

ternative attempts to reconstruct physics and chemistry. Both Ostwald's doctrine and the responses to it among the scientific community were the expression of individual creativities rather than expressions of a national spirit or samples of the mentality of their epoch.

The 'New Philosophy of Nature' around 1900 – Metaphysical Tradition and Scientific Innovation¹

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1. Innovations: The 'New' Philosophy of Nature and its Ambiguous Relation to its Past

Ostwald claimed that his *Lectures on the Philosophy of Nature* from 1901 (the lectures were published in 1902),² together with his journal *Annalen der Naturphilosophie* (founded in the same year),³ marked a new epoch in the history of philosophy of nature as a sub-discipline of philosophy.⁴ Ostwald himself took pains to make clear that a philosophy of nature really was a novel and unusual project, given the bad esteem that this branch of philosophy was held in: "The title philosophy of nature [...] has an evil ring to it. It evokes a movement that was dominant in Germany a hundred years ago, the leading figure being the philosopher *Schelling* [...]. Its influence, however, was restricted to *Schelling's* compatriots, the Germans, and perhaps the Scandinavians [...]. Its reign in Germany did not last long; it was uncontested for at best twenty years".⁵ The philosophy of nature of the idealist type, then, succumbed to the practical success of the natural

¹ I would like to thank Fergus Henderson for correcting my English.

² Ostwald, W., *Vorlesungen über Naturphilosophie*, gehalten im Sommer 1901 an der Universität Leipzig, Leipzig 1902. All translations are my own.

³ Ostwald, W. (ed.), *Annalen der Naturphilosophie*, Leipzig, 1902 ff.

⁴ Ostwald, W., *Moderne Naturphilosophie*, I. Die Ordnungswissenschaften, Leipzig, 1914 (a revised edition of his 1902 *Vorlesungen über Naturphilosophie*), p. V. – On the history of philosophy of nature, see Dingler, H., *Geschichte der Naturphilosophie*, München, 1932 (repr. Darmstadt, 1967); Hennemann, G., *Naturphilosophie im 19. Jahrhundert*, Freiburg/München, 1959, and the works cited in n. 7.

⁵ Ostwald, *Vorlesungen über Naturphilosophie*, p. 1.

scientists; natural science had, according to Ostwald, been neglected in the heydays of idealistic philosophy of nature so that this period was "known to be a period of the deepest depression of natural science in Germany".⁶ In his days, according to Ostwald, the relationship between the sciences and philosophy seemed to be entirely reversed, and, therefore, it became possible to rehabilitate the project of a philosophy of nature: "In our days, [...] everywhere in the camp of the scientists there are efforts to contribute to the whole sum of philosophical knowledge. Our time is therefore prepared to experience a new development in the philosophy of nature".⁷

Ostwald's claim to be the very initiator of this movement – in the later edition of his *Lectures on the philosophy of nature*, he mentions an American journalist, who "in jest" attributed to him the peculiar ability to be, on average, at least 1½ years ahead of his time⁸ – was not seriously doubted.⁹ Ostwald even speaks of a "mass movement" that he had initiated.¹⁰ That this is really true can be illustrated by the fact that the popular book-series *Library of science* (*Bücherei der Naturwissenschaft*), published by Reclam in Leipzig, was opened with an *Outline of the philosophy of nature* by Ost-

⁶ *ibid.*, p. 3.

⁷ *ibid.*, p. 3. – The same diagnosis is presented in Siegel, C., *Geschichte der deutschen Naturphilosophie*, Leipzig 1913, a work that shows how well established the 'new' philosophy of nature had become shortly after its emergence. In particular, cf. pp. 332-342; p. 332: "It is interesting indeed, how, since about the 1870ies, philosophers and natural scientists, each starting from his special area of research, converge or encounter each other in dealing with the same problems". Cf. also Classen, J., *Vorlesungen über moderne Naturphilosophen* (DuBois-Reymond, F.A. Lange, Haeckel, Ostwald, Mach, Helmholtz, Boltzmann, Poincaré und Kant), Hamburg, 1908.

⁸ Ostwald, *Moderne Naturphilosophie*, p. V.

⁹ Even when Hans Reichenbach discusses *The modern philosophy of nature* in 1931, severely criticizing the earlier philosophy of nature, the opening lines of his book evoke the memory of Ostwald's *Lectures*; according to Reichenbach, "[t]he title philosophy of nature acquires, in our days, a new ring" (Reichenbach, H., *Ziele und Wege der heutigen Naturphilosophie*, Leipzig, 1931, p. 3).

