude the latter on the basis of a call for papers published in a later newsletter dated 1949/1950—signed by Feyerabend himself—to start a scholarly journal to be edited by the Austrian College.<sup>28</sup> This gives weight to the conjecture that a young Feyerabend, age 31, at the beginning of his academic career and on the verge of his academic job-seeking emigration, might have wanted to spice up his bibliography by hinting at a proper scholarly setting of his first publication, which appears to have been grey literature.

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<sup>24</sup> Conversely, all contributions in the newsletter's second part but one are anonymous.

<sup>25</sup> PF 3–1–5.

<sup>26</sup> Application for the chair of philosophy, Auckland University College, dated May 27, 1955; appendix to: Letter from Feyerabend to Popper, May 27 Vienna, 1955. (Thanks to Matteo Collodel for pointing me to this document.)

<sup>27</sup> Taking the publication's naming into account, one can find newsletters with no title, displaying only *Österreichisches College* on the front page, sometimes (but not always) dated by month and year (the essay appears in such a dated newsletter); newsletters titled *Mitteilungen des Österreichischen College* [Transactions of the Austrian College]; newsletters titled *Mitteilungsblatt* [Bulletin], successively numbered and sometimes dated by month and year; and newsletters titled *Informationsschrift des Österreichischen College* [Handout of the Austrian College].

<sup>28</sup> No scholarly journal of this kind is documented—in contrast to other Vienna-based Austrian journals, such as *Wissenschaft und Weltbild* and *Wiener Zeitschrift für Philosophie, Psychologie und Pädagogik*, in which Feyerabend published during the early 50s, and which are preserved in local libraries.

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