¹⁰ Ostwald, *Moderne Naturphilosophie*, p. V.

wald,¹¹ and that, in general, the philosophy of nature was well represented in various popular series of texts and in textbooks.¹²

When, around 1900, this 'new philosophy of nature' was propagated, it found itself in conflict: a conflict between 'old' and 'new', between a retrospective view of the 'old' (that is, late 18th and very early 19th century, associated with German Idealism and Romanticism, in particular with Schelling) philosophy of nature, and the perspective on the 'new', present-day and forward-looking philosophy of nature. On both accounts, a further conflict or even ambiguity emerges. One could – and in fact did – take a twofold stance with respect to the old philosophy of nature: it could be regarded either as obsolete, as having been overcome by the progress of science, or as the very paradigm of a philosophy of nature. The fact that the period around 1900, in its view of itself, was divided between an optimistic self-appraisal and a severe and deep-rooted criticism of its own modernity has been noted in various studies on the cultural history of the fin-de-siècle.¹³ With respect to the philosophy of nature, Ostwald himself,

¹¹ Ostwald, W., *Grundriß der Naturphilosophie*, 2nd ed., Leipzig, 1913 (1st ed. 1908).

¹² See for instance the following texts: Höfler, A., *Zur gegenwärtigen Naturphilosophie*, Berlin, 1904; Keyserling, H. Graf, *Prolegomena zur Naturphilosophie*, München, 1910; Hönigswald, R., *Naturphilosophie*, in: *Jahrbücher der Philosophie* 1, 1913: 60-98; Becher, E., *Naturphilosophie*, Leipzig/Berlin, 1914 (part of the series *Die Kultur der Gegenwart*); Verweyen, J.M., *Naturphilosophie*, 2nd ed., Leipzig / Berlin (vol. 491 of the popular series *Aus Natur und Geisteswelt*); Ziehen, T., *Grundlagen der Naturphilosophie*, Leipzig, 1922 (vol. 182 of the series *Wissenschaft und Bildung*); Palagyi, M., *Naturphilosophische Vorlesungen über die Grundprobleme des Bewusstseins und des Lebens*, 2nd ed., Leipzig, 1924; Ziehen, T., *Naturphilosophie. Kritischer Bericht über die Literatur 1915-1927*, in: *Jahrbücher der Philosophie* 3, 1927: 186-216; Bavink, B., *Die Hauptfragen der heutigen Naturphilosophie*, 2 vols., Berlin, 1928 (vol. 17 and 18 of the series *Mathematisch-naturwissenschaftlich-technische Bücherei*). See also the works cited in n. 7, and the earlier text by Lotze, H., *Grundzüge der Naturphilosophie*. Dictate aus den Vorlesungen, Leipzig, 1882.

¹³ For corresponding perspectives in the history of science literature, see Ziche, P., *Wissenschaftliche Weltanschauung. Gemeinsamkeiten und Differenzen monistischer und anti-monistischer Bewegungen*, in: Kodalle, K.-M. (ed.), *Die Angst vor der Moderne. Philosophische Antworten auf Krisenerfahrungen. Der Mikrokosmos Jena 1900-1940*, Würzburg, 2000, pp. 63-87. – For a more

in the opening paragraphs of his *Lectures*, explicitly states his ambivalent relation to the past; to start with the praise: "We see that Schelling's fundamental idea was basically convincing and immensely fruitful. Schelling summarized this idea in the formula *that thinking and being were identical*. That meant that the same laws cover spiritual life and life in the external world or that both realms show a far-reaching parallelism".¹⁴ Thus, a revival of philosophy of nature (and, for similar reasons, also of metaphysics) could be seen as a legitimate task for a philosopher and for a scientist dealing with philosophical questions. The critique, however, is not far away: "Schelling's fundamental idea was highly valuable as a *program* for an adequate further development. However, a serious error was committed: he thought that this adaptation of thinking and the external world was already achieved, thus leaving the flaws that exist in our thinking out of his consideration. He rather endeavoured to deduce being from thinking".¹⁵ Since our intellect is not perfect, this must lead to serious errors of the type committed by Schelling. It is interesting that Ostwald arrives at the most common charge against the speculative philosophy of nature only at the end of this line of reasoning: "This, then, is the error committed by the philosophers of nature, and that we must avoid: They tried to deduce experience from thinking, whereas we, on the other hand, must regulate our thinking everywhere according to experience".¹⁶ Ostwald's charge, then, is not simply that Schelling uses the wrong method, but rather that his whole concept of the fundamental relations between various sciences is wrong.

In the cover illustration of Ostwald's *Annalen der Naturphilosophie*, his view of philosophy of nature is symbolically depicted as the line of demarcation between the rough land of traditional philosophy, especially metaphysics, and the highly developed, uniformly organized terrain of science. This picture is suggestive, but somewhat misleading. For Ostwald, the task of philosophy of nature is not just to tidy up the intricate region between philosophy and science; rather, his new philosophy of nature was intended to

comprehensive discussion see Ziche, P., *Philosophie und Wissenschaften um 1900. Wissenschaftliche Philosophie als 'nicht-reduktiver Szientismus'*, forthcoming, 2005.

¹⁴ Ostwald, *Vorlesungen über Naturphilosophie*, p. 5.

¹⁵ *ibid.*, p. 6.

¹⁶ *ibid.*, p. 7.

deal, in a scientific manner, with the very foundations of our approach to the external world: "The content of a systematical philosophy of nature will have to consist of the most general concepts which we use in order to orient ourselves in the external world".¹⁷

How is the phenomenon that at the turn of the century philosophy of nature became a "mass movement" to be understood? It seems clear that philosophy of nature forms a part of a much broader movement that is characterised by terms such as "scientific world view", or by the conviction that the 19th century was the "age of science". Organisations such as the German Monist League (but equally rival organisations such as the "Keplerbund") aimed at a popularisation of this view of science.¹⁸ Philosophy of nature can serve as a good indicator for these broader tendencies. The relation between old and new versions of a philosophy of nature was an ambiguous one; corresponding ambiguities can be detected as very general features of the role of science vis-à-vis philosophy around 1900.¹⁹ When Ostwald assigns to philosophy of nature the task to tidy up the thicket between the orderly land of science and the wild backwoods of metaphysics, this task fits well into certain strands of anti-metaphysical thinking prominent in scientific philosophizing. But since that means, at the same time, that one uncovers common ground underlying both science and metaphysics, this tidying up can also be understood as part of a recovery, a re-evaluation of metaphysics, revealing an underlying unity that lies beyond the science-metaphysics distinction.

Philosophy's claim to be of immediate value for science, and philosophy's claim to superiority, is taken up again; not, however, in order to be discarded in a straightforward manner. Rather, there is a shift in accents, a u-turn in the perspective taken towards philosophy of nature and its status

¹⁷ Ostwald, W., *Naturphilosophie*, in Hinneberg, P. (ed.), *Die Kultur der Gegenwart. Ihre Entwicklung und Ziele. Part I, Vol. 6: Systematische Philosophie*, Berlin / Leipzig, 1907, pp. 138-171; quot. pp. 150-151.

¹⁸ On the similarities between the Monist League and the Keplerbund, see Ziche, *Wissenschaftliche Weltanschauung*.

¹⁹ Ziche, P., *Fortschrittsglaube und Verzweigung an der Moderne. Ambivalenzen der Wissenschaftswahrnehmung um 1900*, in: K. Buchholz e.a. (eds.), *Die Lebensreform. Entwürfe zur Neugestaltung von Leben und Kunst um 1900*, vol. I, Darmstadt, 2001, pp. 75-78.

among the various sciences: philosophy of nature (and, henceforth, also metaphysics) come to be understood as a science among other sciences, not as their absolute foundation. Still, foundationalism is not completely overcome; one can still see philosophy of nature as continuing a venerable tradition.

2. Traditions: From German Idealism through Vulgar Materialism to the New Philosophy of Nature

Around 1900, various authors thought of their contributions to the philosophy of nature as being contributions to a new form of science (in the comprehensive sense of the German 'Wissenschaft').²⁰ A standard account of the history of philosophy of nature in the 19th century would distinguish three periods: from the heydays of a speculative brand of philosophy of nature in German idealism, via the fierce reaction against this type of philosophizing brought forward by the materialists – the so-called "vulgar materialists" – of the 1840s and 1850s, to, finally, the complex reaction at the turn of the 20th century. On a second look, these three steps are closely interwoven. The very term "Naturphilosophie" is used by exponents of all three periods; for the vulgar materialists, consult, f.i., L. Büchner's best-selling *Force and Matter*²¹ that announced itself in its title as "empirisch-naturphilosophische Studien", studies based on both experience and philosophy of nature, while simultaneously criticizing the traditional philosophy of nature. Ostwald criticizes both of the two previous epochs, but also adopts aspects of both.²²

²⁰ The claim of novelty is visible not only in Ostwald's writings; a look at the introductory paragraph of Hans Reichenbach's *Ziele und Wege der heutigen Naturphilosophie* from 1931 – to pick an author from a tradition that today one would normally not associate too closely with Ostwald – yields abundant evidence for the optimistic atmosphere in philosophy of nature at the beginning of the 20th century.

²¹ Büchner, L., *Kraft und Stoff. Empirisch-naturphilosophische Studien*. In *allgemein-verständlicher Darstellung*, 9th ed., Leipzig, 1867 (1st ed. 1855).

²² On Ostwald's reaction against materialism, consult his lecture – given at the meeting of the *Versammlung deutscher Naturforscher und Ärzte* in Lübeck in 1895 – on the *Conquest of scientific materialism (Überwindung des wissenschaftlichen Materialismus)* (Ostwald, W., *Die Überwindung des wissenschaftlichen Materia-*

A brief look at some other authors may exemplify the relevant developments in the 19th century. For Johann Friedrich Herbart, student and early critic of the German idealists in the first decades of the 19th century,²³ philosophy of nature is a hybrid enterprise. The idea behind philosophy of nature can even be regarded as the epitome of (metaphysical) philosophizing, but the way to get there is barred for the pure metaphysician. Herbart begins his *General metaphysics* with the bold claim that "Philosophy of nature is the goal of this book. Even if only physicists can get there completely, as far as our empirical knowledge of nature permits, they, too, require the preparatory work of metaphysics".²⁴ Any philosophy of nature has to consist of two parts, an analytical one that starts from the "facts", and a synthetical one that rests its arguments on the principles of metaphysics;²⁵ only both parts together make a philosophy of nature feasible. In this hybrid construction, the ambivalent relation to Schelling that is en vogue around 1900 can already be clearly detected: Herbart concedes the value of "the best in Schelling's teaching, – the proper ontological presentiment to stick to the idea of identity",²⁶ but Schelling is charged with omitting the realm of experience from his philosophizing. The ambiguous evaluation of the merits of Schelling's philosophy of nature, based on the conflict between facts and general theory, can thus be seen to have existed well before Ostwald's philosophy of nature; the fate of Schelling's philosophy of nature is symptomatic of the 19th century's understanding of the relationship between philosophy and science.

Another example, from a highly popular but idiosyncratic thinker who does not fit into one of the various schools of philosophy, again reveals the

lismus, in: Ostwald, W., *Abhandlungen und Vorträge allgemeinen Inhaltes*, Leipzig, 1916, pp. 220-240).

²³ Herbart (1776-1841) taught philosophy at Göttingen and Königsberg; in his philosophy, he combined motives from idealism with a fundamentally realist attitude.

²⁴ Herbart, J.F., *Allgemeine Metaphysik nebst den Anfängen der philosophischen Naturlehre. Erster historisch-kritischer Theil* [1828], in: Herbart, J.F., *Sämtliche Werke*, ed. by K. Kehrbach / O. Flügel, repr. Aalen, 1989, vol. 7, p. 3.

²⁵ Herbart, J.F., *Allgemeine Metaphysik, nebst den Anfängen der philosophischen Naturlehre. Zweiter, systematischer Theil* [1829], in: Herbart, J.F., *Sämtliche Werke*, ed. by K. Kehrbach / O. Flügel, repr. Aalen, 1989, vol. 8, p. 251.

²⁶ Herbart, *Allgemeine Metaphysik*, 2. Teil, p. 310.

same pattern: one of the greatest merits of the philosophy of Eduard von Hartmann,²⁷ who was – due mainly to his *Philosophy of the Unconscious* (*Philosophie des Unbewußten*) from 1868 – highly popular from the 1860s and 70s onwards, was generally thought to be his integration of traditional metaphysics and modern science²⁸ (Ostwald, however, charged him for just passively adopting the results of science²⁹). In a fictitious correspondence with a scientist – but also in his correspondence with the real scientist Ernst Haeckel –, Hartmann sketches the outline of a philosophy that can stand up to the charges of the prototypical natural scientist: “I ask from philosophy that it must not ignore any result safeguarded by natural science; even less can it be permitted to contradict such a result on the basis of apriorical considerations. On the contrary, I think it necessary to make use of these results”.³⁰ For Hartmann, it is clear that philosophy has to respect all the results of science (this he states explicitly, for instance, in his correspondence with Haeckel). What interests the philosopher, however, is a particular aspect of science; what is “philosophical about the sciences” are “the rational aspects in science’s arranging its material and establishing relations within this material”.³¹ The philosophy of nature is thus understood as a mediator between the individual sciences and the universal, unitarian goal of all sciences, and thus goes beyond each of the special sciences, but it does not give up the method of these sciences.³² In his correspondence with Haeckel, both agree that the scientist needs such a philosophy; in Haeckel’s words: “I am forced to this procedure [to adopt

²⁷ von Hartmann, 1842-1906, worked as a private scholar.

²⁸ See, f.i., Wundt, W., *Metaphysik*, in: Hinneberg, P. (ed.), *Die Kultur der Gegenwart. Ihre Entwicklung und Ziele. Part I, Vol. 6: Systematische Philosophie*, Berlin / Leipzig, 1907, pp. 103-137; p. 121: “He [E. von Hartmann] presented [...] a mediation [of a poetical-mystical type of metaphysics] with the positive sciences, in particular with the leading natural sciences of the time”.

²⁹ In Ostwald’s review of Hartmann’s *Weltanschauung der Physik* (Ostwald, W., *Review of Hartmann, E. von, Die Weltanschauung der modernen Physik in: Annalen der Naturphilosophie 1, 1902: 527-528*).

³⁰ Hartmann, E. von, *Naturforschung und Philosophie*, in: Hartmann, E. von, *Gesammelte Studien und Aufsätze gemeinverständlichen Inhalts*, Berlin, 1876, pp. 421-444, quot. p. 425.

³¹ *ibid.*, pp. 426-427.

³² *ibid.*, p. 429.

far-reaching generalisations, and thus fundamentally philosophical – though perhaps not philosophical in an academically acceptable sense – techniques; P.Z.], if I want to impose any kind of order upon the terrible empirical chaos of my science of biology”.³³ Hartmann, too, senses that philosophy of nature has acquired a new respectability, due to the work of scientists and popularizers such as Haeckel, Reinke and Ostwald.³⁴

His own sketches for a philosophy of nature focus on issues from theoretical physics; theoretical physics, like philosophy of nature, “wants to construct nature in deductive fashion, by starting from most general concepts and principles, and utilizing the induction from experience merely as an aid to arrive at these starting-points for deduction”.³⁵ Given Hartmann’s quest for general unification, it is not surprising that key concepts of his discussion of a philosophy of nature are taken up in texts where he discusses other authors, including those contributing to a philosophy of nature, most notably Schelling. His attitude towards Schelling presents an ambiguity similar to the opening paragraphs of Ostwald’s *Lectures on the philosophy of nature* and to Herbart; according to Hartmann: “If Schelling had stuck to his idea that the absolute identity of the real and the ideal could be proved – at least indirectly – by means of induction, and had he understood and adopted this indirect proof as the proper and highest task of philosophy of nature, then his philosophy of nature might have become, given the status of natural science at his time, a paradigmatical text [ein Musterwerk], while, as it actually is, it is downright unbearable for a reader with a scientific education, despite all its ingenious ideas; the reason being that it supplants the scantiness of the scientific knowledge avail-

³³ Haeckel to Hartmann, Nov. 7th, 1874. In: Kern-von Hartmann, B. (ed.), *Metaphysik und Naturphilosophie. Briefwechsel zwischen Eduard von Hartmann und Ernst Haeckel*, in: *Kant-Studien 48, 1957: 3-24*, quot. p. 9. – Ostwald, in his review of E. von Hartmann, criticises that Hartmann’s philosophical ideas did not promote the progress of science; the idea to supplement by metaphysical considerations what is missing in the data of experience was, according to Ostwald, one of the main obstacles for a proper development of science.

³⁴ The botanist Reinke was a severe critic of Haeckel’s Darwinist ideas.

³⁵ Hartmann, E. von, *Die Weltanschauung der modernen Physik*, Leipzig, 1902, p. 210.

able at the time with arbitrary, fictitious constructions".³⁶ Thus, according to Hartmann, too, Schelling has pursued the proper goal, but with the wrong methods.

Finally, a short remark on Ernst Haeckel who, while starting his career as a scientist, became popular through his *Welträtsel*, one of the most widely read books at the turn of the century. Haeckel was seen, for instance by Hartmann, as the leading figure in the new, scientifically based philosophy of nature.³⁷ He himself uses the term "philosophy of nature" frequently in his works; the idea being that philosophy of nature, as that part of philosophy that is based upon science and thus upon our only means of acquiring secure knowledge and a secure basis for orienting ourselves in the world, comprises all that is valuable about philosophy; in the preface to the *Welträtsel*, Haeckel promises to give a "monistic philosophy" that is able to overcome the traditional opposition between metaphysics and the "exact natural sciences" – again, it is a "Naturphilosophie that even today is widely rejected with disgust" that is taken as a model for this task.³⁸

The position of Ostwald in the broad movement associated with establishing a philosophy of nature around 1900 is exceptional in so far as he undertakes great efforts to institutionalize this kind of reasoning and to find adequate ways of publication: lectures, various big volumes, chapters in popular book-series covering various fields of interest, and finally the *Annalen der Naturphilosophie*. The most important texts are – besides his journal – his *Vorlesungen über Naturphilosophie, gehalten im Sommer 1901 an der Universität Leipzig*, Leipzig 1902 (with later editions), a revised version of this book under the title *Moderne Naturphilosophie* (vol. 1: Die Ordnungswissenschaften, 1914), a more popular version in the *Grundriß der Naturphilosophie*, Leipzig 1908 (various later editions) and his chapter on *Naturphilosophie* in the volume on *Systematische Philosophie* of the multi-volume *Die Kultur der Gegenwart*, edited by Paul Hinneberg.³⁹

³⁶ Hartmann, E. von, Schelling's Identitätsphilosophie, in: Hartmann, E. von, *Gesammelte Studien und Aufsätze gemeinverständlichen Inhalts*, Berlin, 1876, pp. 577-603, quot. p. 583.

³⁷ Kern-von Hartmann, *Metaphysik und Naturphilosophie*, p. 19.

³⁸ Haeckel, E., *Die Welträtsel*, Bonn, 1899, preface.

³⁹ Cf. n. 16.

3. Some Aspects of Philosophy of Nature around 1900: Foundationalism in a Naturalized Setting, or from Energetics to "the Most General Science".

It has already become obvious that, throughout the 19th century, philosophy of nature wanted to participate in the success and the methodological and epistemological dignity of the sciences. What are the developments in the sciences that underlie this development? In many accounts of the progress of science in the 19th century, a list of some particularly important and relevant scientific results is repeated almost as a stereotype: as its most important items, it includes the conservation of energy and Darwinism, or more generally, the theory of evolution. Via such theories, Grand Unifying Theories seem feasible, and even to emerge gradually as results of 'normal' science, thus making it understandable why one could think that the sciences vindicated Schelling's idea of unity.⁴⁰ Interestingly, however, it is not necessarily the novelty of the scientific results that fuels philosophical discussion within and of the sciences: looking at Kirchhoff, Hertz or Mach, it is mechanics itself, the oldest, best understood part of science that seeks new foundations; their writings show that the search for better foundations of well-established theories had become a respectable task for a scientist too.

Despite the influence of the (natural) sciences it was clear to all the authors mentioned so far – Haeckel being the exception – that philosophy of nature may not simply be handed over to the sciences; the activity of the philosopher is to be distinguished from that of the scientist. Philosophy of nature is a task different from that of science, but, on the other hand, it has to follow science as closely as possible, and, in particular, no contradictions between philosophy of nature and the sciences can be tolerated. Not only in the relationship to its own past, but also in its relationship to other

⁴⁰ Matthias Jakob Schleiden, the great botanist and highly influential theorist of science, however, explicitly denies the sciences the right to search for all-encompassing theories: "Those were the rigorous and exact natural scientists who realized where their method did not yet reach, and who, therefore, did not attempt to extend its applicability beyond the terrain hitherto conquered by science." (Schleiden, M.J., *Über den Materialismus der neueren deutschen Naturwissenschaft, sein Wesen und seine Geschichte. Zur Verständigung für die Gebildeten* [1863], in: Charpa, U. (ed.), *Matthias Jakob Schleiden, Wissenschaftsphilosophische Schriften* [...], Köln, 1989, pp. 265-308, quot. p. 298).

sciences, philosophy of nature finds itself in an ambivalent situation: it is supposed to be the foundation of all other natural sciences, or the most general science summarizing the results of all these sciences, but at the same time it is to be a science like any of them.

Which status does philosophy of nature occupy in Ostwald's works? How does he try to develop a consistent version of a philosophy of nature? One of his definitions – that philosophy of nature has to deal with the most general concepts we use in our approach to the external world – has already been quoted. According to Ostwald, philosophy of nature, thus, occupies an even more prominent place than it did in Schelling's system: Ostwald claims it to be the most general theory of the concepts by which we orient ourselves in dealing with the (external) world.

How can the traditional claims for the outstanding position of philosophy of nature be reconciled with the necessity of philosophy of nature's becoming a science among others? A first attempt at an understanding could emphasise Ostwald's weakening of the claims of the traditional philosophy of nature, the replacement of Schelling's notion of a deduction of being from thinking through rule-governed relations by the idea of an (ever improving) adaptation of both realms (formulated in terms borrowed from both Mach and evolutionary biology). According to Ostwald, to require philosophy to yield results that are absolutely certain would be "to ask too much from philosophy. Philosophy, too, is an empirical science [...] That she tried to arrive at absolute knowledge was precisely the error committed by philosophy of nature [...], whereas we have seen that only a repeated adaptation of the mind to nature can lead to success".⁴¹ In this way, according to Ostwald, one could claim to follow the lead of the sciences, but at the same time one has to give up the hope of arriving at absolute certainty. Otto Neurath's image of a boat that has to be repaired while being afloat on the sea – his image for the situation of science and of human experience in general – is already to be found in Ostwald: as the image of a bridge that undergoes constant reworking and is never perfect, but always in working order.⁴² Lack of certainty is the price to be paid for

⁴¹ Ostwald, *Vorlesungen über Naturphilosophie*, p. 12. Cf. the quotations from Ostwald's discussion of Schelling's philosophy of nature in section 1, above.

⁴² *ibid.*, p. 13.

achieving unification,⁴³ and even for maintaining the scientific character of the enterprise as a whole: to be scientific means to be a science like any other, no more, but also no less. This makes the loss of certainty easier to accept, perhaps even desirable. Comprehensiveness is traded in for rigorousness – the loss of the latter is compensated by thus turning philosophy into a science among others. Is the reconciliation of the incompatible tasks of following science – i.e., the individual sciences – and, at the same time, presenting general ideas relevant for the whole realm of the sciences as a whole, then, achieved by simply weakening the claims made by philosophy of nature? This would in itself weaken Ostwald's position, and in fact, this view is not adequate: no science, after all, can lay claims to absolute certainty. The failure to acquire absolute certainty, far from weakening his claims, is rather a strong point in favour of a philosophy of nature; it is a precondition of keeping close companionship with science.

One has, however, to go further. A companionship with the sciences is desirable for philosophy only if science is the ultimate foundation of (or the best approximation to) secure knowledge. Foundational ideas, thus, have their comeback, as is already clear from Ostwald's definition of philosophy of nature. For a better understanding of the way how Ostwald pursues these ideas in his philosophy of nature, one can look at the chapter on logic in Ostwald's revised version of his *Lectures*, his *Moderne Naturphilosophie* from 1914. Ostwald claims here that he was the first to recognize the status of logic as the most general science. The need to make this claim explicit shows that he feels that there are rivals: probably those authors that we today would think of as the originators of a logic-centered philosophizing in logical empiricism. Ostwald sketches an image that integrates biologicistic elements and a highly differentiated discussion of the methodology of the sciences: the sense organs provide us with the material of experience; but how do, from this material, experience or rather a unified picture of the world arise? What each individual has to do in order to

⁴³ Cf. with respect to another instance of such arguments, Ziche, P., *Spickers Philosophie als wissenschaftliche Weltanschauung. Philosophische Spekulation, wissenschaftliches Resultat oder religiöses Dogma?*, in: U. Hoyer / H. Schwaetzer (eds.), "Eine Religion in philosophischer Form auf naturwissenschaftlicher Grundlage". Gideon Spickers Religionsphilosophie im Kontext seines Lebens, seines Werkes, seiner Zeit. Zweites Gideon-Spicker-Symposium, Hildesheim / Zürich / New York, 2002, pp. 157-176.

arrive at his understanding of the world, is, according to Ostwald, related to the working of science: a multi-modal integration of the various sense-data is required, including processes of abstraction, of ordering and of concept formation.

One could, then, understand this 'new' philosophy of nature as a form of foundationalism. Its strategy is a twofold one: get to the most general concepts, and develop a theory of ordering relations. Both of these tasks are intimately tied to actual procedures of science: each science has to impose some kind of order upon its variegated data, and it does so by developing clear concepts (e.g. in chemistry, via the search for elements that then allow building up a symbolic and precise language for chemistry). The general framework is an empiricist one; the problem of order arises, in its most general form, from the problem of cross-modal integration of sense data. In the process of concept-formation, the most basic ingredients of concepts ("Begriff-Elemente") have to be integrated; if one follows this process by starting from these elements, one arrives, first, at the most general, most comprehensive, but at the same time poorest – in the sense of having very little content at all – concept, namely the concept of a thing. One can then proceed to concepts such as order, numbers, magnitude, space or time that still are independent of energetics as the theoretical foundation commonly associated with Ostwald's theory of chemistry. Furthermore, one can transform these steps into claims concerning various sciences; it is in this context that Ostwald boasts himself that he discovered the fundamental role of logic (a task that one would normally associate rather with philosopher-scientists such as Bertrand Russell or Gottlob Frege). One could therefore claim that this picture is as close to Russell or Carnap as it is to Haeckel. In any case, it is an attempt, on a grand scale, to run together questions of genesis and of justification.

Is "Naturphilosophie" for Ostwald then what we today would call a "philosophy of science", a "Wissenschaftstheorie"? To be sure, Ostwald employs such terms⁴⁴ – but his attitude is completely different from what today one would expect from a philosopher of science. Philosophy of nature is intended to be a theory of universal foundations, conceived as just a further individual science. From here, the question of the ordering relations be-

⁴⁴ For instance in: Ostwald, W., *Zur Theorie der Wissenschaft*, in: *Annalen der Naturphilosophie* 4, 1905: 1-27.

tween philosophy of nature and the other sciences becomes pressing: is philosophy of nature, with respect to the other sciences, subordinated, juxtaposed, or on a higher level? Ostwald devotes various texts and a whole popular book to the solution of this problem, and arrives at a pyramidal ordering of the sciences: the most general science (logics, or the sciences he labels as *Ordnungswissenschaften*, *ordering sciences*, in his 1914-version of the *Naturphilosophie*), the science with the broadest scope, has at the same time the most restricted content and lies at the basis of the "pyramid of the sciences". The difference between content and scope makes it possible for Ostwald to avoid Schelling's attitude of an all-encompassing universal science. The "Ordnungswissenschaften" are the basis for all other sciences, but they cannot decide in advance on the particular content of the other sciences.⁴⁵ The ambiguities that arise at the very general level of the cultural self-awareness of the fin-de-siècle, and on the very special level of philosophy of nature's referral to its own past, thus lie, in a particular form, at the very heart of this new discipline. It is intended to be a new science, but in order to be a science, it must be judged according to standards already available, and, again at the same time, it must be more than just a further application of sciences that already exist. It cannot be just a further filiation of the already over-specialized, atomized system of scientific disciplines, it has to serve a particular purpose with regard to (all the) other sciences, but it must still be a science. Logic and some branches of mathematics yielded sufficient evidence that these types of new, general sciences did in fact exist, and, furthermore, that they were respectable according to standards universally accepted by the working scientists. It is the generality of these new sciences that makes it possible to understand Ostwald's philosophy of nature as a metaphysical enterprise rather than a philosophy of nature in any more specialized sense.⁴⁶ It must be stressed that the search for increasingly general forms of science is clearly visible as a central point of Ostwald's continuing efforts, when one compares the

⁴⁵ These "Ordnungswissenschaften" can be understood as the theoretical underpinning of Ostwald's activities in the "Brücke".

⁴⁶ Cf. Wilhelm Wundt's evaluation of Ostwald's philosophical ideas as being paradigmatical for the "free-floating thought formations" of late 19th century scientists that Wundt labels as a sort of "involuntary metaphysics" (Wundt, *Metaphysik*, p. 122).

various texts in which Ostwald successively develops his philosophy of nature.

One comes to the question of the mutual relevance of the various ingredients of Ostwald's view of science, particularly when one compares various versions of his philosophy of nature. In the 1914 edition, compared with the 1902 version, there is an important difference: Ostwald stresses explicitly that his considerations do not depend on a commitment to energeticism. This is understandable, given his (partial) conversion to atomism that had now taken place.⁴⁷ He now fills the whole volume with general considerations which in the 1902 edition were treated rather as side issues compared with his pet idea of energeticism.⁴⁸ In the later texts, already in the popular volume from 1908, there is a clear shift in accents: Ostwald now sketches the idea of the most general part of all sciences, a part that can be identified with concrete sciences ("Ordnungswissenschaft"). When he uses "most general part of science" for "philosophy of nature", one sees how intricately this philosophy of nature is interwoven with his broader intentions.

It is important to distinguish this version of a philosophy of nature from rival solutions for the problem as to how a philosophy of nature could participate in the other sciences.⁴⁹ A downright naturalization or an idealized understanding of the role of logic with regard to a most general founda-

⁴⁷ See the paper by B. Bensaude-Vincent in this volume.

⁴⁸ In the 1902 edition, the general part has the task to sort out those parts of philosophy, as transmitted by the history of philosophy that can still be of value for a scientist (Ostwald, *Vorlesungen über Naturphilosophie*, p. VI).

⁴⁹ The basic distinction between Ostwald's view of science and that of the Vienna Circle is this: Although Ostwald has a great deal to say on the methods and the methodology of science, and on the importance of logic in particular, his goal is not to give a logical reconstruction of science. He does not take methodological considerations as the guideline that would allow him to draw a line between what is science proper and what fails to achieve this status. Rather, given his and his contemporaries' strive for comprehensiveness, it is the content of a scientific theory that he is interested in. The Vienna Circle's emphasis on the formal structure of scientific theories is missing in Ostwald's writings. It should be stressed in this context that some Vienna circle theorists, most notably Moritz Schlick himself, actively contributed to the debate on a philosophy of nature.

tion for the scientific value of the other sciences (the logicism of logical empiricists and Husserl's foundationalism are examples) are such rival solutions – but these are not the solutions most thinkers aimed at around 1900. The second has a ring of dualism, of anti-unity; the first evokes the memory of vulgar materialism, and seems, in its eliminative vein, to run counter to the enthusiasm of an all-encompassing scientific world-view. Rather, one could be convinced that now, finally, science was strong and self-conscious enough to deem itself able to incorporate the 'old' philosophy of nature into a naturalized setting. In his reliance on special sciences, dealing with the most general problems in a way acceptable for other specialists, Ostwald can be seen as a scientist, even in his philosophy of nature, but with the caveat that – as his positive attitude towards traditional philosophy of nature sufficiently illustrates – this scientism claims that it could avoid a reductive naturalization. What a 'science' is is now defined by science, no longer by philosophy as an independent instance. Science sees itself as so comprehensive that it does not define itself via exclusion of the non-scientific, but by universally including everything, even the realm of cultural or artistic values, as scientific. The most challenging theoretical idea is the idea of a most general science that, nevertheless, is an 'ordinary' science. In the context of such arguments philosophy of nature comes to be (one form of) an anti-metaphysician's metaphysics, or his substitute or placebo for methaphysics